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A-0001 Iatrogenic elbow flexion contractures in children with amyoplasia

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Iatrogenic elbow flexion contracture is not a very rare elbow deformity after posterior elbow capsulotomy with triceps lengthening or after tendon transfer surgery in children with elbow extension contracture due to amyoplasia. This may cause the patient difficulty in reaching the perineum or using crutches and wheelchair. Fourteen elbows with iatrogenic flexion contractures in 10 patients with an average age of 7 years (4–16 years) were treated in our clinic. At birth, all children had elbow extension contractures with severe limitation of active and passive flexion. All children were treated with posterior elbow capsulotomy with triceps lengthening and tendon transfer to biceps. At an average 3 years after surgery (range 2–5 years), all patients had flexion contractures with an average of 110° (range 70–120°) and severe limitation of self-service.

To solve this problem, the following methods were used:

1. Stretching (cast with Ilizarov device).
2. Stretching with tendon transfer to biceps.
3. Extension osteotomy of the humerus.

After treatment, eight children were able to reach the perineum or using crutches and wheelchair, and two patients became more independent in daily living.

We analyzed the outcomes and found the main courses of iatrogenic elbow flexion contractures in patients with arthrogryposis.

1. Too long fixation elbow in flexion after posterior elbow capsulotomy with triceps lengthening.
2. Too triceps lengthening.
3. A triceps to biceps transfer for restoration of active flexion.
4. One-stage restoration of passive and active elbow flexion (posterior elbow capsulotomy with triceps lengthening and tendon transfer).

Adequate treatment for elbow extension contractures in patients with amyoplasia, saving balance between biceps and triceps, helps to prevent iatrogenic elbow flexion contractures.

A-0003 Is cortical contact necessary to prevent metacarpal stem subsidence in trapeziometacarpal arthroplasty?

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Cortical contact has been recommended to prevent postoperative subsidence of cementless metacarpal stems in trapeziometacarpal joint replacement. Due to relatively large size increments, this is not always possible. We hypothesized that cortical contact is not essential. In this study, 87 consecutive Maïa prostheses (Groupe Lépine, France) were radiographically evaluated immediately after surgery and at 1 year postoperatively. Stem fit inside the intramedullary canal of the first metacarpal and subsidence were measured. In 67 cases, the stem did not have any cortical contact. No subsidence was noted. Our results show that a cementless stem can be safely placed in the first metacarpal without cortical contact if the following conditions are met: the stem is anatomically shaped, the cancellous bone of the intramedullary canal has been properly impacted, stem placement is press fit and rotational stable, and key pinch loading is avoided during the first 6 weeks after surgery.

A-0012 Universal 2 total wrist arthroplasty as a salvage procedure for failed BIAX total wrist arthroplasty

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Introduction: The widely used treatment for failed total wrist arthroplasty (TWA) is conversion to a total wrist arthrodesis. However, salvage of failed TWA by replacing the failed wrist implant may have obvious advantages. In this study, we evaluate a large case series in which failed BIAX implants are converted to Universal 2 implants.
Methods: A retrospective study of patients with failed BIAX implants that had been converted to Universal 2 implants was conducted. All cases were evaluated for clinical outcome and complications, including the need for revision of the Universal 2 implants. The Patient Rated Wrist Hand Evaluation (PRWHE) and the Quick Disabilities of Arm, Shoulder and Hand (QuickDASH) questionnaires measured the function of the affected wrist. Additionally, all patients were asked study-specific questions.
Results: Thirty-seven patients (40 wrists) with failed BIAX implants that were converted to Universal 2 implants were included in this study. Twenty-five Universal 2 implants were still in situ after the mean period of 99 months and demonstrated moderate PRWHE (49/100) and QuickDASH (51/100) scores. The remaining 15 Universal 2 implants were converted to a total wrist arthrodesis or a tertiary TWA. Thirty patients were satisfied with the Universal 2 implant.
Conclusion: Conversion to a Universal 2 implant is a viable salvage option for failed BIAX implants, which maintains the function of the wrist and postpones a possible conversion to a total wrist arthrodesis.
Type of study/Level of Evidence: Therapeutic/IV.

A-0018 Surgical fixation of metacarpophalangeal collateral ligament rupture of the fingers

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Introduction: Collateral ligament injury of the metacarpophalangeal (MCP) joint of the fingers is underreported in the literature and widely underestimated by medical community. Herein, we present the results from a large series of patients and review factors influencing success of surgery.
Methods: We performed a retrospective study of 46 patients who underwent surgical fixation of the MCP collateral ligament using bone anchor in an acute or chronic setting. The diagnosis was predominantly clinical based on laxity testing of the joint. We collected demographic data as well as intraoperative findings and postoperative results.
Results: Postsurgery, with a median follow-up of 17 months, all patients presented with a stable joint and a complete resolution of pain. The mean flexion of the MCP joint was 77.91°, and extension was a mean of 0.84°. We measured the injured grip strength at a mean of 88.52% of the opposite hand, and the mean Quick-DASH score used to evaluate disability was 9.56 on a scale of 100 (with 100 complete disability). Importantly, time from injury to surgery did not influence postoperative results.
Conclusion: Surgical treatment of MCP collateral ligament rupture with bone anchors is a safe technique that gives reproducible positive results that are not influenced by demographic data or time to treatment. This pathology is not rare, and a better diagnosis would increase the incidence in future reports.

A-0019 Mallet fracture: DIPJ volar subluxation is not predicted by fragment size but direction of force and anatomy of DIPJ

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Aims: The aims of the study were to (1) review the mechanism of injury in mallet fractures (MF) in 30 adult patients, (2) identify the direction of force (hyperextension/hyperflexion injury) in the above group, (3) determine whether the direction of force predicts distal interphalangeal joint (DIPJ) volar subluxation; and (4) determine whether the fragment size (% joint involvement) predicts DIPJ volar subluxation.
Method: A retrospective review of 30 patients treated for mallet fracture had X-rays reviewed, interviewed for mechanism of injury, digit affected, and direction of force. A standardized questionnaire was used and

completed by the patient. X-Ray views of the affected finger were reviewed independently by two consultant hand surgeons, the percentage of joint surface area involvement was recorded, and whether DIPJ volar subluxation was present was noted.
Results: Of the 30 patients, 9 patients had hyperextension MF with DIPJ volar subluxation; of these nine patients, seven patients had joint involvement of 25–50% and two patients had 0–25%. Twelve of the 30 patients had hyperflexion MF with no DIPJ volar subluxation: 4 had joint involvement of 0–25%; 4 had 25–50%, and 4 had 50–75%. Nine of the 30 patients were unable to recall direction of force: four patients had DIPJ volar subluxation with joint involvement of 25–50% and five had no DIPJ volar subluxation; two of nine patients had 0–25% joint involvement, one of the nine patients had 50–75%; none of the patients had 75–100%.
Conclusion: MF with DIPJ volar subluxation is an important subgroup and must be identified and managed surgically. Direction of force possibly predicts DIPJ volar subluxation, but there is no correlation between fragment size and DIPJ volar displacement in this group of 30 patients. This is possibly explained by the anatomy of the DIPJ, which is a complex interplay of flexor and extensor tendon balance as well as the strong collateral ligaments.

A-0022 Treatment of advanced Kienbock disease (Lichtman IIIB) with a shortening osteotomy of the radius in 17 cases

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Objectives: For most surgeons, shortening osteotomies of the radius are not indicated in Kienbock disease patients with carpal colapse (Lichtman IIIB). We reviewed and present our cases.
Materials and Methods: Since 1985, all 53 cases of Kienbock disease were treated with a shortening osteotomy of the radius. Patient data and X-rays were reviewed, but only the 17 cases with carpal colapse are presented here. The age of the patients was between 15 years and 66 years (median 32 years), with only 6 left wrists and 5 male patients. There were 11 cases of ''cubitus minus'' and 9 with lunate fragmentation in standard X-rays of the wrist. Last revision of the patients was between 9 months and 23 years after surgery, with a median period of 4 years.
Results: All patients felt better after surgery. Medium flexion–extension of the wrist improved from 68° to 94°, grip strength from 21% to 73% of the other hand, and Mayo Wrist Score from 24 to 68. On a 0–3 scale, pain decreased from 2.19 to 0.66.
Conclusions: Carpal colapse in stage IIIB Kienbock disease is adaptative and its correction is not mandatory. Our results and those of other surgeons, very similar to those obtained in patients without carpal colapse, should enlarge the current indications for shortening osteotomies of the radius in the treatment of Kienbock disease.

A-0023 Addition of liposome bupivacaine to bupivacaine 0.5% in wrist nerve blocks improves analgesia compared to bupivacaine 0.5% alone for Dupuytren's contracture release

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Dupuytren's finger flexion contracture can be treated by injections of collagenase *Clostridium histolyticum* (CCH) into the affected cords. This is often a painful procedure, as pain occurs during CCH injection, the inflammatory response that lasts for several days after injection, and the manipulation to break up the cords. Local nerve blocks can be used to make these procedures less painful. We tested the hypothesis that addition of liposome bupivacaine (LB, EXPAREL®) 1.3% to bupivacaine in ulnar and median nerve blocks results in improved analgesia and longer duration of sensory–motor block compared to blocks performed with bupivacaine alone. Thirty-two patients were randomized to one of both treatment groups and prospectively followed up. Addition of LB to bupivacaine in ulnar and median blocks in subjects having Dupuytren's contracture release resulted in similar block onset but longer block duration, improved pain scores, and improved satisfaction. The addition of LB provided anesthesia and analgesia for both phases of treatment (injection and manipulation) with a single injection.

A-0024 Clinical evaluation of surgical management of hand pathologies under local anesthesia

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Hand surgery can actually be managed under local anesthesia, as described in recent North American studies. It is actually admitted that xylocaine with epinephrine infiltrations are perfectly safe and allow to realize the intervention without using a tourniquet (wide awake local anesthesia no tourniquet (WALANT) technique). Our objective was not to confirm the safety of these procedures (that is already done) but to establish the possibility to realize them in Belgium, where this strategy is less usual, and could be more difficult to accept for the patients and also the surgeons. We realized a multicenter observational prospective study between October 2016 and April 2017, including 44 patients and 47 operations. We wrote two questionnaires: the first one for the patients, asking essentially for pain control, mobility, and satisfaction, and the second one was given to the surgeons, asking for the difficulty of the infiltration and the surgery. We obtained very good results for seven different indications in terms of pain control (71% of response for postoperative pain with step one analgesics), anxiety (1.6 on a scale between 0 and 10 during surgery), and rapid recovery and patient satisfaction (95% of the patients would ask for the same procedure if another surgery was necessary). We observed high levels of comfort for surgeon during the different times of the procedure (100% of surgeons will keep applying this technique). We also confirmed the necessity to wait at least 25 min between infiltration and surgery time (two cases of lengthening of surgical time between 2 min and 3 min because of a premature incision). In contrast, we observed excellent levels of visualization, even with a lower quantity of product than that described in the literature (10 cc instead of 20 cc in carpal tunnel surgery). In conclusion, WALANT was a safe and efficient technique, giving high levels of satisfaction for the patients and the surgeons, with a fast learning curve for the infiltration technique, an excellent visualization of the surgical site, and the possibility to obtain the patient collaboration for many indications (trigger finger and tendon repair).

A-0027 Double nerve transfer for the reanimation of axillary nerve palsies

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Background: Axillary nerve palsies result in a deltoid and teres minor impairment, severely compromising the function of the shoulder. It can occur after a lesion of the axillary nerve or a partial tear of the upper brachial plexus such as C5–C6 brachial plexus injuries (BPIs). It usually recovers in less than 6 months but sometimes incompletely. We describe our surgical management of axillary nerve palsies with double nerve transfers to the anterior branch of the axillary nerve and to the branch of the teres minor.
Methods: We manage axillary nerve palsies with a double nerve transfer, which reinforces the probability of recovery through an axillary or posterior approach with transfer of a branch of the long head of triceps to the anterior branch of the axillary nerve (Lht to AA) and to the branch of the teres minor (Lht to Tm) or an Lht to AA and a fascicle of the ulnar nerve to the branch of the teres minor (U to Tm). We performed an anatomical study to describe the technique and assess the feasibility. We measured the length and diameter of these branches and performed the transfer with tensionless sutures. We operated on 10 patients following this procedure and evaluated the motor deficits in the territory of harvested nerves and the recovery of the deltoid and teres minor.
Results: Ten cadavers were dissected. The mean length for the anterior branch of the axillary nerve, the teres minor, the triceps, and the ulnar nerve branches was 34, 25, 54, and 28 mm, respectively. Their respective diameters were 3, 3, 2, and 2 mm. The transfer was always feasible. We operated on 10 patients. There were four isolated axillary nerve palsies and six C5–C6 BPIs. We performed four Lht to AA with Lht to tm and six Lht to AA with U to Tm. There were no deficits in the ulnar nerve territory, particularly after transfer to both biceps branch for elbow flexion and teres minor branch in C5–C6 BPI cases. Patients with more than 18 months of follow-up recovered a full range of motion, an M4 deltoid and teres minor and an M4 elbow flexion in case of C5–C6 BPIs.
Conclusion: Axillary nerve palsies can cause long-term impairment of the shoulder. Either in isolated or in C5–C6 BPI palsies, the challenge is to recover a good function particularly in external rotation, targeting motor branches of the axillary nerve. We describe our technique to manage such palsies in early stages, the double nerve transfer enhances the chances of recovery without compromising any other function and should be attempted whenever possible.

A-0028 Transfer of a fascicle from C7 root to the suprascapular nerve in C5C6 brachial plexus palsies

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Background: In C5–C6 brachial plexus paralysis, neurotization of the suprascapular nerve (SSN) by the spinal accessory nerve (SAN) is the most common procedure to reanimate the rotator cuff muscles and to stabilize the shoulder. Because of the continuing shortcomings in this transfer, such as trapezius palsy and nerve diameter inadequacy, we propose to systematically preserve the SAN and the function of the trapezius muscle using the pectoral fascicle of the C7 root to reinnervate the SSN after hyperselective intraneurodissection and selection.
Methods: We first performed an anatomical feasibility study including eight brachial plexus dissections on fresh cadavers. A supraclavicular approach was taken, allowing isolation of the SSN, microdissection of the C7 root, and harvesting of an anteromedial fascicle of C7. Once the nerves were freed, several criteria were evaluated such as the length of the fascicle from C7, the excess length between the two nerves, and their diameters. We then planned and performed a systematic C7 to SSN nerve transfer in all our C5–C6 BPI cases whenever the stimulation of C7 fired a response in the pectoralis major muscle. When a distal branch from C7 was also used to reanimate a paralyzed function (e.g. long head of triceps to axillary nerve), the most distal branch was cut first, and we ensured the most distal function (e.g. elbow extension) was still preserved when stimulating C7, before cutting the selected branch.
Results: A tensionless suture was possible in each and every cadaver case, with an averaged excess length of 4.7 mm (range 2.2–7.1). The diameters of the two nerve stumps macroscopically fitted properly, with an average diameter of 2.2 mm for the suprascapular nerve (range 1.9–2.7 mm) and 2.1 mm for the pectoral fascicle (range 1.8–2.6 mm). We operated on seven patients using this technique over the past 18 months. Patients with sufficient follow-up recovered a mean forward elevation of 100°, external rotation with adducted arm at 45°, and external rotation with abducted arm at 60°. There were no deficits in the C7 territory. In one case of C5–C6 obstetrical brachial plexus palsy, there was no response after stimulation of the C7 root, and the remaining function of the upper limb was striked after the stimulation of C8–D1 roots. In such case, the SAN was used to transfer to the SSN.
Conclusions: Both our anatomical study and clinical experience show that a neurotization of the suprascapular nerve by a pectoral fascicle from C7 is possible. When the function of the shoulder was severely impaired by a trapezius palsy resulting from the harvest of the SAN, we believe that a systematic C7 to SSN transfer should be performed in C5–C6 BPIs whenever possible. All of the criteria for clinical success seems present. A clinical study is currently run to assess definitive outcomes in our series.

A-0030 Surgical treatment for polydigit amputation: A retrospective analysis of the clinical results

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Hypothesis: Polydigit amputation is a more severe injury than single-digit amputation. It requires a longer operation time for replantation with a longer warm ischemia time and often a secondary or reconstruction surgery. Therefore, our hypothesis is that the clinical results of replantation for polydigit amputation are not as good as expected. The purpose of this study was to report clinical results of replantation and reconstruction surgery for polydigit amputation.
Methods: A retrospective study of 61 fingers of 21 patients with polydigit amputation who had more than one digit in Tamai's zone III or IV was performed. Nineteen patients were men and 2 were women, with a mean follow-up period of 14 months. The number of amputation fingers, zone of injury, survival rate, and clinical results of replantation and reconstruction surgery at the final follow-up were reviewed and analyzed.
Results: The mean number of amputated fingers was 2.8 (2–5) per patient. Crush injuries were the main mechanism of injury in 15 patients. Five were clean-cut, and one was an avulsion. Regarding the injured area of the fingers, 24 fingers were injured in zone IV, 21 in zone III, 10 in zone I, and 3 in zone III. The survival rate of replantation was 87% (45 of 52 digits). The mean final %TAM of the injured digits was 58%, and the mean %TAM of zone IV was significantly lower than those of other zones (mean 28%; $p < 0.01$). The grip strength at the final follow-up in three-finger amputation was lower than that in two-finger amputation (45% vs 75%; $p < 0.05$). Aging was

negatively correlated with the sensory recovery ($r = -0.36$; $p < 0.05$). In the second toe transfer for finger reconstruction in five patients, the %TAM and grip strength at the final follow-up were significantly higher in patients with the PIP joint than in those without the PIP joint (%TAM, 72% vs 28%, $p < 0.05$; grip strength, 70% vs 21% of the normal side; $p < 0.05$).

Summary

- The success rate of polydigit replantation was similar to single finger replantation.
- Clinical outcomes were poor, particularly in zone IV injuries and in more involved fingers.
- In the second toe transfer for finger reconstruction, better clinical results were achieved in patients with the PIP joint than in those without the PIP joint.

A-0033 Results of the surgical treatment of de Quervain's tenosynovitis: 80 cases with a mean follow-up of 9.5 years

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Introduction: Surgical treatment for de Quervain tenosynovitis is only indicated after failure of medical treatment, promoted by anatomical variations. We used Le Viet's technique to avoid tendon instability. The aim of our study was to evaluate long-term results with the hypothesis that this surgical technique is reliable with lasting results over time.

Patients and Methods: Patients operated on between 1995 and 2015 were included, and the results were assessed with a phone questionnaire with a minimum of 1-year follow-up (FU). Surgical technique described by Le Viet was followed, with a subcutaneous fixation of the retinaculum flap. Presence of any anatomical variant was always specified. In 26 cases, another pathology was treated at the same time. In addition to demographic data, the study looked for the presence of pain quantified by VAS, functional impairment, possible dislocation of tendons, and satisfaction.

Results: There were no preoperative or immediate postoperative complications. Among the 89 operated patients, 74 (80 cases) patients were assessed, with 68 women and 6 men, with a mean age of 48.5 years (19–71 years). The 15 patients who lost to FU had an initial evolution comparable to the rest of the population. A supernumerary septum was noticed in 50 cases and a long abductor pollicis multifascicled tendon in 35 cases. There were no recurrences. Functional impairment was absent in 68 cases, moderate in 8 cases, and significant for 4, including 3 with associated diseases. The mean VAS was 0.76 (0–10). None of the cases reported tendinous dislocation or neuroma. Patients were very satisfied in 72 cases, satisfied in 6 cases, and unsatisfied in 2 cases with associated diseases.

Discussion: The results of this series with a mean FU of 9.5 years are favorable with a total regression of any functional impairment in 85% of cases and a satisfaction rate of 97.5%. None of the cases showed tendon dislocation, neuroma, or recurrence. The residual problems were all related to associated diseases, initially present or developed since.

Conclusion: The Le Viet's technique gives reliable, lasting results without complication or recurrence.

A-0034 Three-dimensional fasciectomy – A new technique for fasciectomy: A study of 585 patients

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Background: Numerous Dupuytren's fasciectomy techniques have been described, each associated with unique surgical challenges, complications, and recurrence rates. We describe a common ground surgical approach to Dupuytren's disease which aims to address the potential contributors to the high recurrence rate and unite current limited fasciectomy practice that varies considerably between surgeons: three-dimensional fasciectomy (3-DF).

Methods: We describe the 3-DF principles: raising thin skin flaps (addressing dermal involvement), excising diseased palmar fascia with a 3- to 5-mm clearance margin (treating highly locally recurrent conditions), and excising the vertical septae of Legueu and Juvara (providing deep clearance, hence addressing all potentially involved pathological tissues). We compared the surgical outcomes between traditional limited fasciectomy (LF) and 3-DF.

Results: From the 786 operations ($n = 585$), postoperative recurrence rates were significantly lower for the 3-DF (2/145, 1.4%) group than the LF group (72/641, 11.2%) ($p = 0.001$), and the time to recurrence was significantly longer (5.0 ± 0 years vs 4.0 ± 0.2 years; $p < 0.0001$). With recurrence excluded, there were no differences between the postoperative complication rates for 3-DF (5/145, 3.45%) and LF (41/641, 6.4%) ($p = 0.4$).

Conclusions: Our results suggest that 3-DF leads to lower recurrence rates and a longer disease-free period for patients, without increasing complications. 3-DF provides a safe, efficacious, common ground surgical approach in the treatment of Dupuytren's flexion deformity.

A-0036 Predictive factors for flexor pollicis longus crepitus after volar locking plate fixation for intra-articular fractures of the distal radius: A retrospective comparative study

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Background: Intra-articular fractures of the distal radius are now widely treated using volar locking plates, but there are many reports about tendinous complications associated with plates and screws. Flexor pollicis longus (FPL) subdermal crepitus (local crepitus on palpation with the thumb flexed and extended and the wrist kept dorsiflexed) was reported as a clinical sign of FPL attrition by volar locking plate. This sign could be followed by FPL tenosynovitis and tendon rupture, so patients with this sign could be recommended to undergo surgery for hardware removal. However, there are no literature analyzing the predictive factors for FPL subdermal crepitus.
Objective: To analyze the predictive factors for FPL subdermal crepitus.
Study design: Retrospective comparative study.
Patients and Methods: Among patients with intra-articular fractures of the distal radius, we retrospectively analyzed 53 patients who were treated with volar locking plates and who also had undergone surgery for hardware removal as prophylaxis for tendinous complications or for patients' preference. Regarding the predictive factors for FPL subdermal crepitus, we investigated the direction of fracture displacement (dorsal or volar) and the presence of full-thickness lacerations of the pronator quadratus muscle identified during surgical dissection as preoperative factors. Regarding postoperative factors, we investigated radiographic parameters of radial inclination, volar tilt, ulnar variance after bony healing, and the plate position using Soong grading. We also investigated the range of wrist dorsiflexion and soft tissue coverage of the plate using Yamazaki's criteria during hardware removal.
Results: The average age of the patients was 55 (range 17–84) years. According to the AO classification system, there were 5 types of B3 fractures, 10 types of C1 fractures, 20 types of C2 fractures, and 18 types of C3 fractures. FPL subdermal crepitus was observed in 20 (38%) patients. In the comparative analysis between patients with and without FPL subdermal crepitus, patients with dorsally displaced fractures had significantly higher incidence rates of FPL subdermal crepitus than those with volar displaced fractures (47% vs 13%; $p < 0.05$). Patients with full-thickness pronator quadratus muscle and those with higher Soong grades had a tendency toward higher incidence rates of FPL subdermal crepitus than those without these factors (55% vs 26%; $p = 0.07$, 45% vs 9%, $p = 0.06$, respectively). Soft tissue coverage of the plate, range of wrist dorsiflexion, and other radiographic parameters were not associated with the incidence of FPL subdermal crepitus.
Conclusions: Patients with dorsally displaced intra-articular fractures of the distal radius should be closely monitored, and if FPL subdermal crepitus is identified, then the patient should be advised to undergo surgery for hardware removal.

A-0037 Findings of an early limited-sequence MRI protocol in suspected scaphoid fractures

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Objectives: The aim of the study was to evaluate the benefits of early limited-sequence (15 min) MRI protocol in suspected scaphoid fractures.
Methods: The patients suspected to have scaphoid fractures by the accident and emergency department were referred to an orthopedic clinic to be assessed by a consultant or a registrar. The main tests used for the clinical assessment were anatomical snuff box tenderness, pain on axial loading of the scaphoid, and tenderness on scaphoid tubercle. If a scaphoid fracture is suspected based on the assessment in the clinic and the review of X-rays taken in the A&E department fail to demonstrate a definitive fracture line, then patients are placed in a splint and an early limited-sequence magnetic resonance imaging (MRI) was done on the same day to rule out an occult scaphoid fracture. This limited-sequence MRI involved mainly only T1 coronal images of the wrist as compared to a whole wrist MRI. This in effect required only 15-min slots for each patient and reduced the

actual scan times to as little as 6 min. The scan will be the reviewed by a musculoskeletal radiologist and reported within 1 week. The patients were reviewed the following week with the MRI results. Once a scaphoid fracture is ruled out, the patients are given a splint for comfort and sent to physiotherapy for the start of mobilization as soon as possible. An audit was undertaken of the management of patients with possible occult scaphoid fractures after institution of this protocol over a 12-month period. The details of the initial clinical evaluation and diagnosis were obtained from the clinic letters. Patients were evaluated based on the clinical test done, whether the protocol was followed or not, the number of further clinic and physiotherapy visits needed, and the MRI findings.

Results: A total of 366 patients referred from A&E as possible scaphoid fractures were included in the study. In 117 patients, radiologically occult scaphoid fracture could not be excluded after initial clinician evaluation. Eighty-one patients had limited-sequence MRI scans according to the protocol. This resulted in the detection of 43 traumatic injuries including 6 scaphoid fractures, 19 carpal bone bruises, 6 occult distal radius fractures, 12 soft tissue injuries, and 25 non-trauma lesions. Fourteen patients had normal scans. Thus, pathology was identified in 83% of cases utilizing this protocol. No injuries are known to have been missed.

Conclusion: This study showed that early MRI is a reliable and quick method for evaluation of patients with suspected occult scaphoid fractures. It resulted in the detection of occult scaphoid fractures as well as other occult wrist injuries, the long-term clinical outcome of which has to be studied further. The utilization of this protocol helped in lowering the period of plaster immobilization and number of clinic visits needed, thereby streamlining the patient care in a safe and reliable manner.

A-0041 Treatment for Dupuytren's disease with a whole vial of *Clostridium histiolyticum* collagenase dissolved in 0.6 ml of solvent

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Over the past few years, treatment for Dupuytren's disease has changed tremendously. Classic treatments include total fasciectomy, serial fasciectomy, and needle aponeurotomy. These treatments are beginning to be replaced by treatment with collagenase. In Belgium, the product is reimbursed for contractures of at least 20°, in at most two joints. The producer advises to use 0.58 mg of active enzyme in a volume of 25 ml for metacarpophalangeal (MP) joints and 0.58 mg in a volume of 0.20 ml for a PIP joint. We tried to minimize the need for two doses using a dose of 0.9 mg in a volume of 0.6 ml. We treated 43 hands in 39 patients. They were followed up for a mean period of 27 months (19–38 months). We recorded gain in extension, recurrence rate, and patient satisfaction. We treated a mean of 2.5 joints per patient (range 1–4). For the radial two fingers, we did not treat enough patients to draw any conclusion. We treated 12 MP joints of the middle finger and gained a mean of 32° at the final follow-up. We treated four PIP joints of the middle finger and lost a mean of 6° of extension at the final follow-up. We treated 20 MP joints of the ring finger and gained a mean of 40° at the final follow-up. We treated 11 PIP joints of the ring finger and gained a mean of 20° at the final follow-up. We treated 19 MP joints of the little finger and gained a mean of 53° at the final follow-up. We treated 21 PIP joints of the little finger and gained a mean of 15° at the final follow-up. Even though large corrections were sometimes obtained, a significant part of the treated joints still had a contracture of more than 20° at the final follow-up (4/51 MP joints and 28/36 PIP joints). Of the 39 patients, 25 were satisfied and 24 of them would have the same procedure again. Seven patients wanted a new treatment (of which two of them would have collagenase treatment again. Dilution of the enzyme in 0.6 ml of solvent seems to increase extension in both MP and PIP joints, even though full correction was not always obtained (mainly for PIP joints)

A-0042 Botulinum toxin in treatment of patients with obstetrical brachial plexus palsy sequelae

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Objective: To asses the efficacy and identify primary indications for botulinum toxin treatment as an option in the management of patients with obstetrical brachial plexus palsy (OBPP).

Material and Methods: Botulinum toxin was used in the treatment of 11 patients with OBPP divided into two groups. In group 1, five patients (mean age 6.2 years) with co-contractions of triceps muscle that significantly limited active elbow flexion were treated

with injection into the medial head of triceps. In group 2, five patients (mean age 3 years) with shoulder internal rotational contracture were injected into subscapularis, latissimus dorsi, and teres major muscles to decrease the strength of shoulder internal rotators and improve both passive and active abduction and exorotation of the humerus. Clinical examination, magnetic resonance imaging, and two-channel surface electromyography were used as examination tools.

Results: All five patients from the group 1 had significant improvement of active elbow flexion: both amplitude and velocity of elbow flexion increased. In all cases, improvement was noticed on the third day after injection with a slight increase during the first week reaching the plato. Normalization of biceps–triceps reciprocal activity was confirmed by two-channel surface electromyography. In group 2, only one patient (1 year girl with no signs of shoulder joint instability) had an improvement of active humerus abduction and exorotation. During examination, it was shown by MRI that in two patients who had no effect after injection, a subluxation of the humeral head took place, two more patients obviously were too old (4 and 7 years) and had rigid contracture of the injected muscles. No side effects or complications in both groups were noticed.

Conclusion: Botulinum toxin treatment is an effective option in the management of patients with OBPP sequelae. Co-contraction of triceps muscle that limits active elbow flexion is the strongest indication. Internal rotational contracture does not respond to this method of treatment so well, as it is described in the literature, especially in older children. Thoughtful examination must be performed before the treatment to exclude humeral head dislocation at first. Botulinum toxin treatment in OBPP patients with function-limiting muscle co-contractions is an effective and safe method. This procedure allows to improve hand function significantly in quite elegant manner almost at any age with long-lasting effect.

A-0043 Scope in hand surgery using surgeon-administered local/regional anaesthesia

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Introduction: Hand and wrist surgeries are often carried out under local/regional anaesthesia. We describe our experience using surgeon-administered local/regional anesthesia (SALoRA) without sedation to deliver acute and elective hand surgery anaesthesia in a tertiary public hospital in Singapore. This is in comparison with wide awake local anaesthesia with no tourniquet (WALANT), which has been increasing in popularity.

Methods: A retrospective analysis was conducted on all surgeries performed under SALoRA between January 2013 and December 2016 at our institution. Surgeries on areas other than the hand, wrist, forearms and elbows were excluded. The records were reviewed to analyze the demographics of the patients and case profile of cases performed and their outcomes.

Results: Of the total 3016 cases performed, 1994 patients (1275 men, age 45.78 ± 16) were available for analysis for the study period. The case distribution was similar to most other published day hand surgery. Tourniquet was utilized in 1357 (68%) of cases with an average operation time of 26 ± 19 min. Mean tourniquet use was 24 ± 15 min. Detailed analysis will be presented.

Conclusion: A wide spectrum of surgeries in the hand, wrist and elbow can be performed using SALoRA safely. This has increased productivity, efficiency and utilization of resources. All these can be performed without the negative points of WALANT, providing a truly bloodless field, quick turnaround time without the need for extra manpower to monitor patients post-LA infiltration and prior to operation and no risk of systemic adrenaline effects.

A-0044 Accuracy of the assessment of the stage of osteoarthritis CMC I joint – X-Ray versus arthroscopy

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Background: Arthroscopy of the basal thumb joint has become a valuable tool in the diagnostic and therapeutic workup of trapeziometacarpal joint osteoarthritis. The aim of this study was to evaluate the diagnostic accuracy of conventional X-ray compared to arthroscopy for the assessment of trapeziometacarpal joint osteoarthritis. We further present a new classification system for arthroscopic assessment of trapeziometacarpal osteoarthritis, because current classification systems do not seem appropriate.

Materials and Methods: In 23 patients experiencing symptomatic trapeziometacarpal joint osteoarthritis, arthroscopic diagnostic workup was performed. The grade of osteoarthritis was evaluated according to

the Outerbridge classification. The preoperative conventional X-rays were presented to 10 experienced hand surgeons who were not involved in the treatment and blinded to arthroscopy results. The probands were asked to determine which grade of osteoarthritis according to the Outerbridge classification they would expect to find in arthroscopy. These ratings were compared with the arthroscopic results.
Results: Of the 23 basal thumb joints evaluated using arthroscopy, 11 were found to have cartilage lesions grade 4 according to the Outerbridge classification, 8 lesions grade 3, 4 lesions grade 2, and no lesion grade 1. Overall, 43% of the cartilage lesions were correctly diagnosed using conventional X-ray. In case of grade 4 lesions, 73% of the probands made the correct diagnosis, in case of grade 3 lesions 38% and in grade 2 lesions 13%. In every case of inaccuracy, the grade of osteoarthritis was underestimated.
Conclusion: The assessment of trapeziometacarpal joint osteoarthritis using conventional X-ray seems to be very inaccurate. Arthroscopy of the thumb saddle joint should be the diagnostic gold standard for trapeziometacarpal joint osteoarthritis. The new classification system presented in this study might facilitate grading of trapeziometacarpal joint osteoarthritis found in arthroscopy.

A-0045 Can open injuries in the hand wait? Our experience with treating open hand injuries as elective day surgery

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Introduction: Open hand injuries presenting through the emergency department are routinely admitted and arranged for surgery acutely. Current practice in most of our local institutions is treating these injuries as emergencies, competing with other surgical emergencies. In this study, we report our results of treating open hand injuries as elective day surgery procedures and the prevalence of deep-seated hand infection postoperatively.
Methods: A retrospective analysis of all patients sustaining open hand injuries who underwent elective day surgery from January 2015 to December 2016 was performed. Polytrauma, bite injuries, active infection, and severe injuries requiring immediate attention for possible replantation or critical revascularization were excluded. Patients who developed deep-seated infection post primary surgery requiring surgical debridement were highlighted and evaluated. Demographic data, injury details, timing to surgical management, and antibiotic therapy were also looked at.
Results: A total of 232 cases (211 men, age 36.87 ± 14 years) were included in this study; 91% were conducted with surgeon-administered local/regional anesthesia. Time to surgery was 49.9 ± 32.2 h. Our results revealed that deep infections were not associated with time of surgery.
Conclusion: Timing to surgery of open hand injuries did not affect the outcomes of deep-seated infection in this retrospective single-center study. Treatment of open injuries in the hand as elective day surgery is a safe and effective means of managing such cases in a busy tertiary hospital. It affords effective utilization of health-care resources and at the same time allowing for a consultant delivered service.

A-0047 How reliable is the radiographic diagnosis of mild Madelung deformity?

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Background: Patients with Madelung deformity exhibit a spectrum of mild-to-severe deformity and distortion of wrist geometry. It may, however, be difficult to reliably distinguish mild Madelung deformity from normal. Given the high prevalence of nonspecific wrist pain, it is important that mild Madelung deformity may not be subjected to overtreatment. This study thus tested the reliability of the diagnosis of mild Madelung deformity on a single posteroanterior (PA) radiograph.
Methods: An online survey was sent to hand and wrist surgeons of the Science of Variation Study Group for evaluation of 25 PA wrist radiographs comprising 5 cases with suspected mild Madelung deformity and 20 radiographs without any evident wrist pathology. Interobserver agreement was evaluated both via average percent agreement and Fleiss' kappa. To evaluate the relationship of rater characteristics and accuracy, a linear regression model was computed.
Results: The interobserver agreement among the 69 participating surgeons was low (=0.12). The overall sensitivity, specificity, and accuracy were 0.30, 0.86, and 0.75, respectively. The mean confidence was 7.4 ± 0.4 for mild Madelung and 7.8 ± 0.5 for normal ($p = 0.112$). The observers' confidence level was the

only factor that had a mild but significant effect on the accuracy of the ratings.
Conclusions: The diagnosis of mild Madelung deformity is unreliable. Until there is good evidence that mild Madelung can be reliably and accurately diagnosed and that we have an intervention that relieves symptoms better than sham surgery, it seems wise to err on the side of caution and treat mild Madelung deformity supportively.

A-0049 Principles of surgical treatment of wrist contractures in children with arthrogryposis

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The prevalence of wrist contractures in children with arthrogryposis multiplex congenita (AMC) is reported from 40% to 88%. For the majority of children with AMC, the wrist contractures are rigid and do not respond to nonoperative care. Multiple surgical procedures have been proposed to correct wrist contractures, but results were controversial because of further limit of motion and recurrence of deformity. The objects of the study were 90 patients (162 upper extremities) with the wrist contractures in AMC, which were examined and treated at the age from 6 months to 17 years in 2009–2016. There are different clinical variants of the wrist contractures including flexion contracture, flexion contracture associated with ulnar deviation, which are the most commonly seen, and isolated ulnar deviation that occurs very rare. Patients were divided into three groups: with C6–C7, C5–C7, and C5–Th1 levels of spinal cord lesion. Clinical, X-ray study, and neurophysiological examination were performed. One hundred and sixty-two operations were performed using the following surgical techniques: tendon transfers, carpal wedge osteotomy, and shortening osteotomy of the forearm bones.

Passive correction of wrist deformities, range of passive and active motions, muscle strength, and functional capacity for grasps decreased in patients with increased amount of damaged segments. Carpal coalition were observed in 29% of cases, most of them, especially total carpal fusion, were revealed in patients with C5–Th1 level of spinal cord lesion (43%). In choosing variant of surgical treatment, the following parameters were taken into account: variant of deformity and possibility of passive correction of wrist contracture. In patients with C6–C7 and C5–C7 levels, tendon transfers were predominated (76% and 82%). In group with C5–Th1 level, tendon transfers and carpal wedge osteotomy in different combinations were performed in equal percentage (51% and 49%). For objective results assessment of surgical treatment, we took into consideration the following criteria: wrist resting position, active extension, cosmetic appearance, and functional capacity for grasps. All results were divided into three groups: good, satisfactory, and unsatisfactory. Children with C6–C7 and C5–C7 levels of spinal cord lesion had 88% and 84% of good results and 12% and 16% of satisfactory. In both groups, restoration of active wrist extension up to the neutral position and more and significant improvement of cosmetic appearance and functional capacity for grasps were achieved. In the C5–Th1 group, patients had 11% of good, 79% of satisfactory, and 10% of unsatisfactory results of treatment. Improvement of wrist position and appearance and minimal increasing functional capacity for grasps were observed. Recurrence of wrist deformity was revealed in 13% (21 wrists), in most of cases in patients with C5–Th1 level of spinal cord lesion (13 wrists).

Varied surgical approach to wrist contractures treatment in cooperation of determination the level of spinal cord lesion can provide predictable results and improve wrist function, appearance, and quality of life of children with AMC as much as possible.

A-0060 Outcomes of the Ivory arthroplasty for trapeziometacarpal joint osteoarthritis with a minimum of 10-year follow-up: A prospective single-centre cohort study

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Introduction: This study investigated the long-term functional outcome after total replacement of the trapeziometacarpal joint with the Ivory prosthesis (Stryker Corporate, Kalamazoo, Michigan, USA) for advanced trapeziometacarpal joint osteoarthritis.
Materials and Methods: In this prospective single-centre study, clinical outcome (mobility and strength), overall function, pain, and radiological outcome were analyzed after a minimum of 10 years of follow-up. Opening of the first web space and metacarpophalangeal flexion and extension were graded. Opposition and retropulsion were graded by Kapandji scores. Key pinch, precision pinch, and grip strength were measured using a calibrated hydraulic pinch gauge and a calibrated hydraulic hand dynamometer. To assess the overall function, the Quick Disabilities

of the Arm, Shoulder and Hand score was used. Pain score was assessed with the visual analog scale. Radiological outcome was evaluated using frontal and profile views as described by Kapandji and Eaton with and without stress.

Results and Discussion: A total of 26 Ivory arthroplasties were evaluated. Of the 32 eligible patients, 24 patients were included in the study. Two patients had bilateral arthroplasties. The female to male ratio was 22:2, and the mean age was 71 (range 57–83) years. The mean follow-up period was 130 (range 120–142) months. Patient satisfaction was high, with 85% of the patients willingly to repeat surgery. Retropulsion of the thumb was significantly improved with 25% compared to preoperatively. Flexion of the metacarpophalangeal joint was improved with 5.5% compared to the contralateral thumb. Overall function improved by 54%. Pain decreased by 81% with a mean visual analog scale score of 1.3/10 at a minimum of 10 years of follow-up. Radiological evaluation revealed polythene wear with secondary joint instability that needed revision in two patients and a broken implant that needed revision in another male patient. Three patients had asymptomatic polythene wear that required no revision but remain in follow-up. One patient had a failure of the prosthesis and was converted to a trapeziectomy. The 10-year overall survival of the prosthesis was 85%.

Conclusion: These long-term results suggest that the Ivory arthroplasty is a reliable option for treating advanced trapeziometacarpal osteoarthritis, because it gives an important improvement in overall function and pain reduction. However, revision of the implant within 10 years after surgery is needed in 15%.

A-0070 Thumb basal joint osteoarthritis – Reconstruction and tendon interposition versus hematoma distraction arthroplasty: A prospective randomized controlled trial

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Purpose: Numerous techniques have been described for the surgical treatment of thumb basal joint arthritis. To date, there is no gold standard surgical treatment.

Methods: The study was designed as a blinded single-centre prospective randomized trial. Patients were treated by trapeziectomy and ligament reconstruction (LRTI) suspension arthroplasty versus hematoma distraction arthroplasty (HDA). Two experienced consultant hand surgeons (first two authors) performed all surgeries in a 2-year designed study with a total of 50 patients in each group. No loses were reported at postoperative 6-month follow-up. Clinical evaluation was evaluated with tip and key pinch and patient perception with a QuickDASH questionnaire. All data were compared with preoperative values at 6 months and published normal values. Surgical time and complications were registered. This project has the approval of the research ethics committee. We present 40% of the study's completion.

Results: These are preliminary results until final data collection. Both groups were statistically equivalent in age, sex, and work status. Tip and key pinch kilograms–force values at 6 months were 4.14 (SD 2.19) and 5.57 (SD 2.57) for the LRTI group and 3.38 (SD 1.41) and 4.75 (SD 1.58) for the HDA group. The LRTI and HDA groups improved 18 points (SD 29.4) and 39 points (SD 34.19), respectively, in QuickDASH score ($p = 0.23$). Surgical time dedicated for LRTI was 39 and 41 min for HDA. We had no complications in LRTI group and one complex regional pain syndrome with good resolution in the HDA group.

Conclusions: To date, at 6-month follow-up, the LRTI and HDA were comparable on all measurements. However, there seems to be a trend in a better functional outcome in the HDA group. This is a statistically nonsignificant difference due to the high dispersion of the QuickDASH data. We expect to increase the level of accuracy as the study progresses.

A-0072 Digital shortening with auricular second phalanx resection into Dupuytren's digital hooks

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Introduction: The fifth finger strong digital hook during the Dupuytren's disease continues to be a therapeutic problem. The fifth finger amputation, which is sometimes the right and imperative solution, has a harsh functional and aesthetical result and exposes the patient to an adjacent digital hooks aggravation. The second phalanx removal with digital arthrodesis is a surgical solution, which may well be suggested. The aim of this study was to report a continuous series of 36 cases.

Materials and Methods: This was a retrospective series of 33 patients; 26 men and 7 women, operated from 1994 to 2015. The patients showed a severe fifth finger digital hook and had a previous surgery in 30 cases. The combined extension deficit was 143° (75–270), and functional and aesthetical discomfort was important. The surgical technique consisted of a dorsal approach, a more or less extensive excision of the second phalanx and an arthrodesis with an alignment of the remaining digital segment, keeping the pulpoungueal complex. During patients' review, the following were observed: functional discomfort and utilization, aesthetical aspect, residual pain, pulpar sensitivity, digital retraction recurrence, and overall satisfaction.

Results: Six patients were dead and two were lost to follow-up. Twenty-five patients (27 cases) were reviewed at the mean follow-up of 64 months (12–280). We did not deplore any postoperative complications. Twenty-two patients (24 cases) were satisfied or very satisfied. The aesthetic result was noted at 7.13/10 (1–10), and pain according to the visual analog scale was 0.46 (0–5). Cold pain was found in nine (33.3%) cases and decreased pulpal sensitivity in three (11.1%) cases. The hand flat could be possible in 21 cases, while in the other cases it was not because of the little finger. Wearing of glove was again possible in 26 cases. The bone consolidation was acquired in 18 (66.6%) cases, while in all other cases, there was a pseudarthrodesis without clinical repercussions. We deplored five local recurrences at the level of the little finger.

Discussion: Digital shortening without a palmar approach seems to bring a satisfying solution with fifth finger severe digital hooks with Dupuytren's disease. This technique allows us to keep a functional digital segment, sensitive and aesthetic, with no important morbidity amounting.

A-0075 Correlation between extension-block K-wire insertion angle and postoperative extension loss in mallet finger fracture

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Introduction: Extension-block pinning represents a simple and reliable surgical technique. Although this procedure is commonly performed successfully, some patients develop postoperative extension loss. To date, the relationship between extension-block Kirschner wire (K-wire) insertion angle and postoperative extension loss in mallet finger fracture remains unclear.

Hypothesis: We aimed to clarify this relationship and further evaluate how various operative and nonoperative factors affect postoperative extension loss after extension-block pinning for mallet finger fracture.

Materials and Methods: A retrospective study was conducted to investigate the relationship between extension block K-wire insertion angle and postoperative extension loss. The inclusion criteria were (1) a dorsal intra-articular fracture fragment involving 30% of the base of the distal phalanx with or without volar subluxation of the distal phalanx and (2) <3 weeks delay from the injury without treatment. Extension-block K-wire insertion angle and fixation angle of the distal interphalangeal (DIP) joint were assessed using lateral radiograph at immediate postoperative time. Postoperative extension loss was assessed by using lateral radiograph at the last follow-up. Extension-block K-wire insertion angle was defined as the acute angle between extension block K-wire and longitudinal axis of middle phalangeal head. DIP joint fixation angle was defined as the acute angle between the distal phalanx and middle phalanx longitudinal axes.

Results: Seventy-five patients were included. The correlation analysis revealed that extension-block K-wire insertion angle had a negative correlation with postoperative extension loss, whereas fracture size and time to operation had a positive correlation (correlation coefficient for extension block K-wire angle: −0.66, facture size: +0.67, time to operation: +0.60). When stratifying patients in terms of negative and positive fixation angles of the DIP joint, the independent t-test showed that mean postoperative extension loss is −3.67° and +4.54° (DIP joint fixation angles of <0° and ≥0°, respectively, $p = 0.024$). When stratifying patients in terms of extension-block K-wire insertion angle (30°, 30°–40°, >40°), analysis of variance showed significantly less postoperative extension loss for higher insertion angles (>40°) than for medium insertion angles (30°–40°). Mean postoperative extension loss difference between higher insertion angle (>40°) and medium insertion angle (30°–40°) was 11° ($p = 0.002$).

Discussion: Both operative factors (extension-block K-wire insertion angle and DIP joint fixation angle) and nonoperative factors (fracture size and time to operation) are important, as they may affect postoperative extension loss when treating acute bony mallet finger via the extension-block K-wire method. Insertion angles within 25°–45° were achieved, and postoperative extension loss decreased inversely within this range. When stratifying

according to insertion angles, significantly lower postoperative extension loss was found in for angles of 40°–45°. Furthermore, lower postoperative extension loss occurs when the DIP joint is extended to more than 0° during the fixation of the transarticular K-wire. Finally, there is higher likelihood for postoperative extension loss in cases with bigger fracture fragment or longer time to operation.

A-0080 Establishment of normal ranges of upper extremity length, circumference, and rate of growth in the pediatric population

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Objective: Upper extremity length and circumference abnormalities are present in a number of conditions in the pediatric population such as Marfan syndrome, brachial plexus birth palsy, mesomelia, and hypochondroplasia. In most cases, upper limb hypoplasia and hypertrophy are diagnosed when one limb appears substantially different from the other during the physical examination. However, occasionally when this discrepancy exists, it can be difficult to determine which limb is the abnormal one. Furthermore, when both limbs are involved in a condition, the diagnosis of upper limb hypoplasia or hypertrophy becomes much more difficult due to the lack of normative values. The purpose of this study was to establish normal values for upper extremity length, circumference, and rate of growth in children aged 0–17 years.
Methods: A total of 377 participants (212 female; 0–17 years) were recruited from a population of pediatric orthopaedic patients and their siblings. Four measurements were taken for each upper extremity of each participant: upper arm length measured from the tip of the acromion to the elbow flexion crease, upper arm circumference measured at 5 or 10 cm proximal to the elbow flexion crease depending on the size of the patient, forearm length measured from the elbow flexion crease to the wrist flexion crease, and forearm circumference, measured at 5 or 10 cm distal to the elbow flexion crease depending on the size of the patient.
Results: Mean values for arm and forearm length and circumference for each age, 0 to 17 years, were established. The determination of a child's expected arm length is dependent on their height, age, and sex, while the calculation of a child's expected forearm length depends on their weight, age, and sex. Expected arm circumference in pediatric patients can be determined by their height, weight, and age. In contrast, expected forearm circumference was independent of age, height, and sex, linked solely to patient weight. Male and female arms and forearms have similar growth rates of lengths and circumferences. No significant differences were found between right and left extremities for each of the four measurements taken.
Conclusions: Contralateral limbs can be used comparatively for length and circumference of the arm and forearm in cases of unilateral upper extremity abnormality. The establishment of normal values for upper extremity length, circumference, and growth rate will be a useful diagnostic tool for upper extremity hypoplasia and hypertrophy, allowing future studies to determine the impact of these variables.

A-0082 Transphyseal humeral separations are associated with high fates of misdiagnosis by radiologists and emergency department physicians

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Objective: Transphyseal humeral separations (TPHS) are rare injuries that lack substantial data regarding injury patterns, diagnostic accuracy, treatment methodology, and overall outcomes. Given the rarity of these injuries, they are often misdiagnosed, which may lead to a delay in care. This study aims to assess the accuracy of diagnosis of TPHS by radiologists and emergency department (ED) physicians as well as their effects on the time to surgery and patient outcomes.
Methods: A retrospective review was conducted at five pediatric institutions to identify all transphyseal humeral separations ($n = 64$) in patients 0–3 years of age from January 1991 to December 2016. Patient demographics, time to surgery, and diagnosis by radiologists and ED physicians were recorded. Frequencies and means were recorded for demographic and epidemiological analyses, the rate of misdiagnosis, and the reported misdiagnoses.

Results: Sixty-four patients with a mean age of 17.4 months were identified. The most common mechanism of injury was accidental trauma ($n=40$), followed by nonaccidental trauma ($n=17$), cesarean section ($n=4$), and vaginal delivery ($n=3$). Time to surgery was greater than 24 h in 40 patients. Accurate diagnosis by the radiologist occurred in 8 instances (12.5%) and by the ED physician in 24 cases (37.5%). In the radiology group, the misdiagnoses (87.5%) recorded were lateral condyle fracture ($n=18$), nonspecific distal humerus fracture ($n=17$), elbow dislocation ($n=4$), supracondylar humerus fracture ($n=9$), and medial condyle fracture ($n=3$). In the ED group, the misdiagnoses (62.5%) recorded were lateral condyle fracture ($n=12$), supracondylar humerus fracture ($n=10$), nonspecific distal humerus fracture ($n=9$), medial condyle fracture ($n=7$), and elbow dislocation ($n=7$). The mechanism of injury did not have a significant correlation with diagnostic accuracy by either group. Moreover, the diagnostic accuracy did not have a significant correlation with time to surgery.
Conclusion: Transphyseal humeral separations are rare injuries that are associated with high rates of initial misdiagnosis, ranging from 62.5% in ED physicians to 87.5% among radiologists. Despite the misdiagnoses, there does not appear to be a relationship to time to surgery. This multicenter analysis provides the largest series assessing the rates of misdiagnosis of transphyseal humeral separations. It is important to consider providing increased education to radiologists and ED physicians to accurately diagnosis TPHS, as these injuries are associated with high rates of non-accidental trauma.

A-0085 Operative management for pediatric and adolescent scaphoid nonunions: A meta-analysis

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Objective: Scaphoid fractures in the pediatric population represent approximately 3% of all hand and carpal fractures; however, their incidence is rising. Cast immobilization has been shown to yield excellent results in the acute phase; however, as many as 10% of patients develop nonunions. Multiple fixation techniques exist but there is no consensus regarding the best surgical treatment following the development of a pediatric/adolescent scaphoid nonunion. The purpose of this study was to evaluate the current body of literature regarding pediatric/adolescent scaphoid nonunions and determine success and functional outcomes following surgical fixation.
Methods: A comprehensive literature review was performed utilizing Medline, Ovid, and Embase databases to compare surgical techniques for adolescent scaphoid nonunions on the basis of union rates, functional outcomes, and operative complications. The initial search returned 2110 publications. Inclusion criteria consisted of a scaphoid fracture with more than 3 months of no clinical or radiographic improvement following cast immobilization and age less than 18 years. Ultimately, 11 studies met inclusion criteria and were included in the final analysis.
Results: A total of 176 surgically treated pediatric/adolescent scaphoid nonunions were identified from the 11 studies, including 157 non-vascularized bone graft procedures and 19 non-grafted rigid fixation procedures. Patients treated with a non-grafted method achieved union with a total random effects model revealing a union rate of 94.6%, while the grafted cohort had a union rate of 94.7%. Functional outcomes including range of motion and grip strength were significantly improved in both cohorts. Patients managed operatively with bone graft had four complications, in contrast patients without bone grafting did not report complications ($p=0.9$).
Conclusions: Surgical treatment of pediatric/adolescent scaphoid fracture nonunions produces excellent union rates and functional outcomes following surgical intervention, using both grafted and non-grafted techniques. Given the current evidence, there is no advantage to the use of bone graft in skeletally immature patients; however, this should always be evaluated in a case-to-case scenario. Future prospective studies are needed to assess whether the outcomes of a specific technique are more favorable and to determine whether differences exist based on fracture location.

A-0086 Cyanoacrylate-assisted four-corner fish-mouth technique for microvascular anastomosis

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Objective: The conventional end-to-end technique of microvascular anastomosis with interrupted sutures can be time consuming especially in the hands of a less experienced microsurgeon. It has been shown to

cause media wall necrosis with intimal hyperplasia, leading to intraluminal thrombosis. Studies have been done on the use of tissue adhesives to achieve sutureless microvascular anastomosis. The 'fish-mouth' technique that was described by Egemen in 2011 combines two sutures that were placed 180° apart with cyanoacrylate tissue adhesive. We describe a modification of the 'fish-mouth' technique, whereby four corner stitches were used instead of two, for microvascular anastomosis.

Methodology: Twelve anastomoses were carried out on bilateral common iliac arteries in six rabbits. Two groups were compared; conventional anastomosis versus four corner 'fish-mouth' (FCFM) technique. Conventional anastomosis involved seven to nine interrupted sutures. For the described technique, four parallel incisions were made at 90° apart of both ends of transacted vessel. Four sutures were placed passing from the proximal end to exit from the distal part of the longitudinal incisions. Each corner was held in place to allow intimal contact between the two lids. The tissue adhesive was then applied onto the 'fish-mouth' flap. Outcomes were measured.

Results: In both groups, 100% patency rates were achieved. The mean anastomosis time for the conventional and FCFM group was 30 and 28.7 min, respectively, and the mean bleeding time was 1.8 and 0.5 min, respectively. Histopathological evaluation for both anastomoses showed distinct findings that were significant. There was no intraluminal adhesive leakage in the FCFM.

Conclusion: Our preliminary results for both conventional and the described technique are comparable in terms of anastomosis and bleeding time. A larger sample size would be needed to produce more significant results.

A-0087 Management of severe radial club hand by soft tissue distraction prior to centralization using JESS fixator

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Objective: In cases of severe radial club hand, that is, Bayne's type III and type IV centralization as a primary definitive procedure is difficult due to tight soft tissue contractures. Precentralization soft tissue distraction is advised in order to avoid extensive dissection, bony resection, and acute stretching of the neurovascular structures. This study aimed to evaluate the quality of the result of stiff radial club hand by soft tissue distraction prior to definitive procedure, to find out the difficulties associated with this technique prior to definitive procedure.

Materials and Methods: In a prospective study, 31 cases with 31 radial club hands of Bayne's types III and IV were treated by gradual soft tissue stretching using differential distraction followed by centralization. There were 4 type III and 27 type IV radial club hands. All hands were fixed with Joshi's external stabilizing system (JESS). Two transfixing 'K' wires were passed in the ulna as well as in the metacarpals wherever feasible and two 'K' wires in ulna and one in the metacarpal were passed in severe contractures. Differential distraction of two turns on radial side and one turn on the ulnar side per day was carried. Mean distraction time was 12.7 weeks (10–20 weeks). Among these, 23 patients eventually underwent centralization and 2 underwent radialization. Six cases were missed for follow-up.

Results: Average age of the patients was 4.9 years (range 1–15 years), with male (M) to female (F) ratio of 1.8:1(M: 20; F: 11). The average radial deviation with HFA (hand forearm angle) improved from $87.45° \pm 23.96°$ preoperatively to $32.00° \pm 32.04°$ postoperatively. HFP (hand forearm position/translation) at preoperative and postoperative follow-ups was 18.40 ± 4.45 mm and 14.78 ± 3.73 mm, respectively. The ulna length at preoperative and postoperative follow-ups was 6.16 ± 0.72 cm and 6.41 ± 0.81 cm, respectively. According to Kanojia's assessment criteria, 19 cases (61.2%) had good outcomes, 6 cases (19.4%) had satisfactory outcome, and 6 cases (19.4%) unsatisfactory.

Discussion: Soft-tissue distraction in severe radial club hands (types III and IV) prior to definitive procedure like centralization is a powerful technique for repositioning the wrist. The differential distraction by JESS achieves improvement in the HFA, HF, without overstretching of soft tissues, nerves, and vessels. JESS external fixator is easy to apply, stable, and of low expenditure and could be readjusted easily.

Conclusion: The present study confirms differential soft-tissue distraction prior to definitive procedure in severe radial club hands helps to achieve better results.

A-0088 Review of errors in distal radius fractures

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Distal radius fractures (DRFs) represent the most common fracture treated by physicians. The bimodal distribution shows two peaks, one of the high energy injuries in young patients and other due to low energy injuries in the elderly. An appropriate treatment of each fracture is important in order to avoid mistakes. Even if it's the most common injury that hand surgeons deal with, we must be aware that each fracture might have its own ''personality'' and we must treat them according to this. We present some cases of failure in the treatment of DRF (a collapse in a non-surgical DRF, an intraarticular screw in a surgically treated fracture, a case of collapse in a surgically managed one, a case of broken screws and plate, etc.) and we ought to analyze the committed errors in order to prevent them.

A-0089 A systematic review of volar locking plate removal after distal radius fracture

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Background: Indication of volar locking plate (VLP) removal after bony healing of distal radius fracture (DRF) is controversial. Studies with various range of removal rate were reported. The purpose of this systematic review was to investigate the frequency and the reasons of hardware removal over the world. We hypothesized that more frequent VLP removal contributes to better clinical outcomes.
Methods: The authors searched all available literature in the PubMed and EMBASE databases for articles reporting on outcomes of treatment using VLP for DRF. Data collection included hardware removal rate, complication rate, clinical, and radiological outcomes. We analyzed correlation between hardware removal rate with clinical and radiological outcomes.
Results: A total of 3472 articles were screened, yielding 52 studies for final review. The mean hardware removal rate was 9%, ranging from 0% to 100%. The mean removal rate in studies from France, Norway, Japan, and Belgium was as high as 19%. The mean removal rate in studies from the United States was low (3%). The most frequent reasons for extraction were routine removal (22%), tendon irritation or tenosynovitis (14%), hardware problem (14%), and patient' request (13%). Although routine removal and patient' request were not counted as complication, correlation between removal rate with complication rate was strong ($\rho = 0.64$, $p < 0.001$). Correlations between clinical and radiological outcomes were week except for volar tilt ($\rho = -0.42$, $p = 0.009$).
Conclusions: There was a diversity of removal rate and reasons in the studies over the world. High frequent VLP removal does not contribute to clinical outcomes including complication rate. Anatomical reduction and appropriate plate selection and placement at the initial surgery are important to reduce further intervention.

A-0092 Bilhaut procedure: Expanding the indications

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Objective: The goal is to consider the possibilities of Bilhaut procedure in congenital polydactyly treatment.
Materials and Methods: Twenty-four Bilhaut operations were performed in children aged from 8 months to 6 years during the last 10 years. Eight patients had thumb polyphalangy, 14 had thumb polydactyly (in 5 cases, polydactyly was combined with duplicated finger triphalangism), and 2 had triphalanged fingers polyphalangism. The indications for Bilhaut procedure were equal developing of the main finger and the additional one, the main finger underdevelopment 30% and less, good-sized clinodactyly at the level of metacarpophalangeal and interphalangeal joint. A classic Bilhaut technique was used in 13 children, while in the rest it was modified according to the specific anatomical features. Only soft tissues of an additional finger were used in two operations, soft tissues and additional proximal phalanx segment were used in two cases and the connection of only proximal or only nail fingers also in two cases. In five patients, the Bilhaut was combined with triphalangism elimination.

Discussion: There is no agreement about Bilhaut procedure in fingers polydactyly. In some articles, the efficacy of this technique versus standard reconstructions is considered not proven. But this technique is constantly being upgraded to diminish its disadvantages. Our opinion is that Bilhaut procedure is excellent when you use only this idea and modify it according to the present anatomical peculiarities. Long-term outcomes show that nail deformity formation is possible. This deformation is easily corrected in older age. Neither growth impairment nor previous mobility impairment was obtained.
Conclusion: Bilhaut procedure in hand polydactyly treatment is expedient to use, and indications for it can be extended.

A-0094 Volar lunate facet – secondary dislocation after distal radius plate fixation: Correction options and salvage procedures

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Objective: The secondary dislocation of the volar lunate facet fragment after operative fixation is a serious problem. Significant predictors of loss of reduction are number of fragments, subsidence lunate distance, fragment size for fixation. Standard fixed angle plates may not provide adequate control of this fragment even when placed sufficiently distal. Carpal translation with volar subluxation more than 4 mm leads to severe wrist dysfunction.
Methods: In revision surgery, anatomical reduction and restoration of the articular congruity is the first key in treatment. The principles are mobilization of the displaced fragments, anatomical reduction and refixation, and neutralization of the tension forces of the short radiolunate ligaments. Sometimes it is necessary to perform an additional volar open wedge osteotomy on the distal radius to correct the radiocarpal joint inclination. For fixation, hook plates or small fixed-angle plates are used. But the plate coverage and the number of screws in the lunate facet does not address all aspects of stability. It is essential to prevent the carpal translation. To reduce the load to the volar ulnar fragment, a temporary radiocarpal arthrodesis for 6–8 weeks is necessary. Therefore, a K-wire fixation between the radius and the lunate is used. Depending on the time factor and anatomical conditions, a reconstruction with reassessment of the fragments is needed and it is not always possible. If the cartilage of the radiocarpal joint is destroyed and severe painful osteoarthritis results, a salvage procedure is necessary. Our standard method is a volar RSL fusion with a fixed-angle frame plate.
Results: Between 2006 and 2014, 11 patients were treated with an RSL fusion from a volar approach. The mean age was 55 years. Average follow-up was 5.2 years. The CT scans at follow-up showed no pseudarthrosis, and no case of midcarpal arthrosis was related to surgical procedures. The clinical results showed good pain relief in all the cases (VAS 2.2). Residual function covers 95° flexion–extension arc, 35° radial–ulnar deviation arc, and 75% of grip strength compared to the contralateral side. DASH score 27 and PRWE score 31 points.
Conclusions: The correction of secondary dislocated volar lunate facet fragments should be performed as early as possible, and the important factor is adequate refixation of the fragments. As a salvage procedure, we perform a volar RSL fusion with good long-term results.

A-0099 The creation of a wide awake hand surgery service in an NHS Trust in the United Kingdom: Challenges, cost savings and effectiveness

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Background: The wide awake local anaesthesia no tourniquet (WALANT) concept has been proved to be an efficient, safe and cheap method to operate on various hand pathologies and trauma. We describe our experience with this method in a major hand surgery unit in the United Kingdom and compare our outcomes with those of a regional private hand surgery centre in Paphos, Cyprus.
Objectives: To show our results with the utilization of the WALANT method in aspects of patient satisfaction, safety as well as cost reduction and improved theatre utilization.
Study design and Methods: In this retrospective study, we present our results from over 100 cases treated with this method in aspect of patient satisfaction, outcomes/complications as well as cost-effectiveness. Cases treated range from carpal tunnel decompressions to open reduction and internal fixation (ORIF) of metacarpals or phalanges using plates and screws, cubital tunnel releases, ulnar collateral ligament repairs as well as trapeziectomies. The method followed was administration of local anaesthesia (LA; lidocaine with 1:100,000 adrenaline) in the

area of the procedure, as advocated by Lalonde et al. No tourniquet was used during the procedure. All the patients were operated on an ambulatory surgery setting and were discharged immediately after the procedure. The mean time from the injection of the LA until surgery commenced was 11.5 min and all the patients were either injected in theatre or in the anaesthetic room.

Results: There was a high satisfaction rate among patients as the procedure was comfortable even for lengthy procedures. Compared to Cyprus, we had two patients who required sedation during the procedure due to panic attacks as well as vasovagal attacks. There was also increased bleeding during the procedures compared to procedures done under a tourniquet; however, this did not prevent us from completing the procedures. Also the fact that the UK patients were operated in a public hospital setting made them more reluctant to have their procedures wide awake and preferred to have their procedure under general anesthesia (GA) as there was no additional cost to them. No persistent ischaemia of digits or any other WALANT-related complications was noted. There were also no operating list cancellations due to lack of anaesthetist and there was a significant reduction in turnover time and as well as significant cost saving based on the NHS National Tariff Prices. Also, there were less cancellations due to patient comorbidities.

Conclusions: Wide awake hand surgery in an NHS hospital can result in less cancellations, improved theatre utilization, significant cost savings as well as improved patient outcomes. However, better implementation measures should be put in place, like permission to inject patients in the ward at least 30 min prior to their surgery in order to allow adrenaline to work better (and therefore have less intraoperative bleeding), staff education regarding wide-awake hand surgery as well as patient education so as more patients opt for it.

A-0104 The double thenar flap for two adjacent fingertip amputations

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Objective: Thenar flap is a well-described technique, but there is a scarcity of reports about its use in patients with multiple fingertip injury. The aim of this study was to introduce surgical technique of double thenar flap and to evaluate clinical outcome and related complications.

Methods: Multiple fingertip amputations treated by thenar flap reconstruction were retrospectively identified and evaluated from October 2013 to October 2016. At the last follow-up, the patients were assessed for cold intolerance in the reconstructed fingers, two-point discrimination, range of motion (ROM), functional outcomes by quick disabilities of the arm, shoulder and hand (DASH) score, functional and appearance outcomes by Michigan Hand Outcome Questionnaire (MHQ), and return to work time.

Results: Twelve patients (24 fingers) underwent double thenar flap procedures medially ($n = 5$) or laterally ($n = 5$) based on pedicled thenar flap used. The donor site was covered with a partial or full thickness skin graft from the medial foot. The combination of injured digits requiring reconstruction included both middle and ring fingers ($n = 9$), both index and middle fingers ($n = 3$). The mean age was 42 years (18–60 years). The mean time for division and inset was 15 days (13–16 days). The mean follow-up time was 13.5 months (12–16 months). All flaps have survived. The mean total active range of motion (TAM) in flexion measured at the last follow-up was 249° (238–260°). Objective sensibility in the flaps was ascertained as an average static two-point discrimination of 6.9 mm (3–7 mm). The mean quick DASH score was 3.3 (range 0–9.1). The mean MHQ score was 93.8 (range 88–100). All patients returned to work within 6.2 weeks on average. No complication was reported.

Conclusion: Double thenar flap technique is a good option for simultaneous coverage of small to large defects in adjacent two fingertips.

A-0105 Comparison of two bone grafting techniques for the treatment of scaphoid waist nonunions: Iliac bone graft versus anterolateral corner of distal end of radius

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Objective: As a source of corticocancellous grafts for treating scaphoid nonunions, the anterolateral corner of the distal radial metaphysis has several advantages over iliac bone. However, comprehensive

comparison on its surgical outcomes compared to the traditional AIBG has not been fully explored. The aim of this study was to compare the two groups depending on the source of corticocancellous autograft (iliac crest vs anterolateral corner of distal end of radius) for the treatment of scaphoid waist non-unions.

Methods: A total of 50 waist nonunions were included in this retrospective follow-up study. Ten patients were not accessible, and two patients refused to attend follow-up checks. Therefore, a total of 38 patients were included in this study with a mean follow-up interval of 16 (12–36) months; 23 patients were treated using iliac bone graft (Group A) and 15 patients with anterolateral corner of distal radius (Group B). Clinical assessment included range of motion (ROM), pain according to the visual analogue scale (VAS), grip strength, Disability of the Arm, Shoulder and Hand Score, Patient-Rated Wrist Evaluation Score, and modified Mayo Wrist Score. The follow-up study on each patient included a CT scan of the wrist which was analyzed for union, osteoarthritis, dorsiflexed intercalated segment instability, and humpback deformity.

Results: Thirty-seven of the 38 (97%) of the scaphoid waist nonunions showed union, 22/23 (95.7%) in the Group A and 15/15 (100%) in the Group B. Union rate and time to union showed no significant differences between the two groups. Radiologically, restoration of scaphoid deformity was corrected, and degree of restoring normal scaphoid alignment evaluated with scapholunate angles showed superior deformity correction capability in Group B than in Group A ($p < 0.05$). Radiologically, the average lateral intrascaphoid angle, the radiolunate angle, and the scapholunate angle are improved postoperatively in both groups ($p < 0.05$). Percentage of significant residual deformity postoperatively was not significant between the two groups. Functional outcomes evaluated with restriction of ROM, modified MAYO score, the PRWE score, the DASH score, and the rate of complications showed no difference between the two groups.

Conclusions: Corticocancellous bone graft from anterolateral corner of distal end of radius has comparable results with the one from traditional iliac crest with regard to bony union, restoring normal scaphoid alignment, wrist function, and it shows better results than the traditional AIBG with regard to restoring normal scaphoid alignment evaluated with the scapholunate angle.

A-0107 Prognostic factors for resumption of work, ADL and hobbies after traumatic hand or wrist injury

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Introduction: Traumatic hand and wrist injuries have a substantial impact, both economically as on patients' lives. For predicting patients' time off work, several biomedical, sociodemographic, psychological and work-related prognostic factors have been suggested in previous studies. No prognostic factors have been previously identified for the time patients need to resume their ADL, resume their hobbies and for the duration of their complaints. The aim of this study was to measure the impact of traumatic hand and wrist injuries more broadly, by investigating prognostic factors for all the abovementioned outcomes.

Methods: In this prospective cohort study, 383 patients with a traumatic hand or wrist injury were included. In 354 patients, there was a complete follow-up. Data were collected through personal interviews. Potential prognostic factors for all outcome measures were identified by univariate analysis. For the time off work, hazard ratios for prognostic factors were calculated using Cox regression. A hazard ratio of 2, for example, means twice as many patients have had an event (returned to work) at any point in time after the trauma.

Results: The type of work, diagnosis, complication, occurrence of the trauma and gender were prognostic factors for the time off work in the Cox regression analysis. Having a blue collar job gives patients a hazard ratio of 2.52 (condidence interval (CI) 1.89–3.37), a diagnosis other than a distortion gives patients a hazard ratio of 2.48 (CI 1.63–3.76) and a complication gives patients a hazard ratio of 1.88 (1.04–3.42). Furthermore, blaming someone else for the trauma gives patients a hazard ratio of 1.70 (CI 1.11–2.59) and female gender resulted in a hazard ratio of 1.61 (CI 1.22–2.12).

In univariate analysis, prognostic factors for ADL resumption, hobby resumption and the duration of complaints are gender, diagnosis, operative treatment and complication. Furthermore, age is positively correlated with the time to ADL resumption and the duration of complaints.

Due to the trauma, 13 patients did not return to work at all, another 17 patients returned to work in a different job, 29 patients did not (completely) resume their ADL, 40 patients did not resume their hobby and 101 patients were not free of complaints

after 6 months. Patients resumed their work partially in a median time of 1 week (interquartile range (IQR) 0–5), fully in 2 weeks (IQR 0–6), their ADL in 4.5 weeks (IQR 1–9) and their hobbies in 5 weeks (IQR 1–12). Patients were free of complaints in a median time of 9 weeks (IQR 5–24).

Conclusion: Prognostic factors for return to work are the type of work, diagnosis, complication, occurrence of the trauma and gender. Prognostic factors for ADL resumption, hobby resumption and the duration of complaints are gender, diagnosis, operative treatment and complication. Age is a prognostic factor for the time to ADL resumption and for the duration of complaints.

Considering these factors can be helpful in explaining patients what to expect in terms of resumption of their daily activities.

A-0108 Correlation of subject self-measured wrist range of motion with direct provider measurement

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Introduction: Range of motion (ROM) is an important outcome measure for wrist injuries. Remote assessment may be useful, but data are limited regarding validity and reliability. We sought to establish intra-and inter-rater agreement between visual estimation, direct goniometric measurement, and measurements of self-taken digital photographs and line tracings of wrist ROM.

Methods: Thirty-seven consecutive patients who had undergone wrist surgery or sustained a wrist injury were enrolled. Active wrist ROM (extension (E), flexion (F), radial deviation (RD), ulnar deviation (UD)) was assessed by three different providers and final ROM measurements included (1) patient estimation, (2) provider estimation, (3) provider goniometric direct measurements, (4) provider goniometric photograph measurements, and (5) provider goniometric tracing measurements. Intra- and inter-rater agreement was described using intra-class/inter-class correlation (ICC) measurement.

Results: Compared to each provider's own goniometric measurements (intra-rater agreement), all three providers had excellent correlation on visual estimation of extension and flexion (ICC range 0.82–0.87), measurements of self-photographs of extension and flexion (ICC range 0.84–0.85), and measurements of self-drawn tracings of extension and UD (ICC range 0.76–0.85). When comparing providers (inter-rater agreement), excellent correlation was seen with visual estimation of E/F/RD/UD (ICC range 0.79–0.95) and on goniometric measurements of E/F/RD/UD (ICC range 0.84–0.94). Agreement was excellent on goniometric measurement of self-photographs of E/F/RD (ICC range 0.83–0.97) and on goniometric measurement of self-drawn tracings of E/F/RD/UD (ICC range 0.86–0.95).

Discussion: Both visual estimation of wrist E/F and goniometric measurements of self-taken digital photographs of wrist E/F had excellent intra- and inter-rater agreement regardless of experience level. Goniometric measurements of self-drawn tracings of E/UD had excellent intra- and inter-rater agreement. These results study support remote monitoring of wrist ROM, especially flexion and extension with visual estimation and digital photographs. We hope that future research will further evaluate the applicability of these methods with the ultimate goal of increasing patient access and optimizing outcomes.

A-0109 Correlation between patient-rated outcome questionnaire and Single Assessment Numerical Evaluation score in the fracture of distal radius

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Objective: To compare the patient-rated outcome questionnaire (PRO) and the Single Assessment Numerical Evaluation (SANE) scores in the fracture of distal radius.

Methods: This study was a retrospective review of a prospectively filled database of 212 patients who underwent internal fixation with volar locking plate for the fracture of distal radius between August 2014 and April 2017. All patients were operated on by the same surgeon. The patient database included postoperative PRO (The Disabilities of the Arm, Shoulder, and Hand (DASH), patient-rated wrist evaluation (PRWE)) and SANE scores at 1 month, 2 months, 3 months, 6 months and 1 year after the operation. Any patient with incomplete data was removed from the study.

Results: The Pearson correlation coefficient (r) between DASH, PRWE and SANE scores was -0.76 ($p < 0.01$) and -0.72 ($p < 0.01$), respectively. In subgroup analysis, the correlation between the PRWE

pain, function score and SANE score was −0.66 ($p < 0.01$) and −0.69 ($p < 0.01$).

Conclusions: This study shows that there is a significant correlation between postoperative SANE and PRO in the fracture of distal radius. We recommend the SANE score as a reliable outcome indicator for the follow-up in the fracture of distal radius.

A-0110 Pollicization in adults: What kind of surgery to use?

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Pollicization is one of the most effective techniques of bilateral grip restoration in trauma sequelae in adults. We need an algorithm of pollicization variant choosing, which depends on the definite anatomical features of misshaped hand.

Materials and Methods: We have an experience of 472 pollicizations in congenital and acquired deformities, and only in 14 cases this method was used in trauma sequelae in adults. Three main variants of this surgery were used. The criteria for selection were thumb amputation level, the rest fingers condition, the scar intensity of hand soft tissues, and the prognosed condition of neurovascular bundles.

Results: Thumb amputation level: in seven cases, the first metacarpal bone and thenar muscles remained unchanged; in six hands, the proximal third of the first metacarpal bone and carpo-metacarpal joint were preserved; in three hands, the first metacarpal bone was absent but trapezoid bone remained.

The rest fingers condition: in three cases, two to five fingers were intact; in six cases, there were stumps of two to five or three to five fingers at the proximal phalanges level; one patient had two to five fingers contractures and metacarpal bones deformation; two patients had two to three metacarpal bones defects; and two patients had proximal phalanges defects with carpo-metacarpal joints destruction.

Scar intensity of hand soft tissues: cicatricial masses at the hand dorsum were found in two patients, at the palmar surface in two patients, and at both dorsal and palmar surfaces in one patient.

Prognosed condition of arteries and nerves: we expected problems with bundles in two patients who had two to three metacarpal bones defects and apparent scars in this region. In five cases, difficulties with dorsal veins were expected.

In four hands, the fourth finger was moved in the thumb position, in the rest cases index was transferred.

Pollicization by Hilgenfeldt technique was performed in five hands, it let us to ignore the dorsal veins condition. In two patients, index was transferred to the thumb position using backflow through the bifurcation of the common palmar digital artery. Pollicization at separated dorsal veins and palmar bundles was made in seven hands.

In 11 hands, transferred finger was connected with first metacarpal bone remnant, and in 3 hands, the reconstruction of the first carpo-metacarpal joint was performed.

Finger transfer together with contracture elimination was performed in one patient. Pollicization in combination with radial flap transfer was used in two patients: in one case simultaneously and in the other 6 months after the thumb reconstruction.

No problems in postoperative period were noticed.

Conclusion: When choosing pollicization variant in trauma sequelae in adults, the following data are to be considered:

- the condition of the dorsal veins, arteries and nerves;
- the thumb amputation level, carpo-metocarpal joint and thenar muscles condition;
- deformation of the finger planning to be transferred,
- prognosed cover tissue deficit by the surgery termination.

A-0111 Core excision and tendon ball implantation for the treatment of advanced-stage Kienbock's disease

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Objective: The treatment strategy for the advanced-stage Kienbock's disease is still controversial, and many kinds of operative method have been reported. We positively rebuilt the lunate by the combination of vascularized bone graft and decompression in these cases for more than 10 years. However, the reconstruction was not promising when fragmentation and collapse of the lunate were extensive. In late years, for these progressive cases, particularly long-term course and/or elderly cases, we performed the combination of the core excision of lunate and the tendon

ball implantation that keep interosseous ligaments for the purpose of pain relief and carpal height preservation. The purpose of this study was to report our operative technique and postoperative results.

Operative Method: From the dorsal approach, fenestration was conducted at the dorsal center of the lunate and excision of internal necrotic bone was performed through this window. During these steps, the interosseous ligaments around lunate and articular cartilage of the lunate should be kept intact as possible. Then, tendon ball which made with the palmaris longus tendon was inserted into the lunate cavity. Postoperatively, the wrist was fixed for 3 weeks with a splint.

Materials: Six cases of five men and one woman with an average age of 46.2 years old were included in this study. The preoperative period ranged from 6 months to 15 years with an average of 5.9 years. The Lichtman X-ray stage was IIIA in one, IIIB in four, and IV in one. The follow-up period ranged from 10 months to 5.9 years with an average of 1.5 years.

Results: The pain relieved in all cases and all returned to a former job. The range of motion was 56% of intact side preoperatively and 68% postoperatively. The grip strength increased from 48% preoperatively to 70% postoperatively. Mayo Wrist Score was good in one and fair in five because of the limited range of motion and the grip strength. The carpal height ration was kept from 0.47 preoperatively to 0.46 postoperatively.

Conclusion: The combination of the core excision of lunate and the tendon ball implantation was effective for pain relief and carpal height preservation. This technique is relatively less invasive and may be one of the options for the treatment of Kienbock's disease in the advanced stage, particularly long-term course and/or elderly cases.

A-0114 Reconstruction of ulnar dislocation of the extensor tendon at the metacarpophalangeal joint

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Objective: Ulnar dislocation of the extensor tendon at the metacarpophalangeal (MCP) joint is a relatively rare condition, which compromises the hand function. We describe a reconstruction technique for this condition and report the results of five cases treated using this technique.

Materials and Methods: Five patients (two women and three men; age 25–82 years) with spontaneous ulnar dislocation of the long finger extensor tendon (extensor digitorum communis (EDC)) were treated. One patient had an additional extensor dislocation of the index finger (EDC and extensor indicis proprius). One patient had additional dislocations of the EDC of the ring finger and the extensor digitorum minimi (EDM) of the small finger. The main symptoms were pain or snapping of the MCP joint. There was no history of trauma and all patients were referred to our hospital several months after symptom onset.

The operation was performed under local anesthesia using lidocaine hydrochloride and epinephrine. Through a longitudinal incision, the extensor tendon was proximally exposed from the MCP joint. A distally based slip of the middle third of the EDC was developed and looped around the radial collateral ligament in a distal to proximal direction under the attenuated sagittal band. During active motion of the MCP joint, the tendon slip was sutured back to itself under proper tension, which centralizes EDC over the MCP joint. The defect of the middle one-third of EDC was closed primarily. After 4 weeks of the MCP joint immobilization in extension, active motion exercise was initiated.

Results: All EDC dislocations were reconstructed using the abovementioned technique. In the patient with EDM dislocation, a half-slip of EDM was used for reconstruction. The radial sagittal band was thin and attenuated in all cases.

There was no recurrence of EDC dislocation of the long finger in any patient. In the patient with preoperative extensor dislocation of both index and long fingers, dislocation of the extensor tendon of the index finger disappeared after EDC reconstruction of the long finger. Another patient, who had preoperative non-symptomatic ulnar subluxation of the extensor of the ring and small fingers, complained of a symptomatic dislocation resulting from repeated prolonged guitar practice after EDC reconstruction of the long finger. This patient required additional reconstruction of the ring and small fingers at a later date. Follow-up ranged from 6 to 18 months. There were no postoperative complications. In all patients, preoperative symptoms disappeared and full function was restored.

Conclusions: This technique is simple, and proper tension can be determined by the surgeon while the patient actively flexes and extends the MCP joint under local anesthesia. Different from previously reported techniques, the central part of the extensor tendon is used as a slip to reconstruct the radial stability, thereby preserving the connection between

the extensors via the membranous juncturae tendinum.

A-0115 The outcomes of extension block pinning and nonsurgical management for mallet fracture

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Purpose: We aimed to compare the clinical and radiographic results of patients with a mallet fracture involving more than one-third of the articular surface, but without a high degree of distal interphalangeal (DIP) joint subluxation, treated with extension block pinning or nonsurgical management.
Methods: Forty-nine patients with a mallet fracture involving more than one-third of the articular surface were reviewed. Twenty-six cases were treated using extension block pinning (surgery group) and 23 were treated nonsurgically (nonsurgical group). At the final follow-up, extension lag and flexion of the DIP joint of the affected digit were measured. Distal interphalangeal joint pain was rated using a visual analog scale and the overall clinical outcomes were graded using Crawford's criteria. Complications, including nail deformity and dorsal prominence, were also assessed. The rate of DIP joint subluxation and fracture fragment size were radiographically evaluated.
Results: Mean extension lag and flexion of the DIP joint and mean visual analog pain scores were not significantly different in the two groups. Outcomes, as assessed using Crawford's criteria, were excellent in 5, good in 12, fair in 6, and poor in 3 in the surgery group, and excellent in 2, good in 11, fair in 8, and poor in 2 in the nonsurgical group. Moreover, the frequency of nail deformity or dorsal prominence was similar in the two groups. The rate of DIP subluxation and mean fracture fragment size were similar between the two groups. All the fractures had united by 3 months after injury in both groups.
Conclusions: The clinical outcomes do not significantly differ between extension block pinning and nonsurgical management for mallet fractures involving more than one-third of the articular surface, but without high degree subluxation of the DIP joint.

A-0119 The clinical research of contralateral C7 nerve transfer

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Objective: To evaluate the outcome of patients treated with contralateral C7 (cC7) transfer and to determine the factors that affect the outcome of this procedure.
Materials and Methods: A retrospective review of 73 patients with total brachial plexus root avulsion injury (BPAI) who underwent cC7 transfer was conducted. All of the surgeries were performed by two stages and the pedicled ulnar nerve was the bridged nerve. The 73 patients were divided into two groups according to different number of the recipient nerves. In group 1 (51 patients), the cC7 nerve was used to transfer to median nerve only. The entire cC7 was used in 11 patients; the posterior division together with the lateral part of the anterior division transfer to median nerve in 15 patients; the anterior or the posterior division alone transfer to median nerve in 25 patients. In group 2, the cC7 nerve was used to transfer to two nerves simultaneously. The entire cC7 transfer to median nerve and biceps branch in 12 patients and transfer to median nerve and triceps branch in 10 patients. The mean follow-up period was 7.3 years.
Results: The efficient of these 73 patients was 54.8% in wrist and finger flexor, 57.5% in median nerve area sensation, 66.7% in the elbow flexor, and 20% in the elbow extensor. The patients with entire cC7 root transfer achieved significantly better recovery than the patients with partial cC7 root transfer. The best function recovery could be induced if the interval between two stages was 4–8 months. Functional recovery of biceps branch was significantly better than that of triceps branch.
Conclusion: cC7 transfer is an effective procedure in treating total BPAI patients. If transferred to single nerve, the entire C7 root transfer can obtain significantly better recovery and we emphasize using the entire root as the donor. The optimal interval between two surgery stages is 4–8 months. If transferred to two nerves, the two recipient nerves should be collaborative in motor function.

A-0122 Volar plate fixation versus plaster in displaced extra-articular distal radius fractures: A multicentre randomized controlled trial

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Introduction: Despite the high incidence of displaced extra-articular distal radius fractures and the substantial implications of suboptimal management, it is still undecided how patients with these fractures should be treated. In recent years, there is a trend towards open reduction and internal fixation (ORIF). However, adequate randomized controlled trials addressing this topic in adults are lacking. The purpose of this randomized controlled trial was to compare the functional outcome of open reduction and volar plate fixation versus plaster immobilization in displaced extra-articular distal radius fractures.
Methods: A multicentre randomized controlled trial in patients from 18 years to 75 years with an adequately reduced extra-articular distal radius fracture (AO type A2/3) was performed. The primary outcome was the functional outcome measured with the Disability of the Arm, Shoulder and Hand (DASH) questionnaire after 12 months. Secondary outcomes included functional outcome measured with the Patient-Rated Wrist Evaluation (PRWE) questionnaire, quality of life measured with the Short Form-36 (SF-36) health questionnaire, range of motion, grip strength, pain as measured on a Visual Analogue Scale (VAS), radiographic measurements, and complications. Clinical and radiological follow-up took place at the outpatient clinic at 1, 2/3 and 6 weeks, and at 3, 6 and 12 months.
Results: A total of 90 patients were randomized to ORIF with a volar plate (47 patients) or plaster immobilization (43 patients). The median age was 59 years (IQR 46–65), and 74% of the patients were women. Median DASH scores were significantly better in the operative group at 6 weeks ($p < 0.001$), and 3 ($p < 0.001$), 6 ($p = 0.004$) and 12 months ($p = 0.018$). The same applied for the PRWE scores and for physical score on the SF-36. The mental score on the SF-36 was significantly better in the operative group at 6 weeks. At 12 months, supination ($p = 0.003$), extension ($p = 0.012$), flexion ($p = 0.007$) and grip strength ($p = 0.011$) were significantly worse in the non-operative group than the operative group. Moreover, VAS pain scores were significantly lower in the operative group up to 3 months of follow-up ($p < 0.001$). During the entire follow-up, operatively treated patients had significant better radiological parameters than non-operatively treated patients. Twelve fractures (28%) in the non-operatively treated group redisplaced within 6 weeks and underwent ORIF, and six patients (14%) had a symptomatic malunion for which a corrective osteotomy was performed.
Conclusion: Patients with displaced extra-articular distal radius fractures treated operatively have better functional outcomes after 12 months as measured by the DASH and PRWE questionnaires than non-operative treated patients. In addition, 42% of non-operatively treated patients are secondarily treated operatively due to a redislocation or a symptomatic malunion.

A-0126 Should collagenase *Clostridium histiolyticum* be used in all joints in the treatment of Dupuytren's disease?

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Introduction/Objectives: The optimal minimal invasive treatment for Dupuytren contractures remains debated. XIAPEX® is a treatment introduced into the commercial market since its approval in 2009. When introducing new efficacious procedures into everyday clinical practice, the effectiveness of these must be evaluated. The aim of this study was to evaluate the effect of XIAPEX treatment at Regionshospitalet Horsens after a minimum 1-year follow-up (FU).

Outcomes of this study were (1) overall improvements in degrees from baseline to FU in metacarpophalangeal joints (MCP) and proximal interphalangeal joints (PIP); (2) contraction recurrence defined as extension deficit (ED) above 20°; (3) Hurst end point defined as ED below 5°
Materials and Methods: Hundred and thirty-one MCP joints and 67 PIP joints treated from January 2013 to May 2016 were available for FU. Mean FU was 2.5 years (95% CI 2.4–2.6). Mean age at treatment was 68 years (95% CI 67–69); 82% were men. Thirty-nine

had received treatment in the affected joint prior to our XIAPEX (22 percutaneous needle fasciotomy, 13 open surgery and 4 XIAPEX).
Results: Baseline mean ED was 49° (95% CI 46–51) for MCP and 56° (95% CI 52–60) for PIP. Mean EDs after correction were, respectively, 0° (95% CI 0–0.4) and 7° (95% CI 4–10) for MCP and PIP. At FU, mean EDs were 7° (95% CI 5–10) for MCP and 42° (95% CI 36–47) for PIP. Overall improvements in MCP and PIP range of motion were, respectively, 42° (38–46) and 14° (8–19). Recurrence rate was 11% for MCP and 79% for PIP joints; 73% of MCP joints achieved the Hurst endpoint and 6% of PIP joints; 90% of the patients were willing to repeat treatment. Uni- and multivariate regression analysis did not identify any correlations between selected predictor variables in any of the reported outcomes.
Conclusions: XIAPEX is a viable first-line treatment of MCP Dupuytren's contractures. However, the results in PIP joint contracture are not optimal and we advice that use in PIP joints should be performed cautiously.

A-0129 Functional outcome after ulna shortening osteotomy in regard to DRUJ configuration

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Objective: Ulna shortening osteotomy is a standard procedure for ulnar impaction syndrome and has shown good clinical results in midterm follow-up studies. The reverse oblique distal radioulnar joint (DRUJ) configuration is associated with inferior postoperative results as osteoarthritis might result from increased pressure in the DRUJ. The aim of this retrospective study was to evaluate whether different configurations of the DRUJ led to different functional and radiographic results.
Methods: Sixty-two patients with a minimum follow-up of 5 years after ulna shortening osteotomy were included in this retrospective study. Preoperative X-rays were assessed for the DRUJ configuration according to the Tolat classification, while postoperative radiographs were evaluated in regard to signs of osteoarthritis using the Kellgren–Lawrence score. Functional outcome was assessed using the Disability of the Arm, Shoulder and Hand score (DASH) score and measuring the range of motion and the grip strength.
Results: Statistical analysis revealed significantly better results in patients with parallel configuration of the DRUJ (Tolat type 1 configuration) for DASH score, grip strength and supination compared to non-parallel configurations (Tolat type 2 and 3). In patients displaying the Tolat type 1 configuration, the mean DASH score was 9 compared to 18 in the Tolat type 2 and 3 groups. Apart from supination, no statistically significant differences were observed in range of motion among all groups. No progressive degenerative changes at the DRUJ requiring surgical intervention were encountered.
Conclusion: While long-term postoperative range of motion failed to display statistically significant differences between different types of DRUJ configurations except for supination, better results regarding grip strength and DASH scores were seen in a parallel-aligned DRUJ configuration. While onset of osteoarthritis seems to be later than the observation period, a non-parallel configuration predisposes patients for inferior functional outcomes regarding DASH score and grip strength.

A-0131 Cat and dog bites are different and require different principles of surgical management

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Objective: We have compared bite injuries caused by cats and dogs and analyzed the distinct tissue damage in relation to the animal's dental morphology. The history of the incident is important in distinguishing puncture wounds caused by a 'snap and release', from avulsion-type injuries associated with a 'grip and hold' bite. We aim to define the principles of surgical management depending on the factors above.
Methodology: We have recorded the demographics, presence of infection, related complications, and bacteriology of all animal bites admitted to our institution from 2013 to 2017.
Results: A total of 71 animal bites were included of which 26 were cats and 45 were dogs. The mean age was 41.2 and 52.1 years, respectively, mean time from presentation-to-surgery was 59 and 25 h, and both have a female predominance. The commonest complication associated with cat bites were infections (61.5%). Dog bites were associated with greater degree of soft tissue damage, which included tendon rupture (6.7%), nerve injury (11%), fractures (4.4%), amputations (4.4%), and skin defects requiring resurfacing (5.7%). The commonest organism for both were *Pasteurella* species.

Conclusion: Cats have two pairs of long and sharp canines that mimic hypodermic needles. We should always assume that deep structures are penetrated and therefore joints, tendon sheaths, and bone surfaces should be debrided in depth and irrigated. Dogs have wider and shorter teeth, and they tend to grip and hold causing an avulsion-type injury with more extensive tissue damage. We believe that a thorough understanding of the animal's dental morphology and pattern of injury is important in defining the surgical management.

A-0135 Arthroscopic wafer procedure versus ulnar shortening osteotomy as a surgical treatment for idiopathic ulnar impaction syndrome

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Purpose: To compare clinical and radiological outcomes and complication rates of the arthroscopic wafer procedure (AWP) and ulnar shortening osteotomy (USO) for idiopathic ulnar impaction syndrome (UIS).
Methods: From May 2009 to June 2014, 42 patients who were older than 45 years with idiopathic UIS underwent either AWP or USO under the following identical surgical indications: (1) ulnar positive <4 mm; (2) Palmer type IID or IID lesion of the triangular fibrocartilage complex; (3) stable distal radioulnar joint (DRUJ)/lunotriquetral joint; and (4) no evidence of osteoarthritis of DRUJ/ulnocarpal joint. The patient assignment was not randomized. Visual analog scale (VAS) for ulnar wrist pain, grip strength, range of motion, Mayo Wrist score (MWS), and the disabilities of arm, shoulder, and hand (DASH) score at 3, 6, 12, 24 months after surgery were used to compare the clinical outcomes. Ulnar variance, cystic change of lunate and triquetrum, and DRUJ arthritis on radiographs were compared within or between groups. Any operation-related complications were also compared.
Results: This study evaluated 19 patients after AWP and 23 patients after USO. At 3 months, AWP produced significantly better outcomes than USO in grip strength (79.6% ± 14.3% vs 62.7% ± 12.6%; $p < 0.001$), MWS (81.8 ± 7.9 vs 71.3 ± 14.2; $p = 0.005$), and DASH scores (19.4 ± 8.4 vs 31.5 ± 14.0; $p = 0.001$); clinical outcomes were similar at 6, 12, and 24 months. Complication rates were 34.8% for USO and 10.5% for AWP, including DRUJ arthritis ($n = 4$), implant irritation ($n = 6$), and refracture after implant removal ($n = 2$) with USO, and secondary surgery ($n = 1$) and tendinopathy ($n = 1$) with AWP.
Conclusions: AWP and USO for idiopathic UIS with subtle positive ulnar variance achieved similar clinical radiological outcomes at 2 years after surgery. However, compared to USO, AWP showed lower complication rates and better grip strength, MWS, and DASH scores at 3 months after surgery.

A-0137 Comparative mechanical properties of conventional and locking Kirschner wire fixation: An experimental study in chicken humerus

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Background: Kirschner wires or K-wire fixation is one of the most frequently used operative procedures for the treatment of phalangeal fracture. However, the insufficient stability to allow early motion and the need of postoperative immobilization are its major disadvantages. Increase the stability of construction by connecting the end of each K-wires together or locking K-wires fixation was designed to solve these problems. Nowadays, there are no evidences supporting this hypothesis.
Purpose: We designed a biomechanical study to compare rigidities of conventional crossed K-wires technique and locking crossed K-wires technique in osteotomized chicken humerus.
Methods: Forty chicken humeri were randomized into two groups. Group 1, each bone was transversely osteotomized and fixed with conventional crossed K-wires method. The locking crossed K-wires fixation was applied in group 2. Ten bones from each group were tested under tension load, and the other 10 were tested under four-point bending load.
Results: Comparing the locking and conventional crossed K-wires groups in tension test, they obtained maximum force of 129.80 ± 13.48 N and 46.68 ± 7.97 N, maximum displacement of 15.43 ± 2.04 mm and 6.57 ± 1.01 mm, maximum stress 129.80 ± 13.48 MPa and 46.68 ± 7.97 MPa, and maximum strain of 30.86 ± 4.08% and 13.14 ± 2.02%, respectively. For four-point bending test, locking and conventional crossed K-wires groups obtained maximum force of 84.23 ± 7.06 N and 46.80 ± 10.54 N, maximum displacement 8.46 ± 1.15 mm and 4.91 ± 1.71 mm, maximum stress 4.60 ± 0.63 MPa and 2.61 ± 0.70 MPa, maximum strain 12.14 ± 1.82% and

6.41 ± 1.19%, and elasticity 59.20 ± 11.46 N/mm^2 and 35.97 ± 5.67 N/mm^2, respectively. Both tension and four-point bending test were all statistically significantly higher in locking crossed K-wires group ($p < 0.001$).
Conclusions: The locking crossed K-wires group has significantly better biomechanical stabilization over conventional crossed K-wires fixation method.

A-0140 Benefits of the implantation of a "wide awake surgery" circuit in hand surgery

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Introduction: Surgery without sedation or cuff ischemia (wide awake surgery, WAS) has become popular in recent years in North America. In Canada, more than 80% of the carpal tunnels are operated outside the operating room using this technique.
Aims: To evaluate the benefits of the implantation of an ambulatory WAS circuit in hand surgery.
Materials and Methods: We present a prospective cohort study comparing 150 cases of ambulatory hand surgery, where only the combination of lidocaine and epinephrine was used, out from the operation room at the office area, without preoperative analysis; and another 150 cases performed under regional anesthesia in the operating theater and ambulatory major surgery circuit with preanesthesia. The resources used, the time spent in the hospital, and surgical wound were evaluated. Patient satisfaction and intra and postoperative pain were collected in a specific survey.
Results: No increase in problems with the surgical wound has been found with respect to surgery with regional anesthesia. The stay in the hospital was significantly lower in the WAS group. The preoperative pain was greater in cases with plexus anesthesia than in those of WAS. The consumption of personnel and hospital resources was much lower for the interventions at the office area. The yield per day was also higher. Time on the waiting list was shortened by more than 3 months. Satisfaction was high in both groups, although always in favor of surgery without sedation, especially during the postoperative period.
Conclusion: Procedures such as Tunnel carpal syndrome and trigger finger can be performed safely by wide awake surgery. Patient satisfaction is similar in both groups. We recommend its use because it supposes a benefit for the patient for convenience, speed and no need to perform the preoperative blood analysis. It also represents a significant saving in hospital resources and an opportunity to free the operating room for other complex surgeries.

A-0143 WALANT for tendon transfers after neglected peripheral nerve and shoulder plexus injuries

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Objective: Study the possibility of WALANT for tendon transfers on forearm and hand.
Methods: During 2016–2017, WALANT was performed in 32 patients with traumatic injuries of peripheral nerves of the upper limb. The average age was 38.7 ± 14.7 (range 16–68). For anesthesia, 20–30 ml of 1% lidocaine with 0.2–0.3 ml of 0.18% solution of epinephrine was used. Thirteen patients underwent thumb opposition restoration (nine patients – medial nerve lesions and four patients – shoulder plexus injury). Ten patients underwent Merle d'Aubigne tendon transfer (seven – isolated radial nerve injury and three – shoulder plexus lesions). Five patients with neurogenic IV–V fingers deformity, due to ulnar nerve damage, underwent transfer of FDS to the tendons of intrinsic hand muscles. Three patients with shoulder plexus lesions and one patient with shoulder medial vascular–nerve trunk injury underwent transfer of ECRL to FDP.
Results: Goal of all surgical interventions, with a sufficient and comfortable level of analgesia, has been achieved. WALANT tendon transfers allowed to solve important issues of intraoperative determination of tension and strength of donor muscle, as well as selection of the method of its insertion, to optimally restore function and avoid pathological settings, hyper-corrections and contractions. The possibility of visual demonstration of restored function, during surgical intervention – to convince the effectiveness of transposition and awareness of the degree of correction, already motivates patients to work closely with the physician during rehab.
Conclusions: WALANT is a modern and self-contained option for intraoperative anesthesia. Its role and place are function-creating interventions involving complex of sliding and active structures, the restoration of which requires close intraoperative interaction with the patient.

A-0144 More alternatives for zones 1 and 2 flexor pollicis longus tendon reconstruction

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Objective: Due to its anatomical features and biomechanical characteristics, reconstruction of flexor pollicis longus tendon (FPL) is difficult and complication rate is high. The purpose of this study was to evaluate the final outcome of a rather large series of FPL reconstructions and to compare these results with those of fingers profundus tendon reconstruction.
Methods: Hundred and seventy-two patients underwent reconstruction of FPL tendon lacerated in zones 1 and 2. Sixty four patients were treated in the acute setting within the first 24 h after injury and in 108 cases surgery was performed after several weeks or even months delay. FPL advancement was carried out in 19 acute cases with distal stump length no more than 12–14 mm. In the acute zone 2 laceration cases, FPL primary grafting procedure from second toe extensor tendon was performed in 25 patients. In 18 patients, primary index flexor digitorum superficialis (FDS)-to-FPL transfer was performed with proximal FPL stump suturing to transferred index FDS tendon in the distal forearm. In two patients with severe FPL gliding channel destruction, silicone spacer from tip to distal forearm was implanted in the acute setting. In 21 late reconstruction cases, FPL advancement was successfully performed, in 65 cases with good flexor tendon bed condition conventional single-stage FPL grafting from second toe extensor was performed, and in one patient index FDS-to-FPL transfer with own proximal end suturing was performed. Twenty-two patients were treated by two-stage reconstruction: at the second stage, free graft procedure using second toe extensor tendon was carried out in 11 patients and in 7 patients index FDS-to-FPL transfer with own proximal end suturing at the low forearm level was performed. One patient had a postoperative course complicated by silicone rod removal because of infection, and three patients declined second-stage surgery.
Results: The functional outcomes were clinically evaluated at follow-up examination 6 months after surgery in 134 thumbs (78% of cases). The overall outcome was excellent in 71 thumbs (53%), good in 36 (26.9%), and fair in 17 (12.7%). The rupture rate was 7.4% (10 thumbs). In the late conventional grafting group, 53 of 65 results were evaluated: 27 (51%) were graded as excellent, 14 (26.5%) as good, 8 (15%) revealed fair function, and in 4 thumbs (7.5%) grafts ruptured. Our reported single-stage grafting results in 132 fingers using also toe extensor tendons included 59.1% excellent, 22% good, 7.5% fair, 2.6% contractures, and 9.7% ruptures. There is no significant difference ($p > 0.05$) in the rate of the excellent outcomes and the rupture rate between the thumb and the fingers conventional grafting groups.
Conclusions: Our practical experience suggests the FPL advancement to be highly effective in the acute setting for its zone 1 lacerations and that this procedure is also often successful for zone 1 FPL late surgery cases. As for zone 2 FPL injuries, primary grafting in the acute setting, conventional single-stage grafting, two-stage reconstruction, and index FDS-to-FPL transfer with own proximal end suturing provide reasonably good outcomes with low complication rates.

A-0147 Revision surgery of failed trapeziometacarpal arthroplasty: Secondary trapeziectomy

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Introduction: Basal thumb arthroplasty is a commonly performed procedure to treat trapeziometacarpal (TMC) arthritis. The risk of failure is highly fluctuating in the literature, and only few report the functional results of secondary trapeziectomy resulting from failed joint replacement. We aim to describe our large series of patients with secondary trapeziectomy.
Materials and Methods: This is a retrospective study of 32 patients undergoing secondary trapeziectomy after failed TMC arthroplasty with a mean follow-up of 48.8 months (±26.8). We realized an objective evaluation of the mobility of the thumb and the strength of the hand, a subjective evaluation with visual analogue scales and DASH questionnaire, and a radiologic evaluation to assess the thumb shortening.
Results: The mean age at revision surgery is 62 years and is composed of 28 women for 4 men. The survival of the prosthesis is 19.5 months, and not reaching 1 year in 66% of the cases. The major indications for revision were loosening of the trapezial implant in 56% of the cases, and luxation of the prosthesis in 22%. The handgrip strengths of the two hands are comparable, as well as the key pinch strength. The Kapandji score reached $9.4 \pm 1/10$ and was associated with an adequate measured mobility of the thumb. The vast majority of the patients were satisfied or very satisfied by the revision surgery

(respectively, 32% and 53% of the patients). The mean DASH score attains 22.6 ± 17.6/100. The mean Barron Eaton's height ratio reached 0.61 ± 0.04 on the injured side and 0.55 ± 0.07 on the opposite hand, and the length difference was not significantly different and did not impact significantly clinical function of the thumb (pain, mobility, strength).

Conclusion: Secondary trapeziectomy is a very efficient rescue procedure that gives good functional results with high satisfaction rates. These data lead us to accept the risk of failure of TMC joint arthroplasty that can be salvaged with a reliable procedure that gives replicable postoperative results.

A-0152 Long-term outcome after distal radial fractures in octogenarians

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Objective: Distal radial fractures in patients over 80 years old are traditionally treated non-operatively in the Netherlands. Little is known of the long-term functional outcome. The aim of this study was to evaluate the treatment and long-term patient-reported outcome of distal radial fractures in octogenarians.

Methods: All consecutive patients over 80 years old with a distal radial fracture presented at the emergency department of a large teaching hospital in the Netherlands in 2015 were registered retrospectively. Radiographic characteristics, AO classification, and reduction technique were scored. Functional outcome after 1 year was evaluated by the PRWE and QuickDASH questionnaires. Correlation between fracture type, treatment, radiological outcome and patient-reported outcome were analysed.

Results: A total of 128 patients (male:female; 4:124), with a median age of 85 years, were included; 97% (120/128) of the patients were treated non-surgically. In 51% (63/128) of the patients, closed reduction was performed. Fracture types were predominantly 23-A2.1 ($n = 37$), 23-A2.2 ($n = 33$) and 23-C1 ($n = 33$). In the 70 patients that completed follow-up, median PRWE score was 3.25 after 1 year and median QuickDASH score was 6.82. Fifty patients did not complete follow-up because of death ($n = 18$), cognitive impairment ($n = 34$) or loss to follow-up ($n = 6$). Dorsal angulation (28.5%) resulted in significantly poorer PRWE scores as compared to the patients without dorsal angulation. No other radiological characteristics could be identified on top of dorsal angulation, even if the factors had resulted in more frequent malunions after cast removal.

Conclusion: The overall long-term patient-reported outcome of octogenarians with non-surgically treated distal radial fractures is good. However, dorsal angulation seems to influence the outcome after 1 year and in this group surgical treatment may be considered.

A-0153 Soft tissue tumours of the hand and wrist

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Introduction and Objectives: Large-scale epidemiological data of soft tissue tumours in the hand are infrequently published. The existing literature is not homogeneous with differing accounts of the commonest tumours. Epidemiological data can provide diagnostic cues to guide the workup and management of hand tumours. Epidemiology is also important in the planning and delivery of healthcare services.

Materials and Methods: A retrospective review of all patients between 2004 and 2015, who underwent excision of hand tumours in a tertiary hospital in Singapore, was conducted. The following data were collected: age, gender, ethnicity, histological diagnosis, laterality, malignancy and location of tumour.

Results: A total of 5000 patients were identified with a mean age of 52 (8–101 years), male to female ratio of 1:1.15. Majority of the patients were Chinese (75%), followed by Malays (9%), Indians (8%) and others (8%). The most common hand tumours excised were ganglions (44%), with the majority located in the wrist. The next most common were giant cell tumours (8%), which were most commonly found in the digits. The majority of soft tissue tumours were benign (99.8%), with only 0.2% malignant cases.

Conclusion: The overwhelming majority of soft tissue tumours of the hand and wrist are benign and this can guide workup as well as counselling of patients prior to operation. Malignant tumours, while the minority, have the potential for significant morbidity and mortality if not appropriately evaluated or treated.

A-0155 High incidence of re-dislocation of paediatric distal both-bone forearm fractures

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Introduction: Metaphyseal fractures of the distal forearm are common in paediatric patients. Displaced fractures need to be reduced and stabilized. In literature, a range of methods of stabilization have been described: above-elbow cast, percutaneous pinning with Kirschner wires and internal fixation. Treating these fractures only by reduction and cast immobilization has been debated in the past. Various rates of dislocation have been described, ranging from 7% to 91%. We conducted this study to invest the incidence of secondary dislocation in AO type 23-M/3.1 paediatric both-bone forearm fractures and to invest weather primary use of Kirschner wires could prevent the rate of secondary dislocation and therefore reoperations in paediatric patients.
Material and Methods: To assess the clinical controversy of the treatment of both-bone metaphyseal paediatric forearm fractures, we conducted a retrospective cohort study of all consecutive paediatric patients who presented at the emergency department of a large teaching hospital in the Netherlands, throughout a 2-year period (2015–2016). We retrospectively analysed the patient files. Radiographic characteristics and OTC/AO-classification were assessed. Type of treatment, reduction technique, surgical interventions, removal of hardware and complications were recorded.
Results: Fifty-one patients (boy/girl 32/19; mean age 9 years) were included in this study. In 14/51 patients, reduction of the fracture in the emergency department was performed. In 12/14 patients, the reduction was insufficient and there was need for reduction in the operating room. One of them needed open reduction and K-wiring. Of the 51 patients, 21 suffered a secondary displacement. Reoperation was performed in all 21 patients: 20 of them were treated with K-wires.
Conclusion: Paediatric distal both-bone forearm fractures have a high rate of secondary dislocation. The primary use of Kirschner wires might prevent this high rate of secondary dislocation and therefore reduce the amount of reoperations in paediatric patients.

A-0160 The association of scapular kinematics and carpal tunnel syndrome

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Shoulder and cervical pain and associated glenohumeral joint movement dysfunctions have been commonly described but have not been reported in upper limb nerve compression. Yet Novak in 1997 reported that repetitive use and static postures is a source of nerve compression and may directly affect nerve tension or pressure, producing chronic compression. The purpose of this study was to demonstrate the relationship between the scapular dyskinesia and the carpal tunnel syndrome and to evaluate the correction of these dyskinesias after carpal tunnel release.

This was a retrospective study of 133 patients (106 women and 27 men) of mean age 45.8 years (22–64). We included patients with carpal tunnel syndrome who were treated between January 2016 and May 2017. Patients who had a history of surgery on the shoulder or who presented signs of thoracic outlet syndrome or subacromial impingement were excluded from this revision. We analyzed descriptively the kinematics of the shoulder on the affected side and noted the presence of kyphotic posture. We performed the same pre- and postoperative analyses: we measured the internal rotation of each shoulder, looked for pain in the upper trapezius, or on the insertion of the pectoralis minor on the coracoid process.

Scapular dyskinesia was present in 83 (62.4%) patients. A thoracic kyphotic posture was noted in 67% of patients. The internal rotation of the affected side was 36° (0–90°) and significantly lower compared to the opposite side which was 50° (0–90°) $p = 2.85 \times 10^{-11}$. Pain in the upper trapezius was found in 44.4% of cases and pain in the insertion of the pectoralis minor in 54.9% of cases. Postoperatively, the rotation was significantly increased at 50.4° (0–90°) $p = 2.54 \times 10^{-8}$. Scapular pain had also improved, with upper trapezial pain found in 27.8% ($p = 5.19 \times 10^{-8}$) and pectoralis minor pain in 44.4% ($p = 5.61 \times 10^{-11}$).

There is a relationship between scapular dyskinesia and carpal tunnel syndrome. These are partially corrected with the release of the carpal tunnel and it can't therefore be concluded whether dyskinesia is one of the causes or a consequence of painful adaptation. So, successful management of the carpal tunnel syndrome should begin with initial

identification of all sites contributing to the presenting symptoms. Treatment must then be directed toward the sources of nerve compression and musculoskeletal dysfunction and not only on carpal tunnel release.

A-0165 The use of dermal substitute Matriderm® and autologous skin grafting in the treatment of soft tissue defects with exposed tendon and bone

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Background: For patients with exposed tendon and bone can be reconstructed with a flap. Because the tendon or bone exposed area has poor vascularity, flap surgery may be impossible or very difficult. In some of these cases, skin grafts are another option. However, skin grafts have some limitations, not available exposed tendon and bone, poor elasticity, scar contracture and limitations of joint motion due to contractures. The purpose of this study was to evaluate the usefulness of dermal substitute Matriderm with autologous skin grafts in the treatment of soft tissue defects with exposed tendon and bone.
Methods: Between 2011 and 2016, 12 soft tissue defect patients with exposed tendon and bone were covered by the Matriderm with an autologous skin graft. We assessed graft survival to evaluate the effectiveness of Matriderm. The Vancouver Burn Skin Score (VBSS) was used to evaluate skin quality after a minimum of 3 months or later.
Results: The take rate of the matrix-and-skin graft was 92%. The mean age of patients was 32.6 years (range 2–76 years). The mean defect size was 63 (range 4.4–420) cm^2. The average follow-up was 9.6 months (range 6–14 months). Median of scar elasticity in VBSS is 2.5.
Conclusions: Matriderm with autologous skin grafts is used to cover the soft tissue defect with exposed tendon and bone, resulting in an excellent functional and cosmetic outcome. In selected cases, it seems to be an alternative option for the management of soft tissue defect that cannot be covered by primary closure or a flap.

A-0167 Wide-awake minimal selective fasciectomy for Dupuytren's contracture

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Background: Most Dupuytren's contracture operations can be performed with tourniquet control under general or brachial plexus block anesthesia. The wide-awake technique is increasingly used in hand surgery.
Objective: The purpose of this study is to show the effectiveness of the wide-awake minimal selective fasciectomy for Dupuytren's contracture.
Materials and Methods: We reviewed 16 patients (36 digits) with Dupuytren's contracture who were treated surgically. Eleven digits (six patients) were in the wide-awake group, who received minimal selective fasciectomy and epinephrine-contained lidocaine as a local anesthetic agent, with a tourniquet wrapping but with no pressure applied (group A). The other 25 digits (10 patients) were in the conventional selective fasciectomy group that received brachial plexus (group B: 10 digits, 5 patients) block or general anesthesia (group C: 15 digits, 5 patients) and a 250-mmHg tourniquet application. The pain was assessed using visual analog score (VAS) during injection, operation (tourniquet's, incision site), and post-operative. Operation time was recorded for each patient. Postoperative total active motion (TAM) and any complications within 4 weeks were recorded.
Results: The mean age of the group A, group B and group C was 68, 62, and 60 years, respectively. Intra-operation (Tourniquet's, incision site) and post-operative pain in the conventional group (groups B and C) were significantly higher than the wide-awake group (group A). Mean operation time was 32 min/digit in group A, 64 min/digit at group B, and 62 min/digit at group C. There were no significant differences between any of these individual groups in TAM.
Conclusion: Wide-awake minimal selective fasciectomy technique offers better comfort for patients and less operative time and as with the conventional technique.

A-0171 Functional and radiographical results of the ISIS CMC prosthesis: A prospective study

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Objectives: Degenerative thumb carpometacarpal (CMC) osteoarthritis is currently one of the most

prevalent joint conditions in the hand, and it can severely hinder hand function. Treatment with carpometacarpal implants, namely carpometacarpal prostheses, is rising as an attractive alternative due to its reported favorable short-term outcomes. Results for prosthetic models featuring threaded cups have been infrequently reported in the past, owing to the high failure rate of previous designs. The objective of this prospective study involving the Isis prosthesis is to assess its functional and radiographical results and its complications.

Materials and Methods: Between April 2014 and June 2017, 28 ISIS CMC prosthesis were implanted in 27 patients. All of the implants were semiconstrained with a threaded, uncemented cup component and an uncemented metacarpal stem. A standard dorsal approach was performed in all of the cases.

We prospectively followed up our patients on a year-to-year basis after the first postoperative year. Pain measured on the visual analog scale (VAS), range of motion, strength, and overall hand function assessed with the Henck and Van Capelle test were obtained for each patient, pre and postoperatively.

The radiographical parameters studied included the pre and postsurgical Eaton stage of the scaphotrapeziotrapezoidal joint, the presence or absence of periprosthetic radiolucent areas, and the distance between the trapezium base and the apex of the first metacarpal head, both before and after surgery. All complications were recorded.

The statistical analysis was carried out with the latest SPSS statistical software version (SPSS Inc., Chicago, IL, USA).

Results: Of the 27 patients, 21 were women. The mean age was 59 years. The non-dominant hand was affected in 21 cases. The mean follow-up was 2 years (1–4). The mean preoperative Van Capelle test score was 19, and it was 36 postoperatively (excellent 36–40 points). The VAS pain scale improved a mean of 6.5 points. Grip strength values improved a mean of 5 kg from the preoperative scores. Pinch strength values improved a mean of 2 kg.

Radiographically, there was a mean increase in the trapezium base to apex of the first metacarpal head distance of 3 mm. None of the cases exhibited radiolucencies or loosening signs.

The Eaton stage did not progress during the follow-up.

The mean satisfaction was 9.5 of 10. All of the patients went back to their previous activities within 3–6 months after the surgery except for one.

No dislocations or infections were recorded in our series. We did register three cases of de Quervain's Tenosynovitis and one case of epicondylitis, all of them resolved favorably with medical treatment.

Conclusions: The ISIS CMC prosthesis has shown to have very satisfactory short-term postoperative results, with a 100% survival rate at 2 years in our series. If technical errors are avoided, complications appear to be minimal. These results compare favorably to those reported in the indexed literature for models with cemented cups, other models with threaded cups, and even models with impacted press-fit cups. Nonetheless, long-term survival studies are recommendable.

A-0173 Fingertip reconstruction with an innervated digital artery perforator flap

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Purpose: To evaluate the results of fingertip reconstruction with an innervated digital artery perforator (IDAP) flap.

Methods: Ten patients (10 fingers) underwent fingertip reconstruction with an IDAP flap between April 2015 and January 2017. The mean age was 46.6 years (range 21–65 years). The defect size was from 1.2×1.5 to 3.0×1.5 cm. The mean follow-up period was 5.9 months (range 4–7 months). Surgically, the distal part of the flap was set at the edge of the wound and the proximal part was extended to the dorsum of the middle phalanx. The incision was begun dorsally or vollary, and subcutaneous tissue was dissected from the periosteum of the phalanx without injury to the extensor tendon paratenon, until the neurovascular bundle was identified at the proximal side of the flap. Following neurovascular bundle identification, the flap was dissected from the volar side to the periosteum and was then mobilized as a digital island flap. The flap was also separated from the neurovascular bundle, except at the pedicle, located distally at the flap, which included the perforator arteries and the subcutaneous veins, to enable the flap to rotate 180°.

Results: All flaps survived without complications, such as congestion, partial necrosis, or any contractures of the proximal interphalangeal joint. A static 2-point discrimination test in the flaps measured 6 mm in two patients and 5 mm in the other patients, compared to 5 mm on the contralateral hand. All patients registered sensitivity to the 0.5 g (number 4, green) Semmes-Weinstein monofilament test, a result comparable to the contralateral hand.

Conclusion: The IDAP flap is a useful method because of its low PIP joint contracture complication rate.

A-0185 Do surgeons agree on what constitutes tension at nerve repair sites?

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Objective: Tension at nerve repair sites is known to yield poor clinical outcomes as a result of impaired vascularity and nerve regeneration. However, no definition of ''tension'' truly exists in clinical medicine. The purpose of this study was to assess whether or not surgeons performing nerve repair agree on how much tension is present when repairing a nerve.
Methods: Fifteen surgeons who commonly perform peripheral nerve surgeries participated in this cadaveric study. The common digital nerves to the second, third, and fourth webspaces were exposed and transected. In a randomized fashion, one nerve in each hand had 2 mm transected from it and one nerve had 5 mm transected. The surgeons were then asked to assess the nerve gaps and tension by visualization alone as well as with tactile perception by reapproximating the nerve ends. A five-point Likert scale was used for each response (i.e. for tension: low, low-to-moderate, moderate, moderate-to-high, very high).
Results: Visual inspection of the gaps following 0 and 2 mm resections demonstrated no significant consensus regarding the gap as small, small-to-moderate, moderate, moderate-to-large or large among the 15 surgeons, with nearly equal numbers of responses being small-to-moderate/moderate and moderate-to-large/large. The gap following 5 mm of resection was felt to be moderate-to-large or large by the vast majority of surgeons. No significant differences were present among the 15 surgeons when performing tactile sensation of the nerve repair to assess tension for the 0 and 2 mm transected nerves (i.e. no difference between low, low-to-moderate, moderate, moderate-to-high, and very high). When trying to re-approximate nerves with 5 mm loss of substance, 87% of respondents believed the amount of tension present represented very high tension and only one surgeon felt it would be suitable for a repair.
Conclusions: The amount of ''tension'' present in a nerve repair varies among surgeons when no nerve or 2 mm of nerve is transected. If 5 mm of nerve is removed when trimming a nerve, the vast majority of surgeons feel that the tension required to reapproximate the nerve ends is very high or moderate-high, therefore consideration for nerve conduits or grafting should occur. ''Tension'' continues to be a term that has no clear definition in clinical medicine, even though the adverse effects of ''tension'' in nerve repair have been well characterized.

A-0186 Assessment of differences regarding the management of pediatric supracondylar humerus fractures between hand and pediatric orthopedic surgeons

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Objective: Supracondylar fractures of the humerus are a common injury in the pediatric population and are managed by a variety of surgeons. As not all hospital centers have a pediatric orthopedics surgeon, adult hand surgeons also handle the treatment of these fractures. The purpose of this study was to determine whether any difference exist in the management of pediatric supracondylar humerus fractures between pediatric orthopedic surgeons and hand surgeons.
Methods: A retrospective review was performed to identify patients treated surgically for Gartland type II or III supracondylar humerus fractures over a 6-year period. Data collected included patient demographics, Gartland classification, time to definitive treatment, preoperative nerve deficit and/or vascular injury, closed versus open reduction, pin configuration, operative time, complications (compartment syndrome, infection, loss of fixation), time and location (inpatient vs outpatient) of removal of hardware, postoperative nerve injury, and physical therapy referral. Two groups of patients were established based on the treating physician: pediatric orthopedic attending surgeons (PO) and hand attending surgeons (HS). Statistical analysis between continuous data was performed with Student's t-test, while Fisher's exact test was used to calculate differences between discrete data. For all analyses, statistical significance was set at $p < 0.05$.

Results: A total of 65 patients were included in the review: 23 patients were treated by HS and 42 patients by PO. Significant differences exist in the rate of open reduction (HS: 17%; PO: 0%), operative times (HS: 40.1 min; PO: 25.4 min), use of cross pins (HS: 26%; PO: 2%), return to the operating room for removal of hardware (HS: 26%; PO: 0%), and referrals to physical therapy (HS: 43%; PO: 7%). There were no differences in the timing of surgery, complication rate, or postoperative nerve palsy between the two groups.
Conclusions: Adult hand and pediatric orthopedic surgeons treating pediatric supracondylar humerus fractures have similar patient outcomes and low complication rates. Differences exist regarding the management of these patients including the potential for substantially higher health-care costs when these fractures are treated by hand surgeons due to the increased use of open reduction techniques, the longer operative times, higher use of cross pins, return to the operating room for removal of hardware, and more referrals to physical therapy.

A-0189 Upper extremity injuries related to pediatric and adolescent sports participation

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Objective: Orthopedic injuries are extremely common in the pediatric and adolescent population. The majority of these involve the upper extremity, with sports participation being one of the most common mechanisms of injury. The purpose of this study was to assess the epidemiology surrounding pediatric and adolescent upper extremity sports injuries.
Methods: A questionnaire was administered to all pediatric and adolescent patients (or their parents) who presented for evaluation of an upper extremity sports-related injury. Data collected included patient demographics, the sport they were playing when the injury occurred, the injury location, the years of experience playing that sport, the amount of formal training in that sport, the competitive setting at the time of injury, and whether the appropriate protective equipment was utilized. The diagnoses were recorded and simple statistical analysis was performed.
Results: One hundred seventy-five patients presenting with upper extremity injuries from sports participation were analyzed (153 men and 22 women). The hand was the most common location of injury accounting for 23% of injuries, followed by the shoulder (15%) and the elbow (9%). The vast majority of injuries were fractures accounting for 59% of cases, followed by acromioclavicular joint separations (3%) and dislocations (3%). Football was the most common sport during which an injury occurred (46%, 80/175), followed by basketball (19%, 33/175). The most common sport during which males sustained an injury was football (52%), whereas basketball was the most common sport that females sustained an injury (27%). The type of play most frequently associated with an injury was unorganized play (40%), followed by organized recreational play (32%). No form of protective equipment was utilized in 61% of patients. Furthermore, appropriate protective equipment was only utilized by 7% (5/69) of patients participating in sports activity in an unorganized manner and by 46% (5/105) of whom played in an organized league. Thirty-two percent of patients had experienced a prior injury while playing the same sport.
Conclusions: Pediatric and adolescent patients frequently injure their upper extremity during sports participation. The vast majority of these injuries occur during unorganized play without the use of protective equipment. Many patients have little to no formal training in their respective sport. The increased use of proper protective equipment as well as improved education of fundamental techniques may decrease the occurrence of pediatric and adolescent upper extremity sports injuries.

A-0191 Ossification of the proximal and middle phalangeal condyles: A radiographic aid for phalangeal neck fracture reduction

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Objective: Phalangeal neck fractures are most often dorsally displaced and angulated. Surgical treatment is often necessary to restore the retrocondylar recess. The purpose of this study was to determine whether radiographic landmarks could serve as a reference tool for assessing phalangeal neck fracture alignment based on age and sex.
Methods: One thousand sixty-one lateral finger radiographs that were interpreted as ''normal'' by pediatric radiologists in children aged 1–18 years were retrospectively reviewed. The proximal and middle phalanges of each digit had a line drawn along the volar cortex (termed the volar phalangeal line (VPL)) and a second perpendicular line was drawn at the level of the phalangeal condyle. A

ratio of the anterior to posterior aspects of the phalangeal condyle was determined at the intersection of these lines. Patient sex was recorded to determine if this influenced the temporal course of ossification. A linear regression model was utilized to determine the average annual coefficient of growth for the phalangeal condyles.

Results: The average coefficient of growth for the proximal and middle phalangeal condyles in the second through fifth digits increased significantly as patient age increased ($p < 0.001$). As children increase in age, the VPL will intersect the phalangeal condyle more dorsally due to the eccentric ossification. The 8- to 9-year-old group had the largest change in size. In most children over 9 years of age, the VPL will intersect the middle third of the condyle. No significant difference exists between the ratios of the proximal and middle phalanges. Gender did not significantly affect the linear regression model.

Conclusions: The phalangeal condyles ossify in an eccentric manner with a rapid growth phase between 8 and 9 years of age. The VPL will intersect the phalangeal condyle more dorsally with increasing age. There is no difference in the time course of development between the proximal and middle phalanges and gender does not influence growth patterns. The volar phalangeal line (VPL) and knowledge of where it should intersect the phalangeal condyle can be used as a reference guide for evaluating the reduction of proximal and middle phalangeal neck fractures in children.

A-0192 Outcomes of radial head fractures in patients under 50 years old: What is better – open reduction internal fixation or arthroplasty?

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Objective: Arthroplasty has been recommended for radial head fractures with more than three articular fragments due to increased complications with open reduction internal fixation (ORIF), including nonunion and loss of forearm rotation. However, the active lifestyles of patients under 50 years of age may not be in line with radial head replacement. The purpose of this study is to evaluate the outcomes of radial head fractures with more than three articular fractures in patients under 50 years of age to determine which treatment may be more appropriate: replacement or ORIF.

Methods: A retrospective review of all patients presenting to a high-volume Level 1 trauma center over a 6-year period to identify patients aged 18–50 with radial head fractures. Factors assessed included patient demographics, age of patient at the time of surgery, the number of fragments, Mason classification, associated soft tissue injuries (if any), dislocations, or other fractures, the need for bone grafting, implant type if replacement was performed, and outcomes data including range of motion (ROM), complications, and conversion to replacement.

Results: Thirty-five patients were identified, with an average follow-up of 8.5 months. Thirty-five percent had greater than three articular fragments. Eighty-five percent of this subset underwent open reduction and internal fixation, with only 15% undergoing prosthetic replacement. The average postoperative ROM in the ORIF group was 67.8° of pronation and 61.6° of supination. None of the patients in the ORIF group experienced nonunion, malunion, or failure of the hardware. Thirty-six percent had removal of their hardware, capsulectomy, and excision of heterotrophic ossification to improve post-operative range of motion. No patients in the group with greater than three fragments corrected by ORIF required conversion to a radial head replacement.

Conclusion: The notion that ''smashed'' radial head fractures (those with more than three articular fragments) need to have a replacement performed may not be optimal for patients under 50 years of age. Treatment of young patients with ORIF of a ''smashed'' radial head can lead to excellent outcomes with low complication rates. Better understanding of the specific fracture patterns of these injuries may help guide surgeons in choosing which treatment to perform for ''smashed'' radial head fractures to optimize postoperative mobility in young patients.

A-0193 Functional assessment and clinical outcomes after combined flexor and extensor tenolysis: A retrospective chart review

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Objective: The majority of hand literature suggests that digital flexor and extensor tenolysis be performed in a staged fashion rather simultaneously. Complications of a one-stage procedure is thought to be related to a compromise in digital blood supply resulting in delayed wound healing, partial skin flap necrosis, or digital ischemia. The aims of this study were to review all combined dorsopalmar

tenolysis cases in a single-centre study and (1) assess the incidence of wound healing complications, (2) compare the difference in pre- and post-active range of motion (ROM), and (3) demonstrate a systematic approach for combing flexor and extensor tenolysis in the same operation.
Methods: A retrospective chart review of all patients undergoing simultaneous digital flexor and extensor tenolysis between 2008 and 2016 was performed. Data were collected on pre- and post-tenolysis passive flexion and extension, and active flexion and extension of each interphalangeal joint (metacarpal, proximal interphalangeal, and distal interphalangeal joint) pre- and post-tenolysis. Wound healing complications were noted and compared to previously published literature on complications following single flexor or extensor tenolysis. A Wilcoxon signed-rank test was used to compare preoperative and postoperative ROM measures. General linear models were used to identify independent characteristics associated with ROM improvement. Variables in the models included age, sex, handedness, and follow-up time. Complication rates were compared between this study and previously published literature via a χ^2 or Fisher's exact test where appropriate. ROM improvement was compared between this study and previously published literature using a two-sample t-test. All statistical analyses were performed using SAS version 9.3.
Results: Twenty-six patients (14 men and 12 women) underwent simultaneous digital extensor and flexor tenolysis between 2008 and 2016. All patients had previously suffered closed or open phalangeal fractures treated conservatively with closed reduction and splinting alone or closed/open reduction with Kirschner wire fixation. The median age at time of surgery was 54 years (IQR 45–64). Preoperative injuries included fracture of the proximal phalanx ($n=9$), fracture of the middle phalanx ($n=2$), metacarpal fracture ($n=2$), crush injury at the PIPJ ($n=6$), dislocation ($n=2$), bite injury/infection ($n=2$), saw injury ($n=4$), and de-gloving ($n=3$). The median total active ROM (TAR) preoperatively of the MCP, PIP, and DIP joints was 73, and the median postoperative TAR was 151, resulting in an overall median improvement in TAR of 40 (5–100; $p<0.001$). Median duration of follow-up was 5.3 months (IQR 3.7–11.4 months) and would healing complications included prolonged swelling (3%), paresthesia (7%), swan neck contracture (3%), hematoma (3%), tendon rupture (3%), and poor result (7%). No cases of partial or complete skin flap necrosis occurred, as well there were no cases of digital ischemia or compromise.
Conclusions: Simultaneous digital flexor and extensor tenolysis is a systematic and progressive approach to combined injuries. The procedure can be safely performed and should be considered in patients with severe stiffness post phalangeal fracture. When performed appropriately, there is little threat to the skin flaps or digital vascular supply.

A-0195 High precision and accuracy with model-based RSA in two different wrist arthroplasties

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Objective: Radiostereometric analysis (RSA) is a method for measuring micromotion in joint arthroplasties, thereby predicting future loosening. RSA has never been used in total wrist arthroplasties (TWA). We investigated (1) the precision of model-based RSA using both phantom and clinical double examinations, (2) the precision of different bone marker distributions in a phantom model, and (3) the accuracy of model-based RSA in two different TWA.
Methods: Reverse engineered models of the Remotion® and Motec® TWA were obtained by laser scanning. Precision and accuracy of the radial and carpal/metacarpal component of each arthroplasty were analyzed with regards to translation and rotation along the three coordinate axes. Precision is the same as repeatability and was analyzed from 10 phantom and 30 clinical double examinations in each arthroplasty. Precision was expressed by a repeatability coefficient as 2 SD of the differences between double examinations. Measured movements above the precision value are certainly caused by true motion and not by measurement error. Levene's test for equality of variances was used to examine the difference in precision between different bone marker distributions. The sample size for future RSA studies was calculated based on the least precise standard deviations from the double examinations. Accuracy is the ''trueness'' of the measurements and was tested in a phantom model with the implants attached to a movable micrometer. A ''zero migration'' stereoradiograph was first obtained, followed by 10 predefined translations from 0.05 mm to 5.0 mm along all three axes, and nine predefined rotations from 0.08° to 6.0° along all three axes, resulting in 72 stereoradiographs. Accuracy was defined as the mean difference between measured and true migrations. When doing migration measurements, one should correct for this error.
Results: In the phantom model, the precision for translations ranged from 0.03 to 0.14 mm and for rotations from 0.18° to 1.56°. In patients the precision

for translations ranged from 0.06 to 0.18 mm, and for rotations from 0.33 to 2.22°. Fourteen patients in each group would be sufficient to detect a difference in translation of 0.1 mm in any direction, whereas 20 patients in each group would be needed to detect a difference of 1.0°, considering an alpha level of 0.05 and a beta level of 0.2 (80% power). Less than four bone markers resulted in inferior precision compared to six markers ($p < 0.05$). Accuracy ranged from −0.06 to 0.04 mm and from −0.38 to −0.01°.
Conclusions: Model-based RSA in TWA is precise and accurate. The method can, therefore, be used to measure micromotion in TWA. Since the implants fill up much of the space within the small wrist bones, the bone markers have to be placed close to the implants where they easily disappear on stereoradiographs. To increase the likelihood of visualizing at least four bone markers, we recommend placing at least six bone markers around each component.

A-0198 The adequacy of emergency room and urgent care center radiographs for pediatric upper extremity injuries

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Objective: Emergency room (ER) and urgent care center (UCC) providers are often the first evaluators of acute pediatric upper extremity injuries, including obtaining radiographs. After evaluation of these patients in the ER/UCC, they are commonly referred to hand surgeons for further evaluation, who sometimes need to obtain additional radiographs. Additional radiographs may increase the length of the visit, the health-care costs associated with the injury, and the radiation exposure to the patient. The purpose of this study was to determine the adequacy of the initial radiographs obtained by ER and UCC providers for pediatric upper extremity injuries.
Methods: A prospective study was performed of patients who presented to the pediatric upper extremity office for injury evaluation after being seen at an outside ER/UCC, during which radiographs were obtained. The adequacy of the initial radiographs was determined in a binary fashion with images deemed ''adequate'' if no additional radiographs were obtained and considered ''inadequate'' if the senior resident or attending physician ordered new radiographs. Patients who required additional radiographs to assess a potential loss of reduction were excluded from the study. The duration of the office visit was recorded for all patients.
Results: Fifty-one patients were enrolled in the study. The average number of radiographs obtained by an outside ER/UCC was 2.9 (SD = 0.87). Fifty-three percent of ER/UCC radiographs were deemed adequate and 47% were considered inadequate. Patients with inadequate radiographs required an average of 3.4 (95% CI: 2.7–4.0) additional images. The most common reasons for repeat radiographs were missing views (33%), an inadequate lateral view (29%), and poor image quality (17%). Patients with adequate images had a significantly shorter clinic visit time ($p < 0.0001$) compared to patients with inadequate radiographs, with a mean difference of 32.0 min (95% CI: 22.4–41.6). Preliminary analysis showed physician assistants took a lower proportion of inadequate images compared to physicians and nurse practitioners. Furthermore, it was noted that the original hand and finger radiographs were typically more adequate.
Conclusions: ER/UCC pediatric upper extremity diagnostic imaging is often insufficient to permit the adequate diagnosis and treatment by hand surgeons. The need for repeat injury radiographs increases radiation exposure to the patient, requires longer clinic visits for the patient and family, and increases the financial cost to the overall healthcare system. ER/UCC providers would benefit from better education regarding how to optimize the radiographs obtained during acute pediatric upper extremity injury evaluations, which would lower patient morbidity and healthcare costs.

A-0202 The EuroQol EQ-5D to measure quality of life in patients with hand and upper extremity conditions: A systematic literature review about its application and measurement properties

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Objective: The most widely used instrument to measure quality of life (QoL) is the EuroQol EQ-5D. However, its use in assessing hand and upper extremity condition-related QoL as well as its measurement properties remain largely undefined. Therefore, the objective of this systematic literature review was to provide an overview of the application of EQ-5D in patients with hand and upper extremity disorders and to analyse its measurement properties.
Methods: We searched in Medline, EMBASE, Cochrane and Scopus for clinical studies investigating patients with orthopaedic disorders of the hand

and upper extremity, where the EQ-5D was used as an outcome measure. Furthermore, we searched for validation studies. Data describing the use of the EQ-5D were extracted. The measurement properties of the EQ-5D and the quality of the validation studies were graded according to the COSMIN guidelines.
Results: Twenty-three studies were included in the review. In 18% of the studies, patients with hand conditions such as carpal tunnel syndrome (CTS), Dupuytren contracture and rheumatoid arthritis were assessed. The remaining studies investigated patients with shoulder conditions. In 65% of the studies, QoL was the primary outcome and in 22%, the EQ-5D was used for cost–utility analyses. The EQ-5D measurement properties were reported in one article investigating patients with CTS, and two articles including patients after proximal humeral fracture. Positive ratings were seen for construct validity with correlations $\geq$0.7 with the Short Form (SF)-12 or SF-6D health surveys. Test–retest reliability was also high with intraclass correlation coefficients $\geq$0.77. Responsiveness was moderate for patients with CTS (standardized response mean (SRM) = 0.5) and high for patients after proximal humeral fractures (SRM = 0.9). However, ceiling effects were identified with 16–48% of the patients achieving the highest score. The methodological quality of the three validation studies ranged from fair to good.
Conclusions: The EQ-5D is increasingly used in patients with hand and upper extremity conditions. Investigations about the measurement properties are few, but the available studies indicate good reliability and validity. Further research should especially focus on the responsiveness in patients with hand conditions.

A-0203 Oligodactyly with thumb

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Background: Oligodactyly of the hand is one of the rarest congenital anomalies of upper extremities and defined as the presence of fewer than five fingers on a hand. Although it usually occurs in association with hypoplasia or absence of ulna, it can occur without abnormality of the forearm bones. The purpose of this study is to present clinical features and radiographic characteristics of hand oligodactyly with thumb.
Methods: Five patients of oligodactyly with thumb who showed normal forearm bones were evaluated. Two patients had three-fingered hand with thumb and three had two-fingered hand with thumb. We analyzed associated abnormalities of carpal and metacarpal bones and measured the lengths of radius and ulna and width of the wrist on the simple radiographs. We also devised new classification system of oligodactyly based on the thumb deformities and locations of missing digits.
Results: Syndactyly among fingers was associated in four patients, clinodactyly caused by delta bone in one, hypoplasia of the thumb in one, camptodactyly in one, symphalangism in one, and radial head dislocation in one. Considering the abnormalities of the carpal bones, the missing digits were presumed to be ulnar-sided digits in two patients, central digits in one patient, and both ulnar-sided and central digits in two patients. In patients with missing of central digits, an adjacent metacarpal was hypertrophied. Although the ulnar variances were within normal range, the average lengths of radius and ulna were 6% and 5% shorter than those of contralateral normal side. The average width of the wrist was 9% narrower than that of contralateral normal side.
Conclusions: Syndactyly and hypertrophied metacarpal were most commonly observed findings in the oligodactyly with thumb. Although oligodactyly with thumb may be a type of ulnar longitudinal deficiency, it can also be a type of central deficiency or combined type of ulnar longitudinal deficiency with central deficiency or radial longitudinal deficiency. We suggest a classification system of oligodactyly with thumb based on locations of missing digits and associated thumb deformities.

A-0204 Extensor pollicis brevis insertion pattern as a possible cause of boutonnière deformity in the rheumatoid thumb

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Objective: Recent studies on the anatomy of the extensor pollicis brevis (EPB) suggest that there are several variations of the EPB insertion. However, no study has focused on the relationship between the insertion pattern of EPB and the development of boutonnière deformity. The aim of the current study was to evaluate EPB insertion pattern

macroscopically and histologically using cadaveric thumbs and to compare its incidence with that of rheumatoid arthritis (RA) patients.
Methods: We investigated 103 fingers (50 right and 53 left) of 58 adult cadavers (25 males and 33 females). Next, we reviewed the surgical records of 24 fingers of 19 RA patients with thumb boutonnière deformity. The incidence of insertion patterns of the cadaveric thumbs and the RA thumbs were compared using the χ^2 test and Fisher's exact test. A p value less than 0.05 was considered statistically significant.
Results: Macroscopically, the EPB insertion pattern was classified into two types: the EPB ending at the level of the MCP joint (Type P) and the EPB ending at the level of the IP joint (Type D). In the cadaveric fingers, 71% ($n=73$) of the fingers were Type P fingers and 29% ($n=30$) were Type D. In the RA patients with thumb boutonnière deformity, 33% ($n=8$) of the fingers were Type P, while 67% ($n=16$) of the fingers were Type D. The incidence of Type D was significantly higher ($p<0.05$) in the thumbs of patients with RA and boutonnière deformity than in the cadaveric thumbs. Histological examination revealed that the Type P fingers consisted of 52% ($n=54$) of Type P1 with the EPB firmly attached to the periosteum at the dorsal base of the proximal phalanx of the thumbs and 18% ($n=19$) of Type P2 with the EPB inserts to the dorsal capsule fibrocartilage complex in the thumbs.
Conclusions: The incidence of Type D was significantly higher in the thumbs of patients with RA and boutonnière deformity than in the cadaveric thumbs. Our results suggested EPB insertion into the distal phalanx might be a potential risk of thumb boutonnière deformity in RA.

A-0206 Comparison of contact and non-contact ultrasound examination of the hand

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The use of diagnostic ultrasound imaging (US) in the outpatient setting of hand surgery practices is low, as evidenced by the paucity of literature surrounding this low cost yet effective modality. The small field of view and poor contact of transducers with curved contours of the hands and feet are some of the reasons that restrict US evaluation. A water bath technique overcomes these limitations. In a prospective study, we imaged healthy volunteers using two techniques; the traditional contact probe with gel and in a water bath at four sites: the first dorsal interrosseous muscle, thenar eminence, flexor tendon, and the median nerve. A group of doctors ($n=25$) from our department were asked to identify named structures by outlining them on the US images. The reliability of the two methods was compared using the inter-rater intraclass correlation coefficient (ICC), which demonstrated that the water bath method was more reliable (ICC 0.97, $p<0.001$), whereas the traditional probe with gel method had only moderate reliability (ICC 0.71, $p<0.01$). Data show that soft structures in the hand are more identifiable by clinicians in a water bath and this methodology should be used more often in clinical practice.

A-0210 Surgical treatment of mucous cysts by subcutaneous excision and osteophyte resection: Results in 68 cases at a mean 6.63-year follow-up

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Objective: Mucous cysts originate from osteoarthritic degeneration. Our hypothesis is that the treatment is based primarily on the removal of osteophytes. The goal of this study is to demonstrate that joint debridement, in addition to excision of the cystic pouch without an associated skin flap or graft, is sufficient in effectively treating mucous cysts with a recurrence rate that does not exceed other techniques.
Methods: Eighty-one mucous cysts were operated. All interventions consisted of an excision associated with a joint irregularity debridement. The mean age at surgery was 62.4 years. In one-third of cases, a nail deformity was present. Gross evidence of osteoarthritis was present in 84% documented cases. Sixty-seven patients (68 cysts) were contacted by an independent evaluator and answered a phone questionnaire on average 6.6 years after surgery (range 1.04–20.8 years).
Results: In the postoperative period, three patients developed infection and one a delayed cutaneous healing (four complications occurred in cysts associated with a fistula). All pre-existing nail deformities had resolved. Four patients preferred to return for consultation but none had developed a recurrence of the mucous cyst. In one case (1.5%), there was a recurrence. It was observed 4 months after excision

of a subungual cyst. The patient was treated by arthrodesis of the DIP joint. In 53 cases (78%), patients felt no discomfort using their operated finger. Patients considered themselves cured in 50 cases (73.5%) and 65 (96%) were very satisfied or satisfied with the procedure and would undergo surgery again.

Conclusions: The recurrence rate in this series is 1.5%. This result is consistent with that of other studies with same technique reporting a recurrence rate of between 0% and 2%. Our only failure may be due to inadequate excision of the cystic pouch because of its subungual location and proximity of the germinal matrix. Results are better than studies with skin graft or advancement flap without joint debridement reporting a recurrence rate of 3.3% and 8.3%. The authors who performed a graft or a flap without systematic joint debridement also have a higher recurrence rate, up to 28%. In our opinion, the positive results of surgeries where skin procedure is performed are due to the associated joint debridement. Our procedure is sufficient to effectively treat mucous cysts with less morbidity. Complications are rare and occur only in cysts associated with a fistula, justifying their early surgical treatment.

A-0226 Risk factors and results of operative treatment of persistent brachial plexus injury caused by shoulder dislocation

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Objective: Brachial plexus injury (BPI) is observed in 5–65% of patients after shoulder dislocation. In the majority of the cases, it can be managed conservatively with satisfactory outcome. However, in some patients, symptoms tend to persist and require operative intervention. The aim of this work is to determine the risk factors for persistent BPI resulting from shoulder dislocation and to find out whether any certain group of dislocators requires enhanced surveillance for unrelenting neurologic deficit of the upper extremity. It also aims to determine the effectiveness of operative treatment in patients with this type of injury.

Methods: The study comprised 73 patients operated on at our Institution for BPI resulting from shoulder dislocation between the years 2000 and 2016, after a mean period of 9.2 months after dislocation. Such potential risk factors for persistent BPI as patient age, gender, energy of initial trauma, presence and type of accompanying injuries and time interval from dislocation to its reduction were analysed.

External neurolysis of BP from axillary approach was the procedure of choice. The results of operative treatment were analysed on a subgroup of 33 patients who completed 2-year follow-up (mean 5.1 years). Motor function of affected limbs was assessed with BMRC scale. Sensory function was evaluated with BMRC scale modified by Omer and Dellon and with Highet's classification. The influence of the above-listed factors as well as time from dislocation to operation and the number of nerves involved on the outcomes of surgery were analysed.

Statistical analysis was conducted with the use of STATISTICA v. 13. Categorical data were analysed using the χ^2 test with Yate's correction. The distribution of two and more than two independent samples was compared through Mann–Whitney U test and Kruskal–Wallis test, respectively.

Results: Shoulder dislocation caused injury to infraclavicular BP. Fibrous scar tissue caused compression of neural elements. Persistent BPI was more common in older patients. Elderly patients more often sustained multiple nerve injuries resulting from low-energy trauma, while single nerve injuries were more often observed in younger patients after high-energy trauma. Single nerve injury was diagnosed in 30% of the patients. Axillary nerve was most commonly affected. Fracture of the greater tuberosity of humerus coincided with total BPI in 50% of the cases. Longer unreduced period caused injury to multiple nerves.

Good postoperative recovery of nerve function was observed in 100% of musculocutaneous, 93.3% of radial, 66.7% of median, 64% of axillary and 50% of ulnar nerve injuries. No recovery was observed in 5.6% of median, 6.7% of radial, 10% of ulnar and 20% of axillary nerve injuries. Injury to a single nerve coincided with unsatisfactory treatment outcomes. Ulnar and median nerve injuries more often required operative intervention due to their low potential for spontaneous recovery.

Conclusions: Since no typical characteristics of a 'patient at risk can be listed, vigilance and systematic control are recommended in all patients manifesting symptoms of neurologic deficit after shoulder dislocation. Obtaining improvement in peripheral nerve function in some patients requires operative intervention. The results of surgery are usually good, with low complication risk.

A-0231 Retrieval analysis of thirty explanted NeuFlex metacarpophalangeal joint prostheses

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Objective: We explanted NeuFlex metacarpophalangeal (MP) joint prostheses to identify common features, such as position of fracture, and thus better understand the reasons for implant failure.
Methods: Explanted NeuFlex MP joint prostheses were retrieved as part of an-ongoing implant retrieval programme. Following revision MP joint surgery, the implants were cleaned and sent for assessment. Ethical advice was sought but not required. The explants were photographed. The position of fracture, if any, was noted. Patient demographics were recorded.
Results: Thirty NeuFlex MP explants were available. Seven (23%) were not fractured. Eleven explants (37%) had fractured at the hinge; nine (30%) had fractured at the junction of the distal stem and hinge; and three (10%) had fractured at both the hinge and distal stem. NeuFlex MP joint explants ranged in size from 0 to 40. Smaller sizes were retrieved from smaller fingers; larger implants came from the middle and index fingers. The age at revision ranged from 43 to 81 (median 58) years. Time in vivo ranged from 6 to 120 (median 58.5) months. All but two implants were obtained from rheumatoid joints, the remainder had osteoarthritis. Discolouration of some explants had occurred; other explants appeared to show no colour change.
Conclusions: This appears to be the first report of the position of fracture of NeuFlex explants. It is also the largest report of silicone arthroplasty explants. The majority (77%) had fractured. Nine (30%) NeuFlex explants had fractured at the junction of the distal stem and hinge; the typical position seen with Swanson and Sutter/Avanta MP joint explants. Eleven (37%) fractured across the hinge; this has not previously been reported although has been seen in in vitro testing. The hinge is thinner than the hinge-stem junction so may be at risk of more rapid failure; however, the median time in vivo for hinge fractures was 63 months as opposed to 54 months for fractures at the distal stem. Intriguingly, 3 (10%) NeuFlex explants suffered fractures both at the hinge and at the junction of the distal stem and hinge which has also never been reported previously. Fracture at the junction of the distal stem and hinge shows the importance of subluxing forces in rheumatoid MP joints and therefore suggests these need to be mitigated as much as possible. Fracture across the hinge could indicate this as a position which could be increased in thickness, to increase the time taken to fracture, although there may be a concomitant increase in stiffness of the implant. With improved designs, patients might suffer fewer or later failures. The latest Norwegian Arthroplasty Registry report shows that revision MP joint arthroplasties accounted for 42% of all MP joint replacement operations in 2015. Therefore, this is an important area where opportunities exist to reduce revision rates.

A-0237 Neuropathic pain after repair of brachial plexus injury: A 30-year follow-up of the Narakas' series

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Objective: Assessment of long-term neuropathic pain evolution, quality of life and satisfaction level after brachial plexus repair.
Methods: We identified 523 patients victim of traumatic brachial plexus injuries who underwent surgical repair by A. Narakas from 1969 to 1992. Two hundred and fifteen patients coming from abroad were excluded from the study. Two hundred and thirty patients could not be located, 13 medical files had been lost and 14 patients had died. Fifty-one patients could be reached by telephone and 46 of them accepted to answer the following questionnaires: Short Form Health Survey (SF12), Neuropathic Pain Symptom inventory (NPSI), ABILHAND and Disability of Arm, Shoulder and Hand (DASH), and satisfaction with the surgery. Data were recorded and statistically analyzed using statistical software (SPSS version 23.0; SPSS, Inc., Chicago, IL, USA). We than reviewed their clinical, operative and follow-up data. Forty-five patients accepted to come back for a physical examination.
Results: Forty-five patients with a mean age of 21.9 years at the time of injury participated in the study. There were a vast majority of men (41 M, 91%). The mean time to surgery was 3.8 months, and the mean follow-up period was 31 years. NPSI score was significantly ($p = 0.05$) higher for complete (C5 to D1) compared to partial injuries (36 vs 22.5). NPSI score of injuries involving C8 and D1 was significantly ($p = 0.05$) higher (37 vs 17) than for other roots. No significant differences were reported in long-term neuropathic pain between avulsion and rupture, as well as supra- or infraclavicular injuries. Complete lesion has a significantly higher NPSI score of

background (7, $p=0.5$) and breakthrough (7.5, $p=0.2$) pain compared to partial injuries. SF12 was directly correlated with NPSI according a linear regression analysis ($p=0.01$). More surprisingly, quality of life was not different between complete and partial lesions. Regarding satisfaction, 36 patients (74%) answered "definitely yes" or "probably yes" whether they would undergo surgery again. Three patients answered "probably not," one answered "definitely not," and six were "uncertain."
Conclusion: Our data suggest that complete brachial plexus injuries generate more pain than partial injuries. This can be explained by the fact that these complete lesions contain C8-D1 roots. Apparently, the lower the lesion is, the greater is the pain. It seems that the long-term evolution of pain is the same between all groups. The quality of life is directly correlated with pain and not function of the limb. Obviously, it is easier for the patients to cope with a non or dysfunctional limb than with omnipresent pain.

A-0239 Wrist and finger motion: A comparison of goniometric and 3D motion capture technique

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Objective: The objective measurement of finger and wrist range of motion (ROM) is of great importance to clinicians when assessing the outcomes of therapeutic interventions and surgical procedures. The aim of the study was to test the reproducibility of active range of motion (ROM) of all fingers and wrist joint angles measured with a 3D motion capture system and to compare it with manual goniometry.
Methods: Active finger and wrist joints motion of 20 healthy volunteers without any previous hand and wrist pathologies were assessed with the 3D motion capture system and measured with a manual goniometer by a trained hand surgeon. Active maximum joint angles of all fingers and wrist were registered twice on two different days to evaluate the test–retest reliability. The mean absolute difference (MAD), standard deviation of the difference (SD) and standard error of measurement (SEM) between measurements were calculated for both measurement systems and compared within the same task.
Results: SEM values for the motion capture method lie between 1.9° and 4.5° except for the MCP5, IP and MCP1 (5.1°–8.5°). For the goniometric measurements, SEM was between 5° and 11° in all joints except for PIP2-5 and DIP5 (4.2°–4.9°). Overall, all agreement parameters reveal smaller individual inter-session differences with the motion capture system. Mean MAD and SD of differences for maximal finger and wrist joint angle measurements were 4.5° and 5.8° for the motion capture system, compared to the goniometry with 7.4° and 9.0°, respectively.
Conclusion: Joint angles derived from 3D motion analysis showed smaller mean of absolute difference, suggesting overall a better reliability for this technique. Furthermore, the advantage of 3D motion analysis is the dynamic evaluation of the wrist and all finger joints simultaneously. Main advantages of the goniometric method are that it is cheap, fast and does not require data post-processing or any knowledge about joint angle calculations.

A-0240 Development of a new measurement method for kinematic analysis of the hand

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Objective: The aim of the study was the development of a method for the simultaneous kinematic measurement of all finger joints, the wrist and the radioulnar joint. It included the choice of the marker set, the definition and standardization of the measured motion tasks, the selection of the kinematic model and the development of the joint angle calculation routine. The main interest was in demonstrating the repeatability of the chosen method.
Methods: Twenty healthy volunteers participated in the study. To investigate the repeatability of the testing protocol, they performed a set of basic motion tasks. Each task was repeated five times and each subject was measured twice on two different days.

The repeatability of the finger joint angles was analysed for two different concepts of the marker set on 10 volunteers and compared. In the first approach, one marker was placed on every finger joint, for the second approach two markers were placed on every bony segment proximal and distal to the joint. Furthermore, two different methods to calculate the joint centres and axis of rotation were examined. The joint centre and axis calculation with a geometric approach was based on the marker positions and anthropometric data. In the functional approach, the individual joint centres and axis of rotation were calculated during a calibration movement by means of

mathematical optimization. The maximum distance of the calculated joint centres and the maximum angle between the calculated joint axes were computed and compared.

Results: The joint angles derived from the two-marker per segment method showed a better test–retest repeatability. The maximal distance between the functional joint centres computed from different trials was 2.4 mm (SD 1.1 mm) and 2.7 mm (SD 1.2 mm) for the TMC and wrist joint, respectively. The mean maximal difference in the orientation of the joint axes ranged between 4 and 7°, when calculated from different calibration trials within the same measurement reflecting a good reliability of the method. A simulation on the effect of a randomly distributed marker placement error of 2 mm showed a higher variability of the geometric approach for the thumb joints and similar results for the wrist.

Conclusion: Based on these results, the marker set with two markers per segment on the fingers avoiding the joint region was chosen for further examination. This is in accordance with the literature, where the skin movement artefacts close to the joint are described to be higher. Furthermore, the functional method was chosen for further examinations of all joints because it revealed a good repeatability of the calculated joint coordinate system. Furthermore, it better represents one's individual anatomical properties.

A-0241 Kinematic analysis of the hand during opening a jar and yoghurt

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Objective: The great relevance of the upper extremities in activities of daily living has made researchers and clinicians gaining increased interest in the assessment of human hand movements. However, the measurement of the small hand joints remains challenging. The aim of the study was to prove feasibility to measure complex manual tasks with a 3D motion capture system, to quantify the repeatability and to analyse the angular motion patterns of two functional tasks in healthy volunteers.

Method: Twenty healthy volunteers were recorded during the performance of a set of basic motion tasks as well as during two functional activities: opening a jar and yoghurt. To analyse the test–retest repeatability, each subject was assessed twice on two different measurement days. The kinematic data were collected with a motion analysis system consisting of 11 infrared cameras. A marker set with 46 skin markers was used to record the kinematics of the hand, thumb and fingers simultaneously.

Results: The kinematics of the functional tasks confirmed to be measurable with the chosen marker set and specific angular motion pattern of the two ADL were reported. Overall, the markers were visible during 97% of the time. The mean active range of motion (AROM) for the individual joints ranges from 17° to 77° and between 19% and 68.5% of the maximum range of motion was exploited during the daily activities.

The repeatability of the mean AROM during the functional tasks, expressed as the standard error of measurement (SEM), was within a range of 2°–13° for the individual joints. The mean SEM over all joints during the yoghurt- and jar-opening task was 5.7° and 6.8°, respectively. The coefficients of multiple correlations tended to show a better repeatability of the angular motion pattern within (0.66–0.92) the individuals than between (0.16 and 0.85) the subjects for both ADL and for all joints.

Conclusion: Thus, the simultaneous motion analysis of the entire hand and fingers during functional tasks is feasible and the joint kinematics could be partially shown to be reproducible during the two analysed activities of daily living. The implementation of the kinematic analysis of the hand within daily activities has provided a first impression of angular motion patterns of two activities of daily living and therefore implies a first step towards the goal to quantitatively measure hand function.

A-0245 Adaptive proximal scaphoid implant: Indications and results

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Introduction: Adaptive proximal scaphoid implant was created for radioscaphoid arthritis treatment in case of scaphoid nonunion advanced collapse of the wrist (SNAC wrist) and scapholunate advanced collapse of the wrist (SLAC wrist). The conceptors first publication in 2000 showed promising results of 25 cases with a 6-month mean follow-up. They concluded that proximal scaphoid arthroplasty is efficient in the treatment of radioscaphoid arthritis and in preventing the carpal collapse.

Materials and Methods: We designed a prospective 38 patients study with a mean age of 55 years, treated between May 2003 and February 2013 by the same

surgeon. Twelve had a large open approach, 7 an arthroscopic approach and 19 a transverse mini open approach. The mean follow-up of this series was 8 years (range 4–14). Indications were painful scaphoid pseudarthrosis 8 times, SNAC wrist stage 1: 7 times, SNAC wrist stage 2: 14 times, SLAC wrist stage 1: 7 times and SLAC wrist stage 2: 2 times. Patients were reviewed clinically and radiographically at 1 month, 6 months, 1 year and at the last follow-up. Three early implant luxations (two palmar and one dorsal) have been reoperated.

Results: Results of this series showed a wrist function increasing in term of pain, range of motion and grip strength. Return to work was achieved in 75% of the cases. The mean modified Mayo score calculated at the maximum follow-up for each patient was 80% (range 70–90).

Discussion: These results are comparable to those published in the literature (Pequignot, Mathoulin, Gilham). Best indications for the use of the APSI are SNAC wrists stages 1 and 2 and SLAC wrists stages 1. This was suggested by the precited authors and confirmed by the results of our series.

Conclusion: APSI is a 'simple' solution for a difficult problem: It diminishes the scaphoid pseudarthrosis pain when conservative treatment has failed, the periscaphoid arthritis pain when associated with radial styloidectomy, and prevents carpal collapse by maintaining the initial scaphoid height.

A-0246 Treatment and survival differences across tumor sites in malignant peripheral nerve sheath tumors: An SEER database analysis

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Objective: Currently, literature is lacking data on differences across all tumor sites in survival and treatment in malignant peripheral nerve sheath tumors (MPNSTs). The Surveillance, Epidemiology, and End Results (SEER) program is a cancer registry that collects data from 18 geographic areas across the United States, encompassing approximately 28% of its population. The SEER database provides a means of assessing possible predictive factors of survival and treatment modalities in rare tumors.

Methods: MPNST cases were obtained from the SEER program from 1973 to 2013. Tumor sites were recoded into intracranial, spinal, head and neck (H&N), limbs, core, and unknown. Patient and tumor characteristics, treatment modalities, and survival were extracted. Survival analyses were conducted using primary tumors only. Overall survival was assessed using univariate and multivariate Cox-regression hazard models per site of origin and of all tumors combined. In the latter, site of origin was an additional variable. Kaplan–Meier survival curves were constructed per tumor site for overall survival (OS) and disease-specific survival (DSS).

Results: A total of 3267 MPNST patients were registered in SEER; 167 intracranial (5.1%), 119 spinal (3.6%), 449 H&N (13.7%), 1022 limb (31.3%), 1307 core (40.0%), and 203 with unknown location (6.2%). The largest tumors were found in core (size, median: 80.0 mm, IQR: 60.0–115.0 mm) and limb sites (size: 70.0 mm, IQR: 40.0–100.0 mm), and the smallest were intracranial (size: 37.4 mm, IQR: 17.3–43.5 mm). Intracranial tumors were resected least frequently (58.1%), whereas spinal tumors were most often resected (83.0%). Gross total resection was most in spinal tumors (42.6%) and least in core tumors (24.9%). Radiation was administered in 35.5% of intracranial and 41.8% of limb MPNSTs. Radiotherapy was given in a neoadjuvant setting in 4.2% and adjuvant in 28.0% of all cases. Preoperative radiation was most often used in limb sites (6.8%). Independent factors associated with decreased survival were older age, male gender, Black race, no surgery, partial resection, large tumor size, high tumor grade, H&N site, and core site (all $p < 0.05$). Intracranial and pediatric tumors showed superior survival (both $p < 0.05$). Similar findings are found in multivariate analyses per tumor site. Overall, patients with intracranial tumors showed superior OS and DSS curves, whereas core tumors had the worst OS and DSS ($p < 0.001$).

Conclusion: Site of origin is an independent prognostic factor for survival in MPNSTs. Intracranial tumors tend to have an even better survival than those arising in extremities. Tumors arising from core sites are associated with the poorest prognosis; head and neck tumors were also associated with poorer prognosis compared to limb sites. Also, pediatric cases were significantly associated with better prognosis compared to adult cases independent from tumor site, size, and treatment modality. Treatment modalities and extent of resection also vary slightly among tumor sites. Physicians should, therefore, be aware of these differences when planning treatment for patients as well as in counselling them. Apart from tumor origin, older age, male gender, black race, higher tumor grade and large tumors may be associated with decreased survival.

A-0252 A review of animal models in hand surgery simulation

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Background: The use of live and cadaveric animal models in surgical training is well established as a means of teaching and improving surgical skill in a controlled setting. We aim to review, evaluate, and summarize the models published in the literature that are applicable to Hand Surgery training.
Materials and Methods: A PubMed search for keywords relating to animal models in hand surgery and the associated procedures was conducted. Animal models that had cross over between specialties such as microsurgery with neurosurgery were included as they were deemed to be relevant to our training curriculum. A level of evidence and recommendation assessment was then given to each surgical model.
Results: Our review found animal models applicable to hand surgery training in four major categories namely microsurgery training, flap raising and hand trauma surgery. Twenty-four separate articles described various methods of practicing microsurgical techniques on different types of animals. Fourteen different articles each described various methods of conducting flap-based procedures which consisted of either local or perforator flap dissection. Eight articles described different models for practicing hand surgery techniques. Finally, eight articles described animal models that were used for head and neck procedures that were also applicable.
Conclusions: A comprehensive summary of animal models related to hand surgery training has been compiled. Cadaveric animal models provide a readily available introduction to many procedures and ought to be used instead of live models when feasible.

A-0257 Comparison of functional outcome following two rehabilitation protocols after flexor tendon repair

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Introduction: Operative techniques and postoperative rehabilitation protocols after flexor tendon repair in zones 1 and 2 have improved over the last decades and are still topic of debate. After the introduction of the Lim/Tsai suture technique with early active motion regime and place and hold (EAM) demonstrating good results, an increased rate of secondary tendon rupture was noted in due course. A modified postoperative controlled active motion (CAM) protocol was established and results of functional clinical outcome are presented. The results are compared to previous published data of EAM regime.
Methods: This is a retrospective analysis of patients, who underwent primary flexor tendon repair in zones 1 and 2 using the Lim/Tsai suture technique followed by CAM rehabilitation protocol from 2014 to 2017. Fifty-six patients with 63 FDP tendon lacerations were included with or without concomitant FDS laceration. Exclusion criteria were replantation, revascularization, age <16 years. Endpoints were total active motion (TAM), extension deficit, grip strength and rupture rate Ø12 weeks after surgery. The results are compared to 46 patients with 51 FDP tendon lacerations and same excluding criteria and suture technique followed EAM protocols with place-and-hold exercises.
Results: The CAM regime compared to EAM protocol was associated with statistically significant ($p < 0.001$) lower TAM values Ø 208°(96–295°) vs 232° (190–290°). Grip strength of the injured side was lower in the CAM group Ø 26 kg (8–52 kg) vs 34.6 kg (14–60 kg) in the EAM group with comparable grip strength of the uninjured side in both groups 43 kg (16–73 kg) vs 45 kg (22–70 kg). There was an equal gender ratio towards male in the EAM group f/m: 1/4.75 compared to the CAM group f/m: 1/4.73.
Active extension deficits were nearly identical in both groups: CAM 14.1° (0–50°) and EAM 12° (5–30°). There were 3 tendon ruptures in the CAM group (4.7%) compared to 14 (9.4%) tendon ruptures after EAM treatment.
Conclusion: Our results demonstrate a favorable effect of CAM protocol on rupture rate and equal extensions deficits compared to previously used EAM rehabilitation regime after tendon repair in zones 1 and 2 using the Lim/Tsai suture technique.

Restrained controlled active motion might be the reason for lower TAM and grip strength values after 3 months. On the other hand, increased tensile force with place and hold exercises could be an explanation for a higher rupture rate.

A-0258 Comparison of clinical results between low-profile plating and external fixation for fracture-dislocations of the proximal interphalangeal joint

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Aim: Fracture dislocations of the proximal interphalangeal (PIP) joint are often difficult to treat despite many treatment options available. We conducted a retrospective study to compare clinical results between two groups of cases, as follows: cases treated by a low-profile plate for internal fixation and cases treated using an external fixator in addition to Kirschner-wire fixation.
Methods: Thirty-seven patients (37 fingers) with fracture-dislocation of the PIP joint, including 34 males and 3 females, followed up for more than 3 months were evaluated. Twenty-five fingers were injured from sports; 9 fingers, from falls; and 3 fingers, from other accidents. Details of the injured fingers are as follows: 9 index fingers, 4 middle fingers, 15 ring fingers, and 9 little fingers. Thirteen fingers were treated by the plate fixation (group P) and 24 fingers using external fixator with Kirschner-wire fixation (group E). In group P, the plates were used for 10 fingers by palmar approach and for 3 fingers by dorsal approach. The period up to bony union, the range of motion of the distal interphalangeal (DIP) and PIP joints at the last hospital visit, and the therapy duration were compared between the groups.
Results: The mean periods up to bony union in groups P and E were 33 and 26 days, respectively. The mean angles of active flexion/extension of the DIP·PIP joints in groups P and E were 63°/−2°·95°/−7° and 53°/−3°·86°/−12°, respectively. Both flexion and extension showed better improvement in group P than in group E. The therapy duration in group P (mean: 77 days) was shorter than that in group E (mean: 96 days).
Discussion: Although this study showed that both methods yield good clinical results, low-profile plating is considered more preferable. Fractured site can be more rigidly fixed on using a plate than on using an external fixator in addition to pinning. The former allows patients to start active motion exercise just after surgery. In addition, the patients treated using a plate had little problem in daily living because of no metal parts exposure. However, the plate fixation method is relatively invasive and technically demanding.
Conclusion: In the treatment of fracture dislocations of the PIP joint, anatomical restoration of the articular surface and an early motion exercise are critical. The treatment method should be chosen according to surgeon's skill and fracture severity.

A-0261 Tension failure greenstick fractures and slightly Z-folded concave side cortex are risk factors for fracture displacement in conservative treatment of pediatric distal radius incomplete fracture without manipulation

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Objective: In the conservative treatment of pediatric distal radius incomplete fractures, although the fracture angulation at the initial consultation is considered to be within the limit of spontaneous correction, the progression of angular deformity within the cast is observed infrequently during the first 2 weeks of cast fixation. In this study, risk factors for the progression of angular deformity in the conservative treatment of pediatric distal radius fractures without manipulation were retrospectively investigated.
Methods: From 2005 to 2013, 70 children (4–14 years) were conservatively treated without manipulation because the fracture angulation during the initial consultation was within 20°. On-call orthopedic residents in the emergency department treated all cases except torus fractures using a long-arm cast with the elbow at 90° and neutral forearm position. Wrist X-rays were performed at 1 and 2 weeks after the injury. The angle between the distal radial fragment and the radial shaft was measured in the lateral view of plain radiograph. Because the angle in the anteroposterior view did not show significant change, this was not assessed in the anteroposterior view. Two examiners blinded to the clinical data performed assessment. Compression greenstick fracture is an incomplete fracture with a slight plastic deformation of the convex side cortex, and significant angulation or overlapping of the concave side cortex. Tension failure greenstick fracture is another type of greenstick fracture with angulation of the concave side cortex and complete disruption of the convex side

cortex. The association between individual factors (age, gender, lesioned side, presence of associated ulna fracture, fracture pattern, direction of angulation, and presence of the slightly Z-folded concave side cortex) and fracture displacement was assessed using Mann–Whitney U-test and Fisher's exact test. A p-value of <0.05 was considered significant.
Results: In total, 28 children had compression greenstick fracture, 10 had tension failure greenstick fracture, 22 had torus fracture, 9 had epiphysiolysis, and 1 had complete fracture. In total, 6 children (4 males, 2 females; mean age, 7.8 years) had an increased angulation of $>10^\circ$ within 2 weeks after the initial consultation; 5 children had tension failure greenstick fractures; and 1 child had a complete fracture. Among the 10 tension failure greenstick fractures, 5 children with fracture displacement had slightly Z-folded concave side cortex, whereas the other 5 children without displacement did not. Tension failure greenstick fracture ($p < 0.0001$) and slightly Z-folded concave side cortex ($p = 0.0009$) showed significant association with fracture displacement. Age, gender, lesioned side, presence of associated ulna fracture, and direction of angulation showed no significant association with fracture displacement.
Conclusion: Tension failure greenstick fractures and slightly Z-folded concave side cortex are risk factors for fracture displacement in the conservative treatment of pediatric distal radius incomplete fracture without manipulation.

A-0262 Partial excision of volar plate and dorsal capsulotomy in patients with post-traumatic ankylosis of finger joint in the hand

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Background: Post-traumatic ankylosis of the finger joint is one of the complications after traumatic hand injury. If there is no improvement through conservative treatments, surgical treatments can be considered. Although several surgical techniques such as dorsal capsulotomy and release of the accessory collateral ligament have been suggested, the result was not satisfactory. The purposes of this study are to suggest new surgical technique to restore finger joint motion and to present the surgical outcome of this technique.
Methods: We retrospectively reviewed 16 patients, 8 males and 8 females, who were diagnosed as post-traumatic ankylosis of finger joint, underwent partial excision of volar plate and dorsal capsulotomy between January 2014 and June 2016 and followed up for more than 1 year. There were 12 metacarpophalangeal (MCP) joints and 4 proximal interphalangeal (PIP) joints. The average interval between the initial injury and the surgery was 64 (range 10 to 120) months.
Results: Of the 12 MCP joints, the average range of motion was improved from 38° to 92° 1 year after surgery. Of the four PIP joints, the average range of motion was improved from 44° to 85° 1 year after surgery. There were no acute complications such as instability, infection, and wound dehiscence. All the patients were satisfied with the surgical outcomes.
Conclusions: Because this technique does not release both collateral ligaments, the joint stability can be maintained. We can also safely release volar plate and dorsal capsule through anterior and posterior dual approaches. Partial excision of volar plate and dorsal capsulotomy can be one of the good options in patients with post-traumatic ankylosis of finger joint.

A-0263 Parenting stress in mothers of children with congenital hand or foot differences and its effect on the surgical decision-making for their children

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Purpose: The main purposes of this study were to assess the levels of parenting stress in the mothers of children with congenital hand or foot differences and to evaluate the effects of this stress on the preferred roles of mothers in surgical decision-making for their children.
Methods: This study included 89 mothers of children with polydactyly of the hand, polydactyly of the foot, a hypoplastic thumb, or macrodactyly. The parenting stress level was assessed using the Parenting Stress Index-Short Form (PSI-SF). Additionally, the mothers were requested to indicate their preferred and retrospectively perceived levels of involvement in surgical decision-making for their children using the Control Preferences Scale, which is comprised of five levels ranging from fully active to fully passive.
Results: The average PSI-SF scores of the mothers of children with polydactyly of the hand, polydactyly of the foot, a hypoplastic thumb, and macrodactyly were 73.2, 75.9, 74.1, and 72, respectively, and 15 mothers (16.9%) had a clinically significant level of stress (PSI-SF ≥ 90). In the mothers of children with

polydactyly of the foot, the PSI score was associated with the preferred role in surgical decision-making. Additionally, as the PSI score increased, the mothers preferred to be actively involved in the decision-making process.
Conclusions: The assessment of parenting stress levels in the mothers of children with congenital hand or foot differences can play an important role in the screening of candidates who require psychiatric treatment or support. The mothers of children with polydactyly of the foot who had higher levels of parenting stress preferred to have a more active role in surgical decision-making for their children. Thus, an evaluation of the PSI in mothers of children with congenital hand or foot differences can aid physicians to modify their style of decision-making based on the preferred role of the mother.

A-0266 The effectiveness of intraoperative 3D fluoroscopy in the treatment of intra-articular distal radius fractures: A randomized controlled trial

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Objective: Three-dimensional (3D) fluoroscopy is thought to be beneficial in the operative reduction and fixation of intra-articular distal radius fractures. The goal of this multicenter randomized controlled trial was to investigate the effectiveness of the additional use of intraoperative 3D fluoroscopy compared to conventional 2D fluoroscopy in patients requiring operative treatment for intra-articular distal radius fractures.
Methods: We performed a multicenter prospective randomized controlled trial where patients were randomized between 3D or conventional fluoroscopy during operative treatment of their distal radius fracture. The primary outcome measure was quality of fracture reduction and fixation. Secondary outcome measures were the number of revision operations and the number of complications after 1 year of follow-up and functional outcome measured with the Patient-Rated Wrist Evaluation (PRWE) questionnaire.
Results: A total of 207 distal radius fractures were included in the study. The postoperative CT scan showed an indication for additional revision of reduction or implant position in 25% of the 3D group versus 31% in the 2D group ($p = 0.34$). There was no significant difference in the number of complications and revision surgeries performed within 1 year. The median PRWE score was 7 for the 3D group and 8 for the 2D group ($p = 0.8$).
Conclusions: The use of intraoperative 3D fluoroscopy does not improve the quality of reduction and fixation in the management of intra-articular distal radius fractures. There was no benefit of intraoperative 3D fluoroscopy with regard to postoperative complications, quality of life, or functional outcome.

A-0267 Carpal alignment: A new method for assessment

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Objective: The aim of this study was to compare the inter- and intra-observer variability of a new perpendicular method with the existing method in fractured and unfractured wrists. Additionally, the agreement between the two methods was analyzed, and normal distribution of carpal alignment in unfractured wrists was investigated.
Methods: Carpal alignment was assessed on lateral plain radiographs using two different methods: one described by Ng and McQueen, and another newly proposed method, the perpendicular method. Using the perpendicular method, the observer draws one line along the inner rim of the volar cortex of the radius and one perpendicular line to the center of the capitate. The carpus is aligned when the line along the inner rim transects the center of the capitate, and consequently the length of the perpendicular line was 0 mm. Three examiners measured the carpal alignment in 100 patients; 50 with nonfractured and 50 with fractured distal radius. Intraobserver and interobserver variability for both methods were determined and expressed as intraclass correlation coefficients. The normal distribution of carpal alignment in a population with unfractured wrists using both methods was also determined.
Results: The interobserver coefficient for the perpendicular method was 0.98 and that for the Ng method was 0.86. The intraobserver coefficient for

three examiners was 0.89, 0.62, and 0.63 for the Ng method. For the perpendicular method, the intraobserver variability was 0.96, 0.89, and 0.72, respectively. In patients with unfractured wrists, the mean perpendicular to the center of the capitate was 0.25 mm dorsally.

Conclusions: The new proposed method is a reproducible method for measuring carpal alignment with a high inter- and intra-class coefficient.

A-0275 Clinical and biological results of autologous fat transplantation for treatment of carpometacarpal-1 osteoarthritis: Differences between the anti-inflammatory effects of fat and ADSPCs on osteoarthritic chondrocytes

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Background: Carpometacarpal osteoarthritis (CMC-OA) is a common clinical condition which affects 11–33% of the elderly population. It leads to pain, weakness and laxity of the thumb. Until now, there is no satisfactory approach to stop the progression of this disease. The most common final treatment option is the excision of the trapezium. In a pilot study, we treated 100 patients with intraarticular autologous fat transplantation. This new therapy is a promising intermediate solution for the treatment of thumb CMC OA. Interestingly, our results showed that just approximately half of the 100 CMC-OA patients who received autologous fat showed a reduction of pain after 1 year.

Objective: Our area of interest in this study is to show how fat and isolated adipose derived stem/progenitor cells (ADSPCs) can influence the cartilage microenvironment by the secretion of bioactive factors.

Materials and Methods: Human fat tissue was collected from five patients undergoing abdominal liposuction. Fat- and ADSPC-conditioned medium was prepared by incubating fat and ADSPCs for 48 h with TNF-α to stimulate the secretion of immunomodulatory factors. Stimulated and non-stimulated fat and ADSPCs were analyzed by RNA-Seq to determine which factors might be involved in the anti inflammatory effect of fat and ADSPCs. In addition, chondrocytes from osteoarthritic cartilage from five patients undergoing trapeziectomy were isolated and subsequently incubated with conditioned medium for 72 h. Before and after cultivation of osteoarthritic chondrocytes with conditioned medium, chondrocytes were analyzed by RNA-Seq to evaluate the effect of fat- and ADSPC-conditioned medium onto the transciptome of osteoarthritic chondrocytes.

Results: The most promising genes are IL6, TIMP2, HGF, TGFβ1, and IDO. In order to see the effect of conditioned medium from fat and ADSPCs on chondrocytes before and after cultivation with conditioned medium, gene sequencing has been performed. The gene expression of MMP1, MMP13, IL1, SOCS1, SOCS3, COL2A1, ACAN, and SOX9 is of special interest.

Conclusion: By the utilization of transcriptome analysis, we have identified important bioactive factors that are involved in the anti-inflammatory effect of fat and ADSPCs onto CMC-OA. Additionally, we have seen that ADSPCs show a different inflammatory response when compared to white fat tissue.

A-0277 Intra-individual comparison of surgical results between open and Paine retinaculotome release in patients with bilateral carpal tunnel syndrome

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An intra-individual comparison of surgical results between open and Paine's retinaculotome release was performed in patients with bilateral carpal tunnel syndrome, each hand was operated by one of the techniques.

Eighteen patients, in the total of 36 hands, were evaluated at the preoperative period and second week, first month, third month and sixth month postoperative period. Patients were evaluated for grip strength, visual analog pain scale (VAS), and for the Boston Carpal Tunnel Questionnaire.

The values of all force types were not statistically different among patients submitted to different surgical techniques. The pain measures did not present differences between the groups of patients submitted to the different techniques. The Boston Carpal Tunnel Questionnaire score showed the group submitted to the open technique presenting significantly higher values in 2 weeks ($t = 2.297$, $p = 0.036$) and 3 months ($t = 2.449$; $p = 0.026$) after surgery for symptom severity. Again, the open technique presented

values significantly higher at 2 weeks ($t = 2.342$, $p = 0.036$), 3 months ($t = 2.413$, $p = 0.028$), and 6 months ($t = 2.553$, $p = 0.023$) after surgery for functional status.

The surgical treatment of carpal tunnel syndrome with Paine's retinaculotome presented better results than the open technique when evaluated by the Boston Carpal Tunnel Questionnaire, and no differences were found regarding measures of strength or pain.

A-0283 Arthroscopic management of distal radius fractures

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Background: We developed a surgical procedure that can facilitate arthroscopic intervention for palmar locking plate fixation for distal radius fracture (DRF) with a less invasive technique. This study is to investigate the effectiveness of our original procedure for the treatment of DRF.
Methods: Four hundred and six wrists of 400 consecutive patients underwent our original procedure: the plate presetting arthroscopic reduction technique (PART) for DRF. The fractures were reduced, anatomical alignment was regained with the aid of a fluoroscopy, and the palmar locking plate was preset. Wrist arthroscopy was then performed and the intra-articular condition assessed. If there were any residual dislocations of the intra-articular fragments, these were reduced arthroscopically, and soft tissue injuries were subsequently treated. The traction was then removed, and the plate was securely fixed.
Results: On arthroscopic inspection, intra-articular dislocations were found to be residual in about 22%, even if reduction seemed to have been achieved when viewed with fluoroscopy. Scapholunate interosseous ligament injury was recognized in about 30%, and traumatic triangular fibrocartilage complex injury was observed in about 45%. The outcome was 76% of excellent, 22% of good, 1.5% of fair, and 0.5% of poor.
Conclusions: Wrist arthroscopy is a feasible adjunct in the treatment of DRF, especially as it enables us to evaluate the reduction of intraarticular fragments and soft tissue injuries. Palmar locking plate fixation recently has become popular, and simultaneous arthroscopic procedures for reduction have become difficult because vertical traction must be applied and released during surgery. PART can overcome these difficulties, and this technique can be performed with a small skin incision, preserving the pronator quadratus muscle, simplifying the combination of plating and arthroscopy, and achieving good final results.

A-0292 Total wrist arthrodesis with a locked, low profile fusion plate without carpometacarpal joint fixation: A bicenter trial

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Objective: Total arthrodesis is the last line of defense in the treatment of painful degenerative or posttraumatic destruction of the wrist. One option for the procedure is the use of a wrist fusion plate with a multidirectional locking system (APTUS 2.5-TriLock Wrist Fusion Plate, Medartis AG, Basel, Switzerland). Compared to conventional implants, the new generation has a low profile height and spares the third carpometacarpal joint (CMC), preserving residual mobility and therefore preventing potential implant removal. The aim of this study was to evaluate hand function, patient comfort, pain and bony consolidation in patients with the APTUS wrist fusion plate. Additionally, the practicability and reliability of the plate were evaluated.
Methods: A retrospective consecutive follow-up of the cases of two independent German hospitals was conducted. Between 2011 and 2016, the APTUS system was used in 28 patients. Of 28 patients, 19 were previously treated with a scapholunate ligament reconstruction, four-corner fusion, scaphotrapeziotrapezoid arthrodesis, or proximal row carpectomy. Total wrist arthrodesis was performed as a result of posttraumatic arthrosis in 22 patients, Kienbock disease in 4 patients, chronic polyarthritis in 1 patient, and infection in another patient. Bony consolidation was assessed by CT scan in all patients. The DASH score, pain measured by visual analogue scales ranging from 0 to 10 (VAS), patient satisfaction, grip strength as well as active pronation and supination were examined. Furthermore postoperative complications were recorded.
Results: Mean follow-up was 21 months (3–39). Using the CT scan as a determining factor, 26 of 28 patients achieved primary bony consolidation. The mean postoperative DASH score was 40 (6–72) points. Pain improved from 7 (3–10) preoperatively to 2 (0–6) postoperatively. Grip strength improved from 14 (0–38) kg to 22 (12–40) kg. Patients achieved

a mean pronation and supination of 140° postoperatively. Of 28 patients, 14 maintained complete active pronation and supination range of motion. Of the 14 patients, 13 were satisfied with the treatment. Problems with the extensor tendon apparatus did not occur. Postoperative complications were found in 6 of 28 patients and included non-union ($n=2$), screw breakage ($n=2$), postoperative hematoma ($n=1$), and infection ($n=1$). Plate removal was only performed in 1 of 28 cases as a result of screw breakage.

Conclusions: Total wrist arthrodesis, using a locked fusion plate that spares the CMC joint, has proved to be a viable treatment option for the end stage of osteoarthritic wrist disease. It leads to acceptable pain relief and grip strength and most ADLs can be maintained. Although there are process-specific complications, patient satisfaction rates are high. Usually hardware removal with this new generation of wrist fusion plate is not necessary.

A-0301 Humeral suspension improves flail shoulder conditions in traumatic brachial plexus palsy

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Introduction: Upper or complete brachial plexus lesions can lead to a severe weakness of the shoulder muscles. Following the denervation and atrophy of these muscles, the maximum range of motion, especially abduction, is impaired. Inferior subluxation of the humerus head in the resting position of the shoulder develops consequently, leading to a flail shoulder. Unfortunately, there are limited therapeutic options to improve this condition. Muscular support can be improved by a trapezius muscle transfer. Glenohumeral arthrodesis is available as a salvage procedure with a high rate of failure. We have developed a surgical procedure for the re-suspension of the humerus head to the acromion, and this study aims to evaluate the efficacy of this method retrospectively.

Materials and Methods: Between 2008 and 2014, 13 patients suffering from a paralysed upper limb and, consequently, flail shoulder were treated with this procedure. The humerus head was re-suspended from the acromion using an artificial ligament. In 6 patients, an additional supraspinatus to trapezius muscle-tendon transfer was performed due to complete supraspinatus wasting. The mean age was 30 years (±11) and the mean follow-up was 36 months (±14). All patients were male, and the right side was affected in 85%. The grade of subluxation was determined by measurement of the distance between the lower border of the acromion and the upper border of the humerus head clinically. Abduction was measured as the maximum possible thoraco-humeral angle using a goniometer, with the patient standing upright in front of the investigator. Pain was measured using a visual analogue scale. Furthermore, the ASES, the UCLA, and the Simple Shoulder Scores were obtained postoperatively.

Results: Abduction was improved from 11° (±18) preoperatively to 54° (±17) postoperatively, $p<0.05$. Pain was reduced from 3.3 (±3.8) preoperatively to 1.7 (±2.8) postoperatively, $p<0.05$. The grade of subluxation was improved from 3.9 cm (±0.6) preoperatively to 0.5 cm (±1.2) postoperatively, $p<0.05$. The mean postoperative ASES, Simple Shoulder and UCLA Shoulder Score were 60.8 (±13.7), 2.6 (±0.9), and 18.2 (±3.6), respectively. All patients reported a highly satisfying stability of their shoulder. No foreign-body reactions or wound healing disorders occurred.

Conclusion: In this article, we present a novel procedure to suspend the humerus head from the acromion in the case of inferior subluxation of the humerus head. Subluxation can be reduced with this procedure, and existing muscle strength can be used exclusively for movement. Restoring dynamic shoulder stability can treat the pain arising from a flail shoulder as well.

A-0302 Clinical improvement in patients older than 80 years after carpal tunnel release

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Objectives: There is still some controversy about the benefits of the carpal tunnel release (CTR) in older patients, even more when the impairment of the median nerve is high. Some previous studies showed partial improvement in patients older than 70 years. The objective of the present study is to asses the clinical improvement in patients older

than 80 years who underwent surgery for carpal tunnel syndrome (CTS) in our service.

Methods: A review of the patients older than 80 years with CTS that underwent surgery in Hospital de la Princesás Hand Unit between 2013 and 2016 was performed by means of a retrospective study. Twenty-eight patients (31 hands) were evaluated. Mean age was 84 years and 23 patients were females. Mean time of evolution before surgery was 27 months.

Pain, paresthesias, loss of strength and sensitivity were registered. Physical exam included Tinel and Phalen tests. In every case, an electrodiagnostic study was performed and sensitive conduction velocity was used to assess the degree of impairment of the median nerve in mild (one case), moderate (10 cases) or severe (20 cases). Surgical technique was open carpal tunnel release. Postoperative improvement of pain and paresthesias, and recovery of the strength and sensibility were registered, so the complications after surgery. Electrodiagnostic postoperative control studies were performed in 16 cases. Data were analyzed with the SPSS statistics program 22.0 and McNemar test.

Results: After CTR, there was an improvement in pain release in all symptomatic cases ($p < 0.05$), and paresthesias in 85% of previous cases ($p < 0.05$). In all of patients with previous loss of strength, there was a subjective improvement, and in 76% of patients with loss of sensibility ($p < 0.05$). The patients from the group of severe impairment of median nerve were reviewed separately and the rate of improvement in paresthesias and recovery of sensibility was similar (82 and 75%, respectively). Electrodiagnostic studies showed improvement in more than 80% of patients.

There were 10 hands with mild or moderate pillar pain at the scar that improve spontaneously in a few months. No disesthesic scars were found, and there was a patient with trigger finger that needed surgery to correct.

Conclusions: Patients older than 80 years old that underwent CTR in our study showed a significant improvement in clinical symptoms and the recovery of strength and sensibility.

There was a significant improvement in the electrodiagnostic studies after surgery.

The clinical improvement of the patients of the study was independent from the preoperative degree of impairment of the median nerve.

A-0307 Evaluation of sarcopenia in patients with distal radius fractures

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Objective: Sarcopenia is a core component of physical frailty that predisposes older people to fall and negatively impact the activities of daily living. The objectives of this study were to compare the prevalence of sarcopenia in patients with distal radius fractures (DRF) with that in age- and sex-matched controls without DRF and evaluate the association between sarcopenia and the occurrence of DRF.

Methods: We prospectively recruited 132 patients over 50 years of age who sustained DRF due to fall and 132 age- and sex-matched controls without DRF. A definition of sarcopenia was based on the consensus of the Asian Working Group for Sarcopenia. Sarcopenic components including appendicular lean body mass, grip strength, and gait speed were compared between the two groups. Other factors assessed for the occurrence of DRF were age, gender, body mass index (BMI), lumbar, and hip bone mineral density (BMD) values. A conditional logistic regression analysis was conducted to evaluate the associations between sarcopenia and the occurrence of DRF.

Results: A total of 39 (30%) of 132 DRF patients were sarcopenic, whereas 23 (17%) of the 132 controls were within the sarcopenic criteria ($p = 0.048$). The patient group had significantly lower lean body mass and weaker grip strength than those of the control group. However, there was no significant difference in gait speed between the two groups. According to regression analysis, lower appendicular mass index in men was associated with an increased incidence of DRF (odds ratio (OR) = 0.84, 95% confidence interval (CI) = 0.72, 0.95), while weaker grip strength and lower total hip BMD values were associated with the occurrence of DRF in both men (OR = 0.77, 95% CI = 0.63, 0.92; and OR = 0.79, 95% CI = 0.64, 0.94, respectively) and women (OR = 0.78, 95% CI = 0.64, 0.93, and OR = 0.73, 95% CI = 0.52, 0.92, respectively).

Conclusions: Sarcopenia is more prevalent in patients with DRF than in age- and sex-matched controls. Lower appendicular mass in men, weaker grip strength, and lower hip BMD in both men and women increase the likelihood of DRF.

A-0310 Intermediate-term results following arthroplasty of the basal joint of the thumb

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Objective: Indication for thumb carpometacarpal joint (CMC-1) arthroplasty is clinical and radiographic osteoarthritis of the joint resistant to conservative treatment. The purpose of this study was to evaluate patient-reported outcome measures after CMC-1 arthroplasty.
Methods: A prospective database was initiated September 2013. Patients prospectively answered Quick-DASH questionnaire preoperatively and at 6 months postoperatively following interposition arthroplasty of the basal joint of the thumb. From 2016, the database further collected 12 and 24 months postoperative values. Two hundred and thirteen consecutive patients were available with 6 months post-operative results. Thirty-five were available after 12 and 24 months each.

SPSS v 24.0 was used. Student t-test and Mann–Whitney U test were used comparing pre- and postoperative values. Pain was evaluated from the Quick-DASH questionnaire quantified on a scale of one to five, five being most pain. The validated Quick-DASH questionnaire was used. $p < 0.05$ was considered statistically significant.
Results: The mean preoperative Quick-DASH was 47.98 (SD 16.30) for the group that had follow-up at 6 months. The mean 6-month postoperative Quick-DASH was 23.94 (SD 20.67), showing an average improvement of 24.04, $p < 0.0001$. The mean 12-monthspostoperative Quick-DASH was 25.52 (SD 22.38). The mean 24-month postoperative Quick-DASH was 19.74 (SD 18.88). There was no significant improvement from 6 to 12 months ($p = 0.85$) or 6 to 24 months ($p = 0.28$).

Preoperative pain was 3.65 (SD 0.71). Six-month postoperative pain was 2.18 (SD 0.98), $p < 0.0001$. Postoperative pain at 12 months was 2.31 (SD 0.99) and at 24 months 1.71 (SD 0.83). There was no significant improvement in pain from 6 to 12 months ($p = 0.91$) or 6 to 24 months ($P = 0.09$).

At 6-month follow-up, 159 of 213 (74.6%) were satisfied with the result, at 12 months 25 of 35 (71.4%) and at 24 months 26 of 35 (74.3%) were satisfied. Patients who were satisfied had lower pain scores and lower Quick-DASH scores at 6, 12, and 24 months ($p < 0.001$ on all parameters) as compared to preoperatively.
Conclusions: CMC-1 arthroplasty is an effective treatment of thumb CMC osteoarthritis. Quick-DASH scores and pain scores improved at 6-month follow-up. There was no improvement in Quick-DASH or pain scores from 6 to 12 months or from 6 to 24 months. Patients who were satisfied had lower pain scores and lower Quick-DASH scores at follow-up compared to patients who were not satisfied.

A-0311 Reconstruction of hypoplastic thumb using hemi-metatarsal composite tissue transfer

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Purpose: This study was conducted to report the functional outcomes of hemi-metatarsal composite tissue transfer in reconstruction of type IIIB hypoplastic thumbs.
Methods: Eighteen patients with type IIIB hypoplastic thumbs who had undergone hemi-metatarsal composite tissue transfer were included in this study with at least 4 years of follow-up. Preoperative DSA was performed to investigate vessel variance. Outcome measures included range of motion and pinch strength. Pediatric Outcomes Data Collection Instrument (PODCI) scores were also collected.
Results: Radial arteries were hypoplastic in 83.3% of the cases, which we chose common palmar digital arteries as the recipient vessel. There was no neurovascular complication. The only donor site complication was a metatarsal fracture, which healed with casting. Range of motion was significantly less than normal for both the interphalangeal and the metacarpophalangeal joints. For the returning cohort, key and tripod pinch were 21% and 45% of normal. The median Kapandji score was 6 (range 3 to 8). The PODCI scores were high for global, upper extremity function, happiness, and pain.
Conclusions: At a minimum 4-year follow-up, hemi-metatarsal composite tissue transfer for types IIIB thumbs was shown to provide good subjective outcomes, despite limited range of motion and strength, and is a feasible method in the attainment of a 5-digit hand.

A-0312 A novel opening wedge osteotomy to correct delta phalanx deformity in clinodactyly

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Purpose: To evaluate the outcomes and complications in a series of children with clinodactyly treated with our novel opening wedge osteotomy of the abnormal Delta phalanx.
Methods: We performed a retrospective review of eight children with clinodactyly treated at our institution with a novel opening wedge osteotomy of the abnormal delta phalanx between 2007 and 2017. This κ-shaped osteotomy included resection of the abnormal longitudinal physis and double opening wedge osteotomy. Preoperative and postoperative clinical angle, radiographic angle, digital range of motion, and pain were compared and complications were recorded.
Results: Ten digits in eight patients were included in the study. All had greater than 28 of preoperative clinical angulation (mean, 40). Mean age at time of surgery was 6 years; mean duration of follow-up was 24 months (range 12–48 months). All digits had significant improvement (mean, 34) in clinical and radiographic angles after surgery. This improvement was maintained at the final follow-up in all digits. Five patients had pain preoperatively and no patient had pain postoperatively. One digit had a recurrent deformity at the final follow-up and three digits developed stiffness at the interphalangeal joint.
Conclusions: Our novel opening wedge osteotomy is an effective treatment for angulation in children with severe clinodactyly although the risk of interphalangeal joint stiffness still exists.

A-0319 Neuroma prevention with NEUROCAP® in a rat sciatic nerve model

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Objective: Symptomatic neuroma may develop after a nerve dissection or bruising of a nerve following any blunt or sharp trauma to a peripheral nerve, whether accidental or planned (i.e. surgery). Neuroma-induced neuropathic pain and morbidity seriously affect the patient's daily life and functional status. By developing a conduit with a closed end (cap), the formation of neuromas will be better controlled by preventing axonal sprouting and escape at the site of nerve transection, and lowering local neurotrophic effects by preventing attraction and activation of nerve growth factors which induce axonal sprouting. The objective of the study was to assess the implantation effects of the NEUROCAP® device in a rat sciatic nerve model.
Methods: In this Good Laboratory Practice (GLP) randomized controlled trial, the right sciatic nerves of 34 male Sprague Dawley rats were dissected and transected per study protocol. The rats were divided into a test group, which received the NEUROCAP device after transection of the nerve, and a control group in which the nerve end was left in situ after transection. Ten animals were sacrificed at 3 months after transection (5 test, 5 control), 16 animals at 6-month follow-up (8 test, 8 control), and 5 animals at 12 months follow-up (3 test, 2 control). Animals were assessed with regards to autotomy behavior during their survival period. Gross macroscopy information was collected regarding neuroma formation, tethering to the surrounding tissue and outgrowth of nerve axons. Histological information was collected regarding neuroma formation, outgrowth of nerve axons, axon alignment and myelination, inflammation and degradation of the study device. Histological data were collected using H&E, Neurofilament 200 and LFB stains.
Results: Seven animals showed severe autotomy in the first 3 days after surgery (three tests and four controls) and were euthanized and replaced, autotomy in all animals resolved 4 months after transection. Three additional animals (one test and two controls) were prematurely euthanized due to non-device related complications, making a final samples size of 31 animals. Histopathology analysis on the raw data at the location of the transected nerve was performed to determine if a significant effect exists between test samples and control samples. At 3 months after transection, the test group had less neuroma formation, less nerve outgrowth, more myelinated nerve fibers, more chaotic fascicles, and more inflammation when compared to a control treatment. Six months after transection, the test group continued to have less neuroma formation, less nerve outgrowth, and less tethering to the surrounding tissue when compared to controls; and fewer chaotic fascicles and less inflammation compared to 12 weeks. These results were maintained in the small group of animals at 12-month follow-up.
Conclusions: The results indicate that the tested device performed better or equivalent to the control treatment at 3-, 6-, and 12-month duration with regards to neuroma formation, outgrowth of axons, axonal alignment, tethering to the surrounding tissue, and myelination.

A-0326 Single palmar approach for proximal row carpectomy and total wrist fusion in the spastic hand

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Introduction: A total wrist fusion (TWF) with proximal row carpectomy (PRC) may help address the severely flexed wrist deformity in patients with cerebral palsy (CP). With proper diagnosis and a well-executed surgical plan, successful surgical outcomes can be achieved. Surgeons described different techniques of TWF in patients with CP. This study aims to show our experience with a volar PRC and TWF, which Gong HS (*Tech Hand Up Extrem Surg* 2010) initially described. Our technique uses the same surgical approach from the volar side and distinguishes itself through the use of a different osteosynthesis material for bone consolidation.
Materials and Methods: In three patients and four wrists, a PRC and TWF were done using a palmar approach. In all patients, the carpal tunnel was released and the superficial flexor tendons were transferred to the deep flexor tendons of the fingers. We used a Medartis 2.5 triLock distal radius plate to obtain wrist fusion.
Results/scores: The bony site fused in an average of 3 months. There was no case of nonunion. The bone fused in an average of 10° of flexion and we obtained an average of 80° of correction. One case presented a postoperative blister that was managed expectantly with a favorable outcome. One case presented a screw loosening, however without the need for further therapy. In all cases, patients and their caregivers were satisfied with the postoperative result.
Discussion: Different techniques of TWF have been described in the literature. With a palmar dissection, flexor tendon surgery and carpal tunnel release can be accomplished through the same surgical incision. The PRC provides sufficient bone stock for a successful arthrodesis without the risk of further comorbidity associated with an iliac crest graft. The palmar arthrodesis is technically feasible and a 2.5 triLock locking plate seems to give enough stability for successful bone healing, even if the construct of palmar application of the plate is biomechanically less stable. No secondary procedure for plate removal was necessary in our patients. The palmar incision might be an advantage in a patient group where the forearm is fixed in a prone position due to muscle spasticity, as well as in a group that chooses the operation for aesthetic reasons, too. While our study group consists of only four wrists, to our knowledge, it is the largest study group where volar PRC and TWF have been described.

A-0328 Prevalence of the Linburg–Comstock anomaly in women with carpal tunnel syndrome

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Purpose: This study clinically evaluated the prevalence of anomalous tendon slips from the flexor pollicis longus to the flexor digitorum profundus of the fingers in a group of patients diagnosed with carpal tunnel syndrome (CTS).
Methods: The prevalence of the Linburg–Comstock anomaly was evaluated in 400 hands from 200 female patients aged >40 years and clinically diagnosed with CTS. The control group consisted of 400 hands from 200 female volunteers aged >40 years. The patients and controls were asked to perform the flexion and pain clinical tests described by Linburg and Comstock.
Results: The flexion test was positive in 305 (76.3%) CTS patient and 242 (60.5%) volunteer hands. The pain test was positive in 261 (65.3%) CTS patient and 108 (27.0%) control group hands. Of the 305 CTS patient hands with positive flexion testing, 244 (80.0%) were also positive for the pain test. Only 98 (40.5%) of the 242 control group hands with positive for flexion testing also had a positive pain test. All these differences were statistically significant ($p < 0.001$).
Conclusions: In this study, the prevalence of the Linburg–Comstock anomaly was evaluated by the flexion and pain tests, which showed significantly more positive results in patients diagnosed with CTS than in the non-CTS controls. The concomitant prevalence of positive flexion and pain tests was also higher in the CTS patients than in the controls. These results suggest that the Linburg–Comstock anomaly may be related to the etiology of CTS.
Type of study/level of evidence: Diagnostic III.

A-0338 Nerve transfer of motor branches from the supinator muscle to the posterior interosseus nerve in tetraplegia: A 1-year follow-up of 17 operated forearms

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Objective: A complete spinal lesion at the C6 level leads to loss of motor function in muscles innervated by the radial nerve, that is, muscles mediating wrist, thumb and finger extension (EPL, EPB, APL, EDC, EIP, EDM and ECU). However, the upper motor neurons that innervate the supinator muscle originate from C5 to C6 level and are intact in most tetraplegic patients with a C6 lesion. Transferring branches containing these neurons to the posterior interosseous nerve can attain reinnervation of extensor muscles. The purpose of this study was to investigate the outcome 1-year post surgery in the first nine patients treated in our unit.
Methods: Between October 2014 and August 2016, 17 nerve transfers were performed in nine tetraplegic patients (8 bilateral and 1 unilateral). The median time after the spinal trauma was 10 months (range 7–15). Preoperative assessment ensured function of the radial wrist extensors (ECRB and ECRL), and intraoperative nerve stimulation of the motor branches to the supinator muscle was performed before section and transfer to the posterior interosseous nerve.
Results: All 17 forearms were assessed 1 year after surgery. Eleven of these forearms were found to have detectable results from the nerve transfer: Six arms were found to have reinnervation with voluntary extension of thumb and fingers, and five arms had some effect including flickers of the extensor muscles and stabilization of the wrist (ECU-reinnervation). Six arms showed no signs of reinnervation. Two of the patients in the first group have had further surgery with grip reconstruction after 12 and 14 months, at which some of the procedures had to be altered due to the regained extension.
Conclusion: Nerve transfer of motor branches from the supinator muscle to the posterior interosseous nerve is a novel option that should be considered in patients with tetraplegia. Contrary to other reconstructive procedures, timing after the spinal injury as well as the age of the patient is of importance since neurodegeneration of the posterior interosseous nerve might decrease the functional outcome. Reinnervation cannot be exactly predicted in each patient, but restored and useful extension of thumb; fingers and wrist in more than one third of the arms should justify the operation in informed patients in our opinion. Later grip reconstruction procedures have to be altered according to the regained functions.

A-0340 Arthroscopic resection of the distal ulna (wafer procedure): An adequate treatment option?

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Objective: The arthroscopic intra-articular resection of the distal ulna (wafer procedure) is one of the treatment options in symptomatic ulnar impaction syndrome. In our Hand Surgical Department, 29 arthroscopic resections of the ulnar head were performed from 2012 to 2016. Range of motion, pain, grip strength and patient satisfaction should be examined.
Methods: Exclusion criteria for our retrospective study of arthroscopic resections of the distal ulna were simultaneous osseous interventions of the carpus, which left 25 patients (average age 53 years, male to female ratio 9:16) for evaluation.

The active range of motion (aROM) and the grip strength (Jamar) were examined. Furthermore, Quick-DASH score was recorded preoperatively and on follow-up exam (mean 26 ± 19 months postop). We evaluated the pain score (VAS 1-10) in rest and on exertion as well as the patient satisfaction.
Results: Pain could be reduced to 1.72 VAS in rest from 3.86 preoperatively and 3.56 on exertion from 7.32, respectively.

The Quick-DASH score improved from 48.7 preoperatively to 32.2 in the follow-up.

Active ROM (extension/flexion) was 109.2° preoperatively and 114.2° in the follow-up. For pro-/supination active ROM was 163.8° preoperatively and 165° in the follow-up exam.

Grip strength (Jamar) was 96.7% compared to the non-treated side.

Almost 93% of the patients were satisfied with the result of surgery.
Conclusions: Subjective parameters (Quick-DASH and VAS) and patient satisfaction showed a marked improvement after surgery, and active ROM reached the initial levels.

The arthroscopic resection of the distal ulna seems to be well suited to alleviate the symptoms of ulnar

impaction syndrome without a long period of convalescence. Even if we prefer the open ulna shortening osteotomy for patients as a standard procedure, the arthroscopic wafer procedure seems to be a good alternative treatment option, if the shortening osteotomy is not possible due to DRUJ configuration or not approved by the patient.

A-0341 Comparative, retrospective study of elbow flexion gain in patients with brachial plexus injury who underwent neurotization with part of the ulnar nerve to the biceps muscle or to the free gracilis muscle

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Objective: In an upper brachial plexus injury, the gain of elbow flexion is an important condition for the functional improvement of the affected limb. As a therapeutic option, we have the neurotization surgery of the ulnar nerve in the musculocutaneous nerve, the success of which is related to how soon the procedure can be performed. As an alternative, we have the free transfer of the gracilis muscle with neurotization in the ulnar nerve, which would be recommended for cases in which the procedure is performed later and in which changes resulting from chronic denervation of the flexor muscles of the elbow are irreversible. Therefore, the time limit within which we recommend each of these procedures to be performed is not well defined. The primary objective of our study was to compare the results of these treatment methods in terms of elbow flexion strength improvement and, secondarily, to evaluate the influence of the time variation between injury and surgery in these results.
Methods: We performed a comparative, retrospective study that evaluated 69 patients with upper brachial plexus injury. The patients underwent surgical treatment with neurotization of part of the ulnar nerve in the motor branch of the musculocutaneous nerve (48 patients, the Oberlin group), or free transfer of the gracilis muscle (21 patients, the Free group) for elbow flexors with neurotization in part of the ulnar nerve. The primary outcome was evaluated using the scale defined by The British Medical Research Council (BMRC) and a minimum follow-up of 12 months was defined. The secondary outcome referred to the effect of time between trauma and the plexus surgery, and the results obtained for gain in elbow flexion with the Oberlin surgery. These results were compared with those obtained by means of free muscle transfer surgery. We used the criteria of M4 or more to classify the elbow flexion as a good result.
Results: No statistically significant difference was observed, regarding the ability to obtain a M4 score or higher between the Oberlin (61.3%) and the Free groups (61.9%). In assessing Oberlin subgroups, operated on within 6, 9 and 12 months, we obtained good results in 65%, 60.5% and 58%, respectively, with no statistically significant differences between subgroups. The same was observed when each Oberlin subgroup was compared individually with the Free group. The integrity of the triceps did not interfere with the final gain of elbow flexion. Considering the possibility of a M2 score or higher, which would allow for complementary surgery, such as the Steindler procedure, we had similar results, with 87% for the Oberlin group and 95.2% for the Free group.
Conclusions: The neurotization surgery of the ulnar nerve on the motor branch of the musculocutaneous nerve, when the operation takes place within 12 months of the injury, and the free transfer of the gracilis muscle and neurotization in the ulnar nerve in patients with upper brachial plexus injury, showed similar gains in elbow flexion strength.

A-0344 Bipolar transfer of the pectoralis major muscle for restoration of elbow flexion in 29 cases

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Objective: The aim of this study was to evaluate the functional outcomes of bipolar pedicled pectoralis major (PM) transfer to restore elbow flexion. A technical refinement was developed, allowing direct distal fixation on the biceps muscle and avoidance of a tendon graft.
Methods: We retrospectively reviewed 29 transfers in 28 patients who ranged from 5 to 65 years of age (mean age of 31.2 years.). The loss of elbow flexion was due to brachial plexus palsy for 24 patients, elbow flexors necrosis in four and poliomyelitis in one patient. The whole PM muscle was mobilized and fixed proximally to the coracoid process. Intraoperative positioning and post-operative immobilization of the shoulder and the elbow flexed at 60°

and 120°, respectively, allowed direct distal fixation of the muscle to the biceps brachii tendon. Outcome evaluation included measurement of active elbow flexion range of motion, and elbow flexion strength according to the MRC grading system and to the maximum weight sustained at the level of the wrist.
Results: At the last follow-up (mean of 13 months, ranging from 4 to 37 months), 41% of the transfers ($n=12$) recovered grade-4 elbow flexion strength and were able to lift 2.2 kg on average (ranging from 0.5 to 5 kg). Fifty-two per cent of the patients ($n=15$) recovered grade-3 strength, and 7% ($n=2$) had a poor result (i.e. grade-2 elbow flexion). The mean active elbow flexion was 100° (ranging from 30 to 150°) and the patients had 0 to 10° elbow flexion contracture.
Conclusions: Our results indicate that bipolar PM transfer is a reliable and effective procedure to restore elbow flexion. Flexion of the shoulder and elbow allowed the transfer to reach the elbow fold and avoided the use of an interposition graft between the distal PM and the biceps brachii tendon.

A-0348 Clinical and MRI evaluation of Kienböck's disease treated by "Camembert" radial osteotomy: Follow-up of minimum 5 years

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Objectives: In Kienböck's disease, to avoid collapse of the lunate, radius shortening osteotomy is the most common treatment. Different osteotomies have been proposed. Neutral shortening and radial closing wedge are the most popular. The "Camembert" osteotomy is a wedge osteotomy that shortens the radius in front of the lunate, not in front of the scaphoid. The aim is to unload the lunate by redirecting the compression stress of the grip forces towards the scaphoid, in the hope that protects lunate from collapse. The authors reviewed a series with a minimum follow-up of 5 years.
Methods: Fourteen wrists of thirteen patients have been operated between 2002 and 2012 by one operator. Three patients were lost, and the series exposes the results of 11 wrists on 10 patients: 6 men and 4 women. The mean age is 40.6 years and the follow-up is 7 years.

In five cases of positive ulnar variance, an ulnar shortening osteotomy according to Sennwald was used in addition to Camembert.

There were two patients Lichtman's stage 1, five stage 2, 4 stage 3A. MRI showed 1 case of oedema of the lunate and 10 cases of heterogenous lunates (oedema + necrosis).

Preoperatively, the flexion/extension arc was 95°, radial/ulnar tilt 38°, pronosupination 172°. Mean grasp was 13.8 kgF, pain on VAS 8.2, PRWE score 82.3, and SANE score 26.6%.
Results: All osteotomies healed within 3 months. Extension (+9°), ulnar deviation (+10°), grasp (+15 kgF), PRWE (−57), and SANE (+53) improved significantly. Pronosupination decrease was not significant.

MRI aspect of the lunate improved 10 times on 11, and 4 lunates healed with normal homogenous signal. Global results were excellent in 3 cases, good in 5, fair in 2, and bad in 1. The bad result was due to luno-capitate arthritis, not to lunate fracture or collapse.
Discussion and Conclusions: Popular radial shortening osteotomies give in 1/3 to 2/3 cases good clinical results. But in half cases, they don't avoid lunate degenerative changes. The goal of the camembert osteotomy is not to heal the lunate, but to protect it from fracture and collapse, and to maintain the best shape as possible until it heals. This series shows frequently good result with no worsening of the lunate shape. This osteotomy, by unloading the lunate and not scaphoid, seems efficient to protect the lunate. Radiological and MRI aspect of the lunate improve most of the cases. It can be used combined with ulnar shortening according to Sennwald when ulnar variance is neutral or positive. Our results on our 11 oldest cases are hopeful. We propose this procedure for Lichtman stages 1-2-3A if there is no cartilage nor ligaments lesions.

A-0358 New open and arthroscopic-assisted approaches of the axillary nerve

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Introduction: Previous studies have described a segment of the axillary nerve (AN) that cannot be surgically explored through standard open surgical approaches (blind zone). The aim of this study is to evaluate the feasibility of combining the standard posterior approach to the AN with the use of the arthroscope to visualize all segments of the AN and determine the AN length that can be seen through

standard and extended anterior, axillary and posterior approaches.

Materials and Methods: Ten fresh frozen shoulders in five adult human torsos were included in the study. A standard posterior approach was performed on four shoulders and dry arthroscopy was performed through the surgical opening in an attempt to visualize all segments of the AN. A surgical clip was applied to the most proximal and anterior segments of the AN that could be visualized with the arthroscope. A standard open deltopectoral approach was then performed to determine the exact location of the surgical clip and its relation to the origin of the AN. Then, we attempted to explore the AN through three different surgical approaches (each approach was performed in two shoulders): a standard and extended anterior, axillary and posterior approaches. Surgical clips were used to mark the AN length that was visualized through each approach.

Results: Using the arthroscopic-assisted approach, all segments of the AN (including the blind zone) were visualized from the quadrilateral space to their origin from the posterior cord in all four specimens. The surgical clip was found at an average 1 cm (range from 0.5 cm to 1.5 cm) from the origin of the AN from the posterior cord. Compared to the standard approaches, the extended anterior, axillary and posterior approaches improved the visualization of the AN by 3.6, 1.5 and 2.8 cm, respectively.

Conclusions: This cadaveric study shows that it is feasible to visualize all segments of the AN (including the blind zone) using this novel arthroscopic-assisted approach that combines the use of the standard posterior approach to the AN with dry arthroscopic exploration. Clinical studies are necessary to evaluate the utility of this novel approach. None of these extended approaches independently was sufficient to expose the entire course of the AN.

A-0359 Ultrasonography of the pretendinous cord in Dupuytren's disease: A pilot study to correlate morphological patterns before treatment to clinical outcome after 2 years

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Objective: The morphology of the pretendinous cord in Dupuytren disease is poorly described in vivo, and especially in respect to recurrence after treatment. This prospective study was designed to describe the morphology of Dupuytren cords by ultrasound before treatment and to correlate the ultrasonographic characteristics of these cords to clinical development after treatment.

Methods: Thirty-nine patients with a Dupuytren contracture of at least 20° in the metacarpophalangeal joint who were scheduled for minimally invasive treatment in a randomized controlled study were examined. The position of the pretendinous cords in relation to flexor tendons and neurovascular bundles were categorized. The structure of the cords was described and characterized as nodular, fibrillary or mixed. The patients were randomized to treatment either by needle fasciotomy or collagenase (CCH) injection, and ultrasonography was again performed once the cord had ruptured. After 2 years, the patients were examined for recurrence of the contracture and presence of a pretendinous cord, and these outcomes were correlated to the morphology of the cord as described by ultrasound before treatment.

Results: The structure of the cord was less organized than in the adjacent tendon. A majority of the patients (90%) had cords with both nodular and fibrillary components, and four patients (10%) had fibrillary cords. The position of the cord in relation to the neurovascular bundle and the flexor tendon was variable: in 28 cases (72%), the cord was identified exclusively volar to the flexor tendons. In 11 cases (28%), the cord was identified in the same depth from the skin as the flexor tendon, crossing over from one side of the tendon to the other. In the transverse projection, the digital blood vessels were visualized in 16 cases, whereas digital nerves could only be localized in 3 fingers.

There was no significant difference between the needle fasciotomy group and the collagenase group in either rupture length or mobility gain in the treated joint. After 2 years, the clinical results were compared to the ultrasonographic findings before treatment. Two patients had recurrent contracture, and both of these patients had cords with nodules before treatment.

Discussion: This study showed that the morphology and position of the pretendinous cords in relation to the flexor tendons can be well described by ultrasound. Blood vessels and nerves were, however, more difficult to visualize. Only two of 39 patients had a recurrent contracture after 2 years, and even though both had nodular cords before treatment, the

study population proved to be to small to establish a significant correlation.

A-0361 Microsurgical reconstruction after pan-plexus injury: Where is the optimal gracilis distal tendon attachment for elbow flexion?

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Introduction: Reconstruction after pan-plexus root avulsions often includes microsurgical reconstruction using a gracilis free functional muscle transfer (FFMT). For elbow flexion reconstruction, the FFMT distal tendon is inserted into the biceps tendon or more distally (i.e. flexor digitorum profundus [FDP]/flexor pollicis longus [FPL] tendons) for combined elbow and finger flexion; the theoretical drawback of the latter approach is weaker elbow flexion. We sought to critically compare elbow flexion strength with a biceps tendon versus a FDP/FPL tendon attachment to determine which insertion point resulted in better elbow flexion.
Methods: Thirty-nine patients underwent FFMT with either a biceps tendon or distal attachment. The groups were compared with respect to postoperative elbow flexion strength, as well as preoperative and postoperative DASH scores, range of motion, and other surgical and demographic characteristics. A biomechanical analysis was performed simulating different tendon attachments to determine which reconstruction resulted in optimal elbow flexion mechanics.
Results: Distal tendon attachment was associated with M3 or M4 elbow flexion and greater range of motion compared to the biceps tendon attachment ($p < 0.05$). There were no statistically significant improvements in DASH scores. Biomechanical analysis demonstrated a 15–30% greater torque with the distal tendon attachment and with a 10 cm and 15 cm from the elbow axis of rotation in the radius attachment compared to the biceps tendon.
Conclusion: The FDP/FPL tendon attachment of the gracilis FFMT distal tendon was superior in achieving elbow flexion strength. Patients with only elbow flexion reconstruction may also benefit from a FDP/FPL tendon attachment or from a more distal attachment to the radius.

A-0366 Proximal row carpectomy in the treatment of wrist arthritis: Is it still a valid indication? Evaluation of clinical outcomes

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Proximal row carpectomy (PRC) is an accepted surgical technique for the treatment of wrist degenerative arthritis. Despite of being a motion-sparing procedure, patients frequently complain of residual pain and functional limitation.

This study aims to evaluate the clinical outcome of the patients with wrist degenerative arthritis treated by PRC with a minimum of 6-month follow-up.

A total of 22 patients (14 men and 8 women) were treated by PRC between 1992 and 2015 in our hospital. Of them, 20 underwent a minimum of 6-month follow-up examination (two excluded: one died and one didn't cooperate with the study). Clinical and radiological examinations were performed after a minimum of 6 months post-operatively. We evaluated the range of motion (ROM) of the wrist, grip strength, presence of resting pain and pain during physical activities and the patient's satisfaction with the treatment. ROM was measured with handheld goniometer and grip strength was measured with dynamometer and compared with the opposite side. The pain intensity was graded according to the visual analogue scale (VAS) and DASH score was applied. By radiological examination, we assessed radiocapitate joint degeneration and translation of the capitate bone in relation to the lunate facet of the radius.

Twenty patients (90.9%) with a mean age of 61.2 years (43–75 years) were evaluated with a mean follow-up of 13.4 years (minimum of 6 months and maximum of 23 years). In 10 patients, PRC was performed for SNAC or SLAC-wrist conditions. Other etiologies were Kienböck disease (five cases), rheumatoid arthritis (three cases), post-traumatic (three cases) and psoriatic arthritis (one case). Pain relief at rest and during physical activities was statistically significant. At the follow-up examination, most patients (87%) reported an overall improvement. Pain with strenuous activity was reduced by 52% and resting by 87%. Improvement of ROM and grip strength several months after operation have been observed. The flexion–extension ROM varied between 60° and 90°, the radial deviation varied between 0° and 15° and the ulnar deviation varied between 15° and 35°. The average grip strength was 64.4% of the unaffected side. There was an improvement from pre op DASH score of 75.0 (48.2 to 84.0) to a

postoperative DASH score of 20.8 (11.2–28.0). In this retrospective analysis of the functional postoperative outcome of PRC, all patients showed radiological decreased of the radiocapitate articular space without functional impact.

As shown by our results as well as the published data, PRC is an effective surgical procedure for the treatment of wrist degenerative arthritis. This approach is favoured by its technical simplicity and the good functional outcomes, as shown by the maintenance of wrist motion, satisfactory grip strength and pain relief. We still favour PRC as a salvage procedure in order to offer the patient some wrist motion, ensuring that there is no osteoarthritis over the capitate and the lunate facet preoperatively. Despite having some functional limitation and progression of the degeneration of the radiocapitate joint, the patients are globally satisfied with surgical result, which is in accordance with previous studies.

A-0369 Pollicization in mirror hand

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Background: Thumb reconstruction with pollicization in mirror hand is technically challenging procedure due to its wide variation in anatomy and complexity. Mirror hand is rare entity to be deal with, even at tertiary care centre. Proper pre-operative planning and meticulous surgical technique increase its successful outcome.
Case report: Here we are representing 2.5 year old male with ulnar dimelia type 1 of left side with 2 ulna and 8 fingers without thumb. Patient was planned for pollicization in our hand unit. Patient has active range of motion at elbow 0°–10° of flexion while at wrist 20°–30° of flexion. After proper radiograph, DSA was done to rule out any vascular anomaly.
Operative technique: A decision was made to amputate two radial most fingers while pollicizing third radial most finger. Following Ezaki incision, radial vessel for targeted finger followed from common origin to proximal 1 cm and ligated away from bifurcation. Most radial syndactyly fingers were removed after their vessels ligation and subperiosteal dissection of metacarpal bones. Dorsal and palmar interossei attached to respective lateral band. Distal physis cut with knife and proximal metaphyseal cut at flare. Both end sutured with Ethibond 3.0 in flexed position so that final position was extension, 45° of abduction and 110° of pronation. The redundant thumb was removed in second stage and transverse metacarpal ligament was reconstructed. With this approach, we will be able to give the patient a functional thumb and four fingers.
Conclusion: Pollicization with other fingers amputation in same sitting in patients with mirror hand gives acceptable cosmetic and functional results. The elbow of suck patients remains an enigma still. The case is being presented in the conference to discuss the rarity of such entity and to discuss the advance surgical planning to reconstruct the whole upper extremity.

A-0377 Donor site morbidity of vascularized bone grafts from the medial femoral condyle

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Objective: The transplantation of vascularized bone grafts from the medial femoral condyle is an established microsurgical procedure to improve bone healing and restore vascularization of osseous defects. To date, objective data concerning the donor site morbidity are rare. We present the findings in 22 patients.
Methods: From 2008 to 2016, a medial femoral condyle bone graft was raised in 33 patients for microvascular transplantation. In the follow-up study, the functional state of the donor site was analyzed by the Lower Extremity Functional Scale (LEFS), the OAK score of the orthopaedic knee working group of the swiss orthopaedic society, and a 3-D gait analysis (Bertec, FP 4060-08-200). Scar quality was assessed by the Vancouver Scar Scale (VSS). The Visual Analog Scale was used to ask for postoperative and to assess actual pain.
Results: Of the 33 patients, 22 (67%) consented to participate in this study (4 female and 18 male patients). The indications were eight scaphoid nonunions, two metacarpal and one digital bone defect as well as nine avascular necrosis of the talus, one bone defect of the tibial pilon and one of the contralateral distal femur. Mean follow-up time was 35.8 (12–98) months and mean age was 30 (16–52) years. Mean in-patient time was 11.1 ± 7.7 days. One minor surgical revision was performed at the donor site for hematoma. Mean LEFS score was 74.9 ± 9.5 and OAK score was 92.4 ± 9.6. Scar quality

was rated to average 1.8 ± 1.3 on VSS. Retrospectively, the postoperative pain was estimated by the patient as 3.2 ± 2.8 on VAS (resting) and 4.9 ± 3.1 on activity. At follow-up examination, pain was adjusted as 0.1 ± 0.2 (resting) and 0.6 ± 1.4 (activity) on VAS. The 3-D gait-analysis showed regular gait cycles in all 22 patients.

Conclusion: Transplantation of a medial femoral condyle bone graft is associated with a low donor site morbidity. In the midterm follow-up, the functionality of the knee joint and the gait were almost unimpaired. Donor site morbidity can be considered as being of minor concern in the decision-making for a free microvascular medial femoral condyle bone graft.

A-0381 Reconstruction of the spinal accessory nerve with selective fascicular nerve transfer of the upper trunk

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Objective: Spinal accessory nerve palsy is frequently caused by iatrogenic damage during neck surgery in the posterior triangle of the neck. Due to late presentation, treatment often necessitates nerve grafts, which often results in a poor outcome of trapezius function, due to long regeneration distances. Here we report of a distal nerve transfer using fascicles of the upper trunk related to axillary nerve function for reinnervation of the trapezius muscle.

Methods: In this study, five cases are presented where accessory nerve lesions were repaired using selective fascicular nerve transfers from the upper trunk of the brachial plexus.

Outcomes were assessed at 18 ± 8 months after surgery, documenting active and passive range of motion as well as pain levels using the visual analogue scale (VAS).

Results: All five patients regained good to excellent trapezius function (four patients M5, one patient M4). The AROM of shoulder abduction improved from 55° ± 18 before to 151° ± 37° after nerve reconstruction. In all patients, unrestricted shoulder arm movement was restored with loss of scapular winging when abducting the arm. Pain levels decreased from 6.8 to 0.8 on the visual analogue scale (VAS) and subsided in four of the five patients.

Conclusions: Restoration of accessory nerve function with selective fascicle transfers related to axillary nerve function from the upper trunk of the brachial plexus is a good and intuitive option for patients who do not qualify for primary nerve repair or present with a spontaneous idiopathic palsy. This concept circumvents the problem of long regeneration distances with direct nerve repair and has the advantage of cognitive proximity to the target function of shoulder movement.

A-0384 HaptiVisT: The concept of a haptic and visual assisted training simulator for complex bone drilling in the minimally invasive hand surgery

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Objective: In the minimally invasive hand surgery, surgeons perform complex bone drilling in the operating room to fix tiny fractures with K-wires almost without a sight and without hurting any risk structure. In contrast to time-consuming and unrealistic training methods, we will offer surgeons an innovative opportunity to train their theoretical and practical skills by connecting virtual reality elements and haptic man-machine interaction to a compact haptic and visual-assisted training simulation system (HaptiVisT).

Methods: To track the position of a drill in real space and to transfer its position to the computer, a haptic device with force feedback is used. Through adding an algorithmic calculated force feedback, virtual objects, which are only visible on the computer screen, become tactile. Preprocessed and segmented CT data of a human hand with its risk structures as well as the driller and K-wire model are visualized in a virtual three-dimensional (3D) space via transmitting surface and volume rendering data to an autostereoscopic single-user 3D-monitor to generate a 3D-depth effect. In contrast to common

3D-visualization techniques, no glasses are needed, because of an eye tracking bar mounted on top of the monitor. An additional touchscreen monitor provides a graphical user interface (GUI) to choose different tools, alter the rotation speed and create an X-ray image for checking the actual K-wire position. For a bimanual haptic and feeling of important marker points on the hand, a haptic arm phantom will be 3D-printed by using rapid prototyping. For detecting the transfer and rotation of the haptic phantom, special markers will be attached and tracked by a stereoscopic real-time tracking camera. Hence the visualization on the monitor will follow the recorded movement.

Results: The software for the training system is developed within chai3d (www.chai3d.org), an open source C++ library for computer haptics. To create a realistic drilling simulation, a collision detection between the drill model and the human bones is essential. The used collision detection of the chai3d haptic points [5] is combined with the bullet physics library (www.bulletphysics.org) to firstly enable an interaction between the K-wire tip and single voxels of the bone volume and secondly to simulate collisions of rigid bodies and thirdly to calculate their resulting forces. Therefore, during the drilling process, it is possible to interact and remove several voxels (volume pixels) from bone objects. The drilling process itself is separated in several drilling modes to emulate the correct drilling behavior during the intervention.

Conclusion: Our training system for complex bone drilling in the minimally invasive hand surgery should close the gap to existing training systems and give surgeons the possibility to train their skills in preparation of real interventions. The software of the drilling process with its collision detection and all technical relevant components (haptic device, haptic phantom, 3D-monitor, tracking camera) are combined into a compact overall system. The effectiveness and resulting improved ability of a surgeon must be carefully evaluated.

A-0388 Implant-related joint infections of the hand

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Objective: Successful management of implant-related infections (IRI) requires combined surgical and antimicrobial therapy. There are few published data and the management is not standardized.

Methods: We reviewed charts of patients with IRI that were treated at the Inselspital from 2006 to 2016. Infection was grouped in osteosynthesis-related infection (ORI) and arthroplasty-related infection (ARI). Definition of IRI required criteria is as described previously (*Open Forum Infect Dis* (2017) 4(2): ofx058.). The interval from device implantation to symptoms was used to categorize infection in early ($\leq$4 weeks) and late (>4 weeks). Pathogenesis was categorized in exogenous and haematogenous.

Results: We identified 25 patients with 28 implant-related joint infections. Thirteen (52%) were men, and the median age was 51 years (IQR 41–65). ORI accounted for 14 (56%) and ARI for 11 (44%) of the episodes. The majority of episodes were late (21, 82%). There were 17 (68%) exogenous and 8 (32%) haematogenous categorized infections. Most ORIs were exogenous (13; 93%), 64% of ARI were haematogenous. In ORI, the third and fourth digits (each 5; 32%) and the DIP joint (12; 75%) were most commonly affected. In 7 (59%) of the ARI, a silicon arthroplasty of a small joint, in 4 (33%) patients a total arthroplasty of the wrist and in one (8%) patient there was an ulnar head arthroplasty involved. In 92% of the cases, a pathogen could be identified. *Staphylococcus aureus* was the most commonly found species (12, 48%) followed by *Streptococcus* spp. (5, 20%). The infection was successfully treated with 1 intervention in 17 (68%) episodes; in 7 (28%) episodes more than 1 intervention was required. In ORI, all implants were removed, whereas in ARI, 5 (41%) implants were retained. The median duration of antibiotic treatment was 42 (IQR 34–72) days for both ORI and ARI. One patient was treated with antibiotic suppressive therapy. Twenty-two (88%) episodes were cured with 1 or 2 interventions and 42 (IQR 34–72) days of antibiotics. Ten (91%) episodes with ARI showed resolution, five (45%) with remaining implant.

Conclusion: Most episodes were categorized as late infections with an exogenous pathogenesis and caused by *S. aureus*. Eighty-eight percent of episodes were cured with one or two surgical interventions and 42-day duration of antibiotics.

A-0397 Anatomy and treatment of thenar muscles in primary surgery for radial polydactyly

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Objective: Radial polydactyly encompasses a diverse group of congenital anomalies. The variable and

often complex anatomy needs to be recognized by those carrying out reconstructive surgery. There are limited data within the literature regarding thenar anatomy in radial polydactyly. Our review contributes to the current knowledge of thenar anatomy.
Method: A review of prospectively collected, operative anatomical data in patients undergoing primary correction of radial polydactyly.
Results: Thenar muscle anatomy and its treatment were recorded systematically in 44 thumbs during primary surgery for radial polydactyly. Wassel groups II–VII were represented. Abductor pollicis brevis muscle inserted into the radial duplicate in 18, ulnar duplicate in 11 and both duplicates in nine. There were six Wassel group II thumbs in which the thenar muscles inserted normally, proximal to the polydactyly. Thenar muscles were found to have variable insertions anywhere from the metacarpal base (Wassel IV, V and VII) to the distal phalanx (Wassel III $n = 1$) and flexor sheath of dominant ulnar duplicate. Anomalous musculature, anomalous tendons and hypoplastic muscles were more prevalent in proximal levels of duplication and in the triphalangeal cohort. The commonest procedure undertaken was elevation of the thenar muscles with a periosteal flap and transfer from radial to ulnar duplicate. Division of anomalous tendons of abductor pollicis brevis and adductor pollicis was also required to remove deforming forces.
Conclusion: Our findings demonstrate the variability in thenar muscle anatomy in radial polydactyly. Variability in insertion site, anomalous muscles and tendons were observed. We advocate careful anatomical exploration of thenar muscles at the time of primary surgery to guide treatment.

A-0399 Elbow flexors spasticity: Combined muscle lengthening and hyperselective neurectomy

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Objective: Surgical treatment of the spastic elbow typically involves muscle lengthening when muscle contracture is present. It has been our experience that early satisfactory results often deteriorate after a few months when spasticity of the involved muscle(s) is severe.

The purpose of this prospective study was to assess the results of combining hyperselective neurectomy (HSN) with the muscular release in spastic elbows presenting with muscle contracture and severe spasticity.
Methods: Over a 5-year period (2012–2017), 16 patients (16 elbows) were treated by tendons lengthening associated with HSN. Spasticity was assessed by the Ashworth and the Tardieu scales. Evaluation included active and passive ranges of movement (AROM and PROM), elbow muscles strength (MRC scale), functional goal, House scale and patient/caregiver satisfaction (VAS scale).

Criteria of inclusion were elbow flexion contracture greater than 20° with severe spasticity (Ashworth ≥ 2)
Results: The study involved 12 male and 4 female spastic patients, 7 of which suffered from stroke, 6 from CP, and 3 from traumatic brain injury. Mean age at brain lesion was 24.6 years (0–71), and mean age at surgery was 39 years (6–74). Average delay to surgery was 14.6 years (3–32). Four patients had no active movement.

Hyperselective neurectomy involved the musculocutaneous nerve in 15/16 patients and the motor branch of the radial nerve to the brachioradialis in 7/16. Muscle lengthening involved the biceps in all cases, the brachialis in 14/16 and the brachioradialis in 3/16. During the same operative session, six other procedures were associated: HSN of the wrist flexors (1), FCR and FCU lengthening (2), PT release (2), FDS, FDP and FPL lengthening (1).

One patient was lost to follow-up. The average follow-up for the remaining 15 patients was 17 months. Spontaneous posture of the elbow improved from 137° to 67°. The AROM improved by 23°, while the AROM midpoint gain was 36°; the PROM and PROM midpoint gain was 28° and 26.6°; there was virtually no loss of strength of the elbow flexors (4.03 to 3.96), with a significant decrease of spasticity (Ashworth from 2.67 to 0.56; Tardieu V3 from 97° to 43°). There were no complications. The preoperative goal was achieved in all patients but 1 (nursing incomplete). The average House classification improved from 0.83 to 1.70

The average satisfaction (VAS) was rated 9.2 by patients and 9.3 by their caregivers.
Conclusions: To the best of our knowledge, this is the first report of the association of tendon lengthening and HSN in the spastic upper limb.

Our results show that when severe spasticity is associated with elbow flexors contracture, HSN, by acting on the spastic component of the deformity, contributes to the improvement of the tendon lengthening procedures, with a lasting effect at 17 months follow-up. A prospective comparison between lengthening alone and lengthening + HSN would

theoretically be needed in order to reinforce these findings.

A-0403 Predicting clinical outcome after surgical treatment in patients with carpal tunnel syndrome

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Purpose: Carpal tunnel release (CTR) is typically offered to patients with moderate electrophysiological abnormalities when night splints no longer prevent waking with numbness, and preferably before there is any static numbness, weakness, or atrophy. The ability to predict the amount of symptom relief after CTR could be beneficial for managing patient expectations and therefore improve treatment satisfaction. Therefore, the aim of this study is to identify predictors for the outcome of CTR and to determine their contribution in predicting outcome at six months postoperatively.
Methods: A total of 1049 patients that requested CTR between 2011 and 2015 at one of eleven Xpert Clinics in the Netherlands were asked to complete online questionnaires at intake, 3 months and 6 months postoperatively. Patient demographics, comorbidities and baseline scores were considered potential predictors for the effect of surgery on the Boston Carpal Tunnel Questionnaire (BCTQ) score and its domains.
Results: A low score on the BCTQ at intake, a co-diagnosis of a trigger finger, ulnar nerve neuropathy, carpometacarpal-1 arthrosis, or instability of the wrist were associated with a smaller improvement in the BCTQ domains after a CTR at 6 months postoperatively and accounted for 35–42% of the variance in our multivariable regression models.
Conclusions: Results of our study can be used as a tool to pre-operatively manage patient expectation on symptom relief from surgical treatment. Since only a relatively small (approximately 40%) of the variance can be explained using the present variables, we suggest that future research on predictive factors for symptom relief after CTR show focus on other factors, including non-physical factors such as mental health, pre-operative expectations and disease awareness.
Type of study: This prognostic study is a retrospective cohort study which can be classified as a 2B level of evidence.

A-0405 Item reduction of the Boston Carpal Tunnel Questionnaire using decision tree modelling

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Background: The patient experience of disease is becoming more important in both clinical practice and research. A widely used patient-reported outcome measure (PROM) to assess the severity of carpal tunnel syndrome (CTS) is the Boston Carpal Tunnel Questionnaire (BCTQ). While measuring PROMs could improve care, lengthy questionnaires can be burdensome for patients. Therefore, the aim of this study is to reduce questionnaire length of the BCTQ by using the χ^2 automatic interaction detection (CHAID) algorithm to produce a decision tree version of the BCTQ while maintaining a minimum loss of information.
Method: For this study, all BCTQs that were completed as a part of routine outcome measurement between January 2012 and September 2016 by patients who were treated for CTS at one of the clinics of Xpert Clinic were used for the analyses. Completed questionnaires were randomly divided into a development and a validation data set in a three-to-one ratio. Optimization of the CHAID algorithm was performed in the development data set to find the best parameters for the development of the decision tree version of the BCTQ (DT-BCTQ). The ICC was calculated between the original BCTQ scores and the predicted (sub)scores by the DT-BCTQ in the validation data set. Bland–Altman plots were made to analyse the agreement between the BCTQ and the DT-BCTQ.
Results: By using 10,055 completed questionnaires, we were able to develop a DT-BCTQ that reduced the number of questions needed to ask a patient from 11 to maximally 3 for the symptom severity scale (SSS) domain and from 8 to maximally 3 for the functional status scale(FSS) domain. The ICC between the original BCTQ and the DT-BCTQ was 0.94. The mean difference between the BCTQ and the DT-BCTQ for the SSS was 0.05 (CI = −0.48, 0.57), 0.02 (CI = −0.45, 0.49) for the FSS and 0.04 (CI = −0.31, 0.39) for the total BCTQ score.
Conclusion: By creating the DT-BCTQ, we successfully reduced the amount of questions needed to ask a patient from 18 to a maximum of 6 questions when administering the BCTQ. This DT-BCTQ might reduce

patient burden by shortening answer time and could therefore increase response rate when used for routine outcome measurement. Further research should focus on the clinical implementation of the DT-BCTQ and the experiences of patients with the electronic DT-BCTQ. This way, the collection of data in clinical practice and CTS research by using the DT-BCTQ can be optimized.

A-0408 Characteristics of radiocarpal dislocations at a level 1 trauma center: A 9-year review

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Objective: Radiocarpal dislocations are uncommon and only reported in the literature in case reports and small retrospective studies. The purpose of this study was to investigate the overall incidence and various patterns associated with radiocarpal dislocations at a high-volume level 1 trauma center.
Methods: A retrospective review was performed of all patients presenting to a level 1 trauma center over a 9-year period to identify those with radiocarpal dislocations. Patients were identified utilizing the trauma registry to isolate ICD-9 codes specific for radiocarpal dislocation. Factors assessed for included incidence, injury mechanism, associated injuries, mortality, Injury Severity Score (ISS), length of hospital stay (LOS), treatment, complications, and need for subsequent procedures. Peri-lunate and lunate dislocations were excluded.
Results: Twenty patients were identified, with an average age of 39.5 years. Eighty percent of the radiocarpal dislocations identified were closed injuries. Eighty-five percent of these radiocarpal dislocations (17/20) had high-energy mechanisms, such as motor vehicle or motorcycle collisions. Concurrent injuries with radiocarpal dislocations included ipsilateral upper extremity fractures or dislocations, high-energy lower extremity long bone fractures, neurovascular trauma, and tendon injuries about the hand/wrist. There were no associated mortalities. Complications occurred following surgical intervention in 45% of the patients, primarily the inability to initially close the surgical wounds (44%, 4/9). Return to the operating room was required for 55% (27%, 11/20) of the patients, most often for removal of hardware (55%, 6/11), wound closure (36%, 4/11) or partial or complete wrist fusion (27%, 3/11). Both ISS and LOS were lower for closed dislocations (ISS: 15.6; LOS: 7.6 days) in comparison to open dislocations (ISS: 26.5; LOS: 15 days). Radiocarpal dislocations with concomitant wrist fractures increased the chance of lengthened hospitalization when compared to purely ligamentous injuries. There was no difference between the ISS of dislocations with fracture versus those with only ligamentous involvement ($p = 0.91$).
Conclusions: Radiocarpal dislocations can be characterized as high-energy mechanism injuries, frequently involving concomitant visceral or long bone trauma, and more often seen in males. Neurovascular and bony/soft tissue wrist injuries, especially distal radioulnar joint injuries can be associated. ISS and LOS are variable and do not appear to have any significant relationships to injury characteristics. Infection, distal radioulnar joint instability, inability to primarily close surgical wounds, and need for removal of hardware were observed in our series and can guide providers in setting expectations for these patients.

A-0412 TRIGGER trial

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Objective: TRIGGER is the first international, multicenter, multidisciplinary RCT on the management of a very common hand condition: trigger fingers. The primary objective of TRIGGER is to compare the effect of steroid injections and surgery in the management of trigger fingers in adults – the top research priority in the BSSH guidelines.
Methods: TRIGGER is being executed in several phases: (1) clinician survey; (2) patient and participant involvement (PPI); (3) pilot RCT; (4) final RCT; and (5) guideline revision. This abstract describes results from the first two workstreams.

A bespoke electronic clinician survey comprising branching logic was developed and applied to relevant groups (general surgeons, orthopaedic surgeons, plastic surgeons, rheumatologists and general practitioners) using the methods previously developed by the RSTN to support high completion

rates. The survey items explored the current treatment of trigger fingers, patient pathways and clinician preferences. The information from the survey and PPI will be used to refine the RCT protocol and to support trial funding applications.

Results: The clinician survey was posed to professionals from over 80 hand centres in the United Kingdom and the Netherlands. The results demonstrated variation in patient pathways, referral strategy, preferred treatment, operation technique, type of injection and thoughts on specific patient groups (i.e. diabetes and rheumatoid arthritis). Based on the recent BSSH guideline, this variation is not based on high quality evidence.

The provisional RCT design will compare steroid injection to surgery for the treatment of adults with trigger fingers with follow-up of 1 year. TRIGGER is very pragmatic and clinicians may use their own preferred type of injection and operating technique. The primary outcome is resolution of triggering. Secondary outcomes are level of pain, hand function (PROM), costs and complications. The scale of the study will make it possible to run several subgroup analyses: type of surgery, type of injection, thumb versus long digits, diabetes and rheumatoid arthritis.

Conclusions: The clinician survey shows trigger fingers are managed very different between doctors in both the United Kingdom and the Netherlands. This reinforces the need for an improved evidence base to inform guidelines on trigger finger management, which the design of TRIGGER should make possible.

A-0413 Distal radius non union: A challenging problem

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Introduction: Distal radius nonunion is an extremely rare complication of distal radius fractures (DRF). Etiology of nonunion is not well understood, although most nonunions are the result of open and infected DRFs. Anamnesis of the nonunion is mostly long (from 12 months to 15 years) with frequent soft tissue complications including CRPS, nerve entrapment and tendon adhesions or ruptures. Most of the cases have multiple surgical procedures foregoing before definitive treatment. Due to the great bone comminution, osteomyelitis, DRUJ derangement and soft tissue adhesions, treatment of distal radius nonunion is a challenging problem. Distal radius reconstruction and salvage procedure are main treatment modalities. The purpose of this study was to evaluate results of 14 cases treated with special attention to heal distal radius and realign DRUJ and longitudinal stability of the forearm bones.

Patients and Methods: We reviewed 14 cases of distal radius nonunions treated between 2003 and 2017. Ten cases were treated by radius nonunion treatment and ''anatomical'' DRUJ reconstruction via concomitant massive ulnar shortening. In four cases, salvage procedures were performed. They consisted of two DRUJ arthroplasties, one wrist fusion and one bone forearm. All ulnar abreviations were from 5 mm to 15 mm. In three cases, additional soft tissue reconstructions followed after bony healing. Pre and postop X-rays, CT scans, concomitant soft tissue pathologies, previous medical history, range of motion and pain scores were studied in all cases. The functional results were evaluated by DASH.

Results: All radius nonunions healed. In 12 cases, radiocarpal motion was preserved, and forearm rotation was restored to 80% of contralateral side in 13. Pain score and DASH decreased significantly, grip strength increased, and visual deformity has improved to close to normal alignment. Although forearm was shortened at the end of treatment compared to contralateral side, longitudinal stability was preserved in 10 cases where ''anatomical reconstruction'' was pursued by ulnar shortening as additional procedure to nonunion treatment. X-rays at the end of treatment were not anatomical and showed some degenerative changes in all segments of wrist joint but no signs of clinical instability or pain in load were present in 10 cases. In two cases, signs of radio-ulnar instability were present having no influence on forearm function.

Discussion: Most distal radius nonunions are massive bony deformities with DRUJ derangement and soft tissue adhesions. Size of distal fragment is small. The aim of nonunion treatment is healing the radius, realigning forearm stability, reconstruction of anatomy and improving function of the forearm. This may be gained by concomitant radius reconstruction and ulnar shortening. Due to the degree of radius malalignment and soft tissue scarring, ulnar shortening ranges from 5 mm to 15 mm. Forearm anatomy is then restored. In our series, no problem with healing of ulnar osteotomy appeared and forearm stability was restored in 9 of 10 cases of anatomical reconstruction and 2 cases of DRUJ arthroplasty.

A-0416 Short to intermediate results of the Motec total wrist arthroplasty

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Objective: Degenerative conditions of the wrist joint result in pain and mechanical dysfunction. The role of total wrist arthroplasty in the management of degenerative wrist conditions is still being defined. There are many different implant designs available for use in wrist replacement surgery. The Motec Wrist uses a ball and socket type of articulation. Few reports on performance of this prosthesis are available. Our goal was to evaluate the clinical and radiological outcome of this type of wrist arthroplasty.
Methods: We performed a retrospective review of 16 consecutive wrists that underwent total wrist arthroplasty with the Motec prosthesis (Swemac Orthopaedics AB, Sweden) between 2011 and 2016. Patients were assessed for pain (VAS) and function (ROM, Quick Disability of the Arm Shoulder and Hand (QuickDASH) and Patient-Rated Wrist Evaluation (PRWE). Complications and revision surgery were noted. Standardized radiographs were taken to assess osteolysis, loosening, and subsidence. The difference between the optimal center of rotation (COR) of the wrist and the center of rotation of the implanted prosthesis was determined, since we believe that failure to restore the optimal COR of the wrist negatively contributes to performance of the prosthesis.
Results: The Motec prosthesis was implanted in 16 wrists (15 patients, 10F/6M, 11R/5L). Mean age was 55.6 years (39–71). Rheumatoid arthritis was the most common indication for surgery (10). Other indications included SNAC (2) and SLAC (1) wrist, malunited distal radius fracture (1), dysplasia (1), and Kienbocks disease (1). Mean follow-up was 28 months (5–55). One prosthesis had a single component revision due to impingement after 6 months. To date, one prosthesis has shown distal component loosening but the patient is asymptomatic and has not been revised. There have been no cases of instability, dislocation or implant breakage.

The COR of the prosthesis and measured deviations of the optimal COR of the wrist showed differences on the X-axis (radio-ulnar) of 0.1–5.7 mm. For the Y-axis (proximal–distal). differences were 0.3–13 mm.

QuickDASH scores show a mean of 24 (range 0–68). Mean for the PRWE is 30 (range 0–76) and for the VAS 2 (range 0–8).

Mean flexion of the wrists is 42°and extension 38°, with a mean arc of motion of 80°. Mean radial and ulnar deviation are 10 and 15°, respectively, with a mean arc of motion of 25°. One of the 16 wrists showed an ROM that does not meet the minimum criteria for normal ADL.

Overall, two distinct groups could be defined: one group of 11 wrists that had excellent functional outcome in DASH and PRWE scores and 1 group of 4 wrists that underperformed.

The last group showed greatest differences between optimal COR and COR of the prosthesis.
Conclusion: Fair to excellent short to intermediate term results were achieved using the Motec wrist arthroplasty in a mainly rheumatoid arthritis group of patients. The suggestion that re-establishing the center of rotation coincides with a good outcome is confirmed in this study.

A-0417 The effect of wrist position on tendon loads following pulley sectioning and operative reconstruction

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Objective: Post-operative rehabilitation after surgical reconstruction following pulley rupture is vital and must balance potential rupture of the pulley reconstruction due to aggressive therapy from adhesion formation due to overly cautious protocols. The purpose of this study is to identify the optimal wrist position required for rehabilitation following reconstruction using tendon load as a metric for strain at the pulleys.
Methods: Fourteen digits comprised of the index, long, and ring fingers were tested from five cadaveric specimens on a validated novel in vitro finger motion simulator devised to actively achieve full finger flexion and extension. Servo-motors were used to generate motion through the tendons under load or position control using a closed-loop feedback system. The simulator is designed to measure and record tendon forces, joint ROM, and tendon excursion. FDP loads were measured sequentially with native intact pulleys, A2 and A4 pulleys sectioned, and finally with reconstructed A2 and A4 flexor

tendon pulleys. Each pulley condition was tested in wrist neutral, and 30° of wrist flexion and extension. Using the simulator to measure FDP tendon load, the effects of wrist position on sectioned and reconstructed A2 and A4 pulleys were analyzed using a 3-way repeated-measures ANOVA.

Results: With the wrist in neutral, FDP tendon loads were 8.5 N, 6.2 N, and 7.8 N with pulleys intact, sectioned, and reconstructed, respectively. With a flexed wrist, the loads were 8.5 N, 4.7 N, and 5.4 N. When the wrist was extended, the loads were 8.7 N, 5.2 N, and 6.7 N. With pulleys reconstructed, the wrist position had a significant effect on tendon load ($p = 0.030$). The flexed wrist position resulted in a 31% reduction of FDP load compared to the neutral wrist position ($p = 0.010$). Wrist extension also produced an apparent reduction, though not statistically significant.

Conclusions: Sectioning of the A2 and A4 pulleys resulted in a significant reduction in FDP tendon load as compared to the intact state. Subsequent reconstruction, however, restored loads to within no significant difference of the intact state, which supports the decision to reconstruct. Placing the wrist in 30° flexion resulted in a reduction of tendon load after reconstruction. These results may suggest that rehabilitation of surgically reconstructed flexor tendon pulleys should be carried out with the wrist flexed in order to reduce strain on pulley reconstructions.

A-0420 Limitations of fixation with single volar locking plates in marginal fractures of the distal radius

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Objective: In marginal fractures of the distal radius, osteosynthesis of the lunate fossa fragment (LF) is an important process to prevent postoperative subluxation of the wrist joint, but the fragment size that can be fixed by volar locking plate (VLP) alone has yet to be determined. In this study, we used three-dimensional computer-aided design (3D-CAD) to demonstrate the limitation of fixation by a single VLP for marginal fractures with different shapes.

Methods: We made seven bone models with different morphologies. To specify each model, the prominence of the volar rim in the sagittal plane was digitalized and designated the volar offset (VO). Using a 3D scanner, three locking plates with screws mounted were scanned: Biomet DVR (plate D), Acumed Acu-Loc distal (plate A), and Medartis ADAPTIVE 2 (plate M). Plate M is a polyaxial plate in which the surgeon can set the screw position arbitrarily; thus, the screw was set toward the most proximal direction. In 3D-CAD, the plate was installed on the bone just below the watershed line. The axis of the bone on the coronal plane was matched with the long axis of the plate. If the screws protruded intraarticularly, the plate was adjusted to the most distal installable position without protrusion. The three plates installed on each of the seven bone types yielded 21 digital models. We measured the length of volar cortex between the screw insertion site and the articular surface in the sagittal plane and referred to it as the fragment length (FL). This indicated the smallest bone fragment size that could be fixed. We also measured the volar protrusion of the plate (VP) from the bone. $VP > 2$ mm is demonstrated to be a risk factor for postoperative flexor tendon ruptures according to several past studies.

Results: The average VO was 9.3 mm (7.2–12.1 mm). Intraarticular screw protrusion occurred when plate D was installed on bones with VO greater than 9 mm. The screw protrusion was resolved when the plate was relocated more proximally ($FL > 9.8$ mm). In plates A and M, protrusion did not occur, and FL was >7.1 mm. In plates A and M, bones with $VO < 8$ mm showed $VP > 2$ mm, but plate D did not show $VP > 2$ mm.

Conclusions: These results indicate that bone fragments less than 9.8 mm cannot be fixed with a proximal VLP. Distal or polyaxial plates are indispensable for fixation of small LF. Moreover, fixation of bone fragments measuring 7.0 mm or less is impossible with the VLP alone, and alternative fixation like a wrist spanning plate should be considered. This study also clarifies the challenges associated with plate installation given differences in bone anatomy. We demonstrated that the screw tends to protrude intraarticularly when applying the plate distally on a bone with a large volar rim. Protrusion of the VLP, which can cause flexor tendon irritation, should be carefully examined when fixing bones with a small volar rim.

A-0430 Minimal important change and patient acceptable symptom state for the brief Michigan Hand Outcomes Questionnaire in patients after PIP joint arthroplasty

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Objective: The interpretation of study results should not only be based on statistical significance, but on what is relevant for patients. In this respect, the minimal important change (MIC) or smallest change after treatment that patients perceive as important has become increasingly prevalent. Yet reaching the MIC does not necessarily imply that patients feel well after treatment. A corresponding measure is the patient acceptable symptom state (PASS) defined as the value beyond which patients consider themselves well. The concept of PASS has rarely been studied in patients with hand disorders. Therefore, our study objective was to determine the MIC and PASS of the brief Michigan Hand Outcomes Questionnaire (brief MHQ) for patients 1 year after PIP joint arthroplasty.
Methods: We used data from our prospective registry including patients who underwent PIP or thumb IP arthroplasty with the CapFlex prosthesis (KLS Martin Group, Tuttlingen, Germany). Patients completed the brief MHQ (score 0–100) before surgery and 1 year after surgery. At follow-up, patients answered a question about the perceived change of their hand condition compared to before surgery. Based on this answer, we used the anchor-based mean change method to determine the MIC. Another question about satisfaction with the treatment result was used to calculate the PASS with receiver operating characteristics (ROC) curves. The PASS for the entire group as well as for subgroups of low (baseline brief MHQ scores less than or equal to the median score) and high function (baseline scores above the median) was calculated.
Results: We included 124 patients with 128 operated fingers. The median brief MHQ baseline score was 44 (range 6–83). It improved from mean 44 points (95%CI: 41–47) at baseline to 71 (95%CI: 66–75) at 1 year ($p \leq 0.001$). The MIC was 20 points. The PASS score for all patients was 64 points (sensitivity = 0.79; specificity = 0.93; area under curve (AUC) = 0.86). Patients with low baseline scores had a PASS of 52 (sensitivity = 0.88; specificity = 0.86; AUC = 0.87) and those with high baseline function had a PASS of 72 points (sensitivity = 0.73; specificity = 1; AUC = 0.87). Of all patients, 67% reached the PASS as well as 64% and 74% of the low and high function patients, respectively.
Conclusions: The clinical relevance of the MIC and PASS is important when interpreting treatment outcomes in both daily practice and clinical trials. Patients after PIP arthroplasty, who improve by 20 points or more in the brief MHQ, experience a relevant change. Patients with a postoperative score of 64 points or higher can be considered as having an acceptable symptom state. However, the PASS depends on the preoperative patient status.

A-0435 Retrograde free venous flap for the reconstruction of the hand: Report on 16 large flaps for the dorsum of the hand

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Free venous flap for the reconstruction of the hand is slowly becoming a common practice for the reconstruction of the hand. Free venous flaps plugged to the donor artery, against the direction of the vein valves (known as retrograde free venous flaps), demonstrated in our practice a valuable solution for large and composite defects to the dorsum of the hand.

From March 2010 to June 2017, we performed 16 retrograde free venous flaps to reconstruct the dorsum of the hand and digits. All flaps were larger than 20 cm^2 with the largest being 104 cm^2. Patients were 12 males and 3 females with an average age of 40 years (range 17–67).

We reconstruct two web spaces, six dorsum of the hand, eight large defects to the dorsum of the digits with one flap covering two digits.

The donor site was always the palmar surface of the forearm.

We followed the patients for 6 months, looking for the rate of survival of the flaps, partial and complete loss, rate of acute and late revisions. We measured the function according to the part of the hand we reconstructed.

We observed no complete loss, 2 partial skin losses (no fat necrosis) with no need for a secondary covering procedure. As secondary procedures, we had to perform a separation of a syndactyly in a case of multiple finger coverage. One case needed the ligation of a late onset of an arteriovenous shunt. Two flaps for finger defects needed a correction because of some redundancy of the flap.

We think that retrograde arterialized free venous flaps are a valid option in the reconstruction of the dorsum of the hand, even for large defects. The size of a retrograde free venous flap seems to be an important factor influencing the rate of survival: with this subgroup of relatively large flaps, we achieved a rate of survival of 100%.

A-0440 Complications after a simple operation: The trigger finger

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We believe that after a little trigger finger operation, the patients heal well and fast. Despite of this, our prospective data collection system shows many complications in our daily practice.

We have run a prospective data collection on trigger finger patients in the last 2 years. Since the start up, we collected data about 272 patients. We register the pain level at the site of the operation, the wound status, the satisfaction, the lack in range of motion of the fingers or any other complications after surgery. The type and duration of physiotherapy is also recorded.

Forty-two patients were excluded because of lack of data. We registered the following temporary complications: excessive scar formation causing complaints for the patients in 13.7%, decreased range of motion causing need for physiotherapy in 61.2% and severe pain (more than 5 VAS points) in 11.2%. All these complications influenced the satisfaction of the patients.

Despite of the small incision and the simplicity of the procedure, some complications occurred in 43% of the patients. Fortunately, none of the mentioned problems lasted more than 3 months and we did not have any permanent or long-term complications. Dissatisfaction of the patients may be reduced by informing them about these possible temporary inconveniences.

A-0443 Upper extremity penetrating wounds: Prevalence and etiology

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Introduction: Upper limb is one of the most common sites of penetrating injuries due to its frequent interaction with the surrounding environment and direct contact with harmful agents. Penetrating trauma usually produces musculotendinous and neurovascular injuries, fractures and amputations.
Objective: To evaluate the epidemiology, causes and frequency of upper extremity penetrating injuries from a hand surgery center.
Materials and Methods: Data of a 2-year period (May 2014 until May 2016) from the outpatient clinic were acquired and patients were invited for a survey. Records from demographics, site of injury and etiology were obtained. Descriptive statistics and comparison of proportions with χ^2 test was performed.
Results: Database search retrieved 1648 records, of which 598 were included in the study after exclusion criteria. Most were males (77.8%), right-handed (95.82%), with mean age of 37.27 years. Manual workers were the most injured (50.00%) and fingers were the most affected site (51.84%). Among etiologic agents, glass was the most frequent (33.77%). Prevalence of amputation was higher in machinery injuries ($p < 0.05$) when compared with other agents. Younger patients (<18 years) had more glass-related injuries while older patients (>60 years) had more traumas caused by power tools ($p < 0.05$). Women had more injuries resulting from blades and glass ($p < 0.05$). Manual workers had higher frequency of machinery trauma and amputations ($p < 0.05$).
Conclusion: The most frequent etiology was glass, especially in minors (<18 years). In women and older patients (>60 years), there was high frequency of traumas caused by blades and power tools, respectively. More severe injuries were caused by machinery and related with work activity.

A-0444 Distal radio ulnar joint assessment: Reliability and validity of forearm torque

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Objective: Physical assessment of the distal radioulnar joint (DRUJ) has traditionally been confined to measurement of grip strength and range of motion. Forearm rotational strength is rarely assessed even though facilitating forceful rotation is a major function of the DRUJ. We hypothesized that measuring forearm torque could provide useful information in the evaluation of DRUJ disorders and treatments.

We therefore designed a simple method to easily record forearm torque in the clinical situation. We report the results of a study performed to evaluate the reliability and validity of the new test method.

Methods: Forearm torque was measured in standing position using the commercially available Baseline Wrist Dynamometer (Fabrication enterprises, White plains, NY, USA) equipped with a shovel handle. The dynamometer was attached to vertical, wall mounted rails to enable adjustment according to the individual height of the subject. Thereby all subject could be tested with the elbow by their side and flexed to 90°. Two raters measured maximum isometric forearm torque on 30 healthy subjects on three occasions. One rater also measured the same individuals on three occasions using the Baltimore therapeutic equipment (BTE; Baltimore, Maryland USA) as a standard reference in order to evaluate validity. The ICC model 2.1 was used to calculate intraclass correlation coefficients (ICCs).

Results: Intrarater ICCs for rater 1 were 0.96 for supination torque and 0.92 for pronation torque.

Corresponding values for rater 2 were 0.95 and 0.91. ICCs for rater 1 when measuring torque with the BTE were 0.94 (supination) and 0.91 (pronation). Interrater ICCs for supination torque were 0.94 and for pronation torque 0.88. ICCs for comparison between the baseline and BTE were 0.88 for supination torque and 0.74 for pronation torque.

Conclusions: Our test method could consistently measure forearm torque and proved valid when the BTE was used as a reference. The test method is easily applied in the clinical setting and has a potential to improve evaluation of DRUJ function.

A-0447 Iatrogenic nerve injuries of the upper extremity in childhood

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Objectives: Iatrogenic neurovascular injuries including compartment syndromes are serious complications in the treatment of fractures in childhood. These can result in significant functional limitations.

Children disorders like pain and loss of sensory are frequently neglected. This is a specific problem in childhood and often leads to delayed diagnosis and therapy.

Materials and Methods: Fifteen patients with severe complications after trauma of the upper limb in childhood were treated from 2004 to 2017.

Seven patients presented symptoms of an acute or undergone compartment syndrome. Three of them were seen primal as adults with long-term consequences of missed compartment syndrome resulting of an upper limb fracture.

Five patients with injuries of the ulnar nerve and two with injury of median nerve were treated – all of them operatively. One patient with lesion of the radial nerve was treated conservatively.

In addition, a review of literature was performed.

Results: In most cases of nerve lesion or compartment syndrome, clear symptoms were primary neglected and complaints of children were not taken seriously. Therefore, the diagnosis was delayed or missed.

Mechanical problems like pinching the nerve by fracture or osteosynthesis, vascular lesions or established compartment syndrome mostly were ignored for days to several months – even in cases of explicit findings. Severe functional deficits remained, which required delayed necrectomy and functional reconstruction by tenodeses and muscle transfers.

In four cases of nerve injuries, reconstruction with nerve grafts was necessary due to the long-term mechanical problems. Three times a neurolysis was adequate. Only one of these seven children – with a neurolysis – had a complete remission. The others showed only partial reinnervation.

In the literature, dislocated supracondylar humerus fractures of children are associated with complications such as neurovascular collateral damage and iatrogenic nerve lesions in up to 36% of cases. Iatrogenic lesions of the ulnar nerve are reported with a frequency of 2.5–6% and of the radial nerve with a frequency of 5 and more %.

There is only limited literature about nerve lesions combined with other fractures of the upper extremity. In an analysis of iatrogenic lesions of the radial nerve, the lesion occurred in 50% after treatment of forearm shaft fractures, in 39% after distal-metaphyseal radius fractures and in 11% after radial neck fractures. In 15% the motor branch and in 5% the main trunk was affected.

Conclusions: Every disorder after untreated or treated fracture such as swelling, pain, loss of sensory or paleness are potential signs of severe complications such as compartment syndrome or lesions of vessels or nerves. Complaints like dysfunction or paraesthesia always have to be taken seriously. Ultrasound and MRI are established methods to diagnose nerve or vascular lesions in time, while compartment syndrome is mainly detectable by clinical signs. Early surgical treatment after consequent diagnostics is required. Thus good results are possible.

In case of missing early treatment, several surgical steps including necrectomy, muscle and tendon release and muscle transfers can become necessary to reconstruct limited function.

A-0449 Microsurgical flow-through flaps for reconstruction of volar tissue defect of fingers

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Objectives: Composite tissue defect of the volar surfaces of fingers is frequently associated with digital vessel damage. Different reconstructive methods were used for such injuries, like digital artery flap from adjacent finger, A-A typed flow-through venous flap, or vein graft combined with a regional flap. Flow-through glabrous flaps can provide esthetic tissue coverage as well as revascularization.
Methods: Between June 2010 and April 2017, we prospectively studied the use of microsurgical flow-through glabrous flaps to achieve simultaneously digital revascularization and soft tissue coverage in 21 fingers of 18 patients who experienced volar injuries, comprising 7 great toe fibular flaps, 4 medial plantar flaps, 3 pedis medialis flap, 3 hypothenar flaps and 4 thenar flaps. The nerve passing through the great toe fibular flap or medial plantar flap was used to repair digital nerve defects.
Results: All flaps survived completely. During a mean follow-up period of 13.6 months, the majority recovered excellent appearance and function. The flaps had the characteristics of normal finger volar skin: hairless, with similar texture and color. The sensation of finger pulp which repaired with neurovascular flap gained satisfactory recovery.
Conclusions: Glabrous flow-through flaps provide excellent reconstruction for fingers with volar injuries associated with digital vessel damage. The great toe fibular flap and the medial plantar flap are reliable and useful options for complicated finger injuries associated with digital vessel and nerve injuries. Flow-through thenar flap is our first choice if the patient denied to harvest flap from foot.

A-0450 The effect of adipose derived mesenchymal stem cells on neoangiogenesis in processed nerve allografts

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Improved blood supply can provide additional biological support for nerve regeneration to processed nerve allografts by enhancing the local delivery of growth factors. The purpose of this study was to measure the effect of mesenchymal stem cell (MSC) seeding of processed nerve allografts on the neoangiogenesis in the nerve allograft in a rat model.

Sciatic nerve grafts of 10 mm were obtained from Sprague-Dawley rats, decellularized and transplanted back into a 10 mm sciatic nerve gap model in Lewis rats. Before transplantation, each nerve allograft was seeded for 12 h with either nothing, 1 million undifferentiated MSCs or 1 million MSCs differentiated into Schwann cell-like cells. These three groups were compared with a control group that received a nerve autograft. Sixteen weeks after the surgery, five recipient rats per group were sacrificed. To study the trend of neoangiogenesis over time, five extra rats were sacrificed after 12 weeks for both MSC groups. After the sacrifice, the vasculature of the nerve was preserved by aortic infusion of Microfil. The nerve grafts were dissected and with the use of micro-CT (Inveon Multiple Modality PET/CT scanner) and conventional photography (Canon 5D Mark III) of the sciatic nerves from both sides of each rat, respectively, the volume and the surface area of the vasculature were measured. All volumes and surface areas were measured as a percentage of the total nerve volume/area and are presented as a ratio of the untreated side.

The average vascular surface area ratio after 12 weeks was 0.72 in the group with undifferentiated MSCS seeded on the allograft and 0.99 for the group with differentiated MSCs seeded on the allograft. After 16 weeks, both ratios were increased to 0.80 and 1.27, respectively. In the autograft group, the ratio was 0.84 after 16 weeks and the ratio of the allograft group was 0.59. The volume ratio obtained by micro-CT after 16 weeks was 2.04 in the autograft group compared to 0.69 in the allograft group, 1.82 in the allografts seeded with undifferentiated MSCs and 2.31 in the allografts seeded with differentiated MSC. The vascular surface area ratios and the vascular volume ratios are positively correlated to each other, implementing that both methods

can be used trustfully in the in vivo analysis of neoangiogenesis in nerve grafts.

Compared to 'plane' processed nerve allografts, the neoangiogenesis is significantly enhanced by seeding either differentiated or undifferentiated MSCs on processed nerve allografts. The degree of neoangiogenesis in the autograft is equalled by both MSC groups, of which the group with differentiated MSC has a significantly enhanced neoangiogenesis compared to autografts. This study not only demonstrates proper methods for analysing neoangiogenesis in nerve grafts, it also shows that seeding MSC on the surface of nerve grafts results in an enhanced blood flow. This knowledge can be of great importance in the process of improving outcomes of peripheral nerve repair in the future.

A-0464 Microsurgical and non-microsurgical tricks in thumb replantation

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Objective: We analyze the peculiarities of the thumb reimplantation with modified algorithm depending on the level and mechanism of amputation and tricks to reduce the operative time and enhance the success rate and functional outcome.
Methods: From 1067 replantations over a 27-year interval (1990–2017), 132 involved the thumb: 107 males (81.06%) and 25 females, 68 sharp amputations, 37 crushings, 27 avulsions. Peculiarities: Bone shortening avoided vascular grafts and provided thumb stability in IP destruction prioritizing stability over length conservation. In IP level amputations combined with EPLT and/or FPLT teno-muscular avulsion, IP arthrodesis was performed. When arterial anastomosis was not possible, various compensatory procedures were employed: rerouting of a nearby vessel, vascular extensions based on anastomotic vessels, venous grafts (avulsions). In proximal amputations (base M1) with retracted pollicis brevis artery, no attempts to retrieve it, instead rerouting nearby arteries is preferred. Longer vascular grafts can be used when necessary allowing a proximal anastomosis up to the radial artery or its palmar branch both for safety and ease of positioning. The Robbins cuff technique reduced the anastomosis time. In trans-ungueal amputations (Ishikawa II–III), for better access, replantation begins with nerve and artery anastomosis followed by bone fixation. We prioritize the quality of the neural anastomosis. If direct anastomosis was not feasible, nearby sensitive nerve rerouting or nerve grafting was performed. Vein gaps were occasionally resolved by turning one proximal vein with a pivot point at an anastomotic branch with another vein. Skin defects were covered with flaps or skin grafts. To cover both skin and dorsal vein defects, 11 Foucher port vein kite flap and 7 Simonetta flaps were used. The concept of finger bank was applied for thumb reconstruction in pluridigital amputations. Follow-up of the vascularization of the reimplanted segment was done thru a ''skin window'' used also for local heparinization (''biochemical leech'').
Results: The success rate was 84.84% with 2PD 8–14 mm. Thumb-digital pinch was possible in all cases (Kapandji scale 4–10). In FPLT and EPLT avulsions, resection associated with TFS 4 and TEP2 transfer do not affect the quality of the recovery. The use of the rerouting of a nearby vessel and Robbins technique shortened the operative time. The use of the ''biochemical leech'' for 5–8 days led to improvement of the results in distal reimplantations, 18 nail deformities (14.6%), 20 failed cases, and in 5 we covered the distal phalanx with a Littler flap (ulnar side of the third finger).
Conclusions: The algorithm for thumb replantation must be adapted to the type of lesion, the level and mechanism of amputation in order to improve the success rate and functional outcome. Bone shortening is indicated especially in trans-IP amputations. IP fusion provides solidity of a shorter thumb without functional damage. Avoiding Pulvertaft in FPLT and/or EPLT avulsion and IP arthrodesis are good strategy when tendons are avulsed from their muscles. Using nearby sensitive nerve, vessel rerouting and Robbins cuff, shortening the operative time and improve results

A-0468 Immediate rehabilitation after distal radius fractures stabilized by volar locking plate: A prospective randomized trial

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Objective: Distal radius fractures (DRFs) are very common and operative treatment by volar locking

plate became the standard therapy in the last decade. Main reason for open reduction and stabilization with a palmar locking plate is the possibility for early postoperative mobilization. There are only a few studies that compare early postoperative mobilization after DRF with immobilization. The main aim of this study was to compare early postoperative mobilization after DRF with a 5-week cast immobilization.
Methods: Hundred patients with an isolated distal radius fracture treated by open reduction and internal fixation by a volar locking plate were prospective randomized in two groups. One group (''early mobilization''; EM) received a removable thermoplastic splint for 1 week and was allowed to move the wrist directly postoperative. The other group (''immobilization group''; IM) received a not removable cast for 5 weeks. Both groups underwent physiotherapy 2 times a week. At 6 weeks, 9 weeks, 3 months, 6 months and 1-year post surgery ROM, grip strength and radiographs had been evaluated. Additionally, Quick Disability of the Arm, Shoulder and Hand (QuickDASH) questionnaire, Patient-rated Wrist Evaluation (PRWE), modified Green O'Brien (Mayo) score and pain according to the VAS (visual analog scale) score was analyzed.
Results: Patients in the EM group had significant better range of motion in the extension/flexion and grip strength up to 1 year, in the radial/ulnar deviation up to 9-weeks, in supination/pronation up to 6 months. As well QuickDASH and PRWE score had been better up to 6 months post surgery. The modified Green O'Brien score differed significantly up to 1 year. No differences in respect of loss of reduction, pain, duration of physiotherapy and sick leave could be found.
Conclusion: Early wrist mobilization after distal radius fractures, stabilized by a volar locking plate, is a save post surgery treatment and leads to an improved range of motion and grip strength up to 1-year post surgery compared to a 5-week immobilization.

A-0471 Reconstructive surgery for the types V and VI of duplicated thumbs

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Purpose: It is technically challenging to correct the Wassel types V and VI duplicated thumbs, which involve thumb metacarpus. The retrospective clinical study was performed to present preoperative status, surgical technique, and postoperative results in patients with type V or VI duplicated thumbs.
Materials and Methods: Surgical procedures were performed including the osteotomy for the duplicated metacarpus, repositioning of the thenar muscles, releasing of the first web space and adductor muscle, and on-top plasty in 42 patients with type V and in 15 patients with type VI duplicated thumbs. In type V patients, the osteotomy of the metacarpus and repositioning of the thenar muscles were performed in all cases. The narrow first web space was corrected using Z-plasty or 5-flap Z-plasty along with the release of adductor muscle. In type VI patients, on-top plasty was performed which combined thumbs of radial and ulnar side to make one that had good nail appearance and durable bone and tendon. In some cases, tendon transfer was performed to reconstruct EPL and FPL tendon. Also, corrective osteotomy with K-wire fixation was done to make a reasonable axial alignment. Wires were removed at 3 weeks postoperatively, and thumb spica splint was applied to prevent progressive thumb deformity.
Results: The operation was conducted when the patients were 11 months (10–25 months). Secondary corrective surgery was performed in three patients to correct soft tissue repositioning. The range of motion in the metacarpophalangeal joint and the interphalangeal joint was 60° (20–80°) and 20° (15–40°), respectively. Subjective satisfaction score of the guardians were 75 (60–95) points out of 100 points. The average DASH score was calculated as 4.5.
Conclusion: The purpose of reconstructive surgery for the types V and VI of duplicated thumb is not just removing remnant thumb, but making a functionally and aesthetically acceptable one by combining better components between two thumbs. Reinforcement of the opposition and secure first web space are also important. Clinical experiences and creative surgical plan are required to obtain good postoperative results in treating type V and VI duplicated thumbs.

A-0478 Types of thumb opposition loss and approach to surgical tactics demarcate

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Objective: There is a necessity for a different approach to the choice of treatment in patients with a thumb opposition violation. It is important to

correlate opposition violation degree with upper limb structural losses. This will give us a complex classification of the opposition loss, close to the surgical needs of restoration method choose.

Methods: Structural and functional state of upper extremity in 120 patients with thumb opposition violation was evaluated. All patients more than 6 month's opposition loss history. Type and degree of opposition violation and impairment of various upper limb structures (in attitude of their influence on the opposition, and as a resource for transposition needs) have been estimated.

Twenty-one patients – isolated nerve injury, 23 – several nerves, 16 – brachial plexus injury, 51 – multistructural injury, and 9 – severe ischemic contracture of the hand.

According to the pragmatic treatment tactics, patients are divided into four main groups:

Zero-group – compensated violation of thumb opposition, associated with carpal canal syndrome, median nerve demielienization or axonal injuries. Presented minor violations of rotation and abduction, which do not require opponensplasty. As additional procedures are possible not resource-based methods (Gamitz).

Group 1: Patients with low, mistreated median nerve injury, or low median and ulnar nerve trauma with incomplete re-innervation. There is a notable lack of thumb rotation and abduction. Traditional methods of transposition (Thompson, Brand, Huber) most likely will proper.

Group 2: Significant functional failure of the thumb, patients with high, neglected damage of the median and ulnar nerve. Thumb does not participate in handgrips. Appropriative transpositions of extensors or double tendon transpositions (Taylor, Burkhalter, Tubiana)

Group 3: Structural and functional disorders go beyond of first finger muscles paralysis.

Group 3a: Thumb joints contracture. Most apparent treatment – simultaneous joints mobilization and opponenosplasty with early active rehabilitation (or 2-stage restoration).

Group 3b: Opposition loss associated with structural integrity damage of thumb or long fingers functional disability. Opponenosplasty can be provided, after an anatomical reconstruction, or IP or PIP thumb joint fusion.

Group 3c: Substantial violation of thumb structural integrity, significant deficit of muscle-donors with thumb anesthesia – saddle joint fusion, metacarpal rotation osteotomies, or restoration of lateral grip thumb-to-index, as alternative – practice of splints or orthoses.

Conclusion: Presented approach conceptually demarcates the therapeutic tactics, especially in complex cases; therefore, it can be taken as a viable basis.

A-0479 Super microsurgery: Open guide technique is the appropriate technique for microvascular anastomosis to be integrated into a microsurgical training process?

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The microsurgical anastomosis has historically represented a challenge of certain complexity, which has been related to the surgeon's skillfulness and experience. There are supermicrosurgical anastomosis techniques that have shown encouraging results, which makes us think that may be reproduced by ''in training'' surgeons. It was necessary to determine whether the open guide technique is the one with the best results, it is suitable for the process of training and if microsurgeons in training are able to achieve satisfactory results using the proposed technique during their training. An experimental study of microvascular suture with open guide technique was developed, by comparing the results of an expert surgeon with the results of ''in training'' microsurgeons, to determine if this technique is suitable for its integration into a process of microsurgical training. Eighteen New Zealand small rabbits were used for this study in which we performed 34 flaps of the superficial inferior epigastric artery dissecting and checking the diameter of it, we found arteries of 0.6 mm in diameter or less, after we sectioned the artery we performed an anastomosis with a 10 zeros monofilament suture. The flaps were evaluated daily until completion of five assessments to determine their vitality, resulting in 100% viability of the flaps of the expert surgeon against an 88.23% viability of the flaps performed by the inexperienced surgeons.

We concluded that the open guide technique could be performed by surgeons in training with a high success rate and can be included in a training program in microsurgery.

A-0482 Pisiform excision: A solution for a long-term ulnar sided wrist pain. A retrospective analysis, comparing pre- and postoperative measurements

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Objective: Chronic pain in the pisotriquetral area is often caused by pisotriquetral arthritis. Other causes such as tendinitis of the flexor carpi ulnaris and post-traumatic pain from the pisiform bone might also result in chronic ulnar-sided wrist pain. When conservative treatment is insufficient, a pisiform excision is often performed. The aim of this study is to evaluate the postoperative outcome after pisiform excision.
Methods: This study is a multicenter retrospective analysis, in which all patients after pisiform excision were included between 2011 and 2015. The primary outcome was pain, measured in visual analogue scale (VAS). Secondary outcomes were range of motion of the wrist (ROM), strength of the wrist in kilogram (JAMAR), wrist function and limitations measured with the Patient Rated Wrist/Hand Evaluation (PRWHE) and complications. A repeated measurement and Sidak analyses were used for the statistical analysis of the VAS. For the analysis of the ROM and strength, a paired sample t-test was used. A Wilcoxon signed rank test was used for the analysis of the PRWHE.
Results: One hundred and seventy-five patients were included (79% women) with an average age of 49 years; 67% had pisotriquetral arthritis. There was a significant decrease in pain perception up to 3 months postoperative ($p < 0.05$). Three months postoperative, a mean improvement of 13° ($p < 0.001$) palmarflexion/dorsiflexion was achieved and 18% increase in strength ($p < 0.001$). Twelve months postoperative, the wrist function measured with the PRWHE improved from a mean of 64 to 25 ($p < 0.001$). Two complications occurred: one postoperative wound infection and one thrombosis of the operated arm.
Conclusion: To date this is the largest, in literature published, postoperative analysis after pisiform excision. Effectiveness was analyzed using patient-related outcome measurements. The results show that pisiform excision is an effective and safe treatment for ulnar sided wrist pain related to the pisotriquetral joint when conservative treatment fails.

A-0484 Does cognitive capacity interfere with the outcome of Oberlin transfer?

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Background: To determine the relationship between the functional outcome obtained with Oberlin transfer and the patient's cognitive level, and the time elapsed between trauma and surgery.
Methods: Eighteen patients were evaluated, of whom 17 (94.4%) were males and one was female (5.6%), with a mean age of 29.5 years (17–46 years), with a traumatic injury to the brachial plexus (C5–C6 and C5–C7). We evaluated the active range of motion, elbow flexion strength and ASH (Disabilities of the Arm, Shoulder and Hand) and determined the correlation between the outcome obtained and the patient's cognitive level, as assessed by the Mini-Mental State Exam (MMSE).
Results: We found statistically significant correlations between the MMSE scale and strength recovery (84.4%, $p < 0.001$), which was classified as excellent; between the MMSE and BMRC scales (78.4%, $p > 0.001$), classified as good.
Conclusions: We found a positive correlation between the cognitive capacity and functional outcome of patients submitted to Oberlin surgery. The time elapsed between trauma and the surgical procedure has an inversely proportional correlation.

A-0490 A prospective clinical trial on NEUROLAC nerve conduits for nerve repair in hand trauma

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Objective: Traumatic nerve injuries of the upper limb and particularly the hand are one of the most common and most challenging surgical problems in trauma centres worldwide. The majority of patients with such injuries are at the peak of their employment productivity, as such satisfactory functional recovery is crucial.

When the transected nerve ends are amenable for primary tensionless repair, traditional epineurial neurorrhaphy is the gold standard for peripheral nerve injuries. In cases where the gap cannot be

bridged by direct epineural suturing (>5 mm), the surgical options will include nerve grafting or nerve conduit bridging techniques.

The objective of this observational study is to describe the clinical results of the reconstruction of peripheral nerve traumatic lesions in the upper extremity by using bioresorbable copolyester poly DL-lactide-ε-caprolactone nerve conduits (NEUROLAC®, Polyganics B.V., Groningen, the Netherlands) in emergency or in elective surgery within 6 months after trauma.

Methods: This three-arm observational study included 30 patients with upper limb injuries as a result of a sharp object. Patients were divided into three equal treatment groups: one group with nerve gaps 5–20 mm received NEUROLAC for the nerve repair, one group with nerve gaps <5 mm were treated with neurorrhaphy and an additional NEUROLAC as wrap, and the third group with gaps <5 mm acted as control group and received neurorrhaphy.

Main outcome measures of the study were sensory and motor nerve recovery. Recovery was measured by muscle/grip strength measurement (motor), 2PD and monofilament tests (sensory), and graded according to the criteria of the Nerve Injuries Committee of the British Medical Research Council modified by Mackinnon–Dellon. Recovery of mixed nerves was assessed using the Sakellarides grading system. Electrical conductivity (motor and sensory) was measured with a nerve conduction test.

Primary outcome assessment of all parameters was performed at 6 and 12 months after surgery.

Results: Between December 2014 and June 2015, 30 patients were enrolled in the trial (21M/9F; aged 18–70 years). The three groups were comparable considering their demographics. Sensory recovery was S2 in the NEUROLAC conduit group and >S3 in the NEUROLAC wrap group. Motor recovery was >M2 in all groups. Mixed nerve recovery was >M2/S2 in both the neurorrhaphy and the NEUROLAC conduit group and >M3/S3 in the NEUROLAC wrap group. Electrical conductivity showed a reduced latency time in both NEUROLAC groups opposed to unvaried latency in the neurorrhaphy group. Two complications were recorded consisting in granulomas on the fingers.

Conclusions: At 6 and 12 months after implantation, the NEUROLAC conduit shows similar results in terms of motor and mixed nerve recovery when compared to neurorrhaphy, while the sensory recovery shows better outcomes than neurorrhaphy alone. When NEUROLAC is applied as a wrap around the repair zone, the recovery in small nerve gaps seems to be further improved. Electrical signal transduction is quicker in both situations where NEUROLAC is used, suggesting an intrinsic recovery over suturing alone. These results indicate NEUROLAC to contribute to sensory and motor nerve recovery and signal conduction.

A-0492 Classification of distal radio-ulnar joint pathology in rheumatoid arthritis

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Objective: To develop a classification of distal radio-ulnar joint (DRUJ) destruction in rheumatoid arthritis (RA) based on radiographs in order to guide treatment.

Methods: Following approval by the hospital audit committee, we reviewed the most recent wrist radiographs of 100 patients (117 wrists) known to have RA. The inclusion criteria were adults with a diagnosis of rheumatoid arthritis with some radiological DRUJ abnormality and no previous wrist or DRUJ surgery. The exclusion criteria were other inflammatory arthritis and inadequate radiographs, that is, no good postero-anterior (PA) or lateral views. Where patients had changes on radiographs of both wrists, then both were assessed separately giving a total of 117 sets of wrist radiographs. We used the latest radiograph as the one for the classification not least as some earlier radiographs showed no or minimal radiographic changes.

We recorded demographic data including age (in years) at the time of the radiographs and gender. In the wrist, we recorded the Larsen grade and the presence of any erosion of the ulnar side of the lunate. For the DRUJ, we assessed ulnar variance, and subluxation of the DRUJ (shown by ulnar head subluxation relative to the distal radius), the presence of a secondary shelf, that is, volar radial prominence of the distal radius usually helping support the radius and, based upon prior observations, whether the ulnar head was supporting the lunate, that is, acting as a proximal buttress with evidence of the force transmission shown from the lunate to the ulnar head. Where possible this was confirmed on a CT scan.

The data were recorded in an excel spreadsheet and analyzed to assess for associations between the data sets.

Results: We assessed 117 wrists in 100 patients with a mean age of 53 years. There were 19 men and 81 women; we assessed 94 right and 25 left wrists. The Larsen grades were 0–5; they did not correlate well with DRUJ destruction. There was lunate erosion in 31 (26%).

In the DRUJ, the ulnar variance was a mean of 0 (range −2 to +2) mm. There was DRUJ subluxation in 59 (50%), shelf formation in 60 (51%) and the ulnar head was supportive in 7 (6%).

Conclusion: DRUJ destruction is gradable and can provide guidance for treatment. Grade 1 should avoid ablative surgery. Grades 2 and 3 typically need ulnar head excision with or without ulnar head replacement. Grade 4 is so destroyed that only a Darrach's procedure is warranted. A new finding of a supportive ulna head occurred in 3%. It is best confirmed on a CT scan. The significance is unclear but suggests these patients may benefit from a Sauve–Kapandji procedure or an ulnar head replacement rather than a Darrach's procedure to reduce the risk of carpal collapse or carpal stabilization such as a Chamay procedure. This would also help explain why most patients have a Darrach's procedure do not have increased carpal collapse but some do.

A-0496 Direct sutures in extended upper obstetric brachial plexus reconstruction

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Introduction: Severe upper and total obstetric brachial plexus lesions must be explored and reconstructed within the first months of life. The frequently encountered non-conducting neuroma in continuity are routinely excised and grafted by sural interposition fascicles. In specific cases, when the gap is around 1 cm and the mobilization of the distal plexus is achievable, a direct coaptation of both the proximal and distal nerve stumps after histographic control is feasible – we present those cases among our patient series.

Materials and Methods: We performed direct (intraplexic) coaptations in 12 children between 2013 and 2015: 4 combined upper and middle trunk, 3 only upper trunk, in 3 C5 or C7 were sutured onto the C8 contribution to the lower trunk, in 2 partial upper trunk.

All patients were followed clinically and video documented.

Results: We observed good functional improvement in all cases, comparable to autologous grafts. In upper lesions treated by direct coaptation of the upper trunk, an additional spinal to suprascapular nerve transfer seems to improve passive and active shoulder lateral rotation much better.

Discussion: In selected cases with short gap after neuroma resection, the direct stump coaptation is feasible and appealing. Suture tension is reduced by 8/0 sutures and a more adducted-elbow flexed limb position and immobilization. Clear advantages are the missing need for sural nerve harvest and the coaptation of thick, fiber rich nerve stumps of good regenerative capacity. Potential drawbacks are the risk of suture rupture and intraneural fibrosis; also do we observe some more coactivation. So far our clinical results are promising and feared complications are rare.

A-0499 Radial to brachioradialis nerve transfer, does it improve elbow function in upper brachialis plexus injuries?

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Objective: Oberlin procedure improved dramatically the results of upper brachial plexus injuries (UBPI) with root avulsion. Modification of this procedure by adding nerve transfer for brachialis further improved the results. The third component of the elbow flexion means brachioradialis has been overlooked yet. We evaluated the results of our patients with C5–C6 root avulsion who underwent a fascicle of median nerve to biceps, one fascicle of ulnar nerve to brachialis, and compare between patients who underwent transfer of one fascicle of radial nerve to barchioradialis and those without this transfer.

Method: We reviewed our patients with C5–C6 root avulsion who underwent modified Oberlin procedure between January 2005 and December 20015. From 42 patients, 7 cases had an additional procedure with transferring a fascicle of radial nerve to brachioradialis nerve. We reviewed the anatomical finding in the operating note and compared the results of these patients with the patients without this additional transfer with respect to force of elbow flexion and the speed of elbow flexion. At the final follow–up, the additional transferred group underwent electromyographical examination to be assessed for reinnervation of the brachioradialis muscle.

Results: In two patients with radial to brachioradialis transfer, we failed to anastomosis of this transfer because of thinness of the recipient nerve which was branched before exiting of the radial nerve. In the other five cases, the mean force of the elbow flexion was 5 kg which was more than the other group with 3.8 kg, but the differences were not statistically significant. The mean speed of the elbow

flexion was 16 s for 10 full range of motion of the elbow in additionally transferred group and 21 s in the other group. In all of these five patients, electromyography patients showed reinnervation of brachioradialis.
Conclusions: Radial to brachialis transfer can help to improve the results of the classic modified Oberlin procedure in C5–C6 avulsion for elbow flexion, but this improvement is not significant. This transfer is theoretically helpful in the cases with C5–C6 avulsion that neuromuscular junction of biceps and brachialis has been injured due to the primary trauma.

A-0502 Validity and reliability of a hand-held dynamometer for measuring forearm rotation strength compared to the Biodex

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Objective: In order to evaluate the effect of treatment concerning forearm rotation, rotational muscle strength is assessed using, for instance, the Biodex®, an expensive and spacious machine, or a hand-held dynamometer named the Baseline® hydraulic wrist dynamometer (BHWD), a portable and convenient device. Unfortunately, the clinimetric properties of the BHWD are unknown. Therefore, the aim of this study was to determine the concurrent validity, the intra- and inter-rater reliability of the BHWD compared to the Biodex, a gold standard.
Methods: An observational test–retest design was set up. Healthy participants without neurological illness or injury of the hand, wrist or elbow in the last 6 months were included. During four sessions, pronation and supination strength were measured three times per session on both arms using the BHWD (three sessions) by two observers and using the Biodex (one session). Concurrent validity was established using Pearson's correlation coefficient (r) for the parametric measurements and Spearman's rank correlation coefficient (rs) for the non-parametric measurements. Intra- and inter-rater reliability were established using intraclass correlation coefficients (ICC) for both rotational directions. To determine the agreement within one observer and between two observers using the BHWD, Bland–Altman plots with limits of agreement (LoA) were generated.
Results: Twenty-one healthy participants (42 arms) were included. Concurrent validity for pronation strength was $r = 0.650$ ($p = 0.000$) and for supination strength rs = 0.677 ($p = 0.000$). Intra-rater reliability for pronation strength was ICC = 0.912 ($p = 0.000$) with a mean difference of −2.57 (LoA: −33.28; 28.14) and for supination strength was ICC = 0.967 with a mean difference of 4.48 (LoA: −21.08; 30.03). Inter-rater reliability for pronation strength was ICC = 0.888 ($p = 0.000$) with a mean difference of 0.76 (LoA: −34.68; 36.19) and for supination strength was ICC = 0.958 ($p = 0.000$) with a mean difference of 4.43 (LoA: −24.46; 33.32).
Conclusions: The BHWD used according to the measuring procedure in this study cannot replace the isometric mode for pronation and supination strength of the Biodex.

A-0503 Treatment of complex distal radius fracture nonunion with posterior interosseous bone flap

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Objective: Nonunion of distal radius fractures is disabling. Treatment is difficult and the results are not predictable. However, posterior interosseous bone flap (PIBF) has been successful in treating forearm nonunion. To treat distal radius fracture nonunion with PIBF as a new procedure.
Methods: This prospective non-randomized cohort study was performed at two hospitals in Tehran between January 2011 and September 2015. PIBFs were applied in nine patients (10 nonunions) with a mean age of 55 years. Union success rate, grip strength, wrist range of motion, and forearm rotation were then evaluated.
Results: Although four of the patients had a history of infection, all participants achieved fracture union at a mean time of 3.8 months. Grip strength improved by 12.4 kg. There was also 36° improvement in wrist flexion, 20° improvement in wrist extension, 60° improvement in forearm supination, and 46° improvement in forearm pronation. The range of motion and grip strength improvements were significant.
Conclusions: Pedicled PIBF is a new option for treating distal radius fracture nonunion. The results are predictable in achieving union and good function, and this technique can be successfully used in cases with extensive soft-tissue damage or infection.

A-0505 Are there unfavorable results after collegians treatment?

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Objective: Unfavorable results of collagenase include adverse effects of the drug and unsatisfactory results out of the patients' and surgeons' view. There are few published data.
Methods: One hundred and forty-six applications of collagenase (120 patients) were analysed between 2015 and 2016. In 10 patients, 2 infiltrations (0.78 mg) and in 2 patients, 3 infiltrations (0.78 mg) were administered. In 16 patients, 2 simultaneous infiltrations (1.16–1.56 mg) were applied. The follow-up included a minimum of 6 months after the last treatment.
Results: Nineteen patients reported unsatisfactory results. One patient was treated with a painful nodule of the plantar aponeurosis. Two heavy smokers did not respond after one respective two applications with a remaining extension deficit of 70, respectively, 50° at PIP joint level. Seven patients showed improvement of the MCP extension but worse PIP joint flexion and extension. These patients demonstrated CRPS like reactions after the infiltrations or had a diabetes. In four other patients with a severe diathesis of Dupuytren's disease and multiple previous surgeries, one collagenase infiltration improved the extension deficit only for 1—3 years, but was felt to be more acceptable than recurrent surgery. Two patients did not improve after 1, respectively, 2 infiltrations of collagenase in the fifth digit and wanted surgery with good success. In two patients with severe spasticity and Dupuytren's disease, collagenase was administered as off label use with only moderate success in one patient. In one of four patients with painful nodule-like disease without extension deficit, collagenase was applied and did not work. Radiation instead could decrease pain.
Discussion: Risk for non-responders of collagenase treatment are severe smokers, diabetic patients and patients with diffuse nodular painful Dupuytren's disease, as well as probably the M. Ledderhose. Insufficient responders after one treatment of collagenase without CRPS reaction may benefit from a second or third treatment or limited surgery. Radiation is probably more effective to control pain in nodule-like disease without extension deficit than collagenase.

A-0507 Opinions regarding the management of pyogenic flexor tenosynovitis (tendon sheath infection)

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Background: Pyogenic flexor tenosynovitis (PFT) has long been recognized as a severe infection of the hand with the potential for disastrous outcomes if inadequately treated. The mainstay of treatment for over a century has been with emergent surgical washout. More recent evidence suggests a potential role for conservative management with a combination of intravenous antibiotics, elevation and splinting. We aim to assess current management of pyogenic flexor tenosynovitis to guide further education and research into this potentially devastating condition.
Method: An electronic survey was distributed via email to all surgeons on the Pulvertaft database. The survey was compiled by a group of hand surgeons and piloted within a tertiary centre for hand surgery prior to dissemination. The questions were focused on three clinical vignettes describing pyogenic flexor tenosynovitis of increasing severity. The responses were analysed using SurveyMonkey.
Results: Almost 50% of respondents would proceed to surgical decompression and washout even in patients diagnosed within a few hours of onset. This increased to 88% of respondents when treating a patient who has had symptoms for several days and failed a trial of oral antibiotics. The majority of respondents would not consider flexor sheath aspiration regardless of the clinical scenario. For those advising surgical intervention, the majority felt this should be performed within 24 h in all three scenarios. More than 50% of respondents would advocate active mobilization either immediately or as soon as possible regardless of the severity of the infection. Almost all of the respondents would use either general or regional anaesthesia for the procedure and a two-incision technique with catheter irrigation.
Discussion: Our survey demonstrates a huge variation among clinicians in the management of pyogenic flexor tenosynovitis. Advice from the pre-antibiotic era of emergent surgical debridement continues to be followed by many and a proportion of surgeons continue to use an open technique. The importance of immobilization is often stated throughout the literature but many clinicians advocate early active mobilization. Further study into the management and outcomes of pyogenic flexor tenosynovitis is

required to establish best practice guidelines for this rare but potentially devastating condition.

A-0508 Defining displacement thresholds for surgical intervention for distal radius fractures: A Delphi study

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Aim: Distal radius fractures (DRF) are very common yet controversy exist regarding which require treatment and this is reflected by significant variation in the surgical intervention rate. Evidence regarding which fractures would benefit from intervention is varied and largely poor quality.

This study had three aims: to identify which radiographic parameters in distal radius fractures are clinically important; quantify the threshold of displacement at which intervention should occur and investigate which patient factors influence the threshold of the decision to intervene.

Method: A modified three round Delphi study was carried out and responses were qualitatively analysed.

Participants: The Delphi panel was composed of three groups of national and international expert surgeons:

1. Hand and wrist surgeons
2. Trauma surgeons
3. International researchers

Forty-six participants initially agreed to take part. Forty-three completed the first round and all then completed three rounds.

Participants were asked questions based around case vignettes in patients of three ages (38, 58, 75 years). They were asked to rank radiographic parameters in order of importance, the threshold of displacement at which they would intervene and rank which patient factors influenced their decision to operate. Free text comments were sought throughout and explored.

Trial registration: The protocol was registered with ClinicalTrials.gov (Identifier: NCT03126474).

Results: For all age groups, ulnar variance was ranked as the most important extra-articular parameter followed by dorsal tilt, step was ranked as the most important intra-articular parameter.

Agreed thresholds were the same for all parameters for patients aged 38 and 58. Surgeons would intervene in patients aged 38 and 58 with +2 mm ulnar variance, 10° dorsal tilt, 2 mm step and 3 mm gap. In patients aged 75, the agreed thresholds were 20° dorsal tilt, 3 mm step and 4 mm gap, consensus was not achieved for ulnar variance.

Mental capacity, pre-injury functional level and medical co-morbidities were ranked as the three most important factors influencing the decision to intervene. Qualitative analysis suggested that pre-injury function was the main theme within these factors.

Conclusions: Our findings provide useful advice about which parameters should be measured and radiographic thresholds for intervention. These thresholds may then be modified depending on important patient factors. This information can help guide clinicians with management decisions and reduce variation.

A-0510 Short to long-term follow-up of surface replacement MCP arthroplasties

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Introduction: Resurfacing of the MCP joint with flexible implants is considered to be the Golden Standard of the MCP joint arthroplasties. So far, few reports of SR-MCP arthroplasty has been presented.

Material: This prospective study includes 79 patients mean age 59 years (22–86). One hundred and thirty-seven SR-MCP cemented arthroplasties with a follow-up 62 months (2–137). Main indications were rheumatoid arthritis (RA) 104 joints and osteoarthritis (OA) 33 joints. In the RA group, severe conditions with volar sub- or volar dislocation were included. Moreover, 7 Tupper arthroplasty and 2 joints flexible silicone arthroplasties have been revised to SR-MCP.

Results: Preoperative ROM MCP mean was 45° (0–88) and at last follow-up (FU) ROM was 41° (0–98), $p =$ NS. VAS of pain at rest/activity was preop 51/46 mm versus 7/16 mm at last FU, $p < 0.01$. Grip strength preop 16 kgF (2–60) and at last FU 15 kgF (0–44), $p =$ NS. Pinch grip preop 1.8 kgF (0.5–5.2) and at last FU 2.4 kgF (0–5.8), $p < 0.01$. QDASH preop 57 (20–95) and at last FU 35 (2–89), $p < 0.01$.

Complications: No infections were recorded. Two prostheses were revised to silicone implants due to loosening and two due to instability. Estimated survival for 11 years was 95%. Eight RA patients with 13 joints had later joint instability due to insufficient collateral ligament and the collateral ligaments were then reconstructed. Three of these joints still suffer from instability.

Conclusions: SR-MCP arthroplasty in OA and RA patients with stable joints have few complications and improved significantly regarding qDASH, pain and pinch. ROM were unchanged. For instable joints

in RA patients, silicone prosthesis may be the first choice option.

A-0511 Comparison between donor nerves to motorize the free gracilis muscle transfer for elbow flexion: A retrospective study of 55 consecutive cases in traumatic adult brachial plexus injuries

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Objective: The authors seek to determine which donor nerve (spinal accessory, intercostal, median or ulnar) results in better elbow flexion after microsurgical reconstruction.
Methods: Between February 2003 and October 2014, 59 patients with traumatic brachial plexus injury were submitted to a free gracilis muscle transfer to restore elbow flexion. Four patients were excluded due to vascular failure of the transferred muscle, infection or follow-up of less than 12 months. The final study population was 55 patients. The patients were divided in four groups according to the nerve transferred to the gracilis: spinal accessory nerve (SAN), intercostal nerve (ICN), motor fascicles of the median nerve (MED) and motor fascicles of the ulnar nerve (ULNAR). The British Medical Research Council (BMRC) scale was used to evaluate elbow flexion strength.
Results: Of the 55 patients enrolled, 54 were males (98.2%) with a mean age of 28.9 years. The mean follow-up period was 28 months. Thirty-six cases obtained muscle strength M3 or M4 (65.4%): 6 M0 (10.9%), 4 M1 (7.2%), 10 M2 (18.2%), 13 M3 (23.6%) and 21 M4 (38.2%). The mean interval to first recorded M3 muscular strength was 16 months. Patients stratified by donor nerve achieving = M3 had the following distribution: SAN 83.3% (15/18) SAN graft 50% (2/4), ICN 60% (3/5), ICN graft 33.3% (1/3), MED 60% (3/5) and ULNAR 60% (12/20).
Conclusion: The comparison between different donor nerves did not reveal a statistical superiority for any of them in free gracilis muscle transfer in traumatic lesions of the brachial plexus. However, the SAN transfer showed a tendency to perform better followed by the ulnar nerve transfer.

A-0512 Short to 11-year follow-up of SR-PIP arthroplasty

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Introduction: Arthroplasty of the PIP joint with SR-PIP has been an option to flexible prostheses or arthrodesis. A number of complications have earlier been reported related to SR-PIP arthroplasty.

The aim of this study is to report results of uncemented and cemented SR-PIP arthroplasties.
Material: This study is a prospective study of 93 women and 15 men and includes 126 SR-PIP arthroplasties with a follow-up to 11 years (115 joints with a minimum of 1-year follow-up (FU)). Median age 63 years (26–83). Main indications are rheumatoid arthritis (RA) 25 joints. Osteoarthritic (OA) joints 89 and 13 other indications. In the RA group, few cases with severe Boutonnière deformity or MCP arthroplasty in the same finger were included in the early part of the study. Mean values are presented.
Results: Preoperative PIP joint ROM 37° (0–75) and at 1-year follow-up (FU) ROM was increased to 52° (−16–120) (p = NS) and at last FU 47 (0–120) (p = NS). VAS of pain at rest/activity preoperative 44/60 mm and at 1 year 6/18 ($p < 0.01$) and at last FU 6/16 ($p < 0.01$). Grip strength preoperative 17 kgF (2–42) and at 1 year 18 kgF (1–40) (p = NS) and at last FU 17 (1–40) (p = NS). Pinch grip preoperative 2.4 kgF (.0–5.7) and at 1 year 2.7 kgF (.5–9.0) (p = NS) and at last FU 2.6 (.5–6.8) (p = NS). Preoperative qDASH/PRWE 46/52 and at 1 year 31/28 ($p < 0.05$) and at last FU 35/31($p < 0.05$). Patients' satisfaction at last FU was 69 mm (1–100). Eleven years estimated survival of implant in RA is 52% and OA 91%.
Complications: No infections. Loosening around the stem of 15% of the prostheses at last FU. Eleven joints revised to arthrodesis, three due to dislocation in severe RA. Tenolyses in seven joints due to adhesions of the extensor tendon. One stem was re-positioned postoperatively due to incorrect position. Seven FDS tenodesis performed due to hyperextension.
Conclusions: Arthroplasty with SR-PIP prosthesis has unchanged ROM of PIP joints and strength but pain and PROM improved significantly. A high amount of soft tissue problems postoperatively is reported. Survival of the prosthesis is high in OA but low in RA. Severe RA cases with Boutoniere deformity should be avoided.

A-0513 Six-month to seven-year results of revision of a wrist arthroplasty to new wrist arthroplasty

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Introduction: The aim of this study was to review our results of revision wrist arthroplasty to a new wrist arthroplasty.
Methods and Materials: Maestro and Remotion implants are two modular total wrist joint prostheses. These two prostheses were used for revision of former KMI/UTW. All cases were bone grafted and some combined with cementing. In 11 cases, almost the whole carpus was gone and a new technique for reconstruction of carpus with a structural bone block was used.

Patients were evaluated pre- and postoperatively with ROM, grip strength, visual analogue scores of 0–100 mm (VAS) of pain and satisfaction. Functional and general outcomes were evaluated using the Quick-DASH and PRWE questionnaires. Radiographs were obtained pre-operatively and at follow-up.

The procedure was performed in 18 patients: 5 men and 13 women. Median age was 6 years (32–76). All diagnosis except one were RA. Median follow-up was 33 month (range 4–84).

Revision arthroplasty was performed with the Maestro implant in 11 cases and the Remotion implant in seven cases. Cement was used in six cases.
Results: Wrist extension and flexion was preoperatively 29/27° and at follow-up 35/15. Radial/ulnar deviation was 0/29° versus 12/24 postoperatively. Grip strength, in kgF, was preoperatively 7 (range 2–18) and at follow-up 16 (7–26). VAS pain was preoperatively at rest/activity; 26/44 and at follow-up; 27/35. Quick DASH and PRWE scores were preoperatively 56, respectively, 57 and at follow-up 45 and 37. VAS satisfaction at latest follow-up was 69 (0–98). Seven years estimated survival is 87%.

No infections or dislocations were encountered, but radio-graphically loosening of two Remotion prostheses occurred and they were consequently revised to total wrist arthrodesis. One excision of an exostosis in carpus.
Conclusions: The short-term to midterm outcome of this heterogeneous case series indicates that revision wrist arthroplasty could be an alternative to revision to a total wrist arthrodesis.

A-0515 Fractional lengthening of the volar forearm muscles: An anatomical study

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Objective: Fractional lengthening is one of the surgical options for treating muscle contractures associated with spasticity of the upper limb. It consists in multiple transverse tenotomies at the musculotendinous junction (MTJ). The goal is to lengthen the tendon, yet preserving the continuity of the muscle-tendon unit. The main pitfall of this technique is over-lengthening, and subsequent post-operative disruption of the muscle-tendon unit.

The aim of this anatomical study was to measure the length of the muscle-tendon overlapping zone for each individual volar forearm muscle, to define the useful zone (UZ) for carrying out fractional lengthening, and to evaluate its feasibility for each flexor.
Methods: Dissections have been performed on 20 fresh adult cadaveric upper limbs. All the forearm flexor muscles have been studied.

We defined for each muscle, the length of overlapping at the MTJ, and the UZ in which lengthening is feasible without risk of disruption. A 3D mapping of the tendon location within the musculo-tendinous unit has been also performed after cross-sectioning the MTJ.
Results: The UZ average length was 3.5 cm for the FCR, 12.2 cm for the FCU, 4.4 cm for the FDS II, 5.9 cm for the FDS III, 4.9 cm for the FDS IV, 2.7 cm for the FDS V, 6.5 cm for the FPL, and 7.6 cm for the FDP.
Conclusions: According to our results, fractional lengthening appears reliable, reproducible, and effective for those muscles whose UZ is relatively long (>5 cm), with homogenous results, that is, the FCU (longest UZ of all the flexors), the FPL, the FDP, and the FDS III. Regarding the FCR, the FDS II, and the FDS IV, whose UZ is shorter and variable, the feasibility of the procedure and the number of tenotomies should be carefully evaluated intraoperatively, on a case by case basis. And finally, the FDS V useful zone is very short, with a thin and fragile tendon in all cases, leading to a major risk of rupture.

A-0520 Metacarpal corrective osteotomy in patients with Wassel type IV radial polydactyly

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Background: In the surgical management of Wassel type IV thumb duplication, correction of the angulation deformity in the thumb metacarpophalangeal (MCP) joint is one of the most important procedures in order to prevent recurrence of the deformity and instability in the joint. The purpose of this study is to evaluate the correction of the angulation deformity of the thumb MCP joint after metacarpal osteotomy and the maintenance of the joint angle 2 years after surgery.
Methods: We retrospectively reviewed 34 patients with Wassel type IV thumb duplication who underwent surgical treatments and were followed up for more than 2 years. Of them, 13 patients who underwent both soft tissue procedures and metacarpal osteotomy for the reconstruction of the thumb MCP joint were enrolled in this study. The average age at the time of surgery was 11 months. We measured the angle between the anatomical axis of the first metacarpal and that of the proximal phalanx of the thumb on thumb posteroanterior (PA) radiographs at initial visit. We repeated the measurement on PA radiographs immediate after surgery and 2 years after surgery.
Results: The average angulation deformity of thumb MCP joint was 25 (range 16–34)° preoperatively. During surgery, we performed metacarpal closing wedge osteotomy at the level of metacarpal neck after excision of the extra-digit and fixed the metacarpal bone with longitudinal K-wire. We removed the K-wire 3 weeks after surgery. The average angulation of thumb MCP joint was improved to 2 (range 0–5)° immediate after surgery. However, the average angulation of the joint was worsened to 5 (range 0–10)° 2 years after surgery.
Summary: Metacarpal osteotomy is a very useful procedure to correct the angulation deformity of the thumb MCP joint effectively in patients with Wassel type IV thumb duplication. Considering the residual angulation deformity of thumb MCP joint 2 years after surgery, 5° of overcorrection can be recommendable.

A-0531 Interpretation of ulnocarpal stress test in different forearm rotations

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Purpose: Ulnocarpal stress test is an essential physical examination for differential diagnosis of ulnar-sided wrist pain. However, there were some debates on the interpretation of the results of ulnocarpal stress test according to different forearm rotation positions. The aim of this study was to analyze the correlation of positive results of ulnocarpal stress test in different forearm rotations with specific tender point of the wrist joint.
Methods: From March 2015 to February 2017, 54 patients who were diagnosed as ulnar impaction syndrome or ulnar styloid impingement syndrome by MRI or arthoscopy were included. We performed ulnocarpal stress test in forearm supination and pronation position and checked tenderness on dorsal lunate and ulnar head area (point A) and ulnar aspect of triquetrum and ulnar styloid area (point B). We analyzed odds ratio and statistical significance between positive physical examination and sites of tenderness using Fisher's exact test; p values $\leq$0.05 were considered statistically significant.
Results: Forty-six patients had tenderness on the point A and finally diagnosed as ulnar impaction syndrome through consistent radiologic findings; subchondral sclerosis, subchondral cysts, and ''kissing'' lesions of the lunate, triquetrum, and ulnar head. Among them, 40 of 46 patients had positive ulnocarpal stress test in forearm supination position. Odds ratio of positive ulnocarpal stress test in forearm supination and tenderness of point A was 8.25 and it was statistically significant. Eight patients had tenderness at point B and were diagnosed as ulnar styloid impingement syndrome with radiographic chondromalacia between proximal triquetrum and the ulnar styloid. Six of eight ulnar styloid impaction syndrome patients had positive ulnocarpal stress test in forearm pronation position. There were 12 patients who were diagnosed as ulnar impaction syndrome had positive ulnocarpal stress test in both supination and pronation positions.
Conclusion: Patients who had positive ulnocarpal stress test in forearm supination tend to have a tenderness on the luno-triquetral joint area and be diagnosed as ulnar impaction syndrome, and who had positive ulnocarpal stress test in forearm pronation tend to have a tenderness on the ulnar aspect of the triquetrum and ulnar styloid area and be diagnosed as ulnar styloid impingement syndrome.

A-0532 Physeal bar resection under guidance with a navigation system and endoscopy for correction of distal radial deformities after growth plate arrest

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Objective: Growth arrest after trauma may be caused by the formation of a physeal bar across the physeal cartilage. Without treatment, the resulting angular and longitudinal growth disturbance will progress throughout the remainder of a child's growth periods. Langenskiöld introduced physeal bar resection to reestablish growth and to prevent progressive limb shortening and angular deformity. However, this method is a demanding procedure and is not always successful. The extent and location of the physeal bar should be determined accurately. In addition, the physeal bar must be resected completely and the normal physis must be retained undamaged.

Navigation systems have been introduced for intraoperative guidance to obtain better accuracy while endoscopy has been introduced to allow minimally invasive surgery. An endoscope has an intrinsic light source and the ability to magnify images of a narrow or closed space. Their use enables intraoperative identification of the extent of a physeal bar and allows more accurate surgery.

We describe illustrative cases of premature distal radius physeal arrest treated by Langenskiöld's method using a navigation system combined with endoscopy.

Methods: During the operation, we used a 3-dimensional imaging system (ARCADIS Orbis 3D; Siemens, Munich, Germany), with the capacity to create a 3-dimensional image (axial, coronal, sagittal). These scan data were transferred to the CT-based navigation system (Kolibli navigation station 2.0; BrainLAB, Feltkirchen, Germany). The operation was performed under general anesthesia. Then, two threaded pins were inserted into the shaft of the radius. A fixed-based tracker was connected to these pins. A high-speed handpiece attached to a 4-mm diameter drill was connected to the universal tracker. Using this navigation system, we were able to identify the location of the physeal bar and the direction of drilling in three dimensions (axial, coronal, sagittal). The drill was passed into the physis along the physeal bar under navigation. Then the cavity made by drill was irrigated and dried with a narrow suction tip, and a 1.9-mm, 30° endoscope (Stryker, Kalamazoo, MI, USA) was introduced dry into the canal produced to check the accuracy of direction and resection of the physeal bar. This maneuver (drilling under navigation, followed by irrigation, suction, and endoscopy of the canal) was repeated until the physeal bar was completely resected. After resection of the physeal bar, the cavity in the bone was filled with bone wax. After operation, the wrist was immobilized in a cast for 2 weeks and checked by radiography at outpatient department visits every 6 months until the growth plate close.

Results: We performed this method for premature distal radius physeal arrest cases. After operation, the deformities of all cases have been improved. The recurrence of physeal arrest dose not happened.

Conclusion: Growth arrest after trauma causes severe deformity and loss of function. Langenskiöld's method provides excellent treatment, but is very demanding. We consider that the combination of both tools is more suitable than the technically demanding Langenskiöld's method alone.

A-0533 Influence of distal radius fracture internal fixation on social and psychological patients well-being in late post-operative period

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Objectives: The aim of the study was to analyze the attitude of patients to surgical treatment of distal radius fractures by fixation with plates and its impact on their social and psychological condition in a late postoperative period.

Methods: We have proposed a questionnaire of 19 questions, assessing the quality of life of patients after distal radius fracture fixation. Questions consider patients' concerns while planning surgical treatment, rehabilitation and life after surgery.

We questioned 31 patients after open reduction and internal fixation of distal radius fractures with DVR or VA-LCP plates from 2010 to 2017.

Among the participants, the number of male patients was 9 (29%), female – 22 (71%). The average age was 55 years, with median of 59, minimum – 27, maximum – 82 years. Mean time elapsed since operation was 1183 days, with a minimum of 95 and maximum of 2442 days. The study included patients undergoing surgery both with and without wrist arthroscopy. Removal of the plate was considered an exclusion criterion.

Results: We analyzed the patients' answers.

-61.3% (19) believe their lives changed after the operation.

-41.9% (13) of patients think about the plate routinely or during physical activity.

-74.2% (23) of patients frequently discuss their operation, 83.9% (26) would easily joke about it.

-16.1% (5) of patients use the operated hand less.

-77.4% (24) think the strength in the hand did not change after the operation, in 22.6% (7) it became weaker.

-12.9% (4) of patients think the limb would move better without fixator.

-83.9% (26) see no visible difference in their hands.

-6.4% (2) needed to cover the surgical scar.

-19.4% (6) feel the plate under the skin.

Only 12.9% (4) consider removing the implant. For most of them (51.6% – 16), secondary surgery was the main reason not to. If it was, hypothetically, removed, 74.2% (23) of the questioned would throw it away rather than keeping it.

-3 (9.7%) of the patients had encountered any complications while passing the airport metal detectors.

-12.9% (4) had the need of written confirmation of having the implant.

-1 patient (3.2%) was denied an MRI due to having an implant.

Finally, none of the patients doubted choosing surgery and all of them, faced with the choice again, would choose the same.

Conclusion: The results of the study confirm the effect of the operation and implant presence on the social and psychological well-being of patients. Subjects actively and in detail answered the questions. The questionnaire helped to form an idea of the attitude of patients to having metal implants in their bodies and its effect on their daily life.

A-0539 Avanta Preflex silastic implant in metacarpophalangeal joint arthroplasty in rheumatoid arthritis

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Background: Silicone metacarpophalangeal (MP) joint arthroplasty is a valuable option for the treatment of ulnar drift in the hands of patients with rheumatoid arthritis (RA). There are two designs for silicone MP joint arthroplasty. One is the straight type (Swanson or Avanta/Sutter), and the other is the preflexed type (NeuFlex or Avanta Preflex). There are many reports of the results with each implant. However, to the best of our knowledge, there have been no previous reports about the results of the Avanta Preflex implant.

Objectives: The purpose of this study was to evaluate the short-term outcomes when the Avanta Preflex implant was used to treat RA patients with ulnar drift.

Methods: A retrospective review of Avanta Preflex silicone MP joint arthroplasties was performed in 26 patients (32 hands, 128 implants) with RA. Patients were evaluated at an average of 48 months (minimum follow-up period, 24 months). Objective results included grip strength, ulnar drift, extensor lag, and arc of motion measurements at the MP joints. Preoperative and postoperative data for grip strength, ulnar deviation, and finger motion were compared using the paired two-group t-test. The level of significance was set at $p < 0.05$. Anteroposterior and lateral radiographs were obtained at the time of latest follow-up for all fingers. The radiographs were reviewed for erosions adjacent to the silicone implant and implant fractures. Subjective results were evaluated with visual analogue scale (VAS) scores, which measured pre- and postoperative pain at rest and during use, hand function, and cosmetic appearance. Patient satisfaction was noted.

Results: The mean grip strength improved from 5.0 kg preoperatively to 6.5 kg at the time of final follow-up ($p = 0.023$). The mean ulnar drift improved from 33° preoperatively to 14° at the time of final follow-up ($p < 0.001$). The mean arc of motion of the MP joints improved from 28.4° preoperatively to 45.1° at the time of final follow-up ($p < 0.001$). The mean extension deficit of the MP joints improved from 55° preoperatively to 20° at the time of the final follow-up ($p < 0.001$). At the final follow-up examination, radiographic evaluation revealed that 4 (3%) of the implants were definitely fractured and 98 (77%) were intact or mild angulation. The VAS assessments (0—10) showed overall decreases in pain at rest and with use and improvements in hand function and cosmetic appearance. Statistical analysis showed a significant improvement in cosmetic appearance ($p = 0.01$). Twenty-three patients (90%) were satisfied with their results.

Conclusions: Arthroplasty of the MP joints with the Avanta Preflex implant provides a more functional arc of motion and improvement of grip strength and appearance in short-term follow-up. The Avanta Preflex implant appears to give similar results to those obtained with other silicone implants in RA patients.

A-0545 fingertip reconstruction with occlusive dressing: Clinical results and biological analysis of the dressing contents

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Aim: To evaluate the fingertip reconstruction with occlusive dressing and explore the mechanisms and the mediators of this ''fingertip regeneration.''
Patients and Methods: Thirty-eight patients, 4 females, with a mean age of 47.2 (22–73) who sustained a fingertip injury (amputation 20% amputation with crush: 80% – Zone1: 50%, Zone 2: 40%, Zone 3: 10%) have been treated with occlusive dressing (occlusive dressing – tegaderm – each 6 days during 3–6 weeks). Two evaluations have been conducted: (1) prospective clinical analysis with a final assessment at 1 year by an independent operator to measure the aesthetics and functional results (Weber, Semmes Weinstein monofilament, QDash; (2) a biologic analysis of the dressings in order to search microorganisms, cytokines, and growth factors (19 cases). Statistical tests have been conducted on quantitative and qualitative variables.
Results: Of 38 patients, 33 have been reviewed with a mean follow-up of 16.4 months (12–25) Among the 33 patients reviewed, the healing was acquired in 4.1 weeks (3–6) with 4 dressings (3–6). The thickness of the fingertip was excellent in 40% and good in 60%. Eight percent of patients were satisfied or very satisfied. Weber test reached 5 mm for the fingertip reconstruction (3 mm for the opposite side), Semmes Weinstein was 4.1 (3.7 opposite side). Quick dash reached 13.8 (11–20). Twenty percent have cold intolerance without correlation with injury or functional results. Forty percent of patients had dysesthesia during 1.2 months (1–2). Bad smell was considered as a problem in 20% of cases. There were no infections on this series. The delay to return to work was 5 weeks (3–6 weeks). The analysis of the dressing exudates brings to light a pullulement of saprophyte bacterium of the skin but also pathologic species, different at each week, and presence of angiogenic factors (PDGF, VEGF, EGF).
Discussion and Conclusions: 17 publications, 14 series (2 comparatives) with 382 patients have been published concerning occlusive dressing with good and reproducible results. Before 2001, authors (Mennen, Quell) have reported large series with weber of 4 mm after 2 months of dressing with no infection.

After 2001, the use in Burn (Prommersberger), assessment by US (Hoigné) of the regenerated fingertip and biological analysis of the containt of the dressing (Lasserre) have been published. The occlusive dressings remain a reliable and reproducible alternative for treatment of fingertip injuries in zones 1 and 2. This reconstruction seems to depend on bacterium pullulement and cellular growth factors liberation. Our work is the first to report clinical and biological assessment.

A-0546 Anatomical study of the anconeus muscle

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Objective: The aim of this anatomical study was to clarify the anatomy of the origin of the anconeus in the lateral epicondyle and to define the anatomical variants and innervations patterns of this muscle as well as the distance of nerve branch in relationship with the lateral epicondyle.
Methods: Fifty-five elbows from 30 formulated cadavers with Cambridge solution were dissected.

Thirteen cadavers were males and seventeen were females with ages between 62 and 98 years. Mean age was 76 years. Twenty-eight elbows were right and twenty-six were left. We studied the macroscopical shape of the anconeus muscle, the exact origin in the epicondyle and insertion in the ulna as well as the innervation patterns and the relationships with the surrounding structures. Measurements were made with a digital calibrator (TopCraf).
Results: We observed a close relationship between the lateral joint capsule of the humero-ulnar joint and anconeus muscle. We observed a clear continuity between medial head of triceps and anconeus muscle in 19 specimens. We observed a double innervation pattern in anconeus muscle through a recurrent branch of posterior interosseus nerve in 15 of 54 elbows.

The entry point of the branch into the anconeus muscle was measured in relationship with posterior border of epicondyle at 0°, 30°, 45°, and 90° of elbow flexion. The horizontal distance was 11.36 mm (9.3–12.87), 12.5 mm (10.18–13.91), 13.98 mm (11.76–15.59), and 16.87 mm (14.56–19.04), respectively. The vertical distance, in relationship with transepicondylar axis, was 2.34 mm (0–7.57), 4.21 mm (0–8.61), 8.21 mm (4.92–11.32), and 13.32 mm (11.58–15.59 mm).

These data demonstrate a growing horizontal and vertical distance between the entry point of the anconeus nerve branch with the increase of elbow flexion degrees. This distance is higher in men.
Conclusions: This complete anatomical study of anconeus muscle with the description of the relationship between the anconeus motor branch and the lateral epicondyle and its variation with elbow flexion, as well as its possible involvement in the lateral pain of the elbow and the demonstration of the existence of a pattern of double innervation to the anconeus through a recurrent branch of the posterior interosseous nerve can help to better understand of both the anatomy of this muscle and the possible causes of pain in this area.

A-0547 A novel use of QR code stickers after orthopaedic plaster application

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Objective: We have developed a novel solution to ensure that information and contact details are always available while a patient is in plaster. A roll of tape is applied over the outside of the plaster containing both phone numbers and a Quick Response (QR) code. When scanned with a smartphone, the code loads the plaster team's webpage from the hospital website, containing information and videos including enhancing patient recovery.
Methods: A unique roll of tape was designed and distributed to apply on all plasters. On returning to the plaster room, patients filled in a questionnaire about their use of the tape. A total of 101 patients were surveyed between November 2015 and February 2016. The questionnaire contained 10 binary questions.
Results: Ninety-seven per cent had a sticker on their plaster when they returned to clinic; 19% of patients scanned the QR code; 56% of patients had a smart phone, which could be used a QR code reader; 95% of the people who scanned the QR code found the information useful; and 9% of patients used the contact details on the plaster to seek advice.
Conclusion: The use of the QR code for advice about plaster problems has not been previously used. Our results show that this is an effective tool in the proactive management of plaster problems and patient reassurance. Now we are developing a portfolio of information accessible to our patients using the QR code.

A-0551 Bone defect at hand level solved by the induced membrane (Masquelet) technique

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Introduction: Twenty-six cases of bone defects in the hand were treated using the induced membrane technique, thereby avoiding the need for allograft, microsurgery and amputation.
Methods: Twenty-three patients (mean age 51.7 years, 85% males, 65% work-related accident) with 26 bone defects in the hand were included prospectively in the study at three participating hospitals. Nineteen cases were traumatic and seven were septic. The bone defect was at least one phalanx long and averaged 2 cm (0.5–7) in length. Thirty-eight percent of the injuries were extra-articular. All cases were treated using the induced membrane technique which consisted of stable fixation (with flap if necessary) and filling the void created by the bone defect by a cement spacer (PMMA). The second stage of the treatment was performed 3.7 months (1–14) after the first stage; the cement was removed and the void filled with cancellous bone taken from the distal radius in 22/26 cases. Bone union was evaluated prospectively on X-rays and CT scans (if needed) of each case by a surgeon not involved in the treatment. Failure was defined as nonunion at 1 year or uncontrolled sepsis at 1 month.
Results: Two of the bone defect cases failed to achieve union. No septic complications occurred and all initially septic cases had resolved. Bone union was achieved in 5 months (1–14) in 92% of cases. Two biopsies provided evidence that osteoid tissue was created by the Masquelet technique. TAM of injured finger reached 114° (20–250). The QuickDASH was 19 (4–40) and return to work was possible after 6 months (1–24).
Conclusion: Masquelet first described 35 cases of large tibial nonunion defects treated by the induced membrane technique in which the defect was filled with cancellous bone. The cement spacer induces a foreign body membrane (neo-periosteum) that acts as a biological chamber. In animal models, Pellissier and Viatteau showed that this membrane secreted growths factors (VEGF, TGFbéta1, BMP2)

and was osteoinductive for cells. This technique can be used in emergency or septic conditions where the bone defect cannot be treated by shortening. It allows early mobilization and does not require microsurgery to achieve bone union.

A-0553 Mechanisms of failure in base of thumb implant arthroplasty: A systematic review

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Objective: The objective of the current systematic review was to identify the complications leading to implant failure in basal thumb arthritis
Methods: The systematic review was performed according to the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) guidelines. The medical data bases PubMed, Medline, Embase and Cochrane data base of systematic reviews were searched on 27th May 2017 using a Boolean combination of key word and Mesh terms. A bibliographic hand search was done for all articles included for full-text review and all relevant review articles in the past 10 years.

The identified implants were grouped by design concept in to five groups: Total joint replacement, hemiarthroplasty, interposition with no, partial and total trapezial resection. The number of reported complications was combined for each implant design group and overall by simple addition. Implant-years were calculated by multiplying number of arthroplasties in each study by the study mean length of follow-up. The rate of each complication was calculated for each implant design group, and an overall rate as a proportion of the number of cases with each complication divided by the total number of Implant-years for each design group. A 10-year rate of complication was calculated subsequently and expressed as a percentage.
Results: A total 128 articles were included post full text review. Four articles were level I, 1 level II, 21 level III, 102 level IV. A total of 5299 arthroplasties in 5576 patients were identified; 82% were done on females and 55% on the dominant hand. The mean age of the patients ranged from 51 years to 71 years, and the mean length of follow-up of the studies ranged from 4 months to 196 months (16 years). A total of 54 separate implant types for base of thumb arthritis were identified; 20 total joint replacements, 5 hemiarthroplasty, 12 interposition with partial trapezial resection, 15 interposition with total trapezial replacement, and 2 interposition with no trapezial resection.

Eleven implant-related complications were identified which lead to at least revision of one implant. The overall 10-year revision rate for all implants combined from most common to least common: Aseptic loosening (6.19%), dislocation (5.43%), persistent pain (3.77%), subluxation (1.03%), fracture of implant (0.91%), peri-prosthetic fracture (0.83%), foreign body reaction (0.79%), infection (0.59%), osteolysis (0.48%), implant subsidence (0.44%), and periprosthetic ossification (0.16%)
Conclusions: The evidence supporting the use of implant arthroplasty must be improved by means of prospective studies with long-term follow-up. Many types of implants of different design concepts, materials used, and methods of fixation have been invented to over the past 50 years. The top three complications leading to implant failure were aseptic loosening, dislocation, and persisting pain. Designs susceptible to aseptic loosening were total joint replacements and hemiarthroplasties. All designs were susceptible to dislocation. Implant revision due to persisting pain was higher in designs used with partial trapezial or no trapezial resection and lowest in the total joint replacement and interposition with total trapezial resection groups.

A-0554 Wide-awake flexor pollicis longus and digital nerve repairs on patients in the prone position

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Objective: Wide-awake, local anesthesia, no tourniquet hand surgery is a growing field of hand surgery with many advantages described in the literature. The goal of this study is to validate this technique with the patient in prone position for the flexor tendon and nerve repairs of the thumb.
Method: We describe our first experience using this technique with eight patients positioned on his abdomen (prone) under WALANT anesthesia. We performed a primary repair of a laceration of flexor

pollicis longus (FPL) and both palmar digital nerves (DN) at the level of the proximal phalanx for three patients, a FPL repair for two patients, a DN repair for two patients and an exploration of the wound for one patient. The patients were positioned in a prone position during the injection of local anesthesia and for surgery. We injected local anesthesia (20 cc of 1% lidocaine with 1:100,000 epinephrine: 2 cc of bicarbonate 8.4%) using tumescent local anesthesia technique. Waiting at least 30 min after injection and before cutting is important to achieve maximal vasoconstriction.

Result: There was no need for any additional local anesthesia injections or sedation. No tourniquet was required, and visualization was excellent.

In the usual supine position with the patient on his back, the wrist is supinated and the thumb position causes the surgeon to tilt his head to accommodate. We found the prone position offered improved exposure of the palmar thumb because it tends to lay flat against the table. This was especially advantageous when we performed wide-awake microsurgical digital nerve repair.

The prone position can also be helpful to decrease hand movement during local anesthetic needle insertion. Two patients were somewhat anxious in the beginning, so the prone position was helpful since it made it harder for them to look at his hand. The patients were comfortable lying on their abdomen with a pillow under the shoulder for head comfort. After the repair, he was able to move the thumb without difficulty when we asked him to so we could perform the intraoperative total active movement examination.

Conclusion: With wide-awake surgery, we were able to enjoy the advantages of prone position for thumb FPL and digital nerve microsurgery repair, while avoiding the risks associated with prone position in patients under general anesthesia. We were able to educate the patient with verbal postoperative instructions as we closed the skin and applied the splint.

The ideal patient positioning for wide-awake hand surgery is where both the patient is fully comfortable and the surgeon gains technical advantages and improved visualization from the positioning. We suggest that surgeons consider the prone position for thumb surgery in the wide-awake patient.

A-0556 Dual mobility trapeziometacarpal prosthesis for active people

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Objective: Despite of good results at midterm follow-up, implantation of a trapeziometacarpal prosthesis (TMP) in active patients is still controversial. The aim of this prospective monocentric study was to analyze the outcome of a dual mobility TMP permitting a specific early active rehabilitation program, and thus to evaluate the duration of sick leave.

Method: Between June 2015 and June 2016, 15 working female patients, aged between 43 and 63 years, have been treated with a dual mobility TMP Maia® (Lepine™, France) for thumb arthritis after failure of conservative treatment (intra-articular steroid injection and customized splint). At 48 h post operative, self-active motion was encouraged in the daytime and splinting was advised at night during 1 month.

All the patients have been evaluated clinically (mobility, visual analogue scale of pain, PRWE score), and radiologically at 1-month and 1-year follow-up. The duration of sick leave and the condition of the return to work were noted.

Results: Clinically, the PRWE and VAS scores were 77.7 and 8.3 before surgery, 13.9 and 1.14 at 1-month follow–up, and 3.9 and 1.0 at 1-year follow-up. There was no infection and no complex regional pain syndrome. The Kapandji score of opposition of the first column was 10 for all the patients.

The radiological examination at 1-month and 1-year follow-up did not showed any mobilization or radiolucent lines of the cup or stem. The mean duration of the sick leave was 52.5 days (extremes 30 and 60). Thirteen patients returned to work at the same job and two changed their activity.

Conclusion: There is no study about the treatment of basal thumb arthritis with a TMP in working population. Theorically, the trapeziometacarpal prosthesis would be the best option for a faster return to work in comparison with a trapeziectomy, but the implantation of a total arthroplasty in young people is still controversial.

Furthermore, the 3 to 4 weeks immobilization of the thumb column is usually recommended after TMP implantation: The risks are the dislocation (maybe resolved with a dual mobility) and the lack of osteointegration of the cup coating. In this study, the dual mobility with early active rehabilitation permitted to have 52.5 days of sick leave. There was no

problem of osteointegration of the cup at 1-year follow-up in this short series. The dual mobility trapeziometacarpal prosthesis is a very good option for working people.

A-0557 Ultra-thinned pedicled groin flap to salvage degloved ring fingers: A report of four cases

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Objective: Non-replantable ring finger avulsions generally require amputation at the first phalanx or the metacarpal level. Our purpose was to report our experience of salvage of degloved fingers, class III according to the Urbaniak classification (*J Hand Surg Am* 1981) using a pedicled ultra-thinned groin flap.
Methods: Four slim patients aged from 16 to 24 years had a complete degloving of their ring finger with intact interphalangeal capsuloligamentous apparatus. The amputated fragment included the distal phalanx. It was lost in two patients and not suitable for replantation in two others. The groin flap was harvested from the lateral groin area with an 8 cm long tubed pedicle and immediately defatted to a mean thickness of 4 mm (3–5 mm). It was then wrapped around the digit. All donor sites were closed primarily. Postoperatively, the patient mobilized the finger immediately at least 30 min twice per day. Flap division of the pedicle was performed after 3 weeks. Last follow-up examination included measurement of the pain level, the cold tolerance, the total active motion (TAM), and aesthetic evaluation by the patient.
Results: Finger salvage was successful in all patients. A partial flap loss occurred after 10 days postoperatively in one patient, at the junction with the recipient area. After excision of ischemic tissues, the flap could cover the volar aspect of the digit, while a full-thickness skin graft was applied on the dorsal aspect. At a mean follow-up of 8 months (6 to 14), all the patients were satisfied with the aesthetic result and reported no pain or cold intolerance. TAM was 180° in average (range 170 to 190°).
Conclusions: Ultra-thinned groin flap is a viable option to cover degloved digits when replantation is not feasible or failed, avoiding additional loco-regional donor site morbidity. The functional and aesthetic results were satisfactory in all our cases. Requirements are integrity of the proximal interphalangeal joint, the flexor superficialis tendon and the central slip of the extensor tendon. An intensive postoperative physiotherapy regimen is crucial to achieve a complete arc of motion of the digit.

A-0558 A double plating technique to treat proximal ulnar comminuted fractures: A retrospective multicentric study

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Introduction: Comminuted fractures of the proximal ulna are severe injuries often associated with bone and ligament injuries of the elbow joint (Monteggia lesion, radial head fractures, dislocation or the elbow). The treatment of these fractures is very demanding and the functional results often fair due to associated injuries.

In a multicentric retrospective study, we report the results of the treatment of these fractures fixed by a double plate technique. The aim was to evaluate the fiability of the fixation and to compare it with other series fixed by two plate in term of bone union, function of the elbow joint, and complications due to plates).
Method: Twenty-four patients with an average of age of 45 years (32—67 years) sustained a comminuted proximal ulna fracture between 2002 and 2012. The fractures were associated in five cases with a Monteggia type lesion, in two cases with elbow dislocation, and in four cases with a Mason 3 radial head fracture. Four patients had an open fracture. These comminuted ulna fractures included nine Mayo Clinic IIIB fractures. Bone fixation was performed with third-cylinder tubular plates or anatomical Medartis plate, one plate on each side of the proximal ulna allowing more versatile solutions for screw insertion.
Results: With a minimum follow-up of 2 years (24—56 months), 21 of 24 patients achieved bone union with a delay of 3.5 months. No septic complications occurred. In 72% cases, Morrey score indicated excellent to good results with a mean score of 84. Mean flexion reached 128° (90°—140°), lack of extension reached 15° (0°—35°). Pronation reached 84° (65°—90°) and supination 70° (10°—90°). Two non-unions with stiffness have been treated by arthrolysis and new fixation.
Discussion: In the reported series of fixation by plate of proximal ulna fracture, 20% of patients need the removal of the plate. On the other hand, the anatomy of proximal ulna has been rediscovered recently with

the definition of the PUDA (posterior angulation). A single straight plate on the dorsal crest remain unlogical due to the posterior angulation of the proximal ulna (6° on the first 6 cm of the ulna in 96%of patient). There is no report in the literature of technical point of fixation concerning complex fracture of ulna. Two plates mean twofold more solution of fixation. This fixation remains easy to perform and allow with a stable anatomic reconstruction of the ulna to win time to solve others injuries in the spectrum of complex injuries of the elbow.

A-0560 Periphalangeal steel wire loop pullout technique in proximal interphalangeal joint fracture dislocation

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Introduction: The purpose of this study was to analyze the clinical results of seven PIPJ fracture dislocation patients treated with periphalangeal steel wire loop pullout technique.
Material and Methods: From May 2002 to November 2016, among 108 patients with PIPJ fracture and dislocation, we retrospectively analyzed 7 patients (3 men and 4 women) underwent surgical treatment with periphalangeal wire loop pullout with 4–0 steel wire (ETHICON, Somerville, USA). Among seven cases, one female patient was operated at another hospital and after revision surgery at out hospital. The mean follow-up period was 36 weeks, with an average age of 32.4 years (range 13–68 years). Two of the seven cases were in the fourth finger and five cases were in the fifth. The central slip avulsion was in four cases and the volar plate avulsion was in three cases. In four cases, wire loop pullout was performed alone. In two cases, the associated fracture was fixed with K-wire and extension block pinning was added in one case. In all cases, wire was removed 4 weeks after surgery. The radiologic results were evaluated by plain radiographs, and then fracture fusion and postoperative subluxation of the joint were assessed. Clinical results were evaluated by modified Green and O'Brien score, which included range of motion, VAS score, and grip strength.
Results: Three cases of volar avulsion were hyperextension injuries, and four cases of dorsal avulsion were injured by direct contact injury. In two cases with fracture fixation with K-wire, the fracture involved approximately 20% of the joint surface and was performed for additional stabilization. In all cases, the pain decreased (VAS 6.9 to >1.7) and the active range of motion of the PIPJ was restored to about 80% of the normal range (0–120), with a flexion average of 99° and extension average of −5.7°. In evaluating through modified Green and O'Brien scale showed excellent results in four cases, good in two cases, and fair in one case. Mild flexion contracture and buttonhole deformity occurred in one each case, but the treatment was completed after the dynamic splint. Imaging results showed that the joint congruency was maintained without subluxation in all cases. Fragmentation and resorption of bone fragments occurred in one each case, but the clinical outcome was not affected.
Conclusion: In the treatment of PIPJ fracture dislocation involving less than 20–30% of the joint surface, periphalangeal steel wire pullout technique is simpler than the conventional method, no damage to the neurovascular bundle, and can easily adjust the tension because the wire is passed through the skin and fixed outside the body using a button. Treatment with this method has satisfactory clinical and radiological results and is considered as a recommended treatment method.

A-0564 Joint arthroplasty with osteochondral grafting from the knee for posttraumatic or degenerative hand joint disorders

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Objective: To describe the operative procedure and report the clinical outcomes of articular surface reconstruction for various hand joint disorders using autologous osteochondral grafts from the knee.
Methods: Twelve patients underwent articular surface reconstruction for hand joint disorders with autologous osteochondral grafts from the patellofemoral joint. Mean patient age was 36 years (range 15–54 years). The patients were followed for an average of 46 months (range 12–89 m). Metacarpophalangeal joint arthroplasty was performed in five cases and proximal interphalangeal joint in seven cases. The patients' clinical outcomes were evaluated with joint range of motion, visual analog scale (0–10 points), and Disabilities of the Arm, Shoulder, and Hand (DASH) score. Histological examination was performed in three cases after surgery.

Results: Graft union was confirmed in all cases without radiographic evidence of resorption or necrosis. Follow-up radiographic examinations showed good graft incorporation without signs of osteoarthritis such as joint space narrowing. The finger flexion–extension arc improved significantly from an average of 20° to 62°. The mean visual analog scale also improved significantly from 7.0 to 1.5. The mean total active motion showed a significant improvement from 149° preoperatively to 205° postoperatively, and the mean DASH score improved significantly from 33 to 12. There were no significant differences for the arc of finger motion and DASH score between metacarpophalangeal and proximal interphalangeal joint disorders or between hemi and total joint arthroplasty. Histological examination revealed viable chondrocytes in the implanted cartilage.
Conclusion: Autologous osteochondral grafting from the patellofemoral joint provided satisfactory outcomes and may be a useful option for joint surface reconstruction of traumatic or degenerative hand joint disorders.

A-0570 Arthroscopic diagnosis and treatment of injured collateral ligaments in the thumb metacarpophalangeal joint

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Objective: A limited number of reports was found for arthroscopic surgeries and diagnostic tools for thumb metacarpophalagenal joint (MCPJ), regardless of usefulness for reduction of displaced ulnar collateral ligament (UCL) and synovectomy for patients with rheumatoid arthritis. The purposes of this study were (1) to report the arthroscopic anatomy of the uninjured ligaments and other articular structures and (2) to describe the arthroscopic findings of the injured UCL and radial collateral ligaments (RCL).
Methods: The study group consisted of 26 patients (6 women and 20 men) who underwent arthroscopic surgery for collateral injury of MCPJ. We included 18 UCL and 8 RCL injuries. Surgery proceeded under vertical traction. Arthroscopic anatomy was evaluated from video during surgery regarding the uninjured articular tissues, including the collateral ligament of the unaffected side, sesamoids, and palmer plate. In addition, we examined the injured UCLs and RCLs with respect to the degree of injured ligaments, tear site, or reduction of ruptured or displaced ligaments. The degree of injury was defined as follows: incomplete, complete, and displaced. Furthermore, the site of the ligament injuries was classified into distal, proximal, or midsubstance.
Results: At uninjured site, both UCL and RCL with two bundles were clearly visible to obliquely run across the joint and have synovial plica-like meniscus at the rim of the phalangeal joint surface in all patients. The radial sesamoid was clearly visible in all patients, whereas the ulnar sesamoid and palmar plate were difficult to be observed due to coverage of synovial tissues with rich vascularity. In the injured ligaments, the UCL and RCL had complete tear in 16 and 8 cases, respectively. In addition, all but one had distal injury in the UCLs, whereas the injured site of the RCL was not uniform with three midsubstances, three proximal, and two distal injuries. The distribution of the injured site was statistically significant between the RCLs and UCLs. Furthermore, the degree of UCL injury was incomplete, complete, and displaced in two, nine, and seven patients, respectively. Of seven patients with displaced UCLs, five were successfully treated under arthroscopy. Following the reduction, the ligaments were stabilized at the synovial plica-like meniscus. By contrast, the RCLs were completely ruptured without displaced ligaments in all eight patients. Furthermore, six injured RCLs at the proximal of the synovial plica-like meniscus fell into the joint.
Conclusions: This arthroscopic finding showed that both UCL and RCL had synovial plica-like meniscus at the rim of the phalangeal joint surface. Almost UCLs were stabilized at the synovial plica-like meniscus even in complete and displaced injuries after reduction. On the other hand, RCLs were injured at the proximal to the synovial plica-like meniscus in six of eight patients and needed to be repaired in open technique due to difficulty of preservation of reduction under arthroscopy. We believe that the synovial plica-like meniscus could play an important role for stabilization of injured UCL and RCL in the thumb MCPJ.

A-0572 McCash and Jacobsen – open palm technique – versus reverse hypothenar flap for the treatment of advanced Dupuytren's disease

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Objective: This study intends to analyze the optimal surgical approach that allows to have a safe and feasible flap, to ensure a good mid-palm covering which permits tendon sliding, avoiding the McCash or Jacobsen (open palm) technique with a long postoperative care, using the reverse hypothenar flap (RHF).
Methods: Between 1988 and 2017, we operated 517 patients with Dupuytren's disease of which 296 Tubiana stages I–II and 221 with stage III–IV retractions. In all cases with retraction of fingers below 90°, we used V–Y plasty (Brunner) and more than 90° we used Z-plasty in 94 patients, open surgical technique (McCash) in 55 and in 8 cases Jacobsen procedure (L-shaped skin flap), in 30 we used Patton skin graft, 16 laterodigital flaps, 7 skin grafts after Hueston dermofasciectomy, and in 54 RHF. To improve the extension, we performed the release of the check-rein ligaments at PIPJ in 25 cases using Z plasty and elevation of A3 pulley.

Postoperative hand therapy included static and dynamic splinting, exercises, edema control (hand elevated, intermittent Coban wraps, hourly finger motion) and scar management and the main objective being to maintain the range of motion gained intraoperative.
Results: For the patients with the mid-palm defect >2 cm, we used the classic methods, skin grafts or McCash (opening technique), the late onset of functional reeducation determined a period of incapacity more than 14 weeks and an extension deficit of 20–45°. Using the Jacobsen technique, we applied a dynamic splint for 10 weeks to avoid a progressive flexion deformity. In 5 cases with 30° flexion defect remaining, we performed release of the check-rein ligaments at PIPJ to improve extension. For the RHF patients, physiotherapy started immediately postoperative and they had an average of 6 weeks work disability and an overall deficit of 25° (28 cases 20°, 24 cases 25°) extension and 30° in 2 cases. From 54 RHF cases, only in 2 cases postoperative evolution was with flap tip necrosis. For this reason, in recent years, we limited to the minimum the indications of classic, skin grafts or McCash technique in favor of RHF. We indicate the RHF for advanced stages (3–4) of Dupuytren disease for ulnar digital rays to assure early functional reeducation and socio-professional reintegration. The mean Quick Dash score was 23.1 preoperatively improving by a mean of 8.1 points to 15.0 after surgery.
Conclusions: RHF for skin closure in Dupuytren disease is a safe and feasible technique, shortening the healing time compared to classic methods, skin grafts and open palm technique – McCash or Jacobsen procedure – and allow the immediate functional reeducation improving the final results. RHF is a simple technique insuring a good mid-palm covering which permit tendon gliding with a low donor site morbidity. The more intensive physical therapy program for the RHF is improving the final results, as we tested at 8 weeks postoperative. Each technique doesn't exclude the other, each with its own advantages and disadvantages, but patient selection will determine the technique choosing.

A-0576 An outcome study of microvascular replantation in 1013 multi-level complete traumatic finger amputations: A tertiary trauma center experience

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Objective: To compare replantation results of traumatic complete finger amputation at various levels and functional outcomes in a single trauma center.
Method: From January 2009 to December 2015, a retrospective review of 600 patients with a total of 1013 replanted digits was performed. Patient demographics, trauma history, comorbidity, injury mechanism including surgical and functional outcomes were noted. Inclusion criteria were age >18 years old, amputation with phalangeal bone involvement, amputation level distal to metacarpophalangeal joint (MPJ). Exclusion criteria were pulp amputation only, degloving soft tissue injuries, serious concomitant trauma. SPSS v17 was used for the statistical study.
Results: There were 522 male and 78 female patients with a mean age of 39 years; 52% of patients had a single finger amputation, 22% multiple fingers, 20% only thumb, 4.3% with thumb and finger(s), 0.8% bilateral finger amputations. Most injuries (94%) were work-related. Crushing injury accounts for 87%, clean cut 10.5%, avulsion 2.2%. Annual replantation patient number was between 68 and 106 with a failure rate between 13 and 21% (average 17.28%).

We found crush (OR = 2.218, $p = 0.01$) and avulsion (OR = 8.108, $p < 0.001$) injuries significantly correlated with an increased failure rate whereas age (OR = 1.002) and comorbidity were not. Level of amputation from the middle phalanx distal to PIPJ including the DIPJ (middle phalanx level) may be related to higher failure rate. The mean follow-up time was 7.29 months. The average injured hand grip power was 20.21 kg and key pinch power was 5.21 kg. Compared to the contralateral normal

hand, the resulting ratio of grip power was 63%, the ratio of key pinch power was 57% irrespective of digit replanted.

In 518 single digit replantations, middle phalanx level type injuries resulted in a statistically significant limited DIPJ ROM of 14.98° compared with the other more distal level type injuries ($p < 0.05$).

Conclusion: Stable and higher successful digital replantation success rates are achievable today. Old age and comorbidity are not absolute contraindications. Amputations distal to the mid-section of the middle phalanx were associated with an increased difficulty of re-vascularization, difficulty in maintaining venous bleeding/outflow, and a greater degree of ROM limitation. After careful assessment, we may give up avulsion injury without absolute indication. Hands with digit replantation have a moderate loss of grip and pinch power and patients should be prewarned.

A-0577 Patterns of radial notch fracture in elbow fracture dislocations with proximal ulna comminution

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Objective: Recent studies have revealed the relationship between type of coronoid fractures and injury mechanism of elbow fracture dislocations. Although these progresses made prognosis of elbow fracture dislocation better, the treatment of elbow fracture dislocation with proximal ulna comminution, such as posterior fracture olecranon dislocation, has remained the challenging problem. Proximal radioulnar joint plays an important role in elbow function; however, the patterns of radial notch fracture in olecranon fracture dislocation have not been clarified. The purpose of this study is to assess the size and location of radial notch fractures in elbow fracture dislocation with proximal ulna comminution and to analyze the difference among injury patterns.

Methods: We analyzed the 2-dimensional and 3-dimensional computed tomography of 14 patients with elbow fracture dislocation with proximal ulna comminution. Injury patterns were classified as anterior olecranon fracture dislocation (AOFD) ($n = 5$), posterior olecranon fracture dislocation (POFD) ($n = 6$), posterior Monteggia injury associated with terrible triad fracture dislocation ($n = 3$). Number of articular fragments, longitudinal diameter of each fragment, and fracture location in the radial notch joint surface were assessed.

Results: Fractures in radial notch were noted in all cases. Articular surface of radial notch was most comminuted in POFD group. In AOFD group, four cases had two articular fragments and one case had one fragment. In POFD group, five cases had three fragments and one case had two fragments. In posterior Monteggia group, all cases had two fragments ($p = 0.03$). With regard to the location of the fracture line, three of five cases in AOFD group had a fracture line in lower 1/3 of joint surface, four of six cases in POFD group had fracture lines in both middle and upper 1/3 of joint surfaces. In posterior Monteggia group, two cases had a fracture line in upper 1/3 and one case had a fracture line in lower 1/3 of the joint surface. Mean longitudinal diameter of each fragment was 6.7 ± 1.7 mm in AOFD group, 9 ± 3.1 mm in POFD group and 11 ± 4.9 mm in posterior Monteggia group ($p = 0.1$).

Conclusions: In POFD, fracture in radial notch is more complexed, compared to other type of instability pattern with proximal ulna comminution. In the treatment of POFD, attention must be paid to reconstruct the radial notch by open reduction and fixation. Comminution of the radial notch joint surface might affect the stability of radial head and congruency of the proximal radioulnar joint.

A-0586 The fascia lata graft: A new technique for multiple extensor tendon defect repair

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There are many challenges for extensor tendon defects reconstruction, specifically when there is a long gap. We attempt to introduce our new method for these cases with use of facial late inter position graft. Between 2009 and 2016, we have used from TFL graft for eight patients with extensor tendon gap larger than 6 cm. We follow them for at least 1 year and we recorded extension lag and flexion loss for them. Also we follow them for any complication. In five patients, there is three-finger involvement, and in three patients, we have four-finger involvement. Three cases (35%) had synchronous soft tissue damage that repaired with reversed radial forearm flap at the same time.

The total extension loss was between 5 and 20 (mean: 15), and total flexion loss was between 0 and 10 (mean: 5), both of them are acceptable.

A-0589 Effectiveness of application of variable splinting devices in postoperative movement rehabilitation in patients with posttraumatic elbow contractures

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Fractures in the elbow joint constitute only 5–6% of all skeletal injuries, but the level of unsatisfactory results of treatment and contractures of this area remains very high and reaches 20–25%.

In our study, we compared the efficacy of movements development during postoperative rehabilitation in patients with posttraumatic elbow contractures. A retrospective analysis was performed on 69 patients with elbow contractures, who underwent the arthrolysis surgery. Patients were divided into two groups: group 1 – active rehabilitation program without using any fixing devices; and group 2 – restoration of movements using two plaster splints on the upper limb in the position of maximum flexion and extension of the mobilized elbow.

As a result of surgery and of our postoperative locomotor rehabilitation, final degree of flexion–extension movements in the first group of patients (active movements in the elbow joint) increased by 59.58° (from 44.69° ± 12.25° before surgery to 104.28° ± 9.42° in 6 months after surgery), while in the second group of patients, who used two splints, movements increased by 70.7° (from 48.05° ± 12.15° before surgical intervention to 118.75° ± 14.11° in 6 months after surgery). The same results were obtained on the Mayo Elbow Performance Score. In the first group, patients received an average of 75 ± 7.3 points for the Mayo Elbow Performance Score in 6 months after surgery, and in the second group of patients, 84.6 ± 10.5 points. The gain of elbow function according to MEPS in group 1 was 42.8 ± 8.9 points, in group 2 – 49.3 ± 10.9 points.

Treatment of posttraumatic contractures of the elbow joint is extremely complex and unsolved problem and requires an individual approach for treatment and rehabilitation. Comparison of the effectiveness of rehabilitation of patients in the two groups showed a statistically significant increase of movements and better functional outcome by MEPS in patients, who used two plaster splints.

A-0594 Time to union of scaphoid waist fractures treated by percutaneous screw fixation

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Objective: Traditionally our treatment regime of non- or minimally displaced scaphoid waist fractures fixed by a percutaneous compression screw inserted through a volar approach included a scaphoid splint for 6 weeks and active motion for 12 weeks without weight. At week 12, the fracture union was assessed by CT scan and patients were allowed to return back to manual work. Based on recently published studies, we suggested that this treatment regime is too restrictive and sufficient fracture union may be achieved within 6 weeks. Our goal is to assess the time to union of scaphoid waist fractures treated by percutaneous screw fixation.

Methods: This retrospective study investigated 34 patients with acute scaphoid waist fractures between June 2015 and August 2017, which were treated by a percutaneous compression screw (SpeedTip Cannulated Compression Screws 3.0, Medartis) osteosynthesis through a volar approach followed by active motion for 6 weeks without weight. Exclusion criteria were fractures of the poles, a displacement >2 mm, the age <16 years, a delayed treatment >1 month, concomitant injuries at the ipsilateral hand and wrist and lost to follow-up. Twelve patients were excluded. CT scans were used at day 0 to categorize each fracture and at week 6 to assess the union. A musculoskeletal radiologist evaluated the CT scans using the sagittal slices. The length of the united bone was compared with the width of the scaphoid at the fracture line. Two measurements were used to quantify the union based on the following methods: The mean percentage union described by Singh et al. and the weighted mean percentage union described by Grewal et al. A fracture was defined to be united if overall bone contact was more than 50%.

Results: Sixteen of the 22 included fractures were classified as non- or minimally displaced (≤1 mm); 15 of these fractures showed a union rate of more than 50% at week 6 CT scan; 4 included fractures were moderate (>1 mm <1.5 mm) displaced. All showed a union rate of more than 50% at week 6 CT scan. Two fractures were severely (≥1.5 mm ≤2 mm) displaced, one with a union rate of more than 50% at week 6 CT scan and one with a poor union rate at weeks 6 and 12 CT scan. The union rate was more than 50% at month 5 CT scan.

Conclusions: We demonstrate that the majority of non- or minimally displaced scaphoid waist fractures treated by percutaneous screw fixation through a volar approach show a fracture union at week 6 CT scan. Time off work can be reduced considerably by this treatment regime.

A-0596 Clinical and neurophysiological results 2 years after transfer of the interosseous anterior nerve to the deep motor branch of the ulnar nerve

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Objectives: The AIN transfer to the DBUN may improve results after proximal ulnar nerve injuries. We have used this transfer since 2015 and have followed our patients prospectively both clinically and neurophysiologically. We present the results after 2-year follow-up for the first eight patients.
Methods: Patients with the ulnar nerve at the elbow or proximally with a healthy median nerve are candidates for the procedure at our hospital. Six were males, median (with range) age at nerve transfer was 39.0 (55.9). All were right-handed, five had left sided injuries. There were three sharp, and one untidy injury at elbow level, two plexus injuries, one degloving injury to the upper (irreparable ulnar nerve), and one permanent deficit after removal of an axillary schwannoma. Four out of eight injuries underwent primary nerve repair at elbow level, with primary grafting in one case. Nerve transfer was performed at a median time of 220 (534) days after the primary surgery (end-to-side in six cases and end-to-end in two). Concomitant long flexor tenodesis was performed in three cases and nerve transfer of a triceps branch to the axillary nerve in one case. The patients were examined pre- and post-surgically with testing of grip strength, key-, tip-, and tripod pinch strength as well as assessment of intrinsic hand function (Rosen score) and scoring with Quick dash (QDASH). The patients have been assessed neurophysiologically according to a specific protocol both preoperatively and at follow-up. EMG registration was performed in the ulnar nerve innervated muscles while the median nerve was stimulated proximally as suggested by Chan et al.
Results: Median observation time is 2.1 (1.3) years. Patient 8 will be completing the 2-year follow-up in December 2017. QDASH preoperatively (seven patients) was median 36.4 (36.3), QDASH at the final follow-up 2.3 (56.7). The motor Rosen score was 0.24 (0.05) preoperatively, 0.31(0.11) at 6 months, 0.39 (0.39) at 12 months and 0.62 (0.32) (7 patients) at 2 years. We found no significant improvement in the QDASH, but the Rosen motor score was significantly improved at both 1 and 2 years compared to baseline ($p < 0.05$, Wilcoxon signed rank test). All patients had made improvements both clinically (including clawing and the Fromment sign) and neurophysiologically at the last follow-up, but a clear effect of the nerve transfer could only be shown in 3/7 cases.
Conclusion: Our patients have made a significant improvement in intrinsic function at the final follow-up. However, we were only able to show clear effect of the transfer electrophysiologically in three cases. Two of these were direct end-to-end transfers and the last had an irreparable proximal injury (but probably had a pre-existing Martin Gruber anastomosis). The best clinical results were seen among the group with end-to-side transfers, but it would seem this is a result of the proximal nerve surgery. A ''baby-sitting mechanism'' has been suggested for this method (2), but we were unable to confirm this in our study.

A-0597 Early loosening of the Elektra trapezial cup: A histological study

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Objectives: To study possible mechanisms behind the high rate of cup loosening seen after the Elektra™ total joint replacement in the basal joint of the thumb.
Methods: Six female patients were reoperated with salvage trapeziectomies after earlier implantation of an Elektra joint replacement. The indications for the joint replacement were primary osteoarthritis in five and arthritis secondary to SLE in one, and the median (with range) age at the time of surgery was 61.7

(10.7). The trapeziectomies were performed at median 16.8 (39.6) months after the original joint replacement during the period November 2009 to April 2012. The indication for revision surgery was cup loosening (three cases) or recurrent dislocations/instability (three cases). Of six cups, five were the original Chrome Cobalt Elektra cup and one was the second-generation bimaterial cup. At trapeziectomy, the bone was removed in one piece and conserved in formalin. The six trapezia were then embedded in resin and sectioned for further study under the light microscope. In addition, three of the cups were analysed with two spectroscopy methods to confirm the presence of metallic waste products in the periprosthetic bone.

Results: There was almost complete loss of the hydroxyapetite (HA) coating on the three loose cups. The three remaining cups were still osteointegrated, but a low proportion of the metal was covered with bone in the central section that we studied (40–66%) and much of the HA was also gone on these cups. In all six samples, we saw a general osteopenic bone structure and large lytic areas particularly undermining the cups. In these lytic areas, and in the periprosthetic tissue around the cup surface, we found large amounts of macrophages with dark intracellular content. In addition, we saw disordered bone remodelling around the cups. Three cups were selected for further studies with laser ablation inductively coupled plasma mass spectroscopy (LA-ICP-MS) and scanning electron microscopy with energy dispersive spectroscopy (SEM EDS) were we confirmed that the dark staining content in the periarticular cells/tissue consisted of metallic waste products.

Conclusion: We found an early and aggressive metallosis around these six cups. The process seems to involve many inflammatory cells and metallic waste products and is particularly advanced in the bone undermining the cups. This is most likely due to the cannulated design of the first generation of the Elektra cups. The metal on metal design for the articulation seems to be another unfortunate choice contributing to the high rate of loosening that other authors have published after using this prosthesis.

A-0598 Proximal interphalangeal joint denervation: Is it an alternative and efficient surgical procedure for proximal interphalangeal joint arthritis?

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Objective: Proximal interphalangeal (PIP) joint denervation is an alternative procedure to arthroplasty and arthrodesis in cases of osteoarthritis with preserved mobility. Here, we aimed to explore whether PIP joint denervation allows for significant pain reduction in the long term in individuals with preserved mobility in PIP joint OA and rheumatoid arthritis. Secondary objectives were to determine the prognostic criteria for the reduction in pain.

Methods: We assessed the results of 40 PIP joint denervations in 22 patients (21 women) (mean age 63 years (range 39—77)) with PIP joint osteoarthritis (67%) or rheumatoid arthritis (33%) with a mean follow-up of 66 months (range 16–137).

Results: Patients who had another surgery after PIP joint denervation, such as arthrodesis (five cases) or PIP joint arthroplasty (five cases), were considered treatment failures (five patients).

For the 30 remaining cases (17 patients), pain score, decreased by 71% of the preoperative value, was correlated with improved QuickDASH score ($\rho = 0.05$; $p < 0.01$), which was decreased by 47% (SD 42%) of the preoperative value. The mean postoperative range of motion was 52° (SD 21°). Arthrosis continued to progress (increase in Kellgren and Lawrence score by 1.1 (SD 0.8) points) and the axial deviation of the PIP joint progressed by 3.5° (SD 4.3°). The amount of axial deviation of the PIP joint, a very advanced radiographic OA stage and rheumatoid arthritis origin were poor prognostic factors. Posttraumatic arthritis origin and the amount of pain and functional discomfort before surgery were good prognostic factors. For 22/30 cases, individuals were satisfied. Overall, four cases showed transient neurologic disorders and four were considered failures.

Conclusion: We recommend PIP joint denervation for individuals with osteoarthritis and preserved mobility, especially if the pain and discomfort are

significant and there is no pronounced joint deviation. However, in case of very advanced radiographic OA stage, severe axial deviation or rheumatoid arthritis an alternative procedure may be considered.

A-0599 Clinical results of a SL-reconstruction through a dorsal approach creating a three ligament tenodesis with ECRB: A 5-year follow-up

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Objective: Scapholunate ligament injuries are frequently initially misjudged or overlooked with a high potential of developing an SLAC wrist within time. Many treatment techniques have been described previously for the reconstruction of the scapholunate ligament. In this study, we present a not yet published treatment option using ECRB for a three ligament tenodesis through a dorsal approach and its 5-year follow-up clinical data of 38 patients.
Methods: The clinical data of 38 wrists in 36 patients (30 men, 6 women, mean age 53 years), operated by a single surgeon, treated for a scapholunate instability with a nonrepairable SL distance of at least 5 mm were evaluated and compared with known data from similar studies.

We evaluated VAS pain, DASH score, Krimmer score, Mayo score, relative grip strength (Jamar dynamometer and pinch gauge) and ROM of the wrist. In addition, X-ray images were evaluated preoperatively, immediately postoperatively and on average 5 years after surgery concerning SL-angle, SL-distance and wrist-arthritis.
Results: The 5-year results of this large study group ($n = 38$) with a relatively high patient age (53 years – literature 36–43 years) showed a very good mobility of about $80 \pm 1.7\%$ of the opposite (uninjured) side in flexion/extension (literature 40–75%).

The grip strength of approximately $87.5 \pm 9.4\%$ in relation to the opposite side is also higher than the average values of comparable studies (65–80%).

The scores: DASH score (22 ± 20), Krimmer score (80 ± 16) and Mayo Wrist Score (76 ± 17) – support these good results, demonstrating the high overall satisfaction of 8.2 ± 2.5 of 10 on the numerical rating scale.

The radiological findings immediately postoperatively of both SL angle and SL width show a significant correction of the pathological SL position. Similar to other studies, these values become worse over time but do not return to the preoperative values.

No patient in this series had to be reoperated and treated with a total wrist arthrodesis.
Conclusions: The SL reconstruction using a dorsal three ligament tenodesis with ECRB shows – in a 5-year follow-up – good to very good functional results with a high patient satisfaction and good function of the wrist in the everyday life of the patients. This technique should be considered a reasonable treatment option even in relatively old patients with an already developing SLAC wrist.

A-0600 Functional outcome after constraint distal radioulnar joint replacement

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Objective: It is well known that the distal radioulnar joint (DRUJ) is important for the function of the hand and wrist. We studied the functional outcome 1 year after constraint distal radioulnar joint replacement (Aptis).
Methods: We included all patients ($n = 68$) who had an Aptis in a cohort, regardless of diagnosis. Disability of Arm Shoulder and Hand, grip strength, and EQ-5D were compared before and 1 year after surgery. Statistics were performed with paired t-test without correction for repeated measurements.
Results: Age of patients: 43 (14) (years (SD)). Patients had a relatively high DASH score before surgery of 58 (14) and this is relatively high compared to normal 10(14); DASH score dropped significantly to 33(16) and this is an improvement of 25 (12) ($p < <0.01$). Grip strength of the affected arm improved 10 (9) kg to 24 (8)kg ($p < <0.01$). EQ-5D was not significantly improved; it fell from 0.12 (0.50) to value 0.46 (0.40) ($p = 0.07$).
Conclusions: Aptis joint replacement yields good functional results 1 year after surgery in a cohort of patients with mixed indications and relatively big preoperatively functional disabilities due to DRUJ problems.

A-0610 The reading level of surgical consent forms in hand surgery

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Objective: Because approximately half of US adults are functionally illiterate or marginally literate (eighth grade reading level and lower), many health agencies, including the NIH, suggest that all patient-directed healthcare material should be written at a sixth to seventh grade reading levels. This study assesses the reading level of surgical consent forms given to patients to determine if they fall within this suggested reading level range.
Methods: A retrospective chart review of charts from seven hand surgeons at a single academic medical center was conducted. We created a cohort of 210 surgical patients (30 patients from each surgeon) who had surgery from 26 June to 1 October 2017. All information written on the consent form by the surgeon was assessed for reading level and readability using the following validated tools: Flesch Reading Ease, Flesch-Kincaid Grade Level, Gunning Fog Index, SMOG Index, and Automated Readability Index. The consent form template was also analyzed using these tools.
Results: The mean Flesch-Kincaid Grade Level was 10.6 (physician range 6.9 to 13.5). The mean Flesch Readability score was 32.7 (scale 0 to 100, physician range 13.2 to 54.5). The mean scores for Gunning Fog, SMOG, and Automated Readability were 11.8, 8.42, and 11.7, respectively (physician ranges: 7.4 to 15.5; 5.2 to 9.9; 8.5 to 14.6). The consent form template has a Flesch-Kincaid Grade Level of 17.1 and Flesch Readability score of 20.8. The consent form template scores for Gunning Fog, SMOG, and Automated Readability were 21.6, 16.2, and 19.5, respectively.
Conclusions: The average reading level of hand surgery consent forms is considerably higher than the suggested level from governing bodies. It is likely that most patients are unable to understand consent forms and common terminology used during hand surgery. This raises concerns about the informed consent process. Further effort is needed from physicians and health systems to simplify consent form terminology.

A-0611 Double oblique osteotomy and rotation of trapezo-metacarpal joint block (DOOR procedure): A surgical technique about 88 cases

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Introduction: Double oblique osteotomy and rotation of trapezo-metacarpal joint block (DOOR) procedure consists in harvesting the trapezo-metacarpal (TMC) joint in block, after double oblique osteotomy of the trapezium and the base of the first metacarpal. The vascularization is preserved on the radial pedicle. Then the articular block is turned by 180°along the longitudinal axis of the thumb, repositioned and osteosynthesized. This procedure is indicated in the treatment of early TMC-joint osteoarthritis associated with instability and dysplasia in young patients.
88 cases have been performed since 2000.
Surgical technique: The procedure is performed under axillary block, tourniquet control without complete vascular draining in order to visualize the small vessels. A modified Gedda–Möberg approach is used. All the tendon bundles of the abductor pollicis longus are cut near their insertion, placed on wire and retracted proximally. The TMC joint is released by starting on the palmar side, at the deep face of the abductor pollicis brevis and then dorsally passing under the extensor tendons. The peri-articular vascular network is preserved in continuity with the radial artery. When the joint and the pedicle are released, the direction and level of the osteotomies are marked by pins. X-rays control is essential. The osteotomies are performed with a fine oscillating saw, 5 mm below the joint spacing for first metacarpal and at the middle part of the trapezium. The complete release of the articular block is not easy; the pins can be used as joystick to facilitate the extraction. When the joint is harvested, the tourniquet is released to check the blood supply and to control hemostasis. We rotate the articular block 180° on the longitudinal axis of the thumb, and the articular surface between the trapezium and the second metacarpal is an excellent reference. The osteosynthesis is performed by pins (two proximal and two distal). After radiographic control, the tendon of the abductor pollicis longus is reinserted on the periosteum of the first metacarpal basis and on the abductor pollicis brevis aponeurosis. The closure is done without drainage. The post-operative immobilization is 1 month and then the rehabilitation is started.
Results: The technique is demanding but perfectly reliable; 88 cases have been performed since 2000. The clinical results are very satisfactory on pain and strength with a long follow-up. In all cases, the radiographic examination shows a stabilized TMC joint with a perfect alignment of the axis of the scaphoid, trapezium and first metacarpal.
Conclusion: DOOR procedure is our choice solution for early stages of TMC-joint arthritis in young patients (before 50), particularly in cases of dysplasia of the trapezium and TMC-joint instability.

A-0612 Glenohumeral fusion in adults with sequelae of obstetric brachial plexus palsy: A report of 8 cases

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Objective: Deformation of the gleno-humeral joint resulting from obstetrical brachial plexus palsy includes glenoid retroversion and loss of the humeral head sphericity. As a result, patients may show posterior dislocation of the humeral head and significant upper limb functional impairment. There is no consensus as to the optimum treatment of the residual paralytic shoulder after the end of the growth. The purpose of this study was to assess the surgical and functional outcomes of glenohumeral fusion performed in adulthood.
Methods: We reviewed eight patients with complete obstetric brachial plexus palsy who had shoulder arthrodesis. The mean age of patients was 28 years old (16–55). All patients had active periscapular muscles and elbow flexor muscles. Preoperatively, glenohumeral morphology was analyzed with computed tomography scanning of the affected shoulder. Mean shoulder flexion, abduction and external rotation were, respectively, 26°, 25° and −13°. The scapulohumeral joint was fused using a non-locking plate in 30° of medial rotation if the hand was functional, and without rotation if the hand was not. Postoperatively, upper limb was splinted in abduction for 6 weeks. Outcome assessment included a video-assisted measurement of the active range of motion of the shoulder, patients' satisfaction and time to fusion.
Results: At an average follow-up of 7 months (2 to 17 months), the active range of motion in flexion, abduction and external rotation of the affected shoulder were, respectively, 78° ($p < 0.005$), 67° ($p < 0.005$) and 21° ($p = 0.03$). All the patients were satisfied with the intervention. Fusion was obtained between 3 and 6 months and no patient had residual pain.
Conclusions: Shoulder fusion improved the active arc of rotation, flexion and abduction in adults with residual obstetric brachial plexus paralysis. In patients with deficient abduction and external rotation, whether they had or not previous surgical attempts to restore shoulder function, shoulder arthrodesis can improve both shoulder range of motion and strength.

A-0617 Can patients predict their postoperative disability after elective hand surgery?

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Objective: Forecasting is a model commonly used by businesses where past experiences and beliefs inform a projection for future outcomes. This study assessed patients' ability to forecast their postoperative pain and disability.
Methods: Upon Institutional Review Board approval, patients undergoing hand surgery completed a questionnaire before their procedure that (1) measured their current hand disability (QuickDASH), (2) recorded pain (Numerical Pain Scale from 0–10), and (3) assessed their forecasted hand disability and pain at 2 weeks postoperatively. The questionnaire also queried the following psychological factors as explanatory variables: Pain Catastrophizing Scale (PCS), General Self Efficacy Scale (GSE-6), and Patient Health Questionnaire Depression Scale (PHQ-2). At the 2-week follow-up appointment, patients completed the Quick DASH and Numerical Pain Scale to assess their realized disability and pain levels. Bivariate analyses were performed to determine the associations among psychosocial factors, demographic characteristics, and number of prior surgeries with differences in forecasted and realized hand pain and disability.
Results: Sixty patients undergoing hand surgery were evaluated. Bivariate analysis using the Pearson correlation coefficient demonstrated that there is a statistically significant correlation ($r = 0.65$; $p < 0.001$) between forecasted disability and realized disability at 2 weeks after surgery. Patient forecasted pain did not correlate with realized pain ($r = 0.34$; $p > 0.05$). Catastrophic thinking had a statistically significant correlation with difference in forecasted and actual disability ($r = 0.31$; $p = 0.01$) and pain levels ($r = 0.27$, $p = 0.03$). Depression correlated with difference in forecasted and actual pain levels ($r = 0.32$; $p = 0.01$). Self-efficacy and number of prior surgeries did not affect a patient's ability to forecast their postoperative disability and pain.
Discussion: Patients are able to forecast their postoperative disability after surgery, but not their pain. Surgeons can use a patient's ability to forecast their postoperative disability to inform preoperative and postoperative interventions to optimize patient-reported functional outcomes.

A-0619 Good results 7 years after wrist arthroplasty revision surgery in 28 patients

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Objective: Wrist arthroplasties fail due to loosening, instability, malposition, pain and infection. Older designs showed unacceptable failure rates and these failures were inevitable converted to arthrodesis. Modern wrist arthroplasties demonstrate good mid- to long-term results similar to ankle, shoulder and unicondylar knee arthroplasties. There are few reports on wrist arthroplasty revision to new components. We have used the Motec® wrist arthroplasty system for revision of failed arthroplasties since 2006. Results with a minimum 1-year follow-up are presented.
Methods: All patients operated with a wrist arthroplasty in our department are included in a prospective follow-up study. Since 2001, approximately 150 primary arthroplasties have been performed. Twenty-eight patients (18 men), 17 right wrists, 59 (27–83) years old had revision arthroplasties (2 were referred to us) 1.4 (0.4–11.0) years after primary arthroplasty surgery. The causes of wrist arthrosis were SNAC/SLAC (14), lunate malacia (5), distal radius fracture/extensive hand injury (4), primary arthrosis (4) and hemophilia (1). Fourteen patients had altogether 30 wrist surgeries prior to primary wrist arthroplasty surgery. The causes of revision were distal component loosening (17), both components loosening (4), proximal component loosening (2), pain (2), inflammation (2) and infection (1). The revised arthroplasties were ELOS (13), Motec® (11), Remotion® (3) and Amandys® (1). All were revised using the Motec wrist arthroplasty system. The patients were examined prior to revision surgery and at annual follow-up including QDASH, PRWHE, VAS score, AROM, grip strength and key pinch. Radiographs were examined for bone–implant contact, osteolysis and subsidence/loosening.
Results: The latest follow-up was 7 (1–13) years after revision surgery. One patient died after 7 years follow-up (unrelated cause, arthroplasty results included). One patient was lost to follow-up. During the follow-up period, 10 patients had further revision surgery to arthrodesis (7) or new components (3) due to infection (3), inflammation (3) or loose components (4). At the last follow-up, QDASH (50 vs 20), PRWHE (39 vs 10) VAS pain scores at rest (63 vs 17) and activity (65 vs 25), grip strength (10 vs 22 kg) and AROM (76 vs 120°) had improved significantly compared to preoperatively ($p < 0.05$). Key pinch was similar at the follow-up. One distal component demonstrates osteolytic lines surrounding the distal component (average clinical result), and the remaining wrist arthroplasties are radiologically well fixed without signs of loosening/subsidence.
Conclusions: The revision surgery was complicated and further revision surgery was necessary in 25% of the patients. Still, successful revisions lead to high patient satisfaction and pain relief, as well as good functional result similar to the results reported after primary arthroplasty surgery. Infections/inflammations are a problem in revision surgery, we did cultures on all revisions, and still there was a high rate of infections/inflammations (6) among the rerevision patients. Whether infection was present at revision (but not diagnosed) or caused by the revision has been difficult to determine since low-grade arthroplasty infections are notoriously difficult to diagnose.

A-0622 Bone healing in scaphoid fracture non union: Correlation of CT and histopathology

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Purpose: The aim of the study was to assess the biological healing capacity of scaphoid nonunions (SNU) and to compare the results to time intervals after fracture, fracture location and radiological signs of bone healing.
Materials and Methods: Thirty-three patients (28 males and 5 females) who were operated for delayed union or SNU were included. Samples of SNU were taken during surgery and evaluated histologically. Parameters for bone healing were defined and a bone healing activity score was calculated. The healing activity was assessed and the results were correlated to time intervals after fracture.

Radiological examination was done prior to surgery. The location of SNU was assessed on 3D CT reconstructions and grouped in three zones depending on the potential blood supply: a white/white zone (WW), red/white zone (RW) and red/red zone (RR). 2D CT reformations were analyzed for bone density, trabecular structure, sclerosis and fragmentation. The results were compared to the histological findings.

Results: The healing activity for the distal fragment decreased significantly over time. The analysis of the proximal fragment did not show a correlation to the age of SNU. A reduced healing potential was observed at the proximal part already at early time points.

The bone healing activity was worst in the proximal fractures of the WW zone. Increased radiodensity was found in the proximal fracture zone and with increasing age of SNU.

Proximal fractures with normal trabecular structure on 2D CTs had a higher bone healing score in histology and a higher prevalence of active bone healing parameters.

The bone healing score was not significantly different for cases with and without sclerosis of the proximal fragment. The prevalence of active bone healing parameters was significantly less in cases with sclerosis.

Conclusion: The bone healing activity of scaphoid nonunions can be defined by histological healing parameters. Bone healing activity changes over time. It depends on the location of the fracture visualized by 3D CT reconstructions. 2D CT findings of bone density, sclerosis, trabecular structure and fragmentation correspond to bone healing activity of the proximal fragment.

This knowledge can be useful in predicting healing potential of SNU and may be helpful for preoperative planning to choose the least invasive procedure to achieve union.

A-0623 The patient perspective on shared decision-making: Should all decisions be shared?

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Objective: Prior studies on shared decision-making in surgery have been primarily focused on treatment decisions. We assessed the extent to which patients want to be involved in decision-making in the diagnosis, treatment, and postoperative management of a typical musculoskeletal disorder.

Methods: We conducted a prospective, cross-sectional study of preoperative and postoperative patients who presented to an outpatient orthopaedic clinic. Patients were asked to complete a questionnaire containing sociodemographic questions. They were also asked to rate their preferred level of involvement on 25 decisions that are made during surgery, such as decision to have surgery, the date and time of surgery, the type of implant, discharge location, and the use of postoperative imaging. Questions were scored from 0 to 10 (0 no involvement, 5 shared involvement between patient/surgeon, and 10 full involvement). We performed bivariate correlations, analysis of variance (ANOVA), and χ^2 to assess the associations among patient demographics, general mean patient involvement score, and mean patient involvement score for preoperative, operative, and postoperative decisions. Alpha level of 0.05 was the threshold for significance.

Results: Sixty-four preoperative or operative patients were evaluated. Mean patient involvement score was 2.5 ± 1.70. Patients wanted to be most involved deciding when the surgical treatment should be scheduled (4.67 ± 2.98) and least involved deciding the size of the incision (1.17 ± 2.17). Age and education were not significantly correlated with mean patient involvement score ($p > 0.05$). Age had a statistically significant correlation to mean patient involvement score for postoperative decisions ($r = -0.26$; $p = 0.03$), but not for mean preoperative and operative decisions. ANOVA demonstrated that there was a statistically significant ($p < 0.001$) difference in mean patient involvement score between preoperative (3.01 ± 1.78), operative (1.73 ± 1.81), and post-operative (2.44 ± 1.95) decisions.

Conclusion: The results of our study demonstrate patients prefer minimal involvement regarding the choices made during an episode of surgical care. They also desire to be less involved in operative decisions related to their care than in pre and postoperative decisions. This also suggests that there are limits to shared decision-making – patients may not want all decisions to be shared. Older patients in our cohort preferred less involvement in postoperative decisions, which warrants further exploration in future studies.

A-0624 Factors accounting for variation in the biomechanical properties of flexor tendon repairs

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Objective: The means of the biomechanical parameters are compared in most studies investigating flexor tendon repairs, whereas the variation within

the parameters is disregarded. Variation should be regarded because a repair method that has relatively low variation ruptures less frequently than a repair method with a similar mean strength but a higher variation. The purpose of this study was to investigate factors that cause variation in the mechanical properties of flexor tendon repairs.

Methods: The study consisted of hundred samples that were divided in groups of 10 based on repaired material and repair method. Fifty homogenous absorbent sticks were repaired with a simple loop, an Adelaide repair, a peripheral over-and-over repair, or a combination of the latter two repairs. Ten of the absorbent sticks were repaired with a jig to reveal the variation of the testing methodology. The group served as a baseline group to the other nine groups. Moreover, 50 porcine flexor tendons were repaired with the same methods. Contrary to the other nine groups, one group of 10 porcine tendon repairs was performed by several surgeons instead of by a single investigator. The samples were loaded statically until failure. Variations for the specific groups and partial variations for each factor were calculated. To make variations comparable, coefficients of variation were used.

Results: The overall variation of the tendon repairs consisted of partial variations derived from testing methodology, tendon properties, surgical performance, and inter-surgeon performance. Variation of the testing methodology was 13.8%. For example, partial variations for the combined repair were 18.2% (performing the repair) and 17.4% (tendon properties). The effect of tendon material properties on the overall variation was generally less than the effects of surgical performance. The variation derived from repair method consisted of both core and peripheral suture: Sum of the overall variations of both components of the repair was of the same magnitude as the overall variation of the combined repair (22.5% vs 25.2%, respectively). However, the additional inter-surgeon variation was relatively small (13.9%).

Conclusion: Based on the study, a hand surgeon can have a significant impact on the resulting repair. Because the variation of tendon material cannot be affected, a surgeon can reduce the failure rate of the repair by performing more uniform repairs. Lowering the variation of the repair by third leads to decrease of the failure rate to half. Finally, none of the partial variations was markedly greater than the other. The variation of the combined repair is sum of its partial variations, at least with the Adelaide core repair and over-and-over peripheral repair.

A-0630 Assessment of scaphoid fracture patterns using a 3D-CT model

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Introduction: The scaphoid plays a central role in carpal kinematics. It is prone to injury and reported to be the most frequently fractured carpal bone. The complex shape of the scaphoid and its tenuous blood supply increase the risk of non-union. The main goal in scaphoid fracture treatment is anatomical reconstruction to avoid long-term consequences of osteoarthritis and pain. Therefore, imaging has to display the fracture patterns as exact as possible.

Fracture gaps and angular deformities can be well demonstrated and measured using 2D CT imaging. To give an exact picture of fracture patterns and areas important for stability and blood supply, 3D imaging is necessary.

Method: We developed a technique for measurement of intraosseous rotation of the scaphoid for daily clinical use based on surface landmarks on a 3D CT model using common volume rendering software.

Based on this method, we assessed the prevalence of intraosseous malrotation of scaphoid fractures (SF) and scaphoid non-unions (SNU). Forty-five patients (41 males and 4 females) who were treated for a SF (25) or SNU (20) were included. CT scans of both wrists were made and rotation was assessed. The amount of malrotation was compared to fracture classifications, kind of treatment, healing process and age of fracture.

In a second study, we investigated which additional information the 3D CT measurement can provide regarding fracture patterns, stability and vitality. This was investigated in 68 patients (57 men and 11 women) who were treated for SF and SNU. Forty-two patients were treated for SF and 26 for SNU. X-rays, 2D CT and 3D CT images were compared on how well they could reflect the real situation regarding fracture gap, fracture location, fracture plane and course of the fracture.

Results: Our results show that malrotation is a common fracture pattern. In the SF group, we found it to be greater than 4° in 25% of the cases as opposed to 47% in the SNU group. Malrotation is an additional stability pattern that may impact on treatment decisions.

The 3D analysis of fracture patterns provides additional information in comparison to 2D imaging. 3D imaging enables exact information about fracture location and the course of the fracture line in relation to relevant anatomical landmarks. The correlation of

fracture patterns to anatomical regions can give important information on stability and vitality of fracture fragments. This may be especially helpful in preoperative planning.

A-0651 Reconstructive surgery of gunshot and explosive wounds of the upper limb

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Objective: Combat wounds of limbs are an actual and unresolved issue of modern surgery of injuries. In connection with the variety of damaging factors and the complex anatomy of the upper limb, each case can be considered unique and requires an individual approach.
Methods: In our study, patients with gunshot and explosive wounds of the upper limb were included. A total of 18 patients participated in the study. The following indicators were analyzed: the mechanism of injury, the level of damage, the operations performed, the need for osteosynthesis, the need for plastic surgery, the duration of treatment, early and long-term functional results.
Results: The analysis of the obtained data showed for all patients, regardless of the area of damage, treatment began with debridement, application of negative pressure wound therapy from 24 h from admission, monitoring of wound condition (soft tissues), and from 5 to 7 days closure of the soft tissue defect was performed.

There were revealed such feature in the treatment of hand injuries as dissection of the carpal ligament to all patients with wounds in the hand area; primary osteosynthesis was performed using K-wires; in half the cases, the use of reconstructive-plastic methods for restoring soft tissue defects (primary closure, plastic with local flaps, Italian plastic), as well as on the bones (e.g. four-finger pollicization) was required; restoration of tendons, the suturing of nerves and vessels was postponed until the edema and the ability to close the soft tissue defect were reduced.

For the forearm, the principles are similar; in one case, bilocal osteosynthesis of the forearm bones in the external C-frame (Ilizarov apparatus) was performed with a significant defect in both bones.

Patients with lesions in the shoulder region required primary osteosynthesis by an external fixation. Significant soft tissue defects were restored at the same time by the displacement of the thoracodorsal artery perforator flap (in two cases, the technique was supplemented by taking a flap with a rib to restore the bone defect). The final osteosynthesis was performed not earlier than the soft tissue stabilization, in three cases free bone implantation was used with an autograft from the iliac crest. In two cases, posttraumatic neuropathy of the radial nerve was identified, for the correction of which the flexor tendons were transposed to the extensor position.
Conclusions: The approach in the treatment of patients with severe trauma to the upper limb should be comprehensive, according to the principles of orthopaedic damage control, osteosynthesis should be consistent, the main role in assessing the severity and prognosis of treatment is played by soft tissues.

A-0655 A 5-year prospective outcome study of Pyrocardan® arthroplasty for the treatment of thumb carpometacarpal joint osteoarthritis

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Objective: The purpose of this study was to evaluate the results of arthroplasty using the pyrocarbon interposition implant (Pyrocardan®) in the treatment of early and intermediate stage trapezometacarpal osteoarthritis with a minimum follow-up of 5 years.
Methods: It was a prospective and continuous study. The evaluation focused on bilateral objective criteria of mobility (M1—M2 angle antepulsion and abduction, flexion and hyperextension of MP and IP, Kapandji and retro-Kapandji), strength (tip-pinch, key-pinch and grip at Jamar), pain (VAS), functional self-questionnaires (Quick-DASH and PRWE) and standard X-ray. We evaluated a possible subsidence of the implant by the measurement of trapezial and metacarpal indices. All the implants were placed according to the same operative technique by one operator.
Results: Sixty-two implants in 58 patients were included with an average age of 57 years and a mean follow-up of 64 months (56 to 78 months). There were four reinterventions: two for implant removal associated with trapeziectomy and two for a size change of an under-sized and painful implant after 1 and 2 years. The PRWE and the quick-DASH scores were 60 and 52.27 preoperatively and 4 ($p < 0.0001$) and 6.82 ($p < 0.0001$) at 5 years. The mean VAS was 7 preoperatively and 0.6 to 5 years ($p < 0.0001$). The average tip pinch at 5-year follow-

up was 6.5 kg ($p = 0.02$). The other results on strength and mobility were not modified by the intervention. However, they were comparable to the controlateral side both before and after the intervention at the last follow-up. The average recovery time was 12 weeks; 95% of patients were very satisfied and satisfied. Radiologically, there were three significant subsidence of the implant at the trapezium and three at the metacarpal level without any clinical impact.
Conclusions: All patients increased strength and quality of life significantly with significantly reduced pain, sustained mobility and early resumption of activities. The overall satisfaction of patients was high. A therapeutic alternative is always possible in case of failure (3% in the series).

Trapezometacarpal interposition arthroplasty with the Pyrocardan implant is a minimally invasive and effective medium-term solution for the treatment of early and intermediate-stage rhizarthrosis.

A-0656 The extensor mechanism in radial polydactyly: Anatomical findings and anatomical treatment at primary surgery

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Objective: Radial polydactyly (RP) comprises a diverse range of anomalies. Anatomical complexity may be underestimated resulting in poor outcomes from primary surgery and secondary deformity. There is little description in the published literature on the variability of extensor tendon anatomy and its treatment in RP.
Materials and Methods: A prospective anatomical study of 52 primary operations for RP. Systematic recording of operative anatomical findings and procedures performed for the extensor mechanism.
Results: Fifty-two operations in 45 patients, seven bilateral, M = F, Wassel groups II–VII represented. Age at surgery 7 months to 10 years. Extensor pollicis longus (EPL) inserted into both duplicates in 54% (28/52), ulnar duplicate only in 40% (21/52), radial duplicate only in 4% (2/52), and not present in 2% (1/52). Extensor pollicis brevis (EPB) inserted most frequently onto the radial duplicate. Anatomical anomalies included interconnections between flexor and extensor 24% (12/50), interconnections between extensor duplicates, extensor connections to skin, hypoplastic tendons, and EPB with anomalous insertion to distal phalanx acting as EPL. Variability was observed between and within Wassel groups. Procedures for EPL included division of anomalous connections, use of non-dominant duplicate extensor to augment EPL, centralization of EPL, and resection of EPL non-dominant duplicate. The most frequent procedure for EPB was reinsertion on the ulnar duplicate.
Conclusion: There is marked variability of extensor anatomy between and within Wassel groups. We advocate an anatomical approach to treatment. This optimizes results from primary surgery, provides useful prognostic information, and guides management of late deformities.

A-0657 Clinical outcome of collagenase *Clostridium histolyticum* in Dupuytren's disease independent of fibrosis diathesis score?

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Objective: *Collagenase Clostridium histolyticum* (CCH) injection is an alternative to surgery for finger contractures in Dupuytren's disease (DD). Recurrence rate after surgery in DD range from 0% to 71%. Some patients have a benign and limited disease and others have a widespread and progressing form. The term diathesis relates to certain features of Dupuytren's disease indicating an aggressive course. Patients with a severe diathesis have more aggressive forms of the disease with an elevated postoperative risk for recurrent contractures. The factors related to Dupuytren's diathesis are age of onset under 50 years, bilateral disease, history of surgical treatment for fifth ray involvement, Ledderhose disease, knuckle pads and first ray involvement.

Our aim was to present the outcomes of patients with DD contractures treated with CCH injections at our institution and to investigate the relation between the clinical outcome of collagenase *Clostridium histolyticum* treatment and the patients' diathesis score.
Methods: We reviewed all patients treated with CCH injections for contracture in DD in our institution from September 2011 to July 2014. In all patients, the cords were injected with CCH and the fingers were manipulated 2 days later. One to four years after CCH injection patients completed a disease recurrence questionnaire at home. Three to six years after the treatment patients without evidence of recurrence on chart review or questionnaire were invited for a follow-up visit with clinical examination and questions in order to calculate the fibrosis diathesis score.

Recurrence was defined as patients who sought treatment for a return of symptoms or a contracture

greater than 20° in the setting of a palpable cord after initial full or partial contracture correction.

Results: Sixty-seven patients with a total of 79 affected hands were treated with CCH infections (57 males; 10 females; age: 27–87 years). The disease recurrence questionnaires showed a relatively high rate of self-reported recurrence (58%) at a mean follow-up of 21 months. All patients participated in the questionnaire. No correlation was found between the diathesis score and the DD.

Of the 67 patients (79 hands) who were treated, 12 patients (13 hands) were lost to follow-up. A chart review showed that 29 hands had already been operated for recurrent disease. Recurrence was also reported in 10 hands on an earlier clinical visit, at least 2 years after treatment, but these patients preferred no further treatment. The remaining 24 patients (27 hands) were invited for clinical examination; 11 hands showed no recurrence, 17 hands had recurrence. There was a general high recurrence rate (84%) with a mean follow-up of 48 months.

Conclusions: Our study demonstrated a high rate of self-reported recurrence of DD after treatment with CCH injections at a mean follow-up of 21 months, which did not seem to be correlated with the fibrosis diathesis score. The clinical recurrence rate at a mean of 48 months was even higher and probably also not correlated with the fibrosis diathesis score. However, not all patients with recurrence required additional treatment with CCH or surgery.

A-0659 Arthroplasty of the wrist with the Amandys implant: Results of a monocentric series of 38 cases with a minimal follow-up of 5 years

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Objective: The arthroplasty with Amandys implant is indicated in large articular wrist destruction. The goal of this study was to evaluate the midterm results of this implant and to know if the postoperative results persist over time.

Methods: The concept of the Amandys arthroplasty is that of a free interposition radiocarpal and midcarpal spacer implant made out of pyrocarbon. The monocentric series included 38 Amandys implant with a minimal follow-up of 5 years.

Results: Two patients died and four were lost of follow-up. The mean follow-up was 64 months. At the last follow-up, the mean grip strength was 21 kg (67% of the controlateral grip strength and 13 kg before surgery), the mean range of motion in flexion–extension was 75° (66° before surgery), and the mean inclination values was 35° (34° before surgery). The mean total PRWE was 26/100 (62/100 before surgery), the mean Quick-DASH was 28/100 (64/100 before surgery) and the mean pain was 3/10 (6.5/10 before surgery). The grip strength, the PRWE and the QDASH were significantly improved between the follow-up of 2 years and the follow-up of 5 years. No migration or impaction of the implant was observed on X-rays at the last follow-up. Six revision surgeries were necessary to correct malposition of the implant, always in the first year after surgery.

Conclusions: This study confirms that this implant is well tolerated clinically and radiologically and presents a surgical option for treatment of advanced wrist destruction. Its stability depends of the bones resection, the capsuloligamentous tension and the size of the implant but does not change with time. The function of the wrist and the grip strength improves over time.

A-0662 Therapy of fingertip injuries: The semi-occlusive dressing as an alternative option to local skin flaps

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Objective: Fingertip injuries are very common in emergency departments and the reconstruction is a central aim of their management. According to the literature, finger tip injuries in the level of Allen III and IV should be treated by local skin flaps. The main purpose of this study was to evaluate the outcome after semi-occlusive dressing therapy in respect of soft tissue cover, recovery of sensibility and duration of sick leave.

Methods: One hundred and fourteen fingertips injuries from 2009 to 2011, treated with semi-occlusive dressing, were retrospectively analysed. In all of the cases, the injured fingers were only cleaned, debrided and covered with an occlusive dressing. The bone was not shorted, even if the bone was up the wound level. The primarily occlusive dressing was left as long as possible and had been, when necessary, obdurated. The different types of fingertip

injuries were classified according to the levels set by Allen. Furthermore, the treatment time with the semi-occlusive dressing and the period of disability was recorded. On every patient, a Semmes–Weinstein test was performed to document the sensitive outcome.

Results: A total of 114 patients were treated with a semi-occlusive dressing. The mean age was 36 ± 14 years, and the mean treatment duration 21 ± 10 days. The mean period of disability was 30 ± 17 days. After taking off the semi-occlusive dressing, the main period of disability was 8 ± 13 days. According to Allen, following composition of fingertip injuries occurred: 49% Allen 1, 33% Allen 2, 13% Allen 3 and 5% Allen 4. All patients developed a satisfactory tissue cover and the sensibility was, according to the Semmes–Weinstein test, normal. There were no complications like tissue infections, neuroma or osteitis. Also no secondary flap supply was necessary.

Conclusion: The semi-occlusive dressing is an ideal therapy for all kind of fingertip injuries, regardless of the amputation level. There may be even bone exposed on the wound level. It is an easy, cheap and safe therapy with no complications and leads to an excellent result in function, sensibility and carrying capacity. The semi-occlusive dressing is a suitable alternative in treating fingertip injuries.

A-0663 Atypical cleft hand: Surgical technique for grasping improvement

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In this article, we present cases of children with atypical cleft hand classified as oligodacytic (Blauth and Gekeler), type IIA (Foucher) or multidactyly (Woodside and Light), all of them with the absence of the second finger but the corresponding metacarpal is present and normal. Some children have thumb metacarpal-phalangeal (MP) instability. Clinically they have lack of pulp to pulp pinch due to MP ligament insufficiency and difficulty in grasping large objects since first web is narrowed.

Six children between 2 and 13 years old, four girls and two boys, with unilateral atypical cleft hand were included for this analysis. All of them have thumb and ulnar fingers or ''nubbins.'' Second finger is absent in all cases but one, second metacarpal were present and normal. All children have normal global function considering respective ages for daily living activities. Three of them have thumb metacarpal-phalangeal (MP) instability and lack of pulp to pulp pinch.

All children have difficulties in grasping large objects.

Second metacarpal resection and Z-plasty created a wide first web that allowed large objects prehension.

The second ECD tendon transfer improves stability of thumb MP joint that makes pinch grip with fifth finger possible.

The surgical technique presented in this article did improve function in oligodactyly or type IIA atypical cleft hands allowing grasp of large objects

A-0678 Delayed primary repairs of the flexor tendons had better outcomes than primary repairs in zone 2: An outcomes analysis in a single unit

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Objective: We reviewed our patients with complete divisions of zone 2 finger flexor tendons using a six-strand core M-Tang suture with early active mobilization from a single unit and aimed to assess and analyze the different functional recovery of fingers treated with the delayed primary and primary repair.

Methods: We repaired 80 flexor digitorum profundus (FDP) tendons (80 fingers) of 66 patients from November 2013 to May 2017. There are 52 men and 14 women. The patients aged 17 to 65 years, with average of 35 years. Thirty-six fingers were repaired after a delay a mean of 4 (2 to 10) days with primary skin closure and later tendon repair in a non-emergency surgical setting. Forty-four fingers were repaired primarily with 12 h after injury. The FDP tendon was exposed through a Bruner's incision and the tendon was repaired with the 6-strand M-Tang repair using 4-0 looped suture and sparsely placed simple running peripheral suture with 6-0 or 5-0 nylon. After surgery, the fingers were immobilized for 3—4 days and partial range digital active motion was initiated after that. The patient was encouraged to actively move the fingers interphalangeal joints and metacarpophalangeal joint to about ½ of the total motion range in the first 1—3 weeks. Then the patient proceeded to full range of active motion around the end of week 3. The primary repair in our series was performed during the late afternoon or nighttime, while the delayed primary repair was at daytime. We compared the functional results and

demographics and injury factors (gender, age, accompanied injuries, and follow-up lengths) between patients treated with primary repair and delayed primary repair using the Student t-test, Kruskal–Wallis rank sum test and Fisher exact test.
Results: Among the total of 80 fingers, the mean range of motion (ROM) of the proximal (PIP) and distal interphalangeal (DIP) joints was 153 ± 29 with follow-up of 5 to 27 months. According to the Strickland and Glogovac criteria, 46 fingers (57%) were rated as excellent, 19 (24%) good, 11 (14%) fair and 4 (5%) poor. There were no tendon ruptures. The mean ROM in the 36 fingers with delayed primary repair was $161 \pm 25^{\circ}$, which is significantly better than that of 44 fingers with primary repair of $146 \pm 30^{\circ}$ ($p = 0.018$). There are 25 excellent, 7 good, 3 fair, 1 poor in the fingers with delayed primary, and 21 excellent, 12 good, 8 fair, 3 poor with primary repair using the criteria of Strickland and Glogovac. We found no significant differences in demographics and injury factors (gender, age, accompanied injuries and follow-up lengths) between the two groups.
Conclusions: A primary repair in the late afternoon or nighttime has worse outcomes than delayed primary repair as a selective procedure, performed a few days after trauma. We conclude that in order to obtain a better functional recovery, surgeons must have sufficient energy and less fatigue. We suggest that delayed primary flexor tendon divisions are preferable than primary repair in the late afternoon or nighttime.

A-0686 New arthroscopic classification of TFCC injuries

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Objectives: Palmer's classification described in 1989 which was based upon findings of radiocarpal joint arthroscopy is now widely used. Due to several reports of other types of TFCC injury that was not in Palmer's classification, such as the dorsal or coronal tear or due to recent development of DRUJ arthroscopy, we need new thorough classification both includes RCJ and DRUJ sides. We tried to classify our case series of consecutive 213 TFCC lesions in a year period.
Methods: From July 2014 to September 2015 (1 year and 2 months period), 213 wrists of 211 TFCC injury patients who underwent first-look arthroscopy both in the RCJ and DRUJ were included in this study. There were 123 males and 88 females, right wrist of 116, left of 93 and 2 bilateral. Average age of arthroscopy was 39.1 year (range 13–72). All data were recorded on cards and DVDs.
Results: On radiocarpal arthroscopy, 191 TFCC injuries were categorized as traumatic: in which A as the central lesion: slit (13), flap (2), double transverse slit (1), oblique (2), coronal (1), bucket handle (2); B as the ulnar peripheral (150); C as the palmar distal (1); D as the radial: within the disc (4), radial rim (1); E as the dorsal: dorsal isolated (2),extended dorsal to ulnar (8); F as the palmar (2); and G as the horizontal (2). Degenerative tear was found in 48 wrists as similar to Palmer's classification; wear of the disc (9), wear + the LT tear (7), perforation (21), perforation with chondral lesion of the lunate and/or triquetrum cartilages (11). On DRUJ arthroscopy, traumatic TFCC injuries were found in 19 wrists, subclassified with A (proximal slit) (1), B (partial RUL avulsion) (1), and C (complete RUL avulsion) (17). Degenerative findings on the proximal side of the TFCC were found in five wrists with DRUJ arthroscopy, in which degenerative fibrillation on the proximal surface of the TFCC in 2, and relaxed RUL in 3. Isolated injury was found in 144 wrists (67%), in which the RCJ-B type (classical Palmer 1B) tear were 90, followed by DRUJ-C type (complete RUL avulsion) in 17. Double lesions were found in 65 wrists (30%), in which combination of RCJ-B and DRUJ-C (presumable complete ulnar lesion) was the most in 19 wrists. Triple injuries were found in four wrists, all included RCJ-B tear and three wrists included DRUJ-C type.
Conclusion: We classified TFCC lesion based upon RCJ and DRUJ arthroscopic findings. In the isolated injuries, RCJ-B type (classic Palmer 1B) was the most, followed by DRUJ-C type (complete RUL avulsion). One third of our series indicated combined double or triple lesion that included lesions onto the RCJ and DRUJ. To diagnose TFCC lesion thoroughly, both RCJ and DRUJ arthroscopy are necessary.

A-0691 Nerve transfer for restoring pinch strength in high median nerve injuries

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Objective: Our goal is to evaluate the possible reconstruction of thumb flexion in a way to get pinch in the hand using nerve transfer of the motor branch of the extensor carpi radialis brevis muscle (n. radialis) to the n. interosseous anterior (n. medianus) reinervating m. flexor digitorum profundus and m. flexor pollicis longus.
Method: This is clinical presentation in a series of five patients with high injury of n. medianus-innervated muscular paralysis with duration of 8–14 months.

Operative intervention is a nerve transfer under a microscope magnification of the motor branch (n. radialis) of m. extensor carpi radialis brevis (ECRB) to n. interosseous anterior (n. medianus) with clinical outcome-possible pinch in the hand. S-shaped approach is used in proximal 1/3 of the anterior forearm. The branches of n. radialis are found one by one with operating microscope – n. superficialis (sensory), m. extensor carpi radialis brevis (motor), m. supinator (motor) and n. interosseous posterior. The motor branch to the m. extensor carpi radialis brevis is tracked maximally distal and is resected just before entering the muscle. The coaptation is made (end-to-end) to n. interosseous anterior (n. medianus) using surgical suture 9-0. Also nerve transfer of dorsal sensory nerve (n. radialis) to the volar sensory nerve (n. medianus) is made in a way to restore sensibility of the volar part of the digital pulp of the thumb and index finger.
Clinical Results: First clinical manifestations are found 9 months postoperatively. As all patients achieved pinch M4 (in MRC) in 18 months postoperative and maintained the active wrist extension.
Conclusion: This is one good suggestion for restoring the pinch of the hand using nerve transfer in patients with high nerve injury.

A-0705 Validity of the patient-rated wrist evaluation questionnaire in rheumatoid hand

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Patient-Rated Wrist Evaluation (PRWE) is a patient-reported questionnaire focusing on the symptoms and functions in wrist pathologies. It consists of 15 questions of pain and functional activities of the wrist. Rheumatoid arthritis (RA) is a multi-systemic disease involving primarily the inflammation of the wrist and hand joints. Therefore, this study aims to test the validity of PRWE in patients with RA.

Seventy-five patients with RA from one outpatient clinic participated in the study. Patients filled out the Michigan Hand Outcomes Questionnaire (MHOQ) and gross grip strength was measured for both hands. Patients filled out the PRWE questionnaire for each right and left hand consecutively. Questions of PRWE were asked to the patients regarding dominant and non-dominant hand. Correlations between PRWE and MHOQ and gross grip strength scores were analyzed by Spearman's correlation to assess validity of PRWE.

Our results demonstrated that PRWE had negative and strong correlation with MHOQ for dominant hand ($p = -0.83$, $p < 0.001$) and had negative and moderate correlation with MHOQ for non-dominant hand ($p = -0.79$, $p < 0.001$). PRWE showed negative and fair correlation with grip strength for both hands. All correlations were statistically significant ($p < 0.05$).

PRWE is a valid tool for evaluating the wrist involvement in patients with RA. PRWE may be preferred in the clinical setting for its simple and short questions. Additionally, it may provide a sensitive follow-up process for patients with its subscales regarding pain and function separately.

A-0712 Long-term outcomes of the use of a spherical ulnar head prosthesis for failed Sauvé-Kapandji procedures

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Objective: The use of a spherical ulnar head prosthesis (UHP) for the treatment of symptomatic radioulnar convergence after Sauvé-Kapandji (SK) procedure has shown promising results in the short term. This study aims to evaluate the long-term outcome of the original cohort of patients treated with this technique.
Methods: Seventeen patients with confirmation of unstable ulnar stumps both clinically and

radiographically were studied. The etiology for the initial SK procedure included post-traumatic distal radioulnar joint incongruity, primary DRUJ arthrosis and dysplastic DRUJ. All but three patients had a minimum of two and a maximum of six operations prior to having a spherical UHP. All patients suffered from severe pain with difficulty in performing work and daily activities. Ceramic UHP was used for all patients except two of which cobalt chrome head was used.

Results: The average follow-up was 6 years (range 4–17 years). The reduction of pain was statistically significant with 11 patients who remained pain free. The range of motion of the wrist and power grip was maintained to and showed a statistically significant improvement at the late follow-up. The DASH score also significantly improved from 77 to 41 with a $p = 0.03$. The average patients' satisfaction score was 9 of 10.

No signs of loosening of the prosthesis were noted at the late follow-up. The only two patients who had received cobalt chrome head prosthesis developed significant osteolysis as well as pain and had to be revised to the Scheker total DRUJ prosthesis. Two patients who suffered from traumatic dorsal subluxation of the prosthesis were treated with radial osteotomy, both with a satisfactory result.

Conclusion: This study illustrates that the late results of ceramic spherical ulnar head prosthesis for failed SK procedures in this small but representative patient series are encouraging.

A-0719 Wide-awake hand surgery: Limits and complications

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Wide-awake hand surgery or WALANT has been established as a safe and cost-efficient alternative to traditional hand surgery. However, there is only few information on complications or limits of this approach. We report a single surgeon's experience in 318 cases.

Between 2012 and 2017, the presenting author performed 318 acute and elective hand surgical procedures utilizing 1% Ultracain with 1:200,000 epinephrine. All cases were retrospectively reviewed for intraoperative or postoperative complications. In addition, we conducted telephone interviews with the patients after a mean of 7 months after the procedure and asked about further complications and the overall experience.

In two cases of tenolysis of the palm and forearm, respectively, there was incomplete anesthesia, presumably due to incomplete diffusion because of extensive scarring. Both cases were intraoperatively converted to general anesthesia. One patient with delayed sagittal band reconstruction demonstrated a rash on the dorsum of the hand for several days, another patient-reported prolonged swelling of the injection site. An 87-year old patient developed transient coronary spasm without evidence of myocardial ischemia 3 h after injecting 14 ml of anesthesia for carpal tunnel release. Two patients reported that they would have preferred a different form of anesthesia.

Vascular anastomoses demonstrated a highly variable degree of flow during WALANT, ranging from no flow to normal perfusion.

The WALANT approach can be utilized in many different hand surgical procedures. In our experience, anesthesia may be unreliable in cases with extensive preexisting scarring. Patients who are ambiguous about the concept of being awake during surgery should not be persuaded. The WALANT approach should not be performed in cases with preoperatively impaired finger perfusion.

A-0720 Lower recurrence rate of Dupuytren's contracture in metacarpophalangeal joints following collagenase *Clostridium histolyticum* treatment compared with percutaneous needle fasciotomy in a randomized controlled study: Preliminary results

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Objective: Few studies report on recurrence rates following treatment with collagenase histolyticum injections (CI) of Dupuytren's contracture (DC) in comparison to other treatment modalities. To evaluate CI against another minimally invasive treatment modality, an RCT comparing CI and percutaneous needle fasciotomy (PNF) of the MCP-joints in DC was initiated.

Methods: Sixty-two patients suffering from DC with isolated extension deficit $\geq 30^\circ$ in a MCP-joint were invited to participate in the RCT. The patients were allocated to either CI injection in accordance with the manufacturer's guidelines or PNF. Only one treatment pr. patient entered the study.

Patients were followed for 1–3 years. Recurrence of DC $\geq 30^{\circ}$ and/or reoperation of the treated digit were considered failure of the treatment.

Results: Thirty-two patients were allocated to CI and 30 to PNF. Four patients in the CI group withdrew their consent to participate prior to treatment leaving 28 patients in the CI group. In two patients in the PNF group, rupture of the cord was unsuccessful ($<20^{\circ}$ improvement of contracture) leaving 28 patients for follow-up (FU). Fourteen were female and 48 were male patients.

At FU, four patients in the CI group and 14 patients in the PNF group were considered failures. χ^2 8.2, $p < 0.005$.

Conclusion: CI yields superior results as compared to PNF at FU at 1–3 years in the treatment of isolated DC in MCP-joints as the recurrence rate is significantly lower.

Longer follow-up is needed to evaluate the medium and long-term recurrence rates.

A-0722 Use of a photodynamic polymer for intramedullary osteosynthesis of metacarpal fractures: A 3-year experience

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Patients and Methods: From December 2014 until November 2017, 76 patients with metacarpal fractures have been treated with an intramedullarily applied photodynamic polymer (IlluminOss^{TM}). The indications for surgical treatment were either multiple mc fractures, fracture angulations greater than 40° and/or malrotation of digits. All patients with an IlluminOss osteosynthesis and a clinical and radiological follow-up of at least 12 weeks were included in this study ($n = 57$ patients with $n = 61$ fractures). The cohort includes fractures of a single metacarpal as well as multiple metacarpal fractures. Cases with multiple injuries to the same hand, which were treated by a combination of osteosynthesis, were also included.

Results: Eight cases had shaft fractures. In all other cases, subcapital fractures were treated. In three cases, multiple metacarpal fractures were treated. In four cases, adjuvant osteosynthetic material was used. All IlluminOss fractures were healed at week 12. No implant-related infection was seen. In five cases, mild to moderate secondary dislocation was seen but surgical revision was not necessary. In one case with a particularly comminuted fracture, implant failure occurred requiring surgical revision. In two cases of split head fractures, intraarticular protrusion of the implant was seen necessitating operative shortening of the implant. Range of movement was compared to the contralateral uninjured side and improved in the course of clinical follow-up, but was dependent on severity of the injury. Subjective satisfaction measured by the Quick-DASH score was good in all patients.

Conclusion: Osteosynthesis by means of a photodynamic polymer is a safe and stable method to treat metacarpal fractures allowing an early mobilization and minimizing cast treatment. Due to the intramedullary implantation, surrounding soft tissues are preserved. We observed a steep learning curve in terms operating time and use of the implant system. We found a low complication rate comparable to other established paths of treatment, but in general implant removal is not necessary.

A-0730 Influence of plate types on clinical and radiological outcomes of ulnar shortening osteotomy in patients with idiopathic ulnocarpal impaction syndrome

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Background: The purpose of this study was to assess influence of plate types on clinical and radiological outcomes of ulnar shortening osteotomy in patients with ulnocarpal impaction syndrome by comparing AO 3.5 dynamic compression plate, 3.5 limited contact-dynamic compression plate and ulnar osteotomy plate. In addition, the effect of interfragmentary screw fixation during ulnar shortening on radiologic outcomes of ulnar shortening osteotomy was assessed.

Materials and Methods: Seventy-eight patients who underwent ulnar shortening osteotomy using plate fixation and were followed-up at least 1 year were enrolled. Three types of plates were consecutively used: AO 3.5 dynamic compression plate (group 1, $n = 31$), AO 3.5 limited contact-dynamic compression plate (group 2, $n = 19$), AO 2.7 ulnar osteotomy plate (group III, $n = 28$). The patients were also divided into two groups based on performing interfragmentary screw fixation: interfragmentary screw fixation group ($n = 27$) and without interfragmentary screw fixation group ($n = 51$). The clinical outcomes were evaluated by disability of arm, shoulder and hand, Patient-related wrist evaluation. Radiological outcomes including time to bone union, presence of

delayed union which was defined when the union was not observed until 12 weeks, and re-fracture after metal removal were assessed. Other possible factors that might affect bone union such as smoking and underlying disease were assessed.
Results: All patients showed union at the final follow-up. There were no statistically significant differences in both clinical and radiological outcomes according to the types of plates. When comparing the groups treated with and without interfragmentary screw fixation, time to bone union was shorter in the interfragmentary screw fixation group (7.56 ± 2.56 weeks vs 9.79 ± 6.59 weeks, $p = 0.038$). Delayed unions were only observed in 8 of 51 patients treated without interfragmentary screw fixation (15.68% vs 0%, $p = 0.045$). In ulnar shortening without interfragmentary screw fixation group, 5 of 43 patients (11.62%) who removed the plate had experienced re-fracture of the ulna by low energy trauma after plate removal. However, there was no significant difference of clinical outcomes between the interfragmentary screw fixation group and without interfragmentary screw fixation group (Table 2).
Conclusion: Types of plate did not influence the clinical and radiological outcomes of ulnar shortening osteotomy in the patients with idiopathic ulnocarpal impaction syndrome. However, interfragmentary screw fixation with plating for ulna shortening osteotomy has several advantages such as early bony union and prevention of re-fracture after metal removal.

A-0733 Dupuytren disease 7-day manipulation following collagenase: Safety, efficacy and outcomes

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Objective: Determine the safety, efficacy and outcomes of 7-day manipulation following the use of injectable collagenase *Clostridium histolyticum* (CCH) for Dupuytren disease.
Methods: Patients presenting with Dupuytren' disease were offered treatment with collagenase injections. Baseline demographic and medical data were collected. In addition, total passive extension deficit (TPED) and patient-reported outcome measures (PROMS) were recorded prior to treatment, and at 6 weeks, and 6-month post-manipulation. Patients underwent a standard treatment protocol of injection D0 and manipulation D7 under local anaesthetic on an outpatient basis. Results were collected prospectively and analysed.
Results: One hundred and thirty-nine patients (98 males, 74.2%) with a mean age of 65.7 years (range 38.6–87.7) have been treated to date. In 34% of cases, the disease represented a recurrence. Anticoagulants were taken by 63% of patients. There was a significant improvement in PED across injected rays ($p < 0.001$). In addition, patients demonstrated highly significant improvement in function and quality of life on Southampton ($p < 0.001$), URAMS ($p < 0.001$) and ''Patient SET'' ($p < 0.001$) questionnaires. A typical spread of minor complications and no major complications were encountered.
Conclusions: Our data suggest that 7-day manipulation following injection of collagenase is safe to use in patients with Dupuytren's disease. It demonstrates significant improvements in objective and subjective measures of hand function. These data suggest that it is safe and efficacious to manipulate, following collagenase up to 7 days post injection.

and grip strength at 4, 12, and 24 weeks after surgery.

Results: In wrist flexion, volar displacement of EPB was 1.37 ± 0.63 mm in group 1 and 0.31 ± 0.85 mm in group 2 at 12 weeks after surgery ($p < 0.001$), 1.25 ± 0.61 mm in group 1 and 0.36 ± 0.69 mm in group 2 at 24 weeks ($p < 0.001$). The change of tendon subluxation between 12 and 24 weeks was not significant ($p > 0.05$). In wrist extension, dorsal displacement of the tendons was 0.56 ± 1.36 mm in group 1 and 1.92 ± 1.75 mm in group 2 at 12 weeks after surgery ($p = 0.024$) and at 24 weeks ($p = 0.069$). Otherwise, no significant difference between two groups was found in the other position of the wrist. Clinical outcome measures including DASH score, VAS, and grip strength showed no difference between the groups. There were no significant correlations between tendon subluxation and clinical outcome measures ($p = 0.618$).

Conclusion: Tendon subluxation after first compartment release for de Quervain disease is more increased during wrist flexion in the simple midline incision and during wrist extension in the dorsoulnar incision elevating the radial flap. However, tendon subluxation after first compartment release does not affect clinical outcomes.

Level of evidence: Level 1, Therapeutic.

A-0737 Tendon subluxation after surgical release of the first compartment in de Quervain disease: A prospective randomized controlled study comparing simple midline incision and dorsoulnar incision for elevating radial flap

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Purpose: To evaluate tendon subluxations using ultrasonography after release of the first compartment in patients with de Quervain disease and to compare the clinical and functional outcomes between the midline incision and dorsoulnar incision for elevating radial flap.

Methods: This randomized prospective study involving 46 patients with de Quervain disease who required surgical release of the first compartment were divided into two groups: group 1 with midline incision and group 2 with dorsoulnar incision. To evaluate tendon subluxation, the sliding distance of the extensor pollicis brevis (EPB) in five wrist positions were measured at 12 and 24 weeks using ultrasonography: neutral deviation, radial deviation, ulnar deviation, dorsiflexion, and volar flexion of the wrist. Clinical outcomes of the patients were evaluated using the Disabilities of the Arm, Shoulder and Hand (DASH) score, Visual Analogue Scale (VAS),

A-0740 Early radiological results of arthroscopic treatment of the scaphoid nonunion

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Objective: To evaluate the union rate and wrist malalignment correction of arthroscopic bone grafting of scaphoid nonunion in the early postoperative period.

Methods: The study included 41 patients who were operated from 2015 to 2017. Nonunion was located in middle third in 33 and proximal third in 8 cases. Average age of nonunion was 25 month (from 8 to 48). Evident DISI with radio-lunate angle more than 30° was noted in 32 (78%) of cases. All patients underwent arthroscopic resection of nonunion and bone grafting from midcarpal joint. Scaphoid fragments fixation was done by 3 K-wires. Union was noted by CT done in 8 weeks after operation and K-wires were removed. Before, soon after and in 10 weeks after operation, there were noted consolidations, radio-lunate (RL) and scapho-lunate (SL) angles.

Results: Union in 10 weeks after procedure was achieved in 38 (92.7%) patients. There were one failure of union in middle and two in proximal scaphoid third cases. The average RL angle before the operation was 40.7° (15°–50°), immediately after – 23.5° (0°–45°) and in 10 weeks after the removal of K-wires 27.7° (0°–45°). The SL angle before surgery was 67.7° (from 60° to 90°), immediately after −50.2° (30°–50°) and it 10 weeks after – 53.4° (45°–60°). The data comparison shows statistical significance in both angels in both period of measurement – soon after operation and in 10 weeks after it ($p \leq 0.01$).
Conclusion: Arthroscopic management of scaphoid nonunion shows not only high union rate but also significant correction of carpal DISI deformity in early postoperative period.

A-0741 Does bowstringing affect hand function in patients treated with A1 pulley release for trigger thumb: A randomized trial comparing percutaneous versus open technique

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Purpose: The purpose of this study was to determine the extent to which the release of the A1 pulley causes bowstringing in the treatment of trigger thumb, and how the percutaneous technique is beneficial to bowstringing and clinical function over open technique.
Methods: A total of 31 patients with resistant trigger thumb were prospectively randomized to undergo either percutaneous release (17 patients) or open release of the A1 pulley (14 patients). We quantified bowstringing of the digit by measuring further palmar displacement of the flexor pollicis longus (FPL) tendon during thumb IP joint power flexion using ultrasonography at 12 and 24 weeks after surgery. Pain on the visual analogue scale, Disabilities of the Arm, Shoulder and Hand, pinch power, and grip strength were assessed and analyzed to correlate with the ultrasonographic measurements.
Results: Each cohort showed a significant improvement in all clinical outcomes ($p < 0.05$), with no difference between the groups at each follow-up ($p > 0.05$). The bowstringing was greater increased at 12 weeks after surgery in both groups, and the average value of the open release group was greater than those of the percutaneous group compared to before surgery (6.11 ± 1.04 mm vs 5.20 ± 0.79 mm, respectively) ($p = 0.041$). However, the difference of those values was not significant at 24 weeks' follow-up (4.18 ± 0.93 mm vs 3.92 ± 0.77 mm, respectively) ($p = 0.671$) There was no significant correlation between the bowstringing of the flexor tendon and any clinical outcome measures ($p > 0.271$).
Conclusion: Open A1 pulley release of the thumb caused greater bowstringing than percutaneous technique early after surgery. However, bowstringing did not affect clinical hand function in patients treated with either percutaneous or open technique for trigger thumb.
Levels of evidence: Level 1, Therapeutic.

A-0742 Positive experience with the treatment process associated with better outcome after surgery for carpometacarpal osteoarthritis

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Background: Currently, literature indicates that experience with the delivered healthcare influences treatment outcome. However, the relationship between experience with the delivered healthcare during the treatment of CMC-1 osteoarthritis and outcome is unknown. Therefore, the aim of the study is to investigate what the association is between patient experience around the CMC-1 surgery and treatment outcomes in terms of patient-reported outcomes (PROMS) and therapist-reported outcomes (TROMS).
Methods: Patients who received a Weilby procedure for their CMC-1 osteoarthritis between 2011 and 2017 during regular care delivery in 17 outpatient clinics were included. Before and 12 months after surgery, patients completed a PROM: the Michigan Hand Outcomes Questionnaire (MHQ) and a (TROM): strength measurements. In addition, a patient-reported experience measure (PREM) was filled in at 3 months. Regression analyses were used to examine to associations of the different subscales of the PREM on the one hand and the MHQ change scores and strength on the other hand, while adjusting for confounders. Multiple regression analysis was used to determine how much of the variation in treatment outcome between patients could be explained by the PREM scores.

Results: Two hundred and thirty-three patients were included in the analysis. There were positive associations between the PREM and the PROM (the MHQ). The strongest associations were determined for the experience with information provided, communication of the physician and the post-operative care delivered. No associations were found between patient experience and TROMS (strength measurements). The PREM could explain 3.2–8.4% of the variation between patients in MHQ outcomes, depending of the PREM subscale.
Conclusion: This study shows a positive association between experience with the healthcare delivery and patient-reported treatment outcome in surgical treatment of CMC1 osteoarthritis, but no positive association between experience with the healthcare delivery and strength outcomes. These findings suggest that patient-reported treatment outcome in CMC1 osteoarthritis can be improved by improving the experience with the healthcare delivery.

A-0743 Computed tomography angiography allows the classification of the first dorsal metatarsal artery

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Background: Conventional angiography is an invasive technique. Submillimeter computed tomography angiography (CTA) has been shown to be an effective alternative for peripheral artery branches. This study aimed to assess the use of CTA to guide the choice and design of foot donor area for finger or thumb reconstruction.
Methods: This was a retrospective study of 79 patients who underwent finger or thumb reconstruction between January 2011 and March 2014. All these patients underwent preoperative CTA to determine the exact blood supply at the donor site. Preoperative imaging and intraoperative findings at the donor site were compared.
Results: Among the 79 patients (158 feet), 474 artery segments (dorsalis pedis artery (DPA), first dorsal metatarsal artery (FDMA), and toe web artery (TWA)) were evaluated using CTA. Image satisfaction rates of the vessels were $100.0 \pm 0.0\%$, $89.2 \pm 3.2\%$, and $60.1 \pm 5.0\%$ for DPA, FDMA, and TWA, respectively. Among the 158 feet, 90 were Gilbert type I (57.0%), 52 were Gilbert type II (32.9%), 13 were Gilbert type III (8.2%), and three were with poor visibility and could not be classified (1.9%). In all 79 patients, the CTA image of the FDMA was consistent with the intraoperative observations. All reconstructed fingers survived. Follow-up was available for 69 patients. After a 6- to 18-month follow-up, the reconstructed fingers and donor area recovered well, and the reconstructed fingers had strong holding power, without pain.
Conclusion: CTA can produce three-dimensional images for extremity arteries, allowing the preoperative assessment of blood supply and planning of donor site.

A-0744 Hyphenated technique of CT angiography with color Doppler ultrasound for accurate posing before anterolateral thigh flap transplantation in 19 clinical cases

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Background: CT angiography (CTA) and color Doppler ultrasound (CDU) have been widely applied in recent years for the vessel positioning.
Objective: We aim to explore the impact of hyphenated technique of CTA with CDU in free anterolateral thigh perforator flap repair surgery in patients with hand-foot skin injury.
Methods: From March 2014 to December 2015, a prospective study on free anterolateral thigh perforator flap repair surgery in 19 patients in the Department of Hand-foot Microscopic Orthopaedic, Guigang People's Hospital was done. Using CTA scan, the preoperative vessel positioning was done in anterolateral thigh area, validated by CDU detection. The appearance of donor site and the appearance, textures, color, blood supply of skin flaps in the recipient area were monitored after surgery. The functional level in recipient areas of hand and foot were graded by TAM (Total Active Movement) system evaluation method.
Results: Fifty-four perforator vessels detected in donor site of anterolateral thigh area with hyphenated technique of CTA with CDU, while 58 perforator vessels (54 detected vessels and 4 small vessels with diameters <0.5 mm) were observed during surgery. Flaps survived without vascular crisis in all patients.

The postoperative follow-up lasted 6 to 13 months, and the survived flaps exhibited soft texture, good blood supply, good appearance, and skin color was closer to normal skin.
Conclusion: The hyphenated technique of CTA with CDU can detect the perforator vessels accurately, providing a new approach for preoperative estimation of accurate locations of perforator vessels.

A-0746 Clinical application of 3D printing technology for preoperative planning of thumb reconstruction using donor toe

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Background: Although thumb reconstruction surgery has been developed for years and the surgical technology gradually matured, there are still many challenges, including the preoperative design of the prosthesis.
Objective: To explore the clinical application of preoperative precise design for 3D printing and thumb reconstruction.
Methods: This was a retrospective study of 20 patients who underwent the surgery of harvesting toe transplant and thumb reconstruction at the Guigang People's Hospital between January 2015 and December 2016. The 3D model of the thumb defect was created and printed. The dimensions of skin and bones from donor site were precisely designed as reference for surgical operation. The surgery was performed according to the model.
Results: Perfect repair of defects was achieved with satisfying appearance and function. The reconstructed thumbs all survived (survival rate of 100%). Partial skin necrosis was found in two patients, but complete healing was eventually achieved. Follow-up was 3–9 months. The maximum dorsiflexion was 8–30° and the maximum flexion was 38–58°. The two-point sensory discrimination was 9–11 mm. The Michigan Hand Outcomes Questionnaire (MHQ) was 26–45%. Grip power was 31–54%. There were 17 and three patients with satisfaction of 'Excellent' and 'Good' each for the reconstructed thumb and hand function, respectively. The satisfaction rate was 85%.
Conclusion: Preoperative digital design and 3D printing according to the donor and recipient sites allowed a tailored operation. The operation was more precise, the appearance of the reconstructed thumb was good, and the donor injury was minimal.

A-0751 The natural course of triangular fibrocartilage complex tear without distal radioulnar joint instability

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Objective: Triangular fibrocartilage complex (TFCC) tear is a common cause of ulnar side wrist pain. However, its natural course has not been understood. The purposes of this study were to determine the natural course of TFCC tear without distal radioulnar joint (DRUJ) instability and to identify risk factors for the poor outcome after conservative treatment of the TFCC tear.
Methods: We retrospectively analyzed the electronic medical records of the patients sustaining TFCC tear without DRUJ instability. We evaluated the patients with pain visual analogue scale (VAS) and patient-rated wrist evaluation (PRWE) at the initial visit, 4 weeks, 8 weeks, 12 weeks, and over 6 months after the initial visit. The PRWE score $\leq$20 points was considered complete recovery, and the PRWE score $>$20 was considered poor outcome. We used Kaplan–Meier survival analysis and Cox regression modelling to estimate the time to complete recovery and to identify predictors of poor outcome.
Results: A total of 104 consecutive patients with an average age of 39.8 years (range 18–70) were included in this study. A complete recovery was achieved in 54 patients at an average follow-up of 26 ± 28 weeks. Estimated probability of complete recovery was 40.8% at 6 months and 57.6% at 1 year. Older age significantly reduced the risk of poor outcome (adjusted hazard ratio (HR), 0.969; 95% CI, 0.947–0.992; $p = 0.009$), while dominant hand involvement significantly increased the risk of poor outcome (adjusted HR, 2.062; 95% CI, 1.081–3.934, $p = 0.028$). Notably, ulnar plus variance ($p = 0.246$) and the mode of tear (traumatic vs degenerative, $p = 0.5$)) were not significant risk factors. During a mean of 16 months of follow-up, 12 patients underwent surgical treatment, 6 patients changed their vocation, and 8 patients changed their preferred recreational activities due to wrist pain.
Conclusion: This study demonstrates that while more than half of the patients with TFCC tear without DRUJ instability show a self-limiting course, about 40% of the patients still have pain and disability at 1 year. Younger age and dominant hand involvement

are significant independent risk factors for poor outcome after being adjusted for possible confounding factors.

A-0755 Update and increase the quality of analgesia and anesthesia in animal research

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Introduction: Rodents are widely utilized in many types of surgical research and academic procedures. Interest in animal welfare it's been increasing in the last decades due to regulatory and ethical considerations. Recent studies have also shown better results and clinical outcomes when appropriate therapies had been applied to prevent animal pain and stress. Intraperitoneal injectable anesthetic protocols are used in rodents to avoid inhalant anesthesia limitations. Animals are potentially exposed to the highest levels of pain during the procedures. That's why is mandatory to find a suitable and reproducible protocol for these kind of procedures.
Purpose: The aim of the present study was to assess and compare the level of anesthetic plane and postoperative pain obtained from rats with different anesthesia and analgesia protocols.
Materials and Methods: Animals were selected in the setting of another clinical trial consisting on sciatic nerve critic defect and its ulterior reparation by two different methods. Female Wistar rats were used ($n = 27$, weight 214–292 g, age 8–12 weeks). The animals were randomized in 9 groups: combinations of different anesthetics and analgesics. Thus, there were three anesthesia groups (medetomidine + ketamine, fentanil + medetomidine, ketamine + xylazine) and another three analgesia groups (tramadol + ibuprofen, mepivacaine + ibuprofen, tramadol im + tramadol po + ibuprofen).

Anesthetic parameters measured were induction time, loss of pedal reflex, signs of pain during surgery (withdrawal reflex, tachycardia/tachypnea, sounds emitted) and recovery time. Analgesic parameters: respiratory rate, height, feeding, feces, chromodacryorrhea, movement, grooming, position and response to stimuli. Numeric value was assigned to each category to compare different groups and analysis of variance was used to compare these data between groups.
Results: Notable differences were found compared anesthetic protocols. Statistically significant ($p < 0.05$) differences were observed when signs of pain during surgery were studied, with best score in pain scale punctuation in the MK group (0.44) followed by FM (2) and KX (2.33). The longest and shortest induction times were observed in the KX and KM groups, respectively, but the difference was not significant. The shortest recovery time was in the FM group, followed by KM and the longest was MK, lasting in some cases more than 6 h.

Regarding the pain score punctuation after surgery, no significant differences were observed in the fifth postoperative day. In the first postoperative day, the best analgesic protocol was TTI (4.66), whereas TI (9.13) and MI (10.14) groups were very similar. The main significant differences between three analgesic protocols were found in the second postoperative day TTI (3.4), TI (6.71), and MI (9.5), ($p < 0.05$). Five exitus have to be reported (two in KX + TI group, one in FM + MI group, and two in FM + MI group).
Conclusions: Medetomidine plus ketamine regimen anesthetic protocol shown to be the most reliable, safe, and effective method. Long recovery time complication could be management with appropriate care, including respiratory and heart rate and temperature monitoring; electric blanket is recommended. MK anesthesia could also be reversed by atipamezole. TTI analgesia regimen is strongly recommended in the light of these results.

These both regimens have shown to be safer, with a low exitus rate.

A-0756 Post-traumatic interosseous-lumbrical adhesions, diagnosing may be difficult but surgery is easy

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Objective: Adhesions between the tendons to the interosseous muscles, the lumbrical muscles and the deep transverse metacarpal ligament (dTML) can cause decreased range-of-motion (ROM) in the metacarpo-phalangeal (MCP) joints and chronic discomfort in the distal part of the hand. Diagnosing the condition may be difficult and is often made by exclusion.

Methods: Adhesions at the level of the lumbrical-interosseous junction makes it narrow, reducing its proximal excursion which causes symptoms in the intrinsic plus position of the fingers. If the dTML is involved in the adhesions, the distal excursion of the junction is also hampered, for example, the intrinsic minus finger position. We identified five patients with clinical findings suggesting the latter situation. All patients experienced pain and swelling in the distal part of the hand during manual load. The ROM in the neighboring MCP joints was decreased and painful. The pain free ROM was on average limited to only 0/35° (extension/flexion). The condition was either caused by a distortion or contusion trauma to the distal part of the hand (four cases), or by an infection (one case). Three patients were examined with an MRI without any specific findings. No other possible explanation to the condition was found and the patients went on to surgery. The time between trauma to surgery was on average 24 months (range 6–60).
Results: The lumbrical–interosseus junction was exposed through a volar approach. Adhesions between the dTML and the junction were confirmed in all cases with passive motion of the fingers. Release of the adhesions and resection of the distal third of the dTML resulted in normal passive excursion of the muscles and the tendon junction. Immediate postoperative physiotherapy followed. Four patients experienced an immediate decrease in the symptoms. One patient experienced minor pain and swelling during the first 3 months after surgery. At the 6-month follow-up, all patients had pain free and near normal ROM (mean 4/89°) in the MCP joints.
Conclusions: Surgical release of symptomatic interosseous-lumbrical adhesions is a relatively simple and safe procedure, with potential to normalize the function of the hand. Diagnosing the adhesions is the difficult part. The condition is not recognized widely in Europe, which may be explained by the sporadic reporting that almost exclusively originates from outside Europe. All five patients in our series were recruited within less than 2 years, which may suggest that the condition is more common than reflected by the literature.

A-0759 Analysis of interfragmentary motion in scaphoid fractures by 4-dimensional computed tomographic imaging

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Objective: A scaphoid fracture is the most common carpal fracture and is notorious for problems with healing. When healing of the fracture fails (nonunion), a specific pattern of osteoarthrosis occurs, resulting in pain, restricted wrist motion and disability. Scaphoid fracture classification systems recognize scaphoid fragment instability as an important factor associated with the development of nonunion. Since conventional static imaging cannot reveal this dynamic problem, an imaging technique is required that can analyze wrist motion in three-dimensional space over time. To this end, four-dimensional (4D) computer tomographic (CT) imaging is used to conduct two observational studies. In one study, we aim to quantify and compare interfragmentary motion between displaced and non-displaced acute scaphoid fragments. We hypothesize that fragment displacement is not correlated to fragment instability. In a second study, we analyze if scaphoid nonunion fragment instability depends on the position of the fracture line relative to the scaphoid apex. We hypothesize that instability is increased if the fracture line runs distal to the scaphoid apex.
Methods: Eight adult patients were included with a one-sided acute scaphoid fracture or scaphoid nonunion and no history of trauma of the contralateral wrist, which serves as the kinematical reference. One patient with a non-displaced acute scaphoid fracture is included. Seven patients are included with a scaphoid nonunion; six with the fracture line distal to the scaphoid apex and one proximal to the scaphoid apex. Both wrists are scanned with a regular dose CT scanner to obtain 3D images. Guided by a wrist motion device, 4D-CT images are acquired during 10 s of active wrist motion in a flexion–extension and subsequent radio-ulnar deviation plane. The 3D and 4D scans are used to quantify interfragmentary motion over time.
Preliminary Results: No interfragmentary motion was found in the patient with an acute non-displaced scaphoid fracture. Time to union was 6 weeks. Regarding interfragmentary motion in scaphoid

nonunion patients, no differences were found in fragment instability. In scaphoid nonunion patients with the fracture line distal to the scaphoid apex, the distal fragment motion ranged for each individual, from (2–12, 0–6, 1–8, 1–7) degrees for extension, flexion, ulnar-, and radial deviation, measured relative to the proximal fragment. For the patient in which the fracture line runs proximal to the scaphoid apex, these angles were (4, 6, 4, 3) degrees.

Conclusion: Fragment instability of scaphoid nonunion fragments did not depend on the position of the fracture line with respect to the scaphoid apex. Dynamic imaging of joints is a new and promising trend, creating opportunities to quantitatively evaluate normal and pathological wrist kinematics. With 4D-CT imaging, we can quantitatively differentiate between stable and instable scaphoid fractures.

A-0760 Complications after toe to hand transfers in children with pathology of the hand

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Background: Currently, there is no common approach to treatment complications after microsurgical toe to hand transfer, which is an actual problem.

The aim of the study was to analyze ischemic complications after the microsurgical operations in children with a pathology of the hand to improve the quality of surgical treatment.

Materials and Methods: From 2007 to 2016, we did 210 microsurgical toes to hand transfer (306 transplants). And 267 (87.3%) of these, in patients with congenital pathology and 39 (12.7%) with posttraumatic deformities of the hand. In total, 352 fingers were reconstructed.

Results: According to our study, the blood supply disturbance of the toes transplants was in 19 (6.2%) cases of 306. The most of them caused in the early postoperative period (73.7%). The main cause of microcirculatory disorders was thrombosis of the venous or arterial trunks (eight cases). In six patients, the blood supply disturbance occurred as a result of thrombosis of autovenous insertions. Two patients had necrectomy at 7 and 18 days because conservative and operative treatment was not successful.

Conclusion: The method of choice for the appearance of the first signs of the blood supply disturbance in transfer toe is conservative therapy, which includes disaggregants, anticoagulants and hirudotherapy.

The effect of conservative therapy should be performed in 3 h from the beginning of ischemia, if it is absent, the patient must be operated.

The operation includes soft tissue decompression, the mechanical pumping across of vascular anastomoses, and if it necessary, excision of abnormal part of the vessel with subsequent autoplasty.

A-0764 Finger and hand injuries in a pediatric emergency department: A 17-month review from a Swiss tertiary hospital

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Introduction: Hand and finger injuries in children are very common in the paediatric emergency department (PED). Even though demographics and injury patterns have been described previously, scarce data exist on the type of treatment and its outcome. In our institution, the paediatric emergency physicians initiate treatment of all paediatric injuries. Thus, depending on the type of injury, children are either treated in the PED or referred to the department of paediatric or hand surgery. While fractures and injuries to the extensor tendons are mainly treated by the paediatric surgeons, complex injuries and injuries affecting the palm of the hand are treated by the hand surgeons. This study was designed to evaluate possible differences in outcome depending on the treatment received in PED or by surgery subspecialties. Also, based on the study results, a referral pathway was designed to improve efficient patient flow from the PED to subspecialty.

Patients and Methods: All children presenting to the PED with hand/finger injuries or infections over a 17-month period were included in this retrospective study. Patients with polytrauma, injuries proximal to the wrist, systemic infections or allergic reactions were excluded. Demographics (age, sex), date and type of injury, treatment modality in PED and subspecialty referral and subsequent treatment were retrieved from the electronic hospital database. For hospitalized patients admitted to the paediatric or hand surgical ward, length of in-hospital stay (days), detailed information about definitive treatment and administration of antibiotics was collected and where applicable, compared between these departments. Finally, a written feedback form was developed and collected from parents of all

inpatients regarding the outcome of their child's injury after termination of treatment.

Results: From November 2015 until March 2016, 932 children with hand/finger injuries were admitted to the PED. The most frequent reasons for presentation were hand contusion (25.5%), fracture (20.8%) and superficial lacerations (14.9%). Admission to the ward was required for 87 children (9.3%) following multiple hand/finger injuries (19.4%), infections (18.4%) finger fractures (12.6%) and fingertip amputations (11.5%). In this subgroup, 51 children were treated by paediatric (58.6%) and 37 by hand surgeons (41.4%), respectively. Mean duration of hospital stay was 3.37 days (range 1–23 days). Antibiotics were administered to 57 patients (65.5%) with a mean duration of 6.96 days (range 1–21 days). The feedback form was returned in 75.8% of cases reflecting a good overall satisfaction.

Conclusion: Our data are similar to previous studies regarding patient age and sex and type and distribution of injuries in different age groups. This study demonstrates an overall good parental satisfaction with treatment. At current, paediatric hand/finger injuries are treated by paediatric emergency, paediatric or hand surgery subspecialty in our institution depending on the injury pattern and from case to case decision. Like in adult surgery, a subspeciality might be desirable for the treatment of paediatric hand injuries. Furthermore, the aptitude and limits of treatment by PEM physicians should be defined. Based on our results, we suggest the implementation of a clear referral pathway to improve and expedite treatment of more complex injuries are treated in an inpatient setting.

A-0765 The use of titanium miniature plates and screws for the treatment of intra and extra-articular fractures of the hand

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Objectives: Operative treatment of metacarpal and phalangeal fractures is reserved for unstable, irreducible, comminuted, intraarticular, and open fractures. The purpose of this study was to evaluate the outcome of hand fractures treated with titanium, low profile plate and screws.

Methods: Ninety patients (79 men and 11 women) with 114 hand fractures were treated with titanium mini plates and screws. There were 46 phalangeal and 68 metacarpal fractures in the cohort. Mean age of the patients was 36 years (range 11–75). Most of the patients (57 patients, 63%) were manual workers and the mechanism of injury involved a work accident. The dominant hand was injured in 50 patients (55%)

The distribution of the fractures was as follows: One hundred and fourteen fractures involved 113 rays. Thirty-two were open, 27 were intra-articular and12 both open and intra-articular fractures. Twenty-three of the 32 open fractures involved combined hand injuries and in 11 patients open fractures were associated with incomplete (six) or complete (five) amputations (severe damage to one or both neurovascular bundles, respectively).

The fracture was fixed after a mean of 2.9 days (range 0–28) from injury. Regional anaesthesia was utilized in 85 patients and only five patients received general anaesthesia. Combined plates and screws were used in 85 fractures, while in the remaining 29 fractures internal fixation was performed only with screws. Fixation with screws was selected for condylar or intra-articular fractures of the base of metacarpals and phalanges, and for long oblique or spiral diaphyseal fractures.

Results: Mean follow-up time was 39 months (range from 30 to 57). Apart from one case, all fractures were successfully fixed. Grip strength was measured as high as 89% compared to the uninjured hand even in cases of intra-articular fractures. Open intra-articular fractures had the worst outcome in grip strength (67% of the contralateral hand). With regards to tip pinch, open intra-articular fractures had the least favorable outcome (68% of the contralateral pinch strength). No difference was observed between intra-articular and extra-articular fractures for grip strength and for total active motion. DASH score was 8.7 in the intra-articular group and reached 15.6 in the open intra-articular group. Finally, pain as measured with the visual analog scale reached a maximum of 2.3 in all groups, except for open intra-articular fracture, which demonstrated a mean of 3.2. There was no statistically significant difference in grip strength ($p = 0.25$) or total active motion ($p = 0.849$) between extra and intra-articular fractures. TAM and grip strength were statistically different between open and closed fractures ($p = 0.001$ for TAM and $p = 0.013$ for grip strength, respectively).

Conclusions: Low profile plates and screws can be used successfully to establish union and restore alignment of the hand skeleton while achieving satisfactory clinical outcome. Factors that influenced the final outcome included the severity of the initial injury (open vs closed) and not the anatomic location (intra

or extra-articular, metacarpal or phalangeal) of the fracture.

A-0766 Toward standardization of an anatomical coordinate system for the radius in 3D imaging: Reliability of automatic and manual placement

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Objective: In the last decades, promising techniques have been proposed to plan corrective surgery for the radius in 3D space. In many cases, repositioning parameters are expressed in terms of a CT coordinate system. However, since the arm is not always placed in the same way inside the scanner, the positioning parameters do not have a clear relationship with the anatomy. By defining an anatomical coordinate system for the radius (RCS), repositioning parameters can be expressed in more logical terms. If the RCS is accurately defined, repositioning parameters can be compared between individuals, but also between studies. Unfortunately, the RCS is usually poorly defined and often based on a partial scan. Since the repositioning parameters depend on the RCS, an accurate placement of the RCS is important. The purpose of this study was to answer the following research questions: (1) To what extent does the length of the radial shaft influence the positioning error when the RCS is placed by a computerized algorithm? (2) Are physicians better in placing the RCS compared to the placement by a computerized algorithm, if only a partial radius is available? (3) To what extend do anatomical variances of the radius (i.e. segmentation, gender, age, presence of growth plate, left/right wrist) affect the automatic placement of the RCS? We hypothesize that the length of the radius significantly affects the positioning error of the RCS.
Methods: Coordinate systems were placed on healthy radii of 85 individuals. A radius was eligible for inclusion when there was no history of fracture or growth defect. The segmented radii are digitally cut at 9 levels. In each cutting step, 10% of the proximal radial surface is removed. At the final level, only 10% of the distal radial surface remains. A new RCS is placed on each cut radius by the algorithm. The RCS placed by the algorithm on a complete radius acts as the gold standard. Three physicians positioned the RCS manually on three randomly selected radii cut at nine levels. The positioning error of any of the RCS is determined by calculating the RCS-to-RCS transformation matrix and extracting the translation error (Δx, Δy, Δz) and rotation error (φ_x, φ_y, φ_z; rotation sequence: y, x, z) from the matrix for comparison to the gold standard.
Results: Shortening of the radius had a significant effect on the translation error ($p \leq 0.001$) and rotation error ($p \leq 0.001$). Medical doctors positioned the RCS more accurately than the algorithm when 10% of the distal radial surface remained. Segmentation, gender, age, presence of a growth plate, and left/right wrist did not significantly affect the translation or rotation error.
Conclusion: The main findings of this study are (1) when using the computerized algorithm, the RCS is slightly affected by the length of the radius, although the error gets substantial if less than 20% of the distal radius is available in the scan. (2) When only 10% of the distal radial surface remains, the RCS should be placed manually. (3) Anatomical variances do not influence the RCS positioning.

A-0769 Quantifying the positioning error of 3D printed patient-specific surgical guides for the radius

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Objective: Corrective osteotomy is a common surgical treatment option for symptomatic malunion of the radius. Computer-assisted three-dimensional (3D) preoperative planning techniques are based on a bilateral computed tomography (CT) scan of the radii and use the mirrored contralateral bone as reference to optimally plan the reconstruction. In order to transfer the virtual preoperative plan to the patient during surgery, an accurate navigation technique is fundamental. Customized 3D printed surgical guides are an attractive surgical navigation strategy, which is becoming more commonly adopted due to the rapid developments in additive manufacturing technology. However, navigation errors occur if the guide is not properly positioned at the target bone location, compromising the surgical outcome.

Quantitative measurements of guide positioning errors are rarely reported and have never been related to the design of the guide and to the underlying bone anatomy. Our objective is to evaluate the positioning accuracy of two different guide designs (standard vs an innovative design with lateral extension) at different fitting locations (distal, mid-shaft and proximal) on the volar side of the radius.
Methods: Six 3D virtual bone models of healthy right adult radii and two sets of three patient-specific guides (standard and extended) were 3D printed. In each set, the three guides, respectively, fit the distal, mid-shaft, and proximal surfaces on the volar aspect of the radius. Four surgeons positioned each set of patient-specific surgical guides on each radius model. This assembly was subsequently CT scanned and the positioning accuracy was then quantified with a CT-based image analysis technique. Positioning errors were expressed in terms of the mean target registration error (mTRE), total translation error (ΔT) and total rotation error (ΔR) by comparing the actual guide position with the preoperatively planned position. Three generalized linear regression models were constructed to evaluate the influence of the fitting location and the guide design on the positioning errors.
Results: When positioning mid-shaft guides, positioning errors (mTRE, ΔT and ΔR) were significantly higher ($p = 0.0001$, $p = 0.0001$ and $p = 0.001$) compared to distal guides. The novel guide design, featuring a lateral extension, significantly reduced the mTRE, ΔT and ΔR errors in all the volar radius locations ($p = 0.001$) except for ΔR in the mid-shaft region ($p = 0.0001$).
Conclusion: Our study shows that the positioning accuracy of patient-specific 3D printed guides depends on the radius fitting location. This should be carefully taken into account when considering 3D printed patient-specific guide technology in surgery of the mid-shaft. The use of extended guides is recommended for future utilization in distal and proximal radius regions, since it increases the accuracy and precision of surgical navigation.

A-0773 Early sensory re-learning improves sensory outcome even in a long-term perspective: An RCT with 7-year follow-up

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Objective: Early sensory relearning improves sensory outcome regarding discriminative touch/tactile gnosis 6 months after surgical repair of median or ulnar nerve injury. The aim of this randomized controlled trial (RCT) was to evaluate objective and subjective outcome in median or ulnar nerve repair from a long-term point of view.
Methods: Twenty patients, 16 men and four women, with median/ulnar nerve injuries who had been randomized to early sensory relearning ($n = 9$) or traditional relearning ($n = 11$) were assessed at a median of 7 years (range 4–9) after the nerve repair. Objective outcomes were assessed with the Rosen score. Subjective outcomes were assessed with and self-reported single-item questions regarding function and activity, and the DASH and the CISS questionnaires. T-test between groups was used for Rosen score and numerical rating scales. The Mann–Whitney U-test was used to analyze differences between groups for the DASH and the CISS.
Results: The group who had performed early sensory relearning had significantly better results in sensory domain of the Rosen score – and specifically, discriminative touch/tactile gnosis and dexterity. These results were supported by the subjective ratings according to clumsiness, grip function and fine motor skills. No differences were found for the DASH or the CISS.
Conclusions: Early sensory relearning appears to improve long-term sensory function following nerve repair.

A-0776 Long-term results of treatment of scapho-trapezium-trapezoid arthritis by use of pyrocarbon implant

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Background: Scapho–Trapezium–Trapezoid (STT) arthritis is commonly treated by isolated distal scaphoid resection or plus biologic interposition. Isolated distal scaphoid resection can reduce carpal height developing DISI deformity in long-term follow-up. Scapho trapezium pirocarbon implant (STPI) is used as a spacer to maintain carpal height and reduce long-term DISI deformity. Good tolerance of pyrocarbon and profile of the implant give good life expectancy.
Aim: In this retrospective study, the authors describe their experience with the use of a pyrocarbon implant for distal scaphoid in STT arthritis.
Materials and Methods: From January 2007 to September 2017, 39 wrists (Viegas 1 and 2) of 30 patients were treated. All cases were evaluated pre and post-operatively with MMWS, PRWHE and DASH

scores with an average follow-up of 62 months (min 3–Max 125). Four cases were treated bilaterally.
Results: There was an average relief from pain, no significant improvement in flexion extension ROM and significant improvement grip and pinch strength. At the follow-up, there was an average reduction of pain from 7.01 to 2.7 VAS. There was an improvement of grip and pinch force from 51% to 88% of contralateral side. Eighty-five percent of the patients were satisfied with the results and were able to return to the precedent activities. Improvement of DASH from 89 to 29 and of PRWHE from 101 to 27.8. Radiographic controls revealed six cases of complication with one case of dislocation of the implant, light reduction in carpal height in 4 pz and average radio-lunate angle passed from 11° pre-operatively to 14° post-operatively.
Discussion and Conclusion: Replacement of distal pole of scaphoid with STPI can restore a good functionality of wrist and pinch, a complete range of motion free from pain in patients affected from STT arthritis maintaining carpal height and avoiding increase of capito-lunate angle or collapse.

A-0778 Single or double V-flap over a direct-flow homodigital island flap: An alternative technique for volar fingertip injuries of long fingers

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Objective: The use of the direct-flow homodigital island flap for coverage of fingertip injuries usually leads to a flexion contracture of the proximal interphalangeal joint for achieving the distal advancement needed for covering the soft tissue-loss, as well as sometimes the need for donor area skin grafting. Our study presents a different technique that could address these two shortcomings.
Methods: We did an anatomic study in 8 upper limb specimens (32 long fingers) where we created a volar defect 54% of the pulp (50%–57%) and sequentially we performed 5 procedures measuring on each the advancement of the flap and the area of the flap island. The procedures were a direct-flow homodigital island flap with the dissection distal to the PIP joint (group 1), then a V-flap over that island (group 2), then a second V-flap over the distal flap (group 3), then the dissection of the neurovascular bundle until the proximal phalange (group 4) and finally suturing the V-flaps and creating a traditional direct-flow homodigital flap (group 5) to compare the different options.
Results: Group 1 had the lowest values in terms of advancement with 9.7 mm (5–15 mm) and a surface of 23.15 mm^2 (16.8–25.5 mm^2). When added one V-flap (group 2), the advancement was of 15.75 mm (10–21 mm) and the surface was 28.35 mm (18–36 mm^2). Group 3 had the advancement of 18.62 mm (13–23 mm) and the surface of 30.81 mm^2 (20–37.8 mm^2). Group 4 presents the biggest advancement values with 20.56 mm (12–27 mm).
Conclusions: The usage of either one or two V-flaps over an island flap dissected distal to the PIPJ can, respectively, produce an increased advancement of 4 and 7 mm over the classic direct-flow homodigital flap but without crossing the PIPJ, thus decreasing the probability of flexion contracture. Furthermore, the application of one or two V-flaps can increase the covered area in 22% and 33%, respectively, thus decreasing the need of a donor site skin graft.

A-0779 A genome-wide association study of carpal tunnel syndrome

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Background: Carpal tunnel syndrome (CTS) is the commonest entrapment neuropathy, with an estimated population prevalence of 5–10%. Despite being such a common condition, the pathophysiology of CTS is poorly understood, and even less is known about the genetic contribution to the disease. CTS is a complex disease, whereby genetic and non-genetic factors interact to affect overall phenotypic expression. The current best method for locating genetic variants that predispose to a complex disease is a genome-wide association study (GWAS).
Methods: With the aim of discovering genetic variants that confer risk to CTS, we undertook a GWAS in subjects with CTS using the UK Biobank resource, a prospective cohort study of approximately 500,000 individuals from the United Kingdom, aged between 40 and 69, who have had whole-genome genotyping undertaken and have allowed linkage of this data to their medical records. After quality control, we defined 12,106 participants of white British ancestry from this cohort with at least one diagnostic code for CTS as our cases and used the remaining 387,347

white British participants as controls in the association analysis.

Results: We discovered genome-wide significant associations ($p \leq 5 \times 10^{-8}$) at 13 loci across the genome. Of the top three associated variants, rs72755233 ($p = 9.1 \times 10^{-15}$) is a missense mutation in ADAMTS17, rs62621197 ($p = 1.0 \times 10^{-13}$) is a missense mutation in ADAMTS10, and rs3791679 ($p = 3.8 \times 10^{-13}$) resides in an enhancer region in an intron of EFEMP1. All three genes are important in extracellular matrix modulation, and we have demonstrated expression of these genes in tenosynovium collected from within the carpal tunnels of patients undergoing carpal tunnel decompression surgery. rs72755233, rs62621197 and rs3791679 have been reported in previous GWAS studies to be associated with human height, and we found that on average, UK Biobank CTS patients are >2 cm shorter than the controls.

Conclusion: This study sheds new light on the pathophysiological mechanisms that underlie CTS, and it is the first ever study to do so through genome-wide association. While functional assays will be required to confirm whether the candidate genes identified are causally implicated in CTS susceptibility, our findings raise the intriguing possibility that the genetic susceptibility to CTS may arise from aberrant connective tissue architecture or from anthropometric factors such as height, hand and wrist proportions, rather than from rendering peripheral nerves intrinsically more vulnerable to increased pressures.

A-0782 1 or 2 K-wires in surgical treatment of metacarpal-5-fractures?

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Objective: Currently, no guidelines or evidence for the treatment of fractures of the metacarpal V are available and therefore therapeutic regimes are based on individual decisions. The aim of the study was to compare the clinical outcome of osteosynthesis with one versus two Kirschner wires in the treatment of dislocated or malrotated fractures of the metacarpal V.

Methods: We conducted a prospective, randomized multicenter trial in 13 hospitals. Ethic votes were obtained in all federal states of which hospitals took part in the study.

Patients with dislocated fractures of the metacarpal V and therefore need a surgical intervention were randomized either to receive osteosynthesis with 1 K-wire (group 1) or 2 K-wire (group 2). Block stratification with $n = 8$ were used for randomization. Primary endpoint was the functional outcome 6 month after surgical intervention, measured by the Disability of the Arm, Shoulder and Hand (DASH) Score. Secondary endpoints to evaluate the clinical outcome were malrotation >5°, shortening of the metacarpus >2 mm, palmar angulation >30°, delayed union, limitations of fist closure, limitations of extension (extension $n = 0°$)/flexion (flexion $n < 70°$), pain (<10 VAS), operation time, revision rates, infections rates, time of inability to work. For statistical analysis, non-inferiority of the 1 K-wire versus 2 K-wire osteosynthesis with a tolerable alpha error of 5% and beta error of 15% were assumed. Hypotheses were tested by inclusion of confidence interval, including a full analysis set. SPSS 22.0 was used for all tests.

Results: A total of 292 patients were recruited: 146 patients were randomized to group 1, 144 to group 1. Sixty-two patients from group 1 were excluded from data analysis, 73 from group 2 (due to lost to follow-up, withdrawal, protocol, deviations, etc). Baseline data of both groups were comparable. In group 1, the mean DASH score was 3.8 (6.9), in group 2 4.4 (9.4). Regarding the secondary endpoints, no significant differences between the groups were observed. Serious adverse events demanding a surgical intervention occurred in both groups: two in group 1 and three in group 2. Those were three dislocations after surgery, one in group 1 and two in group 2. All were treated with surgical revision and 2 k-wires. Other SAEs were a second trauma with a finger fracture in one patient without harm to the study-related surgical outcome and a tendovaginitis stenosans of the ring finger with was treated with surgery.

Conclusions: Non-inferiority of the osteosynthesis with 1 K-wires versus with 2 K-wires can be assumed. Both treatment options reveal a good clinical outcome.

A-0783 Patient-reported outcome measures for toe-to-hand transfer: A prospective longitudinal study

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Background: Patient-reported outcome measures (PROMs) are an important metric in evaluating

treatment efficacy of reconstructive surgery. Toe-to-hand transfer can restore vital prehensile function; however, this surgery is complex, extensive rehabilitation is required, and there are concerns about donor site morbidity. This study longitudinally explores the benefits of this procedure, from the patients' perspective, using PROMs.

Methods: Twenty-three patients who underwent free toe-to-hand transfers from 2012 to 2015 were evaluated pre- and post-operatively using the following validated questionnaires; the Michigan Hand Outcomes Questionnaire (MHQ), the 36-Item Short Form Health Survey (SF-36), and the Lower Limb Outcomes Questionnaire (LFQ). Subgroup analysis was performed between dominant and non-dominant reconstructed hands.

Results: Mechanism of injury was crush in 83%; the remainder sustained cutting, avulsions, and burn injuries. Thirty-four toes were transferred; 9 great toes, 20 second toes, and 5 third toes. All patients required secondary procedures for aesthetic and/or functional improvement. MHQ results showed significant improvement in overall activities of daily living, work, aesthetics, and patient satisfaction ($p < 0.05$). SF-36 results showed significant improvements in physical and emotional roles ($p < 0.05$). The LFQ showed no deterioration of foot function ($p = 0.55$). Subgroup analysis showed significantly greater improvement in PROMs for patients undergoing dominant hand reconstruction.

Conclusion: PROMs demonstrate the significant utility of toe-to-hand transfer procedures in both functional and psychosocial domains that there are relatively greater benefits in reconstructing the dominant hand and that donor site morbidity is well tolerated.

A-0785 Distal sensory to distal motor nerve anastomosis can protect lower extremity muscle atrophy in a murine model

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Background: Delayed reinnervation of denervated motor neuron has irreversible consequences. We introduced distal motor to distal sensory anastomosis (DDSA) as a practical, time-saving method to protect injured motor neurons and its target tissues.
Methods: Two experimental groups of Wistar rats were studied. In DDSA group, the distal end of the tibial sensory nerve of the left leg was anastomosed to the distal common peroneal nerve. The same nerves were dissected without anastomosis in the control group. Four months later, visual functional assessment of sciatic nerves was performed, and histological structures of the nerves and muscles and ultra-structure of nerves were evaluated.
Results: Significant enhancement was seen in intermediate toe spread factor in DDSA group ($p < 0.05$), but toe spread factor and subsequently sciatic statistic index demonstrated no significant improvement. The surgical procedures resulted in an ipsilateral rehabilitation in DDSA group with statistically significant ($p < 0.05$) improvement in muscle weight and myelinated axon count. Light and electron microscopy evaluations of the histological specimen showed obvious prevention of nerve and muscle tissues degeneration following anastomosis.
Conclusions: Overall, DDSA showed a peripheral nerve could repair, survive, and protect target tissues from degeneration without connection to their cell bodies and central nervous system. Some possible explanations for these positive results could be the restorative role of electrochemical signaling directly from the skin sensory nerve receptors and stimulation of Schwann cell to convert to its regenerative phenotype.

A-0787 Patients' treatment experience influence post-operative results in Dupuytren's disease

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Objective: In modern practice, both physical treatment outcomes, as measured by a clinician, as well as patient-reported outcome measures (PROMs) are used to evaluate health outcomes after treatment. Most recently, patient-reported experience measures (PREMs) were added to this evaluation. These PREMs focus on items such as respect and dignity, communication by physicians and cleanliness or hygiene of facilities. All these factors represent different aspects of the treatment context. Besides being useful in the evaluation of treatment, PREMs can be helpful in clarifying the relation between physical treatment outcomes and PROMs. Previous research has demonstrated that physical treatment outcomes and PROMs are only moderately correlated, which suggests the influence of the psychosocial context surrounding a treatment, such as patient–physician interaction and expectation of the offered treatment. To better understand the role of this treatment context, this study examines the association between patient experiences with treatment context and treatment outcomes after Dupuytren's surgery, using both patient-reported outcome measurements as well as clinician-recorded straightness of the finger as treatment outcomes.
Methods: Patients undergoing limited fasciectomy or percutaneous needle fasciotomy for Dupuytren's contractures between 2011 and 2016 were selected from a prospectively collected database. Patients completed the Michigan Hand Outcomes Questionnaire (MHQ) before and 3 months after surgery, together with a patient-reported experience measure (PREM) while hand therapists assessed the straightness of the finger with a goniometer. Regression analyses were used to examine associations of the different subscales of the PREM with the MHQ change scores and residual extension deficit.
Results: A total of 836 patients were included in the final analysis. There was a positive association between the experience with the treatment and both patient-reported functioning and objectively measured straightness of the finger. The associations between experience with healthcare delivery and PROMs were roughly twice as strong as those between experience with healthcare delivery and physical treatment outcomes. Strongest associations were seen with communication of the physician, post-operative care and information about the treatment.
Conclusion: This study demonstrates a positive association between treatment context and treatment outcome in Dupuytren's disease. These findings suggest that treatment outcomes in Dupuytren's disease could be improved through improving the treatment context.

A-0791 Multiple intermetacarpal perforators flap for dorsal long fingers reconstruction: an anatomical study and clinical applications

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Objective: We investigated the anatomical vascular basis of a multi-perforant dorso-metacarpal flap and reported our clinical experience in the reconstructive surgery of the dorsal long fingers as an alternative to microsurgical solutions.
Methods: In 10 fresh frozen upper limbs, injected with acrylic resin, the dorsal surface of the hand was dissected. The intermetacarpal spaces and dorsal long fingers were evaluated for the characteristics (number, diameter, site and interval of origin, and course) of volar-dorsal perforator vessels. Wide perforator flap, based on multiple intermetacarpal distal perforators, was used for the contemporaneous reconstruction of the all dorsal long fingers.
Results: The mean number of perforators of intermetacarpal space was 3.5, mainly septal-type. Proximally to juncturae tendinum, the vessels were less numerous. In one case, there was no intermetacarpal artery. Some anatomic anomalies were found, especially no Quaba perforator or the absence of commissural artery. The average distance between the Quaba perforator and the metacarpal-phalangeal joint was 1.15 cm (DS 0.58), between the Quaba and the commissural artery was 1.61 cm (DS 0.66). Proximally to Quaba, constant perforators have been encountered at a mean distance of 28 mm, 37.84 mm, 46.42 mm, and 45.5 mm. The mean number of branches for dorsal cutaneous network at the level of long finger was 9 (range 5–15) arising from the proper digital artery. There was no symmetry between radial-ulnar sides or opposite side of an interdigital-space. In four patients, a multi-perforator flap, based on these findings, has been used to cover all the dorsal surface of the long fingers. A good aesthetic and clinical result has been achieved at 6 months of follow-up.
Conclusions: The anatomical study allowed us to identify a constant intermetacarpal perforator network and to perform a reliable distally based intermetacarpal flap. Thermal-crush injury often involved multiple dorsal finger surface forcing the surgeon to a challenged reconstruction. To obviate to a microsurgical flap reconstruction, we propose to raise the entire subcutaneous surface of the dorsal hand in a multiperforator flap. The flap was then mobilized as a turn-over flap to cover the long fingers and then grafted. This autologous functional reconstruction of all involved fingers allows an early and intense rehabilitation to achieve a better recovery. Subcutaneous surface guarantees tendons and joints gliding, with minimal donor site morbidity, avoiding the use of microsurgical solution. Anatomical knowledge achieved, showed a reliable vascular network, able to support a wide adipo-fascial flap.

A-0792 Interobserver reliability study of the classification of scaphoid waist fractures using computer tomography

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Objective: Conventional radiographs have been shown to yield unreliable results in classifying scaphoid fractures. Computer tomography (CT) has been claimed to be the tool of choice in determining the treatment. The use of CT for diagnosing fractures and healing of scaphoid fractures has shown only moderate interobserver reliability. We have therefore undertaken a study of the reliability of the classification of waist fractures of the scaphoid among specialists of orthopedic surgery with a particular interest in hand surgery.
Methods: From 2009 to 2014, CT scans were routinely obtained in patients with fractures of the carpal scaphoid shown on radiographs. Among 186 positive CT scans, 116 were excluded as the fracture was more than 4 weeks old or due to incomplete data set of the CT. Among the remaining 70 scans, we identified 51 scaphoid waist fractures. Sagittal and coronal planes of the long axis of the scaphoid were available in all scans. Seven orthopedic surgeons with a particular interest in hand surgery independently scrutinized the scans classifying each in undisplaced, minimally (<2 mm) displaced, or displaced and suggested a treatment of 4 weeks immobilization, 8–12 weeks immobilization, or screw fixation. Fleiss Kappa values using SPSS v. 24 were calculated and interpreted according to Landis and Koch.
Results: On the average, 38.5% were classified as undisplaced, 41% as minimally displaced, and 20.5% as displaced. On average, 79.5% of the fractures were suggested treated non-operatively and 20.5% operatively.

The reliability of the classification showed an overall Kappa value of 0.50. However, the distinction between undisplaced and minimally displaced fractures showed a Kappa of only 0.38, whereas the reliability was 0.61 when classifying between <2 mm displaced or >2 mm displaced. Selecting between operative or non-operative treatment showed a Kappa of 0.58.

Conclusions: Selecting the best treatment of scaphoid waist fractures remains a challenge. The use of CT showed substantial reliability in the distinction between <2 mm displaced and >2 mm displaced fractures. However, only moderate reliability was found when choosing between non-operative and operative treatment.

A-0795 Complications after elbow terrible triad surgical treatment

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Introduction: Terrible triad injury of the elbow (TTIE), comprising elbow dislocation with radial head and coronoid process fracture, is notoriously challenging to treat and has typically been associated with complications and poor outcomes despite performing a protocolized surgical treatment by expert surgeons followed by adequate immobilization times and initiation of early and controlled elbow motion.

Objective: Identify and analyze the appearance of complications after protocolized surgical treatment of TTIE, assessing its functional outcomes and proportion of patients who required surgical reoperation.

Materials and Methods: Our study uses the database of the Hospital Universitario 12 de Octubre (Madrid, Spain) during the period between 2005 and 2015. Characteristics of the patient, fracture, surgical procedure, associated complications, active range of motion (aROM), as well as the evaluation of the outcomes through the Mayo Elbow Performance Score (MEPS), Broberg and Morrey rating system and the Disabilities of the Arm, Shoulder and Hand score (DASH) were collected. A structured protocol of surgical treatment was performed in all cases.

Results: A total of 62 patients with TTIE were obtained, of which 25 presented complications, 19 of whom were males and 6 were women. Mean follow-up after surgery was 24 months, ranged from 3 to 85 months. The average age was 47, ranged from 29 to 77. The most frequent injury mechanism was fall from own-height and 7 were polytrauma patients.

The majority had a radial head fracture Mason type III (15) and O'Driscoll type II (8) at the level of the coronoid process of the ulna. All patients underwent a lateral approach: Kocher (15) or Kaplan (10). One case required an additional medial approach.

The most common complication (a total of 36 in 25 patients) was heterotopic ossification (12) followed by arthrosis (10). Other complications were surgical wound infection (4), neurovascular injury (4), ulnar neuropraxia (1), incomplete axonotmesis, radial nerve (2), complete lesion of the posterior interosseous nerve (1) and incomplete axonotmesis of the ulnar nerve (1) and median (1), radial head asymptomatic loosening (4), radial neck periprosthetic fracture (1) and cubital-carpal impaction syndrome (1).

Surgical reoperation was required in 4 of the 25 (16%) cases of complications. Most frequent surgical procedure was elbow arthrolysis (2) to treat stiffness.

The mean aROM was 120°/−30°. Mean MEPS was 82 ranged from 70 to 95. Mean Broberg–Morrey score was 88, ranged from 77 to 97 and mean DASH score was 16, ranged between 0 and 56.

Conclusions: According to our experience and reviewing the literature, in TTIE still treated in a protocolized manner, a high percentage of complications persists (up to one third of patients). In spite of this, functional outcomes after surgery are generally satisfactory.

Further research is warranted to determine which surgical techniques optimize functional outcomes and reduce the risk of complications.

A-0799 The use of local vascularized adipofascial flaps for joint capsule reconstruction after contracture release

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Objective: Post-traumatic finger joint contracture affects daily activities of the patients. After the release of finger joint contracture, relapse of the joint contracture usually occurs in clinical practice. Fibrosis of the divided joint capsule which heals by secondary intention is a possible cause of re-contracture. Recently, we employed a novel idea to reduce the scar formation of the joint capsule, in which the divided rough surface was reconstructed by a local vascularized adipofascial flap (LVAF). The

results were compared to similar cases without reconstruction retrospectively.
Methods: This technique was applied in cases of contracture of the metacarpophalangeal joints and flexion contracture of the proximal interphalangeal joints. The LVAF was based on a random pattern flap, with the arterial inflow based at the lateral surface of the proximal phalanx, and from the dorsal metacarpal artery. A wide base ensures the vascularity of the adipofascial flap. The flap was then rotated to cover the rough surface of the joint. After the surgery, this group of patients followed the same rehabilitation instructions as those of the standard capsulotomy method. The arc of motion of the PIP joint was measured during follow-up.
Results: Patients were followed for 7 months and with age of 36.6 years old on average. Significant post-operative gain in the arc of motion (AOM) was observed in all cases. Although no statistical significance in post-operative range of motion was found, the group of LVAF showed more promptness in improvement when compared to the group with standard capsulotomy technique (gain AOM $40.0 \pm 8.9^{\circ}$ vs $24.3 \pm 19.9^{\circ}$, $p = 0.138$). Less pain during the early mobilization was reported by the patients with LVAF.
Conclusions: The short-term outcomes of the LVAF technique showed an equivalent result when compared to those of the standard capsulotomy group, even though there was no significant difference, the gain of AOM appeared slightly better in the LVAF group than in the standard capsulotomy group. Significant pain reduction during early mobilization could be one of the reasons why patients with LVAF experienced a faster improvement in AOM. A longer term of follow-up will be done to know the rates of relapse.

A-0802 Tendon transfers and brain plasticity: Results after BR to FPL tendon transfers

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Objective: Tendon transfers are common in hand surgery. However, to our knowledge, no human studies have dealt with cortical re-modelling in the brain after a tendon transfer. In this article, we present a model that allows us to study the effect on cortical organization after surgical induced change in motor function of the arm and hand. We also present the results after brachioradialis (BR) to flexor pollicis longus (FPL) tendon transfers to create a key grip in patients with cervical spinal cord injury (tetraplegia).
Methods: The model in brief: We have studied the cortical representation of the brachioradial muscle before and after a tendon transfer that changed its function from an elbow flexor to a thumb flexor (BR to FPL-transfer). The MR imaging was performed with a 3.0 Signa HDx MR scanner. Before the study, we had to design a ''muscle map'' of the motor cortex. The participants have some ''disturbing'' muscle activity from respiratory muscles and muscles responsible for head motion etc. Activity from these muscles had to be ''washed'' away to visualize the MRI patterns from the elbow flexor muscles and the thumb muscles. The series consisted of four patients with tetraplegia and three healthy control subjects. The patients were examined preoperatively and a few months postoperatively. The participants went through a sequence of alternating exercises and rest blocks, each lasting for 30 s. Preoperative exercises were elbow flexion and postoperative exercises were thumb flexion. Data from the non-operated healthy controls allowed typical spatial patterns of activation for each of the motor actions to be determined by means of cluster analysis. For each map, the centre-of-mass location of the five most significant clusters was noted and any others discarded.
Results: Results overall indicated that the post-operative key-grip movements in the tetraplegic patients were elicited from a similar brain region as in healthy controls, despite an alternative muscle (BR) being deployed. This may indicate that control of that muscle (BR) shifts from a brain region typically associated with elbow movements to one typically associated with hand movements.
Conclusions: To our knowledge, the findings in the present series are the first indications that the human cortex is capable of reorganizing itself spatially as a consequence of surgically altered motor periphery after transfer of a muscle tendon from the arm to the hand. This postoperative cortical reorganization, with the representation of an elbow flexor moving ''down'' from the preoperative elbow area towards the cortical hand area, appears to reflect the process behind the effect of the training to use the muscle in a new way, to obtain a hand grip instead of flexion of the elbow. Moreover, this cortical reorganization seems to occur within the time frame of the patients' ''learning'' of the new movements, that is, a few months after the tendon transfer.

A-0808 Oxidative protein damage and extracellular matrix changes in diabetic trigger finger patients

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Chronic hyperglycemia underlies cellular complications in diabetes. The mechanisms leading to cellular complications are not fully understood. Additionally, no relation between diabetes and trigger finger pathogenesis yet to be identified.
Methods: To evaluate the effect of chronic hyperglycemia on oxidative protein damage and extracellular matrix changes, we studied trigger finger in patients with ($n = 20$) and without ($n = 15$) diabetes. Pulley tissues were collected after trigger finger surgery and (1) tissue total thiol (T-SH), advanced oxidation protein products (AOPP) levels as markers of oxidative protein damage; (2) tissue sialic acid (SA) content as markers of extracellular matrix changes were measured. We measured plasma C-reactive protein (CRP) level. Additionally, histological evaluation of pulley tissues was performed.
Results: T-SH, AOPP and SA levels of pulley tissues were significantly different in nondiabetic individuals compared to diabetic individuals ($p < 0.05$). Nondiabetic versus diabetic values for T-SH were $22.7 + 1.6$ versus $38.9 + 5.2$ nmol/mg protein and for AOPP they were $175.6 + 9.9$ versus $472.5 + 131.6$ mmol/g protein. Diabetic and nondiabetic values for SA were $0.63 + 0.12$ versus $0.35 + 0.03$ nmol/mg protein. The level of CRP ($1.6 + 0.5$ vs $3.5 + 1.0$ mg/L) was increased in diabetic group with respect to its control ($p < 0.05$). No significant differences in nondiabetic patients were found in histological evaluation compared to diabetic patients.
Conclusion: Diabetes contributes to the redox imbalance of the pulley tissue proteins and extracellular matrix changes. Hence, diabetes could further increase the trigger finger complications. For this reason, controlling diabetes may help reducing cellular damage in diabetic trigger finger patients.

A-0812 How far the indication can be pushed for local perforator flaps in complex defects of the upper limb?

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Objective: The use of free flaps in complex defects all-over the body represents the gold standard for reconstruction. Moreover, the great expansion of perforator flaps in the last decades solved one of the more questionable problems of using free flaps, that is, the donor site morbidity. Even if the use of local perforator flaps brings together a lot of advantages (replacing like-with-like, shorter procedure), some surgeons consider that their use should be limited to simple and small/medium defects, and that they add supplementary donor site morbidity very close to the originally injured area. Despite these facts, we consider that local perforator flaps represent a good indication in very well-selected cases, sometimes even in very complex defects, in which the first goal is represented by the quality of functional recovery.
Material: We present our experience in using local perforator flaps, as both V-Y advancement and propeller flaps in covering complex acute or chronic defects in the upper limb. We take into consideration 37 cases, 13 acute and 24 chronic, in which we performed such a flap in the last 5 years.
Results: All the flaps survived; we registered an uneventful evolution in 18 cases, and a venous congestion of the flap in 19 cases, which progressed towards spontaneous healing in 11 cases, epidermolysis followed by secondary healing in 5 cases, and superficial necrosis needing covering by another surgical procedure in 3 cases. The functional recovery was good in all the cases.
Conclusion: We consider that the local perforator flaps can be successfully used in well-selected cases, even in very complex injuries. In such a very damaged hand, the aspect of the donor site is of secondary importance if the price is a good regain of functionality.

A-0813 Supermicrosurgical free perforator flaps for reconstruction of soft tissue defect of finger pulp

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Objectives: Soft tissue defect of finger pulp or the volar surfaces of fingers are common injuries of hand. Different reconstructive methods were used for such injuries, like digital artery island flap, V-Y advanced flap, dorsal metacarpal flap, pedicled groin flap, and so on. But these methods have obvious disadvantages: bad esthetic outcome or big donor site injuries.
Methods: Between November 2008 and January 2017, we prospectively studied the use of supermicrosurgical perforator flaps to reconstruct soft tissue defect of finger pulp or volar side of finger in 14 fingers, comprising 8 thenar perforator flaps and 6 digital artery perforator flaps. We only harvest the perforator branch of proper digital artery and the cutaneous branch in thenar area for the flaps and a superficial vein for each flap. The nerve branch is harvested with flap to recover the sensation.
Results: All flaps survived completely. We did follow-up 6 months to 3 years post operation, the majority recovered excellent appearance and function. The flaps had the characteristics of normal finger volar skin: hairless, with similar texture and color. The sensation of flaps recovered well.
Conclusions: Supermicrosurgical free perforator flaps provide excellent reconstruction for fingers with soft tissue defect of finger pulp or volar side. The colour, texture and hairless fit well with recipient site. With supermicrosurgical technique, we need not to harvest digital artery or superficial branch of radial artery, which can decrease donor site injuries. The sensation of flap can also be recovered by detecting the nerve branch to the flap.

A-0815 Extended dynamometry

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Objective: The assessment of power is an important part of the assessment of hand function for both surgeons and therapists. The most widely used method is the measurement of grip strength using a Jamar dynamometer, which is an adjustable hand-held device that measures grip strength over five different positional widths. The power that can be applied over the five settings of the Jamar dynamometer usually exhibits a skewed bell-shaped curve; the maximum power being almost always achieved at either setting 2 or 3.

There is the expectation that most patients will perform dynamometry to the best of their abilities but this cannot, however, be assumed in patients who are undergoing work-place and medico-legal assessments. It is observed that patients produce atypical effort curves and variations in grip strength on repetitive testing even when there is no structural or neurophysiological explanation. Dynamometry protocols therefore need to be designed to assess capacity as well as to detect sub-maximal effort. We have therefore developed an extended testing protocol that by repetition mitigates but does not ignore the effects of variation.
Methods: The test protocol comprised two tests at each Jamar position. The sequence starts from the first and narrowest position on the right hand, followed by the first position on the left hand, the second position on the right hand, and so on. Following the fifth test on the left hand at the widest Jamar setting, the sequence is reversed. The largest value for the two attempts at any given side and position is used for the purposes of analysis. Consistency is assessed by calculation of the mean coefficient of variation (CoV) for each pair of attempts for a hand ((standard deviation/mean) $\times$ 100).
Results: Dynamometry was undertaken in 242 volunteers (male:female, 124:118) with a median(range) of 39(18–82) years. Normative data have been obtained for sex and age ranges. Grip strength was significantly influenced by sex, age, height and occupation. Hand dominance did not affect maximum grip strength but the right hand was significantly stronger than the left in right-handed individuals, whereas the sides were comparable in left-handed individuals. The maximum power was achieved at position 2 or 3 of the dynamometer in 96% of patients. There was a significant difference in maximum handle position between women and men in the left hand only. The median consistency was 6.5% and was unaffected by sex, age, height and occupation.
Conclusion: These results serve as a standard by which patients can be judged when undergoing disability assessment.

A-0819 Terrible triad injury of the elbow: Interobserver and intraobserver reliability of computed tomography versus plain radiography in the preoperative planning

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Introduction: The benefit of CT scan in the preoperative planning for the ''Terrible Triad Injury'' (TTI) of the elbow is still unknown. The aim of this study was

to evaluate the interobserver and intraobserver reliability for the preoperative planning of these complex injuries using plain radiographs alone and with the addition of computed tomography (CT) scans.
Materials and Methods: In the first part of the study, four observers (all specialized orthopaedic surgeons) were shown the plain radiographic images of each patient in random order and asked to answer a questionnaire referring to approach and treatment strategies. The radiographic images of the patients were then randomly shuffled and presented to the same observers at an interval of minimum 2 weeks. In the second part of the study, conducted at a minimum of 2 weeks from the last radiographic session, the same four observers were shown the corresponding CT images of each patient in random order, such that they could not be associated with the corresponding plain radiographs. CT images were inclusive of axial, sagittal and coronal cuts. The observers were asked to answer the same questions and were blinded to their own answers at the time of the radiographic evaluation. The CT images of the patients were again randomly shuffled and presented to the same observers at an interval of min 2 weeks. In total, 1568 answers were recorded. Changes in treatment plan and operative approach were recorded. We determined intra-observer and inter-observer reliability and analyzed whether the use of the CT scans helped to increase the adherence to a treatment plan. Kappa coefficients of intra-observer and inter-observer reliability for treatment plans were generated.
Results: The preoperative recommendation for the surgical approach, of the coronoid process fracture, and of the radial collateral ligament changed after reviewing CT scans. The availability of CT scans did not affect the preoperative planning for the radial head and for the medial collateral ligament. The mean intra-observer correlation coefficient (ICC) overall for preoperative planning based on X-rays alone increased by 24% points after adding CT scans.
Conclusion: In these complex cases, the use of CT scans in addition to the plain radiographs increases the intra- and interobserver reliability.

A-0820 Are the superficial transverse palmar ligament and the septa of Legueu and Juvara involved in Dupuytren's disease? Histological and immunehistochemical study

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Introduction: The longitudinal fibers (FL) of the palmar aponeurosis (PA) represent the classic site of development of nodules and chords characteristic of the Dupuytren's disease (DD). The role of the other two components of the PA, the superficial transverse palmar ligament (FT) and of the Septa of Legueu and Juvara (SLJ), is still controversial and the presence of myofibroblasts in these fibers has not been investigated. Its finding could indicate that both tissues are also involved in the formation of the Dupuytren contracture.
Purpose: To determine the histological and immunohistochemical characteristics of the three components of the PA and to determine whether the three components are equally affected by DD.
Materials and Methods: Tissue samples from the three components of the PA (FL, FT and SLJ) were obtained from 15 DD patients, all men, aged between 59 and 75 years (average 67.4 years) during palmar fasciectomy. They all had Dupuytren's disease Tubiana stage II (71%) or stage III (29%). Immediately after removal, each of the three tissues was prepared for histological and immunohistochemical analysis. Immunohistochemistry for TGF-β (transforming growth factor beta), smooth muscle actin (α-SMA), fibronectin, and other extracellular matrix (ECM) components of the PA, such as CD90, Col1, Col2, and Col1, were carried out.
Results: The results showed that the expression of TGF-β was high in FL, FT, and SLJ while the expression of α-SMA was similar in all three tissues, although at lower level than TGF-β. Immunohistochemical expression of fibronectin was similar in all three components of the PA, although not as constant as TGF-β and α-SMA. In addition, the expression of markers for other ECM components was equally high in all the three components of the palmar aponeurosis. Col3 was expressed in half of the tissues, although its distribution was similar in FL, FT and SLJ. None of the patients showed signs of recurrence of the disease at the latest follow-up.
Discussion and Conclusions: The FL are the site of transformation of fibroblast into myofibroblast. Recent studies suggest that TGF-β1 plays an important role in this differentiation, by stimulating the synthesis of α-2 type I collagen and by inhibiting the degradation and α-1 type III collagen. The expression of TGF-β1 is increased at the level of Dupuytren's nodes and chords. In addition, α-SMA, expressed by the myofibroblasts of the Dupuytren contracture and considered a marker for these cells, plays a role in the contracture of PA. Its expression is induced by TGF-β1. Lastly, the myofibroblasts synthesize fibronectin, an extracellular glycoprotein that binds the

myofibroblasts to each other and to the ECM by integrins.

The preliminary results of our study suggest that all the three components of the PA (FL, FT and SLJ) may be affected, even though they appear macroscopically unaffected. Further studies are necessary to quantify the number of cells present in each tissue. A modification of the therapeutic approach used for the treatment of DD should be considered according to the results.

A-0823 Confirmation of the feasibility of ex vivo creation of a novel human multichimeric cells therapy for tolerance induction in vascularized composite allotransplantation

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Objective: Various stem cell-based therapies have been proposed as supportive treatments for patients following solid organ and vascularized composite allotransplantation (VCA) to achieve donor-specific tolerance and eliminate the toxic, systemic, lifelong, multi-drug immunosuppression. We introduce a novel cellular therapy of ex vivo created umbilical cord blood derived multi-chimeric cells (mCC) as an alternative approach to bone marrow–based therapies in support of VCA. The aim of this study was to establish the ex vivo fusion protocol and characterize in vitro the phenotype, genotype, viability and proliferative potential of fused human mCC.
Methods: Twenty-two ex vivo fusions of human umbilical cord blood (UCB) cells were performed. Mononuclear cells (MNC) were isolated from UCB originating from three unrelated donors. Next, MNC were stained separately by PKH26, PKH67 and eFluor670 proliferation dye and fused using polyethylene glycol (PEG). Triple PKH26/PKH67/eFluor670 stained mCC were sorted and assessed by confocal microscopy and flow cytometry for the efficacy of the cell fusion procedure. The viability of mCC (Trypan blue and LIVE/DEAD cell viability assay) and distribution of hematopoietic surface markers (CD4, CD8, CD19, CD45 and CD90) were performed by flow cytometry. PCR-rSSOP (Antigens: A, B, C, Bw, DRB1, DQB1, DR51, DR52 and DR53) and STR-PCR (Loci: TH01, D21S11, D5S818, D13S317, D7S820, D16S539, vWA, TPOX) characterized the genotype of mCC. Proliferative potential of mCC was assessed by colony forming unit (CFU) assay.
Results: Flow cytometry and confocal microscopy analysis confirmed UCB fusion and creation of human mCC. Using PCR-rSSOP and STR-PCR assays, we determined that human mCC are sharing HLA class I and class II antigens, as well as selected loci specific for all three UCB donors used for fusion. After fusion, 90–95% of cells were viable. Phenotype characterization showed similar percentage and pattern of hematopoietic markers distribution on the surface of mCC and UCB donors. Maintenance of proliferative properties of mCC was confirmed by CFU assay.
Conclusions: We have successfully confirmed the feasibility of ex vivo fusion procedure and creation of human mCC. We characterized the phenotype, genotype, viability and proliferative potential of mCC. This unique concept of mCC introduces a novel universal therapy for tolerance induction in solid organ and VCA transplantation.

A-0830 The effect of electromyographic biofeedback training on electrical muscle activity and functional status in zones I–III flexor tendon injuries: Preliminary results

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Objective: In this study, it was aimed to investigate the effect of electromyographic (EMG) biofeedback training applied in addition to early passive mobilization protocol on electrical muscle activity and functional status in zone I–III flexor tendon injuries.
Methods: This prospective randomized study included 14 cases aged between 18 and 56 (31.93 ± 12.22) years and operated for the injury of at least one of the flexor digitorum superficialis (FDS) or flexor digitorum profundus (FDP) tendons in zone I–III. Tendons were repaired with modified Kessler technique using 3-0 or 5-0 Prolene by the hand surgeon. The cases were divided into two groups by block randomization. Early passive mobilization method (modified Duran protocol) to the first group and EMG biofeedback training by surface electrodes in addition to early passive mobilization to the second group were applied. The cases started using the dorsal blocking splint on postoperative days 3 to 5. The same physiotherapist applied the exercise program three times a week, until 12th week. EMG biofeedback training was given to the second group for 4 weeks. Splint use was terminated at 6 weeks postoperatively. Demographic and medical information of the cases were recorded at the beginning of the study. Pain intensity (by visual analog scale),

range of motion (ROM, by modified Strickland classification), electrical muscle activity (by EMG Biofeedback device), hand function (by Michigan Hand Outcomes Questionnaire) were assessed at postoperative 5th and 12th weeks; grip and pinch strength at 12th weeks. Two groups were compared by Mann–Whitney U test.

Results: There were tendon injuries in 15 fingers of 14 patients. Of the patients, seven were females and seven were males (each 50%). The dominant hand of all cases except one was right. The injury was in the dominant hand in seven patients and in the non-dominant hand in the rest (each 50%). Six cases (42.9%) had injury in second, 5 cases (35.7%) in third, 2 cases (14.3%) in fifth and 1 case in both second and third fingers (7.1%). Additionally, 11 cases had injury in zone II (78.6%) and 3 had in zone III (21.4%). Only FDP in 2 fingers (13.3%) and, both FDS and FDP in 13 fingers were cut. In the EMG biofeedback group FDS and FDP electrical muscle activity, hand and pinch grip strength were higher at 12th week. However, there was no significant difference between the two groups in terms of ROM, electrical muscle activity, hand function, hand and pinch grip ($p > 0.05$).

Conclusions: In conclusion, we think that EMG biofeedback training applied after isolated flexor tendon injuries was a useful training method in facilitating tendon excursion and in increasing electrical muscle activity. However, in order to be able to interpret the results more clearly, there is a need for studies with large sample sizes.

A-0832 Retrospective study of secondary surgery after trapeziometacarpal joint arthroplasty

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Objective: Trapeziometacarpal (TMC) joint replacement is increasingly being performed for the treatment of rhizarthrosis. Our goal was to analyze the incidence and the indication of secondary surgery following trapeziometacarpal joint arthroplasty in order to avoid them and to improve long-term implant survival.

Methods: The charts from patients who underwent such an arthroplasty between January 2010 and November 2017 were reviewed. All the cases of patients who were scheduled for any type of secondary surgery were identified.

Results: All the patient have been operated in our hand unit by 24 surgeons; however, 4 senior surgeons took care of 78% of all patients. During the period, 890 TMC total joint prostheses were implanted in 757 patients, with a mean follow-up of 38 months. The implants used were single or dual mobility cups (Maïa®, Moovis®, Touch®). The joint survival was 98% after the mean follow-up. Secondary procedures were scheduled in 18 prosthesis of our patients (2%) and in 6 prosthesis which were implanted in others hospitals. Causes of revision surgery were 10 cases of loosening (7 trapezium cups, 2 stems, 1 bipolar), 3 osteophytes formations, 6 cases of dislocation (acute or chronic), 1 trapezium fracture, 2 incorrect implant positions, 1 cam effect, 1 instability of the thumb. Only 4 revisions required a trapeziectomy. Surgery targeting soft tissues and osteophytes or replacement of one of the implants (usually with a larger size) gave good outcomes with quick recovery of activities as good as primary arthroplasty.

Conclusion: With this study, unlike some articles in the literature, we show that this technique is a safe and reliable procedure and revisions are rarely required. It has the potential for long-term survival rates. Most of the revisions lead to an implant replacement, which allows the patient to keep the benefits of the prosthesis. Fear of higher complication rate of using a trapeziometacarpal implant has slowed us for a long time to choose this indication compared with trapeziectomy. Yet, the early outcomes of the trapeziometacarpal joint arthroplasty show faster recovery and this has completely changed our postoperative rhizarthrosis consultation. In light of this study, in order to avoid revision surgery, the surgical technique must be perfect (learning curve, experience, feeling). Patient education is also essential with a long follow-up. The better understanding of the trapeziometacarpal joint and the improvement of the prostheses could further reduce our recovery rates.

A-0834 Congenital trigger digits: Results of surgical treatment

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Background/aim: Congenital trigger digit is a condition often missed from parents' attention and misdiagnosed by paediatricians during the first year of life. In the literature, both conservative and surgical management are favoured. The purpose of the study

was to review surgical management and outcomes in patients with congenital trigger digits.
Methods: Sixty-two children (35 boys and 27 girls) with 66 trigger digits (58 thumbs six indices and two ring fingers) underwent surgical treatment between 2000 and 2015. Mean age was 26 months (range 8–54 months). An open release of A1 pulley, through a small incision, was carried out after recognition and protection of the digital nerves. General anaesthesia, tourniquet and magnification loops were used routinely for all procedures. Mobility and sensitivity of trigger digits were recorded pre- and postoperatively.
Results: Follow-up period was 29 months (range 16–44 months). Forty-nine patients presented after the first year of life. The involved digits were thumbs in the majority of patients. Postoperatively all patients had full range of motion and normal sensitivity. There were no recurrences of triggering and no infections.
Conclusion: Surgical management of congenital trigger digits provides excellent results, especially in patients who present in older children where conservative treatment has doubtful outcomes. Special attention is needed during surgery due to small size of the neurovascular bundles

A-0836 A systematic review of dressing outcomes after fingertip injuries

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Objectives: To review the available literature to identify the optimum type of dressing for fingertip injuries in terms of the outcomes of patient pain and adherence on dressing change, patient-reported comfort in dressing and time to healing of wound.
Methods: A systematic search using search terms ''finger'' and ''dressing'' was performed on MEDLINE, CINAHL and EMBASE databases. Two reviewers read full-text articles for inclusion and data regarding the outcomes of interest was extracted. Grouped analysis of comparative studies assessing similar dressing regimes was performed.
Results: Eight studies assessing 476 patients were selected for inclusion. The majority of these studies were small (median 42.5 patients per study) and of relatively limited methodological quality.

The most commonly examined dressing was paraffin gauze (examined in five studies). Mepitel® dressing, polyurethane foam dressing and silver sulphadiazine were examined in two studies each. Remaining dressings examined were polymeric membrane dressing, lipocolloid dressing, traditional gauze dressing, Adaptic® finger dressing and fucidin gauze dressing.

Paraffin gauze was reported as inferior to comparison dressings in terms of patient pain adherence on dressing change in the majority of studies. In terms of time to healing, it was reported as equivalent or superior to comparisons.
Conclusions: Insufficient high-quality evidence exists to recommend a single type of fingertip dressing; however, available evidence suggests that paraffin gauze may be more likely to perform poorly in outcomes of patient pain and dressing adherence on dressing change. Further research in this area should include patient-reported outcomes or patient experience measures as well as clinical outcomes.

A-0838 Osseointegrated thumb prostheses as an alternative for toe to thumb transfers

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Objective: Loss of a thumb is associated with impairment of hand function. Fitting patients with conventional socket prostheses can be particularly challenging due to short stumps. Secondary reconstructive procedures (pollicization, toe to thumb transplantation and lengthening) are the most commonly used techniques. Osseointegrated treatment and rehabilitation for amputees has been used for transmetacarpal I level since 1990. This retrospective study presents adverse events, outcome measures and cumulative success rate of this alternative treatment.
Methods: The study includes pre- and postoperative data collected from 13 transmetacarpal I amputees (10 male, 3 female) treated with osseointegrated prostheses. Reasons for amputation were trauma (11) and tumor (2). The patients mean residual extremity length was 41 mm (30–50). Patients were treated with an experimental implant 1990–2004 at Brånemark Osseointegration Center (7), and with a standardized treatment protocol 2005–2017 at Sahlgrenska University Hospital (6). During the surgery, a threaded titanium implant (fixture) is inserted into the residual bone. An abutment is then coupled into the distal end of the fixture and secured with a screw (abutment screw). The healing process takes about 4 weeks after which the patient is supplied with a prosthesis.
Results: The average prosthetic usage time was 9.5 years (0.25–25). Two patients were withdrawn from

the study for unrelated reason (death from unrelated cause). There were 4 non-implant users; one stopped using the prostheses 1 year after surgery S2; two patients had failed osseointegration; one patient had an infection between surgeries S1 and S2 that led to loosening and these 3 patients had their implant removed. One patient had a fall in 2006 leading to a tetraplegic condition and has for obvious reason limited function, although the patient is using the thumb prosthesis daily. Overall 19 complications were reported. The two most common complications were change of an abutment (eight in three patients) and superficial infections (seven in five patients). A total of five patients had no adverse events. The cumulative success rate was 57% and 100% for patients treated at the Brånemark Osseointegration Center and Sahlgrenska University Hospital, respectively. The longest functional implant follow-up time was 25 years.

A total of seven patients with ossointegrated thumb prostheses were tested for functionality. All patients were prostheses users and were able to feel sensation with their osseointegrated prosthesis (2.83–6.65) measured with monofilament. Hand strength tests outcomes: In Jamar grip test showed median 28.3 versus 40.4; B&L pinch test showed 6 versus 9.1; B&L lateral pinch test showed 6.5 versus 9.2 with affected and unaffected hand, respectively. Hand function was 95% of normal function measured with Sollerman's grip-function test.

Conclusions: Experience with the early experimental implant design and treatment protocol has led to the standardized treatment with a considerable higher success rate. Adverse events were few and manageable except for implant loosening in the early group. The patients have 70% of grip strength, 95% of hand function compared with the unaffected hand and measurable sensation via the osseointegrated prosthesis. The reported results indicate that osseointegrated thumb prostheses might be considered an alternative to other thumb reconstruction treatments.

A-0839 Open reduction and internal fixation for Mason type III radial head fractures: Is it different from that for Mason type II fractures?

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Background: We have been preferentially performing open reduction and internal fixation (ORIF) for Mason type III radial head fractures (RHFs), rather than radial head arthroplasty (RHA). The question in this study is whether ORIF really is a 'less' favorable option for Mason III RHFs, as compared to ORIF for Mason II RHFs or RHA. To answer this, we reviewed the outcomes of RHFs of Mason type II and type III and evaluated whether ORIF in fact is a good option for Mason III RHFs.

Materials and Methods: A total of 87 patients who were treated surgically for a radial head fracture were reviewed. The fractures were Mason type II in 39 (44.8%) patients and type III in 48 (55.2%) patients. The surgery for Mason type II RHFs was ORIF in all cases. The surgery for Mason type III was ORIF in 40 (83.3%) patients, RHA in 7 (14.6%) patients, and resection in 1 (2.1%) patient. Radiololgic and functional outcomes at final visit were evaluated and complications were reviewed.

Results: When comparing Mason II RHFs and Mason III RHFs treated by ORIF, no significant difference was observed in extension, flexion and Quick-DASH score ($p = 0.408$, 0.740, and 0.082, respectively), although pronation/supination was significantly better in Mason II RHFs. However, when comparing Mason II RHFs and Mason III RHFs treated by RHA, the Quick-DASH score was significantly better (lower) in Mason II RHFs ($p = 0.006$). Also, the ROM was significantly better in flexion, pronation, and supination, in Mason II compared to Mason III treated by RHA ($p = 0.009$, 0.006, and 0.006, respectively). When ORIF and RHA are compared within Mason III RHFs, there was no significant difference in ROM and Quick-DASH score between ORIF and RHA, except for significantly more flexion deficit in RHA ($p = 0.007$).

Conclusion: ORIF is a good option for Mason III RHFs, which produces outcomes not very different from outcomes of Mason II RHFs. When compared to RHA, ORIF produces similar or better outcomes in Mason III RHFs.

A-0840 Ulnar-sided carpometacarpal articular fractures

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Objective: Ulnar-sided carpometacarpal articular fractures are frequent. Diagnose is often delayed or incomplete and there is no treatment consensus. This systematic review reports the state of the art and possible improvement in diagnosis and treatment.

Methods: Following PRISMA guidelines, terms used in Web of Science database for the research were ''carpometacarpal'' ''joint'' ''fourth finger,'' ''fourth metacarpal,'' ''fifth finger,'' ''fifth metacarpal,'' ''small finger,'' ''little finger,'' ''ring finger,'' ''hamatum,'' ''hamate,'' ''fracture,'' ''dislocation,'' ''articular,'' ''base fracture''. Quality of the articles was assessed with the Moga checklist. Epidemiological, clinical, and radiological data were analysed.

Results: Five hundred articles were found on the database. After exclusion of case reports and articles treating multiple lesions, 16 articles were selected. Based on the Moga assessment tool, three articles (19%) were of acceptable quality. Series included 22 patients in average, 87% affected the dominant hand following a direct punch in 52% and falls in 22%. Male dominance was 95%. Age was 32 years (9–93). When present, metacarpal dislocation was always dorsal. X-ray views were posteroanterior, lateral and different degrees of supination/pronation. CT scan was used in five studies (31%). Five classifications were proposed but were unable to describe all the lesions or were too complicated to use in every-day practice. Average delay of treatment or diagnose was reported in three articles and was 19 days. Initial misdiagnosis was reported in 21%.

A variety of lesions were described, the most frequent being a dorsal metacarpal dislocation with palmar metacarpal impaction. Hamate fractures were mainly dorsal impaction. Eight articles did not report any hamate fracture (50%).

Average follow-up was 27 months (1–168). Fixation included closed reduction and internal fixation (CRIF) by K-wires for articular stability and ORIF by K-wires, mini-screws and miniplate for articular fragments. Thirteen (81%) studies used ORIF, 11 (69%) articles used CRIF, and 11 (69%) articles used a nonoperative treatment.

Radiological evaluation included fusion, displacement, metacarpal shortening, osteoarthritis and the Kellgren–Lawrence scale. Four (25%) articles did not report any radiological assessment. Postoperative CT scan was never reported.

Clinical assessment was performed for pain in 44% and grip strength in 81% of the series. A specific quantitative measure instrument was used in 6 and 81%, respectively; 77% of patients were painless.

Functional assessment was performed in five (31%) articles. DASH in 2 (12%), Michigan hand outcome questionnaire in 6% and Kumar criteria in 6% of the series. DASH score was between 1 and 9, Michigan questionnaire was between 75 and 98 and Kumar was good or excellent. All questionnaires were between fair good and excellent.

Participation assessment showed that 84% of the overall average patients returned to their previous activities/work (43–100%) between 3 weeks and 3 months.

Conclusions: This review outlines a poor quality of most of the articles and consequently a low level of evidence of the results. It appears that systematic oblique views and CT would help detecting adjacent metacarpal and hamate lesions. There is a need for comprehensive classification. Indications for direct articular fracture fixation stay controversial.

A-0842 A novel stem cell therapy of dystrophin expressing chimeric cells of myoblast and mesenchymal stem cell origin for enhancement of muscle regeneration and function

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Objective: Allogeneic stem cell therapies aim to restore muscle tissue after traumatic loss or muscular dystrophies. Limited engraftment due to allogeneic rejection is a major challenge. Muscle-derived chimeric cells (MDCC), created via ex vivo fusion of myoblast (MB) and mesenchymal stem cells (MSC), represent a promising therapeutic option. The aim of this study was to characterize human MDCC in vitro and to assess MDCC efficacy in engraftment and restoration of muscle function in Duchenne muscular dystrophy (DMD) MDX/SCID mice model.

Methods: MDCC proliferation, dystrophin expression, and myogenic differentiation were tested.

Lymphocyte proliferation assay was performed to evaluate MDCC immunogenicity. To test the efficacy of MDCC in vivo, MDX/SCID mice received intramuscular injections to gastrocnemius muscle (GM): Group 1 – vehicle (60 μl phosphate-buffered saline), Group 2 – 0.25×10^6 of MSC and 0.25×10^6 MB, Group 3 – 0.5×10^6 of MB/MSC MDCC. Therapeutic effect was monitored by muscle function tests (wire hanging and grip strength tests, in vivo in situ and ex vivo muscle force measurement). DE was evaluated at days 7 and 90 after MDCC delivery.

Results: Parent cells genotype, dystrophin expression, proliferation and differentiation to mature skeletal myocytes of MDCC were confirmed. Proliferation of responder lymphocytes after stimulation with MDCC was 5.49% (SI = 3.15) compared with the positive controls of 55% (SI = 31) after stimulation with third-party lymphocyte and 10% (SI = 5.8) after stimulation with MB parent cells. MDCC survival and engraftment to GM was confirmed

by dystrophin expression of 17.7% at day 7 and 20.26% at 90 days.

Moreover, dystrophin, HLA-ABC and mature myocyte-specific markers were co-expressed by MDCC confirming human origin and differentiation of MDCC after transplant. MDCC recipients showed increase in muscle force ($p = 0.04$) and improved fatigue tolerance compared to vehicle group.

Conclusion: This study confirmed efficacy of MDCC therapy in restoration of muscle function, which correlated with dystrophin expression in the GM of MDX/SCID mice. MDCC therapy represents a novel, universal approach for restoration of muscle function in muscular dystrophy, traumatic loss and for regeneration of muscle components of VCA.

A-0846 Resurfacing capitate pyrocarbon implant associated with first row carpectomy: It should be an alternative to 4CF and scaphoidectomy in SLAC-SNAC stage III wrists?

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Objective: Four-corner fusion (4CF) is probably the gold standard procedure for the treatment of advanced stages of carpal collapse, when the lunate facet of the radius is still intact. However, in the past decade, the RCPI associated with first row carpectomy (FRC) proved his efficacy in such arthritic wrists. We retrospectively compared our case series of RCPI associated with FRC vs 4CF, for the treatment of SLAC-SNAC stage III wrists.

Methods: Forty-three patients who underwent surgery for SLAC-SNAC stage III wrist OA in our Hand Surgery Department, between 2007 and 2015, were retrospectively selected. All cases had a minimum follow-up of 2 years. Twenty-five patients underwent FRC + RCPI implant (Group A) and 18 patients underwent 4CF with dorsal plate (Group B). The follow-up was 42 months (min 24, max 96) for Group A and 38 months for Group B (min 26, max 58). All patients were clinically (pain, range of motion and grip strength) and radiographically evaluated. PRWE score and DASH score were assessed. Similarly, return to previous working and sport activities was investigated.

Results: In Group A, patients showed consistent pain relief (VAS 2.52), while preserving wrist mobility (mean flexion–extension 26.5°–32.6°, radial–ulnar inclination 12.1°–26.5°) and grip strength (55% compared to contralateral side), with a satisfactory recovery allowing previous working activities. Mean operative time was 76 min. The average DASH score was 19.5 and the average PRWE score was 28.2. No implant mobilization or capitate fracture was detected during the follow-up. One patient presented volar carpal dislocation 1 week after surgery and underwent immediate open reduction and stabilization. One case of persistent pain leads to total wrist arthrodesis 1 year later. No acceleration of distal radial OA was observed.

In Group B, mean VAS was 3, flexion–extension 27.7°–37.7°, radial–ulnar inclination 16.1°–21.1° and grip was 62.3% compared to contralateral side. Mean operative time was 97 min. The average DASH score was 22.7, and the average PRWE score was 27.56. In two cases, non-union of the arthrodesis was observed, and the patients underwent revision with total wrist fusion.

No statistically significant difference was underlined by statistical analysis among Groups A and B for all the measured outcomes and scores, except for a better radial inclination ($p < 0.05$) in Group B. Consistently, DASH and PRWE scores were not found to be statistically different. Grip strength, which has always been the major criticism to FRC, has been slightly lower in Group A but without any statistical difference. Operative time was significantly lower in Group A, while patients' age was significantly higher (54 vs 43 years).

Conclusions: Based on these outcomes for the treatment of advanced stages of OA (SNAC/SLAC stage III), RCPI associated with FRC proved to be a reliable alternative to 4CF and scaphoidectomy, the most widely spread technique, even in older patients. The lack of grip strength that has historically been attributed to FRC seemed to be not significant. On the contrary, the surgical time appears to be lower and there are no risks of non-union.

A-0852 Efficiency of hyaluronic acid in prevention of adhesion formation after flexor tendon tenolysis

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Objective: Standard treatment for symptomatic flexor tendon adhesions is tenolysis and early active mobilization. Appropriate rehabilitation may reduce

but cannot prevent their formation or recurrence. Auto-cross-linked hyaluronic acid polymers are considered to have an antiadhesive effect.

Methods: This prospective, randomized, single-blind clinical trial was conducted from January 2013 to May 2015. Thirty-six patients indicated for flexor tenolysis after previous replantation and revascularization with tendon suture in zone II were enrolled. In the experimental group, hyaluronic acid gel (Hyaloglide®) was applied directly to the flexor tendon just before skin closure. No antiadhesives were used in the control group. All patients were evaluated by testing total active motion (TAM) and DASH questionnaire before the surgery, at postoperative day 14 and 1, 2, 3 and 6 months postoperatively.

Results: No significant improvement of TAM in percent (TAM%) or DASH were detected between the experimental and the control group ($p > 0.05$). The mean improvement of TAM% in sixth postoperative month was 18% in the experimental group and 21% in the control group. On the contrary, we have demonstrated that the smokers have significantly lower improvement of TAM% in the both groups ($p < 0.05$). The mean improvement of TAM% was 16% in smokers and 23% in no-smokers 3 months postoperatively.

Conclusions: We did not show any improvement in functional outcomes of flexor tenolysis associated with the use of hyaluronic acid gel (Hyaloglide). We have demonstrated a direct correlation between smoking and poor results.

A-0853 The advantages of using WALANT anesthesia for hand and wrist fractures: Personal experience

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Objectives: The objectives of this study were to (1) compare the advantages of this type of anesthesia, which allows full hand movement during surgery, (2) present the exact technique and highlight patient benefits, and (3) compare the obtained results including hand therapy protocols with literature.

Materials and Methods: In a prospective manner, 48 patients suffering from hand fractures or even wrist fractures were treated using wide-awake hand surgery (WALANT) anesthesia. The fracture includes metacarpal fractures, hand fractures, and even wrist fractures. This allowed us to discharge the patients after few hours. This technique can be performed with no preoperative testing, no intravenous insertion, and no monitoring and is similar a dental procedure.

The patients could talk with the surgical team and to see the immediate hand movement after skin closure.

Results: We were able to check the fracture reduction and the implant stability, with active motion of the hand. This helped us to decide whether to allow early protected movement after surgery. The patients could see the reduction of their bone on fluoroscopy and they could watch themselves achieve a full range of motion during the surgery. They remember this and know that this will be achievable if they will be so motivated during hand rehabilitation. Most of our fracture reductions were anatomical and the stable fixation was possible with plates and screws.

Conclusions: There are multiple advantages of using this safe technique, both for the patient and for the surgeons. All the patients considered their surgeries a good experience and they were more motivated in hand rehabilitation.

A-0859 Kinesiophobia and its relation with functional outcomes in hand injuries

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Objective: Kinesiophobia is defined as an ''excessive, irrational, and debilitating fear of physical movement and activity resulting from a feeling of vulnerability to painful injury or reinjury.'' Kinesiophobia had been widely assessed in various conditions including neurologic and orthopedic injuries. However, little is known about the relation of kinesiophobia and functional outcomes of hand. The aim of this study is to state the relation of kinesiophobia with hand function outcomes.

Methods: Twenty-six patients (14 women and 12 men) with soft tissue injuries (tendon, muscle and ligament injuries) completed the TAMPA scale for kinesiophobia. Disability of the Arm, Shoulder and Hand (DASH) questionnaire was used to state upper extremity-specific disability level. Hand dexterity, strength and pain intensity were assessed with the use of Jebsen Taylor Hand Function Test (JTT), Purdue Pegboard Test (PPT), hand dynamometer and Visual Analog Scale (VAS). All the assessments were done at 8–12 weeks after diagnoses. Correlation coefficient was calculated with SPSS 21

programme to assess the relation between outcomes.

Results: The age interval of the patients was between 18 and 71 years with the mean age of 39.19 ± 13.91 years. The mean score of TAMPA scale was 39.31 ± 5.05 (minimum 32, maximum 51). The relation was not significant between the TAMPA scale and DASH ($p = 0.43$, $r = 0.16$), JTT page turning subtest ($p = 0.79$, $r = 0.05$), JTT simulated feeding subtest ($p = 0.52$, $r = 0.13$), JTT stacking checkers subtest ($p = 0.10$, $r = 0.32$), JTT picking up large light objects subtest ($p = 0.48$, $r = 0.14$), JTT picking up large heavy objects subtest ($p = 0.13$, $r = 0.30$), JTT writing subtest ($p = 0.34$, $r = 0.26$), PPT ($p = 0.69$, $r = 0.08$), grip force ($p = 0.93$, $r = 0.01$) and VAS ($p = 0.76$, $r = 0.06$). Kinesiophobia was found to be only significantly related with picking up small common objects subtest ($p = 0.02$, $r = 0.43$).

Conclusions: The kinesiophobia score of the patients varied between moderate to high; however, it was not related to hand functioning outcomes. This result may have a relation with the type of diagnosis, patients with soft tissue injury may perform well in hand outcome measures than other injuries like fractures, nerve injuries. The low number of the participants may also lead to this result. Assessments were done in the subacute or chronic phase of the injury for letting the patient to use the hand. Meanwhile during that period hand functioning may be recovered. Therefore, the relation of kinesiophobia may be investigated in also acute phase and with other injuries.

A-0861 Is there a relation between kinesiophobia and sense of coherence in hand injuries?

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Purpose: The sense of coherence (SOC) is defined as ''The extent to which one has a pervasive, enduring though dynamic, feeling of confidence that one's environment is predictable and that things will work out as well as can reasonably be expected.'' It has a significant influence on patients with traumatic hand injuries. Patients with low SOC have lower quality of life and satisfaction in daily occupations. Kinesiophobia is ''fear of movement'' as a result of a feeling of susceptibility to painful injury or reinjury. Recently, the interest of kinesiophobia is increased in the literature. Therefore, this pilot study was designed with the aim of investigating the relation of kinesiophobia with SOC in patients with different type of hand injuries.

Methods: Twenty patients (11 men and 9 women) with hand injuries completed the TAMPA scale for kinesiophobia and SOC questionnaire with the following three components: comprehensibility, manageability, and meaningfulness. All the assessments were done at the first session of the patients. Correlation coefficient was calculated with SPSS 21 programme to assess the relation between TAMPA and SOC questionnaire.

Results: The age interval of the patients was between 18 and 61 years with the mean age of 38.20 ± 13.45 years. The mean score of TAMPA scale was 38.90 ± 5.04 (minimum 32, maximum 51). The mean SOC score of comprehensibility component was 20.75 ± 6.37 (minimum 12, maximum 31), manageability component was 17.30 ± 3.81 (minimum 8, maximum 23), meaningfulness component was 18.60 ± 6.26 (minimum 4, maximum 27). The relation was not significant between the TAMPA scale and manageability component ($p = 0.07$, $r = 0.40$), meaningfulness component ($p = 0.94$, $r = 0.01$) of SOC. Comprehensibility component of SOC was found to be significantly related to TAMPA scale ($p = 0.03$, $r = 0.46$).

Conclusions: It has been shown in the literature that low SOC significantly related to an increased risk of having worse clinical and functional outcomes in patients with moderate orthopedic injuries. We found kinesiophobia was related to comprehensibility component of SOC. Comprehensibility is the cognitive element of the SOC and it means that individuals perceive the internal or external stimuli in understandable, predictable and regular order. Therefore, in hand injuries, the cognitive statement of the patient may be important due to the possible effect on the kinesiophobia and it may thus have potential affect on the recovery process.

A-0863 Pyrocarbon partial scaphoid prosthesis (APSI): Why, when, how

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Introduction: Proximal scaphoid non-unions have always been a challenging surgical problem, especially when there is necrosis of the proximal pole. Many techniques aim at the revascularization or substitution of the avascular pole, trough-out pedicled or free bone-grafts stabilized with small screws of

K-wires. In young patients, these reconstructive techniques are the goal standard, but they are technically demanding, they require a long post-operative immobilization with sometimes poor final wrist motion and their rates of failure and non-union are considerable. In selected cases, before attempting more aggressive treatments such as proximal-row carpectomy (PRC) or scaphoidectomy and four-corner fusion (4CF), a pyrocarbon proximal pole spacer (APSI) can be used to allow early wrist mobilization while preventing carpal collapse and degenerative changes, even in cases when there is already some chondral damage (ICRS I–II) on the scaphoid facet of the radius

Methods: All patients (16 cases) who underwent APSI implant for proximal pole non-unions, in our Hand Surgery Department between 2007 and 2015, were retrospectively evaluated, both clinically (pain, range of motion, grip strength) and radiographically. PRWE score and DASH score were assessed. The mean follow-up was 47 months; all patients with less than 2-year follow-up were excluded from the study. Return to previous working and sport activities was investigated.

Results: Patients showed consistent pain relief (VAS 1.7), while preserving good wrist mobility (mean flexion–extension 66.5°–72.6°, radial-ulnar inclination 16.1°–33.5°) and grip strength (81% compared to contralateral side), with a satisfactory recovery allowing previous working activities. Mean operative time was 43 min. The average DASH score was 13.5 and the average PRWE score was 16.2. One patient presented dorsal dislocation of the implant 3 weeks after surgery and underwent scaphoidectomy and 4CF (he refused revision). One case of persistent pain and poor functional recovery led to scaphoidectomy and 4CF 3 years later. In about 40% of the cases, after several years, some radiographical osteoarthritic changes were observed on the radial side of the capitate (conflict between two convex surfaces), but only one was clinically symptomatic.

Conclusions: according to these outcomes, for treatment of scaphoid non-unions with a necrotic proximal pole, hemi-scaphoidectomy and APSI implant could be a reliable alternative to scaphoid reconstruction in selected cases (patients unwilling more complex procedures and needing a fast return to work), even when some arthritic changes are present on the radial scaphoid fossa. Should the benefits worsen with time, it would still be possible to perform implant removal and more aggressive surgical procedures (PRC or 4CF). It is certainly necessary a longer follow-up to better evaluate the role of these implants in the future.

A-0871 Characteristics of trigger finger in children

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Trigger finger of the thumb, the pollex rigidus, is frequent in young children and easy to treat by release of the A1 pulley. Trigger finger of other fingers is less frequent and has often a different pathology. The stenosis may be localized more distally and must therefore treated different.

Patients and Methods: In a retrospective analysis, children who underwent surgery for trigger fingers in two specialized centers were evaluated. In the cohort of 42 children with a total of 63 trigger fingers in 12 patients with 17 affected fingers, the pathology was a stenosis distal to the A1 pulley. They were treated by a widening at the A2 pulley level mostly by a resection of one limb of the sublimis tendon or widening of the A2 pulley at the age of mean 3.7 years (0.6 to 3.7 years). Patients and their parents were interviewed by phone call and chart review at a mean follow-up of 4.8 years (1.2 to 11.8 years) postoperative looking for functional impairment, persistent pain, satisfaction and complications.

Results: All patients treated by A1 pulley release and resection of one limb of the sublimis tendon had excellent results. One patient had a recurrence and another patient developed a contracture of the PIP joint. In both patients, the widening of the tendon sheath had been performed by widening of the A2 pulley in addition to the A1 pulley release.

Conclusion: Surgeons should be aware that triggering of a finger can be caused by a stenosis distal to the A1 pulley. Persistent triggering intraoperative after A1 pulley release should be treated by resection of one limb of the sublimis tendon and not by widening of the A2 pulley.

A-0872 Surgical treatment of acute injuries of the posterior bundle of the medial elbow collateral ligament

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Objective: Elbow stability is provided by static and dynamic components. Medial collateral ligament (MCL), composed by an anterior, a posterior and a

transverse bundle, plays a central role between 30° and 110° of elbow flexion. Several authors highlighted the undisputed importance of the anterior bundle (AB) as a stabilizer against valgus stress. The aim of this study is to demonstrate that a complete posterior elbow dislocation does not occur until the posterior bundle (PB) is sectioned.

Methods: The biomechanical study on cadavers was carried out in anatomical laboratories with the collaboration of the Department of Mechanical and Aerospace Engineering of the Politecnico di Torino. Sixteen elbows in 8 cadavers (10 women and 6 men; average age 74 years) were included in the study. Clinical evaluations in supination valgus and pronation varus in compression and slight flexion were performed in three conditions: with an intact MCL, with a sectioned AB and with a section of both the AB and the PB.

Results: The biomechanical studies showed that a complete posterior elbow dislocation does not occur until the PB is sectioned. Indeed, if the MCL is intact, the application of a force in supination valgus and pronation varus in compression and slight flexion of the elbow is not sufficient to cause an elbow dislocation. The section of the AB alone causes an elbow instability in valgus stress, but not a dislocation. Only after sectioning also the PB, we obtain a posterior elbow dislocation with a medial rotatory movement: this dislocation is incomplete if the lateral collateral ligament is intact.

Conclusions: The PB of the MCL has a primary role in elbow stability against valgus stress and it prevents elbow posterior dislocation at all flexion angles; so, in case of injuries the reconstruction of the PB is necessary to restore elbow stability.

A-0876 Diagnosis of hand and forearm fractures in whole body CT after polytrauma

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Objective: To assess the amount of identified and missed fractures of the upper extremity of intubated patients who received a whole body CT (WBCT) scan due to assumed polytrauma and the number of visible but neglected fractures.

Methods: In a retrospective design, the electronic chart and diagnostic procedures were reviewed of patients who received a whole body scan in two level 1 trauma centers between January 2013 and December 2015. Only patients who were intubated and had an accident that could cause a polytrauma were included. Epidemiologic data and radiographic reports were analyzed. We looked for missed injuries that were diagnosed in follow-up examinations and reviewed the initial whole body CT for visibility of the injury and the reason for follow-up.

Results: Of the 2826 patients who received a whole body scan, 426 patients met the inclusion criteria. Sixty-six (15.5%) patients had fractures of the hand and/or forearm, with a total of 132 fractures (79 forearm, 53 hand). Patients with fractures of the upper extremity were younger than those without. Fractures of the upper extremity were most common in patients who fell from a height >3 m (24.0%) or were involved in vehicle accidents (23.5%). Of those vehicle accidents, 42% were motorcyclists.

In all, 74.2% of fractures of the upper extremity ($n = 98$) were diagnosed by initial WBCT that is not considered a standard detecting injuries of the extremities; 39.6% ($n = 21$) of all hand fractures and 16.5% ($n = 13$) of all forearm fractures were not detected initially; 89.4% of all fractures of the upper extremity were detected within the first 24 h after admission: 11 fractures were diagnosed by X-ray within the first hour after WBCT, 7 fractures between 1 to 24 h after WBCT. Sixteen fractures were diagnosed later than 24 h after WBCT. Reviewing the WBCT for fractures that were not mentioned initially, 22 fractures were visible, 9 fractures were not visible and 3 fractures were not included in the scan window. Of the 18 fractures diagnosed within 24 h, 11 were visible on WBCT, 5 not visible and 2 not included in the scan window. Sixteen fractures were detected more than 24 h after WBCT with 11 visible, 3 not visible and one not in the scan window.

Conclusion: Reevaluation of WBCT for injuries of the upper extremity would have increased the detection rate of fractures within the first 24 h from 89.4% to 96.2%, only evaluating the hands and forearms in WBCT without using X-ray would have resulted in 90.9%. This shows the importance of reassessment of WBCT with focus on the extremities. From motor cycle accidents or after fall from great height need special attention for injuries of the hand or forearm.

A-0880 Vascularized versus non-vascularized bone grafts in the treatment of scaphoid non-union

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Introduction: Conventional non-vascularized bone grafts as well as vascularized bone grafts are used to treat scaphoid non-union (SN). Due to limited available studies, the field of application using both grafts for SN still remains controversial. The aim of this study was to evaluate a treatment algorithm for the use of both vascularized versus non-vascularized bone grafts based on clinical outcomes and quality of life (QoL) to improve the level of evidence.
Materials and Methods: Based on a retrospective cohort study, including 28 patients with vascularized and 45 patients with conventional bone grafts, functional parameters, radiological outcome, Mayo Wrist Score, and QoL by SF-36 were applied to statistically compare the outcome of these two techniques.
Results: Time between the last procedure or trauma and the study group scaphoid reconstruction was almost double in the vascularized bone grafting group. Comparable union rates were achieved with vascularized as well as non-vascularized bone grafts. Significant differences were observed between both groups for grip strength and radial–ulnar active range of motion. Further functional outcomes, radiological outcomes as well as QoL were found similar for both techniques in patients with surgical union.
Discussion and Conclusions: In order to achieve comparable and appropriate treatment results, vascularized bone grafts are recommended for patients with delayed treatment, impaired scaphoid vascularity, and revision surgery. Even in preselected, complex cases, the results are comparable to conventional grafts, which are the basis for further patient education and approve the powerful role of surgical angiogenesis of vascularized bone grafts.

A-0884 Long-term outcomes for early stages of Kienböck's disease treated with radius core decompression

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Objective: This study was designed to analyze the long-term clinical and radiological outcomes of a series of patients with Kienböck's disease stage II and IIIA treated with radius core decompression.
Methods: This retrospective study included 23 patients with Kienböck's disease (Lichtman stages II and IIIA) who received distal radius metaphyseal core decompression between 1998 and 2005 and were followed-up for at least 10 years. Patient with other stages (I, IIIB or IV) or skeletally immature were excluded. At the last follow-up, the patients were evaluated for comparative wrist range of motion and grip strength. The overall results were evaluated by the modified Mayo Wrist Score and visual analogue scale pain score. We also compared the radiological changes between the preoperative and final follow-up in their Lichtman classification and the modified carpal height ratio (CHR). Complications were recorded. Statistical analysis was performed.
Results: The mean follow-up period was 14 years (range 10–19). Nine were female and 14 were male. Fifteen were stage IIIA and 8 were stage II. Based on the modified Mayo Wrist Score, clinical results were excellent in 9 patients, good in 13 patients and poor in one patient who required a proximal row carpectomy as revision surgery. The mean preoperative pain according to VAS was 7 (range 6–10) and was 1.1 (range 0–6) at the final follow-up, showing a significant improvement ($p > 0.05$). Moreover, at the final follow-up, 18 of the 23 patients had VAS either 0 or 1. No statistical differences were reported in VAS or modified Mayo score improvement between the stage II and IIIA. Compared with the opposite side, the average flexion/extension arc was 78% and the grip strength was 81%. All patients, except one, returned to their original employment.

Radiographic disease progression according to the Lichtman classification occurred from stage II to IIIA in two patients and from stage IIIA to IIIB in another two wrists; while the others 19 patients remained in the same stage as preoperatively.

The average preoperative CHR in stage II was 1.52 (1.48–1.58) and in stage IIIA was 1.38 (range 1.5–1.28). The average posoperative CHR in stage II was 1.50 (1.40–1.58) and stage IIIA was 1.34 (range 1.42–1.25), showing no statistical decreased in the lunate height ($p < 0.05$). No complications related to the core decompression were reported.
Conclusions: Radius core decompression demonstrated favorable long-term results and could be considered as a surgical alternative for stage II and IIIA of Kienböck's disease.

A-0887 Movement imagery skills and its relation with hand functioning in guitar students

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Objective: Musicians use their upper extremities to perform the most difficult tasks when playing their instruments. Studies reported guitar players are at high risk among musicians because guitar playing includes awkward, repetitive movements. When performing professionally, musician should educate the body and be aware of the body without visual feedback to use it efficiently during performance. Movement imagery skill is therefore important for efficient motor and sensory use of the body structures. In this study, we aimed to investigate the movement imagery skills and its relation with upper extremity motor performance.
Methods: Eighteen guitar bachelor students from State Conservatory (3 female and 15 male) participated to the study. Movement Imagery Skill was assessed with Movement Imagery Questionnaire-3 (MIQ-3) and Upper Extremity Motor Performance was assessed with the Upper Extremity Range of Motion Assessment of the Valpar Work Samples.
Results: The mean age of the participants was 22.61 ± 4.48 years (minimum 18, maximum 38). Three participants were at preparatory class, four participants were at first class, five participants were at second class, one participant was at third class and five participants were at fourth class. Thirteen participants were right handed and five were left handed. Mean daily practice time was 4.00 ± 1.49 h. Mean age for starting to play the guitar was 13.33 ± 2.27 years. Mean music education time was 7.11 ± 2.94 years. Intrinsic Visual Imagery mean score was 6.54 ± 0.59, Extrinsic Visual Imagery mean score was 6.63 ± 0.54 and Kinesthetic Visual Imagery mean score was 6.43 ± 0.74. Mean work rate score obtained from Valpar was $92.91 \pm 19.03\%$. There was a significant correlation between left hand preference and Intrinsic Visual Imagery score ($p = 0.025$, $r = -0.527$). No significant relation was observed between the upper extremity hand functions and the movement imagery skills ($p > 0.05$).
Discussion: Analysis of visual imagery skills and kinesthetic imagery skills showed that visual imagery skills of musicians were advanced, which is consistent with related literature. When the motor performance assessment results were analyzed, it was seen that the mean score obtained from Upper Extremity Range of Motion test was lower than the mean score of individuals with disabilities (data about individuals with disabilities were obtained from Valpar Booklet). It can be interpreted that endurance is a major barrier for guitarists in repetitive and awkward motions and positions. This thought was supported with guitarists' feed-backs during the assessments; stating that discomfort and loss of performance become prominent during the Upper Extremity Range of Motion Assessment. It was expected to see a negative correlation between Visual Imagery Skills which are advanced in guitarists and Upper Extremity Motor Performance which is limited. It is suggested to perform more detailed assessments to evaluate movement imagery skills and upper extremity functions. All of the participants were using right-handed guitars regardless of their hand preference. Significant correlations between left hand preference and visual imagery skills revealed that using right handed guitar as a left-handed person may do harm to visual imagery skills. Therefore, it is suggested to regard imagery skills as an important area to focus in non-dominant guitar players.

A-0888 Treatment of fingertip amputation by composite graft and temporary dermo-dermal fusion to the palm in children

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Introduction: In fingertip amputation in toddlers or children of preschool age is frequent. Loss of more than half of the nail bed and exposure of bone asks for coverage and reconstruction of nail bed and length. In small children, the reconstruction by microsurgical replantation is impossible. In adults, Paavilainen described 2009 a successful reconstruction by refixation of the tip by composite graft and temporary dermo dermal fusion of the deepithelialized fingertip to the palm to improve blood supply temporarily. We wanted to check whether this technique is efficient in the not cooperating young children too.
Materials and Methods: From 2000 to 2016, we performed the dermo dermal fusion in 22 children with a median age of 5.3 years. In one case, the amputation level was in zone 2 of Ishikawa classification, 3 in Zone 3 and 1 in zone 4. The amputations were caused by squeezing and avulsion in19 fingers and by a clean-cut in 3 patients. Postoperatively, they were immobilized in fist bandage pressing the tip into the palm and a forearm finger cast for 4 weeks.

Results: In 18 of 22 cases, the fingertip refixation was successful and the major part of the pulp and nail length could be preserved. In three cases, the children had torn their finger out of the palm in the first 10 days postop ahead of time. These three patients healed secondarily with a good result in two and a satisfying result with some shortening of the tip in one patient. In three patients, the fingertip was lost due to necrosis and infection.
Conclusion: This technique is a good tool to gain better length of the distal phalanges and nail bed length in comparison to treatment with semi-occlusive dressings and local flaps. In the aftercare, it is essential to protect the injured finger against pull out.

A-0890 Long-term follow-up after pyrocarbon disc interposition for CMC thumb joint osteoarthritis

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Introduction: The pyrocarbon disc has been designed for the surgical treatment of CMC thumb joint osteoarthritis Eaton, Littler and Glickel grade 2 to 3. It is hypothesized that interposition of the implant will preserve height, stability, strength and movement after surgery as much as possible.

Since the introduction of the pyrocarbon disc, this technique is used in the Jeroen Bosch Hospital (JBZ) in 's Hertogenbosch and the University Medical Center Utrecht (UMCU) in the Netherlands. Our study evaluates the long-term results after pyrocarbon disc implant as interposition hemi-arthroplasty for CMC thumb joint osteoarthritis.
Methods: Between 2006 and 2014, 237 thumbs were operated in the JBZ and UMCU. After approval from the medical ethical committee, all 237 patients have been approached to participate in the study. As primary outcome, patient-reported outcome measurements are obtained, such as pain, function, satisfaction and quality of life. These are measured with five questionnaires (PRWHE, MHQ, DASH, SF-36 and questions to measure satisfaction). As secondary outcome, power, range of motion and position of the disc in the thumb are evaluated. These data will be obtained by hand measurements and radiology evaluation. Statistical analysis will be done.
Results: At this moment, 163 thumbs are included. At the time of the congress, all patients will be included and all analysis will be done. At this moment, the average follow-up is 6.0 years (range 2 to 11 years). The mean age at operation was 59.4 years. Of the 163 thumbs, 9.2% was removed because of ongoing complaints. The preliminary results show a median DASH of 18 and a median PRWHE of 14.5. The MHQ had a total score of 74. Satisfaction with operation and result scored 9.0 (on a Likert scale 1–10). The median JAMAR was 21.9 (100% of the contralateral grip power), the key pinch was 4.8, the tip pinch was 3.2 and the three-point pinch was 4.0 (98%, 98% and 97% of the contralateral hand, respectively). Range of motion with Kapandji was 9.0.
Conclusion: To our knowledge, this is the first study with long-term follow-up after pyrocarbon disc interposition for the treatment of CMC1 osteoarthritis grade 2–3 in more than 150 patients. The preliminary result show a high level of patient satisfaction, preservation of movement and strength without losing height of the first metacarpal and low dislocation of the implants during the follow-up period of average 6 years.

A-0893 Treatment of postoperative pain for distal radius fractures: Corticosteroids versus non-steroidal anti-inflammatory drugs. A prospective study

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Background and **Objectives:** Surgical treatment with blocked plates for fractures of distal radius is one of the most important causes of admission in traumatology service, requiring hospital stays of several days.

The aim of our study was to compare two protocols of postoperative analgesia (NSAIDs vs corticosteroids) with the intention of unifying a protocol and correcting admission times, which in our center is 48 h.
Materials and Methods: A comparative randomized prospective study is designed. All patients operated in our hospital with a blocked plate due to distal radius fracture between April and October 2017 were included.

Inclusion criteria: >18 years and having answered the postoperative questionnaire.

Exclusion criteria: postoperative analgesia infusion pump, polyfractured, reosteosynthesis, cognitive

deterioration, diabetes mellitus, allergy to drugs of the protocol and kidney failure.

Fifty patients, who were randomly assigned into two groups, were included:

- NSAIDs ($n = 25$): paracetamol 1 g/8 h; dexketoprofen 50 mg/8 h alternating with paracetamol; tramadol 50 mg/8 h as a rescue; morphine 5 mg/ml every 8 h if necessary.
- Corticosteroids ($n = 29$): paracetamol 1 g/8 h; methylprednisolone 40 mg/8 h alternating with paracetamol; tramadol 50 mg/8 h as a rescue; morphine 5 mg/ml every 8 h if necessary.

The following variables were collected: age (average 60.2 years), sex (79.6% women), dominance (64.81% non-dominant hands, $n = 35$), work activity (50% of active patients), AO classification, time from fracture to surgery (average 15.3 days), type of anesthesia (96.3% plexus block anesthesia), type of plate used and ischemia time (average 71.35 min).

The patient was evaluated at 24 and 48 postoperative hours collecting: pain using the visual analogue scale (VAS), need for morphic rescues, type of morphic used, need for bandage opening. In addition, patients were asked if they would be discharged and if they were satisfied with pain control.

The statistical analysis was carried out with SPSS statistical software considering $p < 0.05$ as significant.

Results: No statistically significant differences were found between the two groups for the demographic variables (sex, age, work activity and dominance). There were no differences in the time from fracture to surgery, type of plate, type of anesthesia, AO classification or ischemia time.

Regarding postoperative pain, it was similar in both groups ($p = 0.81$ at 24 h and $p = 0.132$ at 48 h).

No differences were observed in the rescues required ($p = 0.164$) nor in the medication used for this. In the first 24 h, there were no significant differences for the need to open the bandage, although it was statistically higher for patients in the NSAIDs group at 48 h ($p = 0.04$).

In all, 79.63% of patients were satisfied with pain control at 24 h and 98.14% at 48 h; 64.81% of patients ($n = 35$) would agree to be discharged after 24 h.

Conclusions: The use of both protocols had similar efficacy, which could increase the analgesic armament in those patients who can not be administered NSAIDs (allergic, kidney failure, etc.)

Most of the patients answered that they would go home in the first 24 h after surgery, which makes us reconsider the average time of admission of these patients.

A-0894 Arthroscopic distal hemitrapeziectomy versus open distal hemitrapeziectomy without interposition in osteoarthritis of the first CMC joint: Two-year follow-up results of a randomized controlled trial

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Introduction: A variety of different treatment modalities are available for osteoarthritis of the CMC joint of the thumb. To date, trapeziectomy alone is seen as the treatment with the least complications and is therefore described as the most favored treatment. Because of removal of the total trapezium in trapeziectomy, there is a higher chance to shortening and collapse of the thumb, which can give less postoperative strength. Distal hemitrapeziectomy does not have these drawbacks. The last years there is a growth in experience in arthroscopic techniques, also for the CMC thumb joint. Arthroscopic techniques offer the potential benefit of earlier recovery.

This study compares arthroscopic hemitrapeziectomy with open hemitrapeziectomy without tendon interposition in a multicenter randomized controlled clinical trial. At the FESSH congress 2016, we presented our preliminary data of 1-year follow-up; we will now have our 2-year follow-up data to present.

Materials and Methods: Since 2014, we perform a multicenter randomized controlled trial in two hospitals. All patients with Eaton and Littler grade 2 or 3, with unsuccessful conservative therapy, are asked to participate in the study. After informed consent is obtained, patients are randomized to either open or arthroscopic distal hemitrapeziectomy. Patients are asked to fill in the PRWHE and hand measurements were done in preoperative setting and at 3, 6, 12 and 24 months postoperative.

Results: The 1-year results showed a PRWHE of 20.6 of the open group (pain 11.4, function 9.2) and 18.8 (pain 11.5 function 7.3) of the arthroscopic group. This score was 56.5 preoperatively in the open group (pain 28.5 and function 28) and 45.3 in the arthroscopic group (pain 22.8 and function 22.5). The preoperative grip power (measured with the JAMAR dynamometer) was for the open group 18.4 and after 1 year 24. For the arthroscopic group, this was 26.1 preoperatively and 34.8 after 1-year follow-up. The Kapandji was 8 in the preoperative setting for both groups and improved to 9.7 and 9.8 for the open and arthroscopic groups, respectively. Of the patients

in the arthroscopic group, 88% would undergo the operation again versus 70% of the open group. After 1 year, there were 3 complications in the open group after 1 year (29 patients) and 1 complication in the arthroscopic group (36 patients). Statistical analysis of the results will be done at the time of the congress.

Conclusion: We will present the results of at least 80 patients with a minimum of 1-year follow-up and 50 patients with a minimum of 2 year follow-up. Earlier results show a slight patient preference for the arthroscopic hemitrapeziectomy after 1 year, but the pain and function scores and hand measurements showed equal improvement. Key grip strength and grip strength seem to be significantly stronger than in similar studies for treatment of CMC I arthritis in the literature. Our goal is to enroll 90 patients, 45 per group as calculated with our power analysis.

A-0901 Three-dimensional virtual planning of corrective osteotomies for paediatric malunited forearm fractures: A prospective study

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Objective: Malunited both-bone forearm fractures in children commonly involve complex three-dimensional (3D) deformations in different planes, which may not be acknowledged on conventional radiographs. The aim of this study was to evaluate the clinical outcomes after 3D-planned corrective osteotomies with use of 3D-printed patient-specific guides for symptomatic malunited both-bone forearm fractures in children as alternative for conventional corrective osteotomies, which are traditionally prepared using X-rays and then executed freehand.

Methods: Prospective study in which we performed 3D-planned corrective osteotomies on participants with paediatric, malunited both-bone forearm fractures. Inclusion criteria were a symptomatic malunited forearm fracture, sustained during childhood, with a deficit in pronosupination (pro- or supination of $<50^\circ$), unsatisfactory clinical improvement after 6 months of conservative treatment and a minimum age of 10 years at inclusion. Exclusion criteria were a congenital or traumatic osseous deformity of the contralateral forearm. Participants meeting the inclusion criteria underwent a 3D-planned corrective osteotomy according to the following steps: (1) CT scans of both forearms are obtained; (2) the location and degree of deformity is determined by overlaying a virtual model of the malunited forearm bones on a mirrored version of the unaffected contralateral forearm bones; (3) virtual cutting planes are set within the malunited forearm bones, which can be angulated, rotated and translated to best match the contralateral side; (4) patient-specific drilling and sawing guides are 3D-printed to help achieve the planned correction during corrective osteotomy. Our primary outcome measure was gain in pronosupination at 6-month follow-up. Our secondary outcome measures were a patient-reported outcome measure on daily functioning (quickDASH), patient-reported scores on pain and cosmetic appearance and the complication rate.

Results: Between 2016 and 2017, six participants underwent 3D-planned corrective osteotomies for paediatric symptomatic malunited both-bone forearm fractures. There was a median age at trauma of 8.9 (interquartile range of 6.5–10.4), a median age at osteotomy of 14.3 years (IQR 12.4–18.5) and a median time between trauma until osteotomy of 5.9 years (IQR 3.5–9.1). Preoperatively there was a mean pronosupination of $58^\circ \pm 15^\circ$ compared to $143^\circ \pm 9^\circ$ of the contralateral side, a deficit of $85^\circ \pm 17^\circ$. At 6-month follow-up, there was a pronosupination of $113^\circ \pm 19^\circ$, a gain in pronosupination of $55^\circ \pm 9^\circ$. There was a decrease in quick-DASH disability/symptom score from 28 ± 16 pre-operatively to 22 ± 17 at 6-month follow-up. Patients reported a decrease in pain score from 2.8 ± 3.3 to 1.8 ± 1.6 and a decrease in score regarding cosmetic deformity from 5.6 ± 2.5 to 3.8 ± 1.6. A low complication rate of 16.7% was seen (1 delayed union).

Conclusions: This prospective study demonstrates that limitations in forearm rotation and patient-reported outcome measures (PROMs) can reliably and safely be improved using 3D-planned corrective osteotomies for paediatric malunited both-bone forearm fractures.

A-0904 Which factors affect limitation of pronosupination after both-bone forearm fractures in children? The long-term follow-up of a prospective study

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Objective: When a child presents him/herself at the emergency department with a both-bone forearm

fracture, it is important for the clinician to realize if there is a high risk of developing a persisting functional limitation. The aim of this study is to investigate which clinical factors are associated with a persisting limitation of pronosupination at long-term follow-up after a both-bone forearm fracture in a child.

Methods: A prospective multicentre long-term follow-up study was performed in which all consecutive children (<16 years) who presented themselves at the emergency department with a both-bone forearm fracture between 2006 and 2010 were included. These participants were included in various randomized controlled trials: distal metaphyseal fractures without need for reduction were treated with below-elbow cast (BEC) versus above-elbow cast (AEC); displaced distal metaphyseal fractures which underwent closed reduction were treated with or without K-wires fixation; diaphyseal fractures without need for reduction or stable after reduction were treated with AEC or AEC followed by BEC; and unstable diaphyseal fractures were treated with 1 or 2 intramedullary nails. The short-term follow-up study of this complete cohort revealed that a refracture and a diaphyseal located fracture were associated with a functional limitation in children with a both-bone forearm fracture at short-term follow-up. For the current study, we invited all participants to revisit the orthopaedic outpatients' clinic for long-term functional assessment after a minimum follow-up of 5 years. One-way analysis of variance (ANOVA) and multivariate logistic regression analysis were used to assess the relationship between a limitation of pronosupination ($\geq 15^\circ$) and the following factors: age at trauma, length of follow-up, dominance of the affected side, location and type of fracture, severity of angulation, number of reductions performed, occurrence of refracture(s) and undergoing of physiotherapy.

Results: Of the 410 participants (77%), 315 were included for long-term follow-up after a mean follow-up of 7.2 ($\pm$1.4) years. There was a limitation of pronosupination $\geq 15^\circ$ in 51 of 315 participants. Analysis of variance revealed that in participants who had a limitation of pronosupination $\geq 15^\circ$ versus those who did not, there were the following statistically significant differences: more complete fractures (51% vs 36%, $p = 0.039$), greater angular deformity of the radius (28° vs 23°, $p = 0.030$), more initial closed reductions (86% vs 73%, $p = 0.045$) and more re-fractures (27% vs 12%, $p = 0.003$). A diaphyseal location of the fracture was seen more often (59%) in participants who had $\geq 15^\circ$ limitation of pronosupination versus those who did not (44%); however, this difference was not statistically significant ($p = 0.058$). Multivariate logistic regression analysis revealed that, when analyzing the effects of various factors simultaneously, one factor was statistically significantly associated with a limitation in pronosupination: the occurrence of a re-fracture (odds ratio of 1.9).

Conclusions: The occurrence of a refracture was the only factor associated with a limitation of pronosupination at long-term follow-up after a paediatric both-bone forearm fracture. Although extensive physiotherapy and a diaphyseal location of the fracture were statistically significantly associated with a superior functional outcome at short-term follow-up, these factors were not associated with superior outcomes at long-term follow-up.

A-0907 Novel use of a vascular flow system to enhance in vitro training in microsurgical vessel repair with biological material

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Introduction and Aims: The gold standard for teaching microsurgical vessel repair is using a live animal model. This is expensive, requires animal licensing and is not readily accessible at short notice to most trainees. The aim was to develop a simple in vitro flow system where the patency and integrity of a vessel repair could be assessed.

Materials and Methods: A simple balloon-based device was designed to allow the flow of coloured water in a low pressure system. It could accommodate both end-to-end and end-to-side repairs and be used under an operating microscope. The field for the repair was set low to allow easy hand placement for stable working, key to good microsurgical technique. Water is used as the circulating fluid, which has a very low viscosity and so deficiencies in repair technique were readily identified. Porcine arteries and veins were used for training in vessel repair and anastomosis.

Results: It was possible to perform end to end, end to side, and differential size anastomoses with this model and check the patency of these repairs. Feedback from both faculty and delegates indicated that the device meets the training requirements for basic and intermediate levels very well.

Conclusion: This novel device works well as a novice and intermediate level training tool to develop microsurgical instrument and vessel handling skills. Use of artery and different sizes of veins made it accessible for trainees of different grades and experience.

A-0914 Comparative study of different incision types in trigger finger release

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In our unit, three different incision types are used: transverse, longitudinal, or zig-zag incision. Our aim was to compare the results of the different techniques.

Continuous prospective data collection has been running in our unit since 2015; 240 patients were included in our study; 56 patients had to be excluded due to incomplete data. Three groups were formed according to the incision type (zig-zag, transverse, longitudinal). The patient's satisfaction (VAS 1-10), the pain level (VAS 1–10), the range of motion was registered four times after surgery (at 1 week, 2 weeks, 4 weeks, 2 months). Significance was measured with Student's t-test ($p = 0.05$).

The patient satisfaction was 9.5 points for zig-zag, 9.01 for transverse incision, and 8.49 for longitudinal incision group at 1 week. At 2 months, these values were 9.5, 9.2, and 8.35, respectively. The pain level was 2.2 for zig-zag, 2.4 for transverse and 3.3 points for longitudinal group at 1 week. Extension deficit of more than 20° was registered at 2 months as follows: for the zig-zag group, no extension deficit, for transverse incision group 3 patients, for longitudinal group 10 patients.

(In conclusion, longitudinal incision caused higher pain levels and lower satisfaction for the patients compared to zig-zag or transverse incision.)

Compared to the zig-zag group, longitudinal incision resulted in significantly higher pain and significantly lower satisfaction levels after 1 week and 2 months as well. Compared to the group with transverse incision, no significant difference was found.

Range of motion was also influenced by the incision type. The best result could be achieved by zig-zag incision, followed by the transverse and longitudinal ones.

A-0921 Triphalangeal thumb: A diverse phenomenon

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Introduction: Triphalangeal thumb is an uncommon phenomenon. By definition a thumb with three phalanges, this basic definition belies the great diversity of clinical presentation. The triphalangeal thumb spectrum includes patients with fully functioning hands with five digits and an opposable thumb, radial polydactyly, hypoplastic thumb and the three-digit hand. We present our experience and evolution of practice in treating this condition.
Methods: A retrospective study of 18 patients presenting with 27 triphalangeal thumbs was performed. Clinical, photographic, radiological and detailed anatomical operation records were reviewed.
Results: A wide range of clinical presentations was observed. Five-digit opposable hands (eight thumbs), radial polydactyly (14 thumbs), three-digit hands (three thumbs) and hypoplastic (two thumbs). Median age at presentation was 2 years (range 8 weeks to 14 years). Twenty-three thumbs underwent surgery. Skeletal procedures included joint excision and fusion, excision of additional phalanges, osteotomies and first metacarpal shortening. Soft tissue surgery included first web deepening and procedures to address anomalous tendon and muscle anatomy. We observed more complex patterns of anatomical anomalies in the radial polydactyly cohort. Choice of procedure was guided by mobility and stability of joints, length and longitudinal alignment of thumb/first metacarpal, opposition potential, musculotendinous units and skin. Variability between thumbs was observed in all bilateral cases.
Conclusion: We advocate detailed anatomical exploration of these complex anomalies at the time of primary surgery. This guides primary treatment and has a useful prognostic role. We favour mid-lateral incisions, which offer excellent surgical access and cosmesis.

A-0922 An anatomical study of triphalangeal thumb in radial polydactyly

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Objective: Radial polydactyly encompasses a wide and diverse group of anatomical anomalies, including the presence of triphalangeal thumb. A number of classifications have been reported based on skeletal anatomy. The complexity may be underestimated resulting in poor results from primary surgery and late deformity.
Methods: A prospective anatomical study comparing our triphalangeal radial polydactyly cohort with our

non-triphalangeal radial polydactyly cohort. We also compare our triphalangeal radial polydactyly cohort with a referenced study in the literature. Diagnosis of triphalangeal thumb is made on the basis of preoperative clinical assessment, radiographic findings and thorough exploration at time of surgery. Detailed systematic operative records of anatomical findings and procedures undertaken are recorded using defined anatomical headings. We have previously presented anatomical findings in our total radial polydactyly cohort and now focus on our triphalangeal radial polydactyly group.

Results: Radial polydactyly total: 47 patients, 54 thumbs.

Triphalangeal radial polydactyly: 10 patients, 14 thumbs.

M:F ratio 1:1. Four cases bilateral. The triphalangeal duplicate was ulnar 6/14, radial 2/14, both duplicates 6/14. Of the six cases of unilateral triphalangeal radial polydactyly, three had a contralateral triphalangeal thumb without polydactyly. When compared to the literature, we saw a larger proportion of Type IVA of which both duplicates were triphalangeal. In contrast, Wood saw a greater proportion of Type VIIC.

Skin: Variability in the pattern of skin envelope sharing was observed, which did not always correlate with the underlying skeletal anatomy; 5/14 (36%) had first web tightness requiring surgical release.

Joint anatomy: Variables noted included reduced motion at the IPJ, dual facet at the MCPJ and shared CMCJ.

Thenar muscle: Insertion on radial duplicate (10/14), ulnar duplicate(4/14).

Dominant thumb: In our total radial polydactyly cohort, the ulnar duplicate was most commonly dominant (47/54). The incidence of radial dominance observed was greater in triphalangeal group (5/14).

Tendons: In the triphalangeal group flexor pollicis longus insertion on the radial duplicate only was seen in 3/14. This flexor pattern was not observed in non-triphalangeal cases. While extensor pollicis brevis inserted more frequently on the radial duplicate, insertion on both duplicates/ulnar only was also observed. Extensor pollicis brevis insertion on the ulnar duplicate only was observed in 3/14 triphalangeal, 1/40 non-triphalangeal.

Surgical procedures: In 12/14 cases, the triphalangeal component was retained. Procedures unique to the triphalangeal cohort included removal of the delta bone (2/14) and DIPJ excision and shortening to correct the triphalangeal component (3/14).

Conclusion: Our study demonstrates complexity and variability of anatomy in radial polydactyly. Greater anatomical complexity is seen in triphalangeal versus non-triphalangeal cases. Wood previously suggested that the triphalangeal thumb be excised regardless of dominance but our experience differs. Compared to radial polydactyly (Wassel I–VI), a tight first web and dominant radial duplicate was more common. There are significant limitations in using a skeleton-based classification and we would advocate an anatomical approach to treatment. Systematic exploration of anatomy at primary surgery has a key prognostic role to aid surgical planning and optimize functional outcome.

A-0925 Histological, immunohistochemical, and microstructural assessment of flexor tendon grafts for pulley reconstruction: A cadaver study

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Objective: Flexor digitorum superficialis (FDS) and palmaris longus (PL) tendons are routinely used in hand surgery to reconstruct deficient pulleys. However, little is known about the structural eligibility for this purpose. The present cadaver study was initiated to analyze histological, immunohistochemical, and microstructural characteristics of human FDS and PL tendons and to compare these to flexor tendon pulleys.

Methods: FDS ($n = 16$) and PL ($n = 4$) tendons as well as A2- and A4- pulleys ($n = 8$) were harvested from 4 fresh-frozen cadaver hands. For histological analyses, the specimens were stained with hematoxylin–eosin. Polarized light microscopy of Sirius red-stained sections was performed to analyze the collagen network. In addition, scanning electron microscopy was performed to illustrate the microstructure of the tendons and pulleys. Finally, microvascular density in the center as well as in the synovial layer of the tendons and pulleys was assessed by immunohistochemical staining with the endothelial cell marker CD31. Data were analyzed for normal distribution and equal variance. Differences between groups were tested using one-way analysis of variance. Values were expressed as mean $\pm$ standard

error of the mean. Statistical significance was set to $p < 0.05$.

Results: FDS tendons as well as A2- and A4-pulleys exhibit a highly hierarchical and tightly interwoven network of collagen fibers. In contrast, PL tendons show a lower degree or structural organization. In line with these findings, immunohistochemical analyses revealed that FDS tendons as well as A2- and A4-pulleys are characterized by a comparably microvessel density within the synovial layer (FDS $84 \pm 15\,mm^{-2}$, A2 $105 \pm 21\,mm^{-2}$, A4 $78 \pm 30\,mm^{-2}$; $p = 0.57$).

Conclusions: The findings of this study indicate that FDS tendon slings are particularly suitable for pulley reconstruction due to the microstructure and immunohistochemical characteristics. Additionally, scanning electron microscopy reveals insights into the microstructure of human flexor tendon pulleys.

A-0926 Pulsed radiofrequency is a new chance to treat neuropathic pain after traumatic peripheral nerve injury

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Objective: Pulsed radiofrequency (PRF) developed with the goal of providing reduction in pain from the use of electrical fields in the absence of neural injury, because of temperature is always under 42°C. Prospective trials have shown a benefit in pain reduction with the use of PRF in a variety of chronic pain states. Studies in literature concluded that has a biological effect unlikely to be related to overt thermal damage and that it targets small diameter C and A delta nociceptive fibres but the action is on small fibres' mitochondria. Use of ultrasound guidance for right positioning PRF in carpal tunnel syndrome has recently reported too. Neurophatic pain (NP) is a complex, chronic pain state that usually is due to damaged, disfunctional or injured nervous tissue, especially peripheral. Post-traumatic nerve injuries are often complicated by NP. In this study, we analyze the efficacy of PRF on neuropathic pain due to peripheral nerve traumatic injury.

Method: Our prospective clinical study included 70 patients (39 male; 31 female) mean age 42 years, all affected by NP after peripheral nerve injury (nerve lesion and surgery repair). They were treated, using ultrasound (US)-guide, with PRF procedure (pulsed dose). At follow-up, they were evaluated at T0 (before-PRF) and at 1-, 3-, and 6 months after treatment with these instruments of evaluation: VAS (visual analogue scale) for pain and SF-36 (Short Form of Health Survey) for quality of life.

Results: After the procedure, all the patients reported a reduction in pain measured by VAS scale about 38%. Follow-up assessment during patients' rehabilitation treatment confirms relief of pain with improvement in rehabilitation program. A gradual return to pain was observed after a 3- to 4-month period. We measured using validated scales such as SF-36 quality of life that improved both in Physical and in Mental score (PCS and MCS).

Conclusion: Radiofrequency treatment in these cases was not only an alternative to pharmacological therapy in NP relief but a new chance when pharmacological therapy isn't enough to control pain. PRF procedure should be considered such as an alternative treatment for all post traumatic nerve injuries, at any level, which are complicated by NP. They are safe in locations where conventional RF (continuous radiofrequency) are potentially hazardous because of high temperature (70–80°) that cause irreversible damage to the nervous tissue, while for PRF there aren't clinical and EMG evidences of any nerve damage. It's useful to control NP during mobilization and sensibility rehabilitation after nerve injury surgical repair. And such as here demonstrated it can be applied in more than one district without complications. Especially in young patients, it would represent an alternative to opioid therapy that compromise their every day life.

A-0929 An alternative to pollicization: Foerster's arthrodesis and callus distraction

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In Blauth 3b thumb hypoplasia, many parents, for various reasons, could not decide whether to amputate the hypoplastic thumb and have an index finger pollicization.

What results can be achieved with this method of operation, what are the advantages and disadvantages?

A meaningful use of the hypoplastic thumb is in the stabilization and extension. In 1930, Otfried Foerster stabilized the thumb in paresis of the thumb muscles. He performed an extra-anatomic arthrodesis between Metacarpal I and Matakarpale II with a bone graft. Other authors also followed this method for thumb hypoplasia.

In the last 10 years, we have operated on seven children between the ages of 3 and 14 years. The bone graft was removed from the iliac crest and stabilized with plate osteosynthesis.

All bone grafts healed. When the fibrous cord between metacarpal 1 and trapezium is cut, the thumb can already be extended by about 20%. All children put their thumbs in daily life. A later correction osteotomy or a callus distraction was performed in four children. All patients (parents) reported that they would have this operation done again.

Advantages: (1) No thumb amputation, (2) obtaining the very important clamping grip between forefinger and middle finger, (3) low-risk intervention, (4) many correction options

Disadvantages: (1) Fixed rigid thumb, (2) problems with unstable thumb ground joint

A-0934 Evidence-based operative treatment of basal thumb arthritis: Has the evidence affected the treatment choices of hand surgeons?

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Objective: Thumb base arthritis is one of only a few conditions facing the hand surgeon that has been subjected to rigorous and extensive research with a clear evidence base for surgical management. Sufficiently powered comparative randomized controlled studies have reported no advantage to ligament reconstruction when compared to simple trapeziectomy. The degree to which this evidence has affected the selection of operative treatment by practicing hand surgeons is being investigated and the results are presented.
Methods: An online survey was performed between March and July 2016. The survey was performed using the SurveyMonkey tool and consisted of 10 questions on the subject of the surgical management of thumb base arthritis. The link was advertised through a social media platform (LinkedIn) and through the BSSH Bulletin. Hand surgeons were questioned regarding their surgical approach, technical details of their favoured procedure and their knowledge of the evidence base for operative management of basal thumb arthritis. They were asked how the evidence had affected their practice.
Results: Sixty-eight hand surgeons from 27 countries replied to the survey; 92.65% of the participants stated that they were aware of the published evidence for the treatment of trapezio-metacarpal arthritis, suggesting that the results of simple trapeziectomy, trapeziectomy and K-wire stabilization and trapeziectomy with ligament reconstruction are not different in the short or long term; 61.76% of participants were not aware of the evidence that patients after prosthetic replacement of the trapezio-metacarpal joint recover quicker than following a trapeziectomy; 78.13% of the participants were aware that there is no evidence that prosthetic replacement of the trapezio-metacarpal joint has better results than trapeziectomy; 78.13% of the participants said that the above-mentioned evidence did not make them change their practice in any way. The reasons given are reported and demonstrate the requirement for larger pragmatic studies or registry studies in hand surgery using a standardized outcome data set reached through consensus.
Conclusion: The results of the survey suggest that most hand surgeons are aware of evidence surrounding the surgical management of thumb base arthritis but the evidence has not been persuasive enough for many of them to change their current practice. The results are brought to the attention of the European hand surgery community in the hope that future collaborative research can be developed to address these concerns.

A-0937 Pain and hand functioning differences during music education in bachelor guitar students

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Objective: Playing-related musculoskeletal pain was reported to be at high rate with the percentage ranging from 60% to 90%. Most of the musicians demonstrate pain during the last 3 months, and some are complaining from permanent pain. It is suggested that music-related illnesses start impairing instrumental play at an early stage in music education. Endurance and speed are important parameters for musicians. And these parameters may be affected because of pain; or musician can hurt self while trying to improve endurance and speed. It is wondered when is the pain getting higher and how is the hand endurance and speed improving during music education. Therefore, it is aimed to investigate

pain intensity and hand dexterity of bachelor guitar students and compare results between classes.
Methods: All the guitar students getting bachelor education during 2017 fall semester at Hacettepe University Conservatory invited to the study. Individuals were excluded from the study if they had any neurological disease, any chronic disorder that causes constant pain, any psychiatric illness or cognitive dysfunction. We set these criteria to understand only playing-related problems. Eighteen students (3 women and 15 men) participated in the study, and only 3 students did not want to volunteer. Pain was assessed with The Musculoskeletal Pain Intensity and Interference Questionnaire for Musicians (MPIIQM). Upper Extremity Motor Performance was assessed with the Upper Extremity Range of Motion Assessment, fine finger dexterity, simulated assembly of the Valpar Work Samples Test. SPSS 21 program was used for statistical analysis.
Results: The mean age of the participants was 22.61 ± 4.48 years (minimum 18, maximum 38). The average pain score was 0.00 at preparatory class, 25.25 ± 9.28 at first class, 12.40 ± 13.97 at second class, 21 ± 0.00 at third class and 7.20 ± 16.095 at fourth class. There was a significant correlation between pain scores and left hand preference ($p = 0.037$, $r = 0.495$), between pain scores and music education time ($p = 0.020$, $r = -0.542$). Upper Extremity Range of Motion test of Valpar indicated more discomfort during assessment; however, its relation with pain was not significant ($p > 0.05$). Hand dexterity assessments showed a decline with years of education, most of the students stopped test because they get tired or had pain. Controversial, none of the Valpar test score showed significant correlation with pain scores.
Discussion: Pain intensity differs between classes, it was remarkable that students at first class report more pain. The endurance is also getting worse with the presence of pain during testing. It was surprising that pain was not correlated with hand dexterity results, because during testing guitarists hardly completed the tests as their classes are increasing. This result may reflect musicians may not want to complete questionnaires or did not want to express pain intensity due to emotional reasons. It was obvious that musicians have problems during their education and an efficient health care delivery system should be established for conservatories.

A-0941 Review of the relevance of the Soong classification with 200 implant removals after palmar plate fixation of distal radius fractures

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Purpose: After palmar plate fixation of distal radius fractures, the implant positioning to the watershed line has been recently associated with increased postoperative complications. Soong et al. published in 2011 a classification concerning the prominence of palmar T-plates. The purpose of this study was to analyze the relationship between the Soong stage of the palmar plate and the rate of postoperative complications in a level I Trauma Center.
Methods: Two-hundred patients who underwent palmar plate removal after a distal radius fracture fixation between 2010 and 2016 in our institution were included in the study. Patients were first classified based on the position of the palmar plate in relation to the watershed line (Soong classification) using the postoperative lateral X-ray images. The complications for each patient (including pain, restriction of range of motion (ROM), neurologic complications and complaints) were analyzed retrospectively.
Results: Twenty-three patients fulfilled the criteria of Soong stage 0 (Group 0), 110 patients of Soong stage 1 (Group 1) and 67 of Soong stage 2 (Group 2). In Group 0, 30.4% of the patients presented pain and 17.3% restriction of the ROM. In Group 1, the rate of the patients who suffered from pain was 32.7% and 24.5% presented restriction of ROM. One patient (0.9%) in this group reported an irritation of the flexor tendons of the finger. In Group 2, 38.8% of the patients presented pain and a restriction of ROM was documented in 16.4% of the patients in this group. Furthermore, 6 patients (8.9%) in Group 2 reported an irritation of the flexor pollicis longus (FPL) tendon or other finger flexor tendons. Among those, 2 patients (2.9%) had a laceration of the FPL tendon which was confirmed by the intraoperative findings. In 2 other patients (2.9%), a rupture of the FPL tendon after the palmar plate osteosynthesis occured. Consequently, the patients in Group 3 presented a statistically significant higher rate of FPL tendon laceration/rupture compared to the patients in group 0 and 1 ($p < 0.05$).
Conclusions: Palmar plates for distal radial fracture fixation classified as Soong stage 2 presented an increased risk of FPL tendon rupture/laceration.

We recommend an early Soong stage 2 palmar plate removal after fracture healing is observed. In Soong stage 1, situations a removal of the plate may also be offered to the patients.

A-0942 Functional outcomes and complications rate of surgical treatment of unstable fractures of the neck of fifth metacarpal with condylar blade plate versus locking anatomical plate

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Objectives: The fracture of the neck of fifth metacarpal also call Boxer fractures occurs in young men with intense activity and constitutes a complex problem in orthopaedic regarding the surgical technique and the type of implant. The purpose of this study is to compare the postoperative results of those fractures with condylar blade plate versus locking anatomical plate.
Materials and Methods: Forty-eight patients (44 men and 4 women) with an average age of 34.5 years were operated on with closed unstable fracture of neck of fifth metacarpal. The indications for operative treatment were (a) angulations° >40°, (b) rotatory malalignment, (c) shortening and (d) failure to maintain reduction. The mean time period to internal fixation varied from 2 to 10 days. The patients were separated in two groups: in group A (cases 27), the fracture were fixated with convectional condylar blade plate 2.3 mm and in the group B (21 cases) with anatomical locking plate 2.3 mm. The surgical approach was the same in both groups (dorso-ulnar), and the plate was placed in the lateral side of the metacarpal. A palmar split leaving PIP joint free for early motion was placed in both groups of patients postoperatively. After 7 days, postoperative patients were allowed to perform daily activities to the rate of tolerance.
Results: The average follow-up was 17 months (range 11–23 months). The DASH Score, Total Active Motion (TAM) of the digit, radiographic parameters (shortening, angulations, time to healing) complication rates, time to return to previous work were to measure the outcomes. The median DASH score were in group A 7.9 and in B 7.4, the median TAM 235° in A and 239° in group B. The median period to radiographic healing was the same in both group, which was 4.6 (4—6.5) weeks. Among the complications in group A were 1 case with malunion, 1 case with hardware failure, 1 case with complex regional pain syndrome, while in group B were 1 case with hardware failure, 2 cases shortening and malunion, 1 case with cellulites of the wound. The major different between the two implant was the cost: the blade plate cost 150 euro and locking plate cost 550 euro.
Conclusion: The fracture of the fifth neck metacarpal accounts to 20% of all hand fractures. Unstable fractures have indication for surgical treatment. Open reduction and internal fixation is the treatment of choice. Both implants achieve stable fixation, low percentage of complications and good functional results. The final cost of implant is the main difference between the two methods.

A-0943 Do patients with an inferior subjective result 12 months after a distal radius fracture improve over time? A long-term 2- to 12-year register follow-up

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Objective: Most patients recover well from a distal radius fracture (DRF). However, in our prospective register, approximately one-fifth still had severe disability at 12 months when evaluated using a patient-reported outcome score. In the present study, we evaluated the longer term subjective outcome in the subgroup of patients with inferior outcome and hypothesized that the patient-reported outcome would improve with time.
Methods: Since 2001, all DRFs in patients 18 years and older at the Department of Orthopaedics, Skåne University Hospital in Lund, are prospectively registered in the Lund Wrist Fracture Register. The Disability of the Arm, Shoulder and Hand (DASH) questionnaire was distributed to the patients after 12 months. In the present study, we defined a DASH score above 35 as suboptimal at the 12-month follow-up. We identified 17% of the patients (445/2571) in the register between 2003 and 2012 to exceed the cut-off. In December 2014, 2—12 year after the fracture, a new DASH questionnaire was sent to the 346/445 patients still alive.
Results: Of the 346 patients, 269 (78%) patients returned the DASH questionnaire at 2—12 years (mean 5.5) after the fracture. Seventy-three (27%)

patients had been treated surgically and 196 (73%) conservatively. The overall median DASH score improved from 50 (IQR 42–61) at 12 months to 36 (IQR 20–55) at the 2–12-year follow-up, ($p < 0.05$). Forty-seven percent had improved over time to return to a DASH score below the cut-off 35. Fifty-three percent remained at a high suboptimal level above 35. Men improved more than women (median 52 at 12 months to 25 at follow-up), compared to women (median 50 to 39 ($p < 0.05$)).

Conclusions: Subjective outcome after a DRF improves over time for patients with an inferior result at 12 months, but more than half of the patients continue to have major disability. Every effort should be made to improve the early outcome.

A-0947 Early mobilization after foveal reinsertion of TFCC: A prospective study of stability and functional outcome

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Objective: Reinsertion of the dorsal and volar radioulnar ligament of the TFCC in the foveal region of ulna in patients with ulnar sided wrist pain, instability over the DRU joint and positive hook test on wrist arthroscopy is nowadays a relatively widespread treatment. The postoperative regime is often immobilization of the wrist in all directions for a long period of time, compared to various ligament procedures in other joints.

The aim of this study is to evaluate the outcomes in a prospective study of early, controlled mobilization after TFCC reinsertion.

Our hypothesis is that early, controlled mobilization is safe in terms of stability and gives a good functional outcome after foveal TFCC-reinsertion.

Methods: Fifty patients with ulnar-sided wrist pain, DRU joint instability and positive hook test during wrist arthroscopy were included.

Preoperative measurements included ROM, grip strength (Jamar) in neutral position, pronation and supination, Quick-DASH (The Disabilities of the Arm, Shoulder and Hand Score) and PRWE (Patient rated wrist evaluation)

The foveal reinsertion was in all patients performed either via a mini-open technique or arthroscopically.

Patients were postoperatively immobilized in an above elbow cast. One week postoperatively, an orthosis was applied that allows flexion/extension of the elbow but prevents rotation of the forearm. At that point, active flexion/extension of the wrist and controlled activation of the muscles in the forearm were started. After 3 weeks, the above-elbow part of the orthosis was removed and free elbow-movement started with controlled pronation/supination of the forearm. Gradually exercises for proprioception and strength were added. Six weeks postoperatively, a shorter splint was used during ''risk-activities'' and night-time for another 6 weeks. Free mobilization after 3 months.

A follow-up with a minimum of 1 year was performed with the same protocol as before surgery including DRU joint stability tests. The patient satisfaction on a 4-graded Likert scale was assessed.

Results: Forty-three patients met all the inclusion criteria for 1-year follow-up. Seven patients were excluded due to concomitant repair of other ligament structures during surgery. Two patients were initially stable but developed instability over time and were reoperated. One of them had a car accident with a new injury to the wrist. Forty-one patients were stable in all directions. One failure out of 43 equals 2.3%.

The median value for Quick-DASH decreased from 40.9 to 9.3 and for PRWE from 46.5 to 11.8. Patient satisfaction was rated 4 (fully satisfied) in 26 patients, 3 (partly satisfied) in 11 patients and 2 (partly dissatisfied) in 3 patients.

ROM in pronation were 96% of uninjured side and supination 93%. Grip strength (% of uninjured side) in neutral position 91%, supination 88% and pronation 89%.

Conclusion: Early mobilization after foveal reinsertion of the TFCC gives, in this study, an excellent functional outcome despite one failure out of 43 patients. This study show that early mobilization is safe and encourage us to further develop and study even more faster rehabilitation protocols.

A-0950 Causative organisms and management in paediatric paronychia: A 4-year retrospective review at a single centre in the United Kingdom and a national survey assessing variation in clinical practice

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Objectives: Paediatric paronychia is the commonest infection affecting the hand and frequently managed by plastic surgery departments. In the United Kingdom, the National Institute for Health and Care Excellence (NICE) guidance suggests the underlying causative organism is usually Staphylococcal and

advises flucloxacillin as first line antibiotic therapy. We aimed to investigate the causative microorganisms in paediatric paronychia, its subsequent management and complications observed within our unit. We surveyed all UK plastic surgery units to ascertain national practices in this condition and adherence to NICE guidance.

Methods: Consecutive patients with paronychia aged ≤16 years were identified over 53 months (January 2012 to June 2016) using clinical coding data. Patient and microbiological data were collated through paper/electronic case note review. A telephone survey of on-call Senior House Officers (SHOs) at all UK plastic surgery units was conducted. Descriptive analysis was performed.

Results: Eighty-four children underwent incision and drainage for paronychia over the study period. The median age was 5 years (range 5months to 16 years). Commonest antibiotics prescribed (where data available) were co-amoxiclav in 62% (33/53) and flucloxacillin in 32% (17/53). Commonest microorganisms isolated were *Staphylococcus aureus* in 18% (35/66), *Staphylococcus epidermis* in 12% (8/66), Beta-haemolytic Streptococcus in 9% (6/66), and no growth in 8% (5/66). Our national survey highlighted the variation in antimicrobial prescribing practices across the United Kingdom.

Conclusions: Antibiotic prescribing in our unit was not consistent with NICE guidance. Our national survey reiterated this and suggests lack of awareness of advised guidance. Although frequently managed, wide variation in clinical practice exists in antimicrobial management of paediatric paronychia.

A-0951 Magnetic resonance arthrography classification of the lesions of the dorsal capsulo-scapholunate septum of the wrist: Arthroscopic correlations

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Purpose: The dorsal capsulo-scapholunate septum (DCSS) is an anatomical structure linking the scapholunate ligament (SL) and the dorsal capsule of the wrist. It should be a predynamic scapholunate stabilizer. The authors, using their experience for the arthroscopic lesional classification and for extrinsic ligaments MRA evaluation, suggest a MRA classification of lesions of the DCSS. As arthroscopic classification, the status of DCSS could be graded in four stages according to the magnetic signal and to the fiber attachment.

Materials and Methods: High-resolution MRI, especially using isotropic three dimensional sequences with orthogonal multiplanar reconstructions on 3T MR systems, allows detailed depiction of DCSS. Recognition of ligament abnormalities is improved by intra-articular or intravenous injection of contrast before the examination.

They report a preliminary study on a series of 53 arthroscopies made between January 2014 and December 2015 with evaluation of SL instability and DCSS laxity.

Results: There is a significant correlation between the lesional stage of the DCSS and the arthroscopic pre-dynamic scapholunate instability stage ($p < 0.001$).

- Stage S0: The DCSS presents an intact aspect.
- Stage S1: The DCSS presents a hypersignal with an aspect of microganglion cyst at dorsal side of scapholunate interosseous ligament (SLIOL).
- Stage S2: The DCSS present a large tear with preservation of small connections between dorsal capsule and scaphoid and lunate.
- Stage S3: The DCSS is completely disappeared.

On this series, MRA imaging of the DCSS was analysed and correlated with the arthroscopic evaluation.

Conclusion: A lesional classification of DCSS with MRA procedure is now available.

A-0952 Contribution of ultrasound in the preoperative assessment of partial wrist denervation: A cadaveric and comparative study

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Objective: Local anesthetic injections are advocated as a key to the presurgical evaluation in patients with chronic wrist pain to determine which patients will benefit from partial wrist denervation. The injection is currently performed using anatomic landmarks as proposed by Berger. The purpose of this cadaveric study is to evaluate the contribution of an ultrasound (US)-guided injection of the posterior (PIN) and anterior (AIN) interosseous nerves.

Methods: We performed US-guided injections of methylene blue on 10 wrists to simulate the local anesthetic injection of the PIN (with a dorsal approach) and AIN (with an anterior approach).

In 10 other wrists, we used the Berger procedure to inject the liquid by a single dorsal approach.

For each wrist, the dissection of the two branches confirmed if the methylene blue was around the nerves or not.

Results: In the US group, the injection was effective for all the AIN (10/10) and for all but one for the PIN. In the Berger group, the injection was effective for 7/10 and 8/10, respectively, for the AIN and PIN. The size of the groups was too small to conclude to significant differences in both groups.

Conclusion: This cadaveric study is the first one to describe this ultrasound procedure. The US-guided technique seemed to be more precise than a blind injection for the AIN and PIN at the wrist. As it is observed with the steroid injection, the ultrasonography should be used for the injection of local anesthetic in denervation tests but we need clinical comparative studies to confirm it.

A-0958 Comparison of clinical and radiological outcomes of AO 3.5 dynamic compression plate, 3.5 limited contact-dynamic compression plate and 2.7 ulnar osteotomy plate for ulnar shortening osteotomy in patients with idiopathic ulnocarpal impaction syndrome

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Background: The purpose of this study was to compare the clinical and radiological outcomes of AO 3.5 dynamic compression plate, 3.5 limited contact-dynamic compression plate and 2.7 ulnar osteotomy plate for ulnar shortening osteotomy in patients with idiopathic ulnocarpal impaction syndrome. In addition, the effect of interfragmentary screw fixation on radiologic outcomes of ulnar shortening osteotomy was assessed.

Materials and Methods: Seventy-eight patients who underwent ulnar shortening osteotomy using plate fixation and followed up at least 1 year were enrolled. Three types of plates were consecutively used: AO 3.5 dynamic compression plate (group 1, $n=31$), AO 3.5 limited contact-dynamic compression plate (group 2, $n=19$), AO 2.7 ulnar osteotomy plate (group 3, $n=28$). The patients were also divided into two groups based on performing interfragmentary screw fixation: interfragmentary screw fixation group ($n=27$) and without interfragmentary screw fixation group ($n=51$). The clinical outcomes were evaluated by Disability of Arm, Shoulder and Hand, Patient-Related Wrist Evaluation. Radiological outcomes including time to bone union, presence of delayed union which was defined when the union was not observed until 12 weeks, and re-fracture after metal removal were assessed. Other possible factors that might affect bone union such as smoking, underlying disease were assessed.

Results: All patients showed union at the final follow-up. There were no statistically significant differences in both clinical and radiological outcomes according to the types of plates. When comparing the groups treated with and without interfragmentary screw fixation, time to bone union was shorter in the interfragmentary screw fixation group (7.56 ± 2.56 weeks vs 9.79 ± 6.59 weeks, $p=0.038$). Delayed unions were only observed in 8 of 51 patients treated without interfragmentary screw fixation (15.68% vs 0%, $p=0.045$). In without interfragmentary screw fixation group, 5 of 43 (11.62%) patients who removed the plate had experienced refracture of the ulna by low energy trauma after plate removal. However, there was no significant difference of clinical outcomes between the interfragmentary screw fixation group and without interfragmentary screw fixation group.

Conclusion: Types of plate did not influence the clinical and radiological outcomes of ulnar shortening osteotomy in the patients with idiopathic ulnocarpal impaction syndrome. However, interfragmentary screw fixation with plating for ulna shortening osteotomy has several advantages such as early bony union and prevention of refracture after metal removal.

A-0960 Dynamic radiostereometric analysis for evaluation of kinematics in the distal radioulnar joint before and after TFCC lesions

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Objective: Traumatic triangular fibrocartilage complex (TFCC) injuries can lead to dynamic distal radio ulnar joint (DRUJ) instability, pain and restricted hand function. Increased translation due to DRUJ instability is difficult to grade by clinical examination

and since image diagnostic methods for evaluation of TFCC lesions and DRUJ instability is currently insufficient, wrist arthroscopy is the gold standard to diagnose and differentiate between lesions of distal component (dc-TFCC) and proximal component (pc-TFCC).

Dynamic radiostereometry (dRSA) can record functional joint kinematics precisely and can potentially be used to grade DRUJ instability.

We hypothesized increased DRUJ instability after cutting the dc-TFCC and the pc-TFCC in comparison with the intact TFCC and aimed to evaluate the DRUJ kinematics using dRSA.

Methods: Ten human donor arms, mean age 78 years (63–90), were evaluated. A motorized fixture simulating in vivo DRUJ movements was developed and forearm pronation to supination was performed in a standardized setting.

Specimens were recorded with 10 Hz dRSA before and after cutting the dc-TFCC at the ulnar styloid, and next the foveal pc-TFCC insertion. Ligament lesion interventions were fluoroscopically visualized and checked with wrist arthroscopy.

Subject-specific CT-based bone models were used for kinematic analysis with non-commercial software. Kinematics of the forearm was calculated using standardized anatomical axes and coordinate systems.

Results: Rotation in the DRUJ is a combined motion; the distal radius pivots around the ulnar head center, the ulnar head translates in anterior and posterior direction in the sigmoid notch and the radius pistons in respect to the ulna.

Kinematic analysis of the anterior and posterior translation in the native DRUJ show a sinusoidal smooth movement of ulnar head in the radial sigmoid notch during forearm rotation. The ulnar head translate in the sigmoid notch reaching the most volar position in supination, and the most dorsal position during rotation of the forearm from pronation to neutral rotation.

In neutral forearm rotation, a combined lesion of dc-TFCC/pc-TFCC results in ulnar head translation to a more dorsal position compared with the intact TFCC ($p < 0.05$).

Forearm rotation from neutral to pronation result in a significant volar translation-shift of the ulnar head in the sigmoid notch after combined dc-TFCC/pc-TFCC lesion ($p < 0.05$).

During forearm rotation, pistoning of the radius changes the ulnar variance, which increases in pronation compared to neutral or supinated forearm rotation ($p < 0.05$). Lesion to the dc-TFCC/pc-TFCC does not affect the ulnar variance during forearm rotation compared to the intact TFCC ($p > 0.05$).

Conclusion: Combined dc-TFCC/pc-TFCC lesion increased translation in the DRUJ. During pronation, a volar translation shift was observed in cadaver arms. This finding may be equivalent to the clinical painful ''giving way symptoms'' often described by patients during forceful forearm pronation.

This is the first study of DRUJ kinematics by use of dRSA, a non-invasive, high-precision radiological analysis method. dRSA can evaluate DRUJ kinematics and quantify DRUJ instability in patients during symptomatic motions and may potentially become a diagnostic tool evaluating DRUJ instability in the future.

A-0961 Distal radioulnar joint instability and injury

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Objective: Distal radioulnar joint (DRUJ) instability is increasingly recognized as a clinical entity post injury. Using a novel in vivo measurement device, we assessed instability post various types of forearm trauma.

Methods: A measurement rig was developed, improved upon and then validated both on cadaveric specimens and against current values from other modalities of measurement in the literature. In vivo DRUJ translation, as a proxy for DRUJ instability, was measured in 410 uninjured, non-symptomatic wrists to establish the 'normal' healthy range. Using the same device and technique, DRUJ translation was measured in four additional groups. Measurements were recorded in 100 clinically lax and symptomatic patients (irrespective of cause), 100 patients post unilateral distal radius fracture, 50 patients post unilateral radial head fracture and 50 patients post unilateral scaphoid fracture. The concept of DRUJ tightening being dependent on hand and forearm positioning was also tested in each of the injured and uninjured groups. Measurements for each limb were compared against the contralateral uninjured limb and an expanding database or 'normal' data. Results were assessed for significance with paired t-test analysis at $p < 0.005$.

Results: Average DRUJ translation in a healthy, uninjured, mixed sex population is 6.5 mm (range 5–8 mm). Translation is not affected by gender, hand dominance or forearm length. Radial and ulnar deviation of the hand, alongside prosupination of the forearm all reduced DRUJ translation. Clinically lax individuals have increased DRUJ translation (mean 14.6 mm), with a range that does not overlap that of the normal population. The tightening

phenomenon of hand and forearm positioning remains in this group, but again never returns to normal ($p < 0.005$).

Post-distal radius fracture, DRUJ translation is also increased (mean 12.3 mm). The measured range for the group again does not overlap that of the normal population ($p < 0.005$). Patients who are symptomatic post fracture have values within the range of the clinically lax population.

Individuals post-radial head fracture had a mean DRUJ translation of 8.7 mm. Those who underwent non-operative or open reduction, internal fixation (i.e. Mason I or II) had an increased mean translation but a range that overlapped the 'normal' range. Individuals treated with radial head replacement or excision had significantly increased measurements, with the largest measurements recorded in any group to date seen in the excision population (mean 18.1 mm). Again the three-dimensional tightening theory was demonstrated.

DRUJ translation was not altered from 'normal' in any of the post scaphoid fracture patients tested, irrespective of severity or treatment modality.

Conclusions: DRUJ translation lies on spectrum and all individuals post distal radius or radial head (Mason II or worse) fractures have a degree of increased translation. DRUJ tightening through hand and forearm positioning exists and persists post injury. Clinically symptomatic DRUJ instability correlates with measured translation >12 mm and is never within the asymptomatic range. These new findings contradict some of the established concepts. While changes post injury are common, they are minimally symptomatic, and treatments need not aim to restore pre-injury translation but purely a degree of tightness below the established clinically symptomatic threshold.

A-0962 Functional outcome comparing a dual mobility cup to a standard cup in total joint arthroplasty of the trapeziometacarpal joint

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Objective: Dual mobility cup design in total joint arthroplasty may result in increased mobility and fewer dislocations. In 2013, a dual mobility cup design was introduced to be used with the Elektra stem for total joint arthroplasty of the trapeziometacarpal joint. The aim of the present study was to determine the functional outcome after trapeziometacarpal total joint arthroplasty comparing a dual mobility cup to a standard (single mobility) cup.

Methods: The patients were prospectively included. All patients had Eaton grade 2 or 3 osteoarthritis in the trapeziometacarpal joint. Patients operated on from June 2010 to March 2015 using the Elektra bimetal cementless screw cup (standard cup, Elektra group) were compared to patients operated on from June 2013 to March 2015 using the Moovis Elektra dual mobility press-fit cementless cup (Moovis group). In bilateral cases, only the first operated hand was included. The Disability of the Hand, Shoulder and Arm (DASH) score, pain using a continuous 100-mm visual analog scale (VAS), grip strength, Karpandji score and extension of thumb were registered preoperatively and at 3 and 12 months after surgery.

Results: Sixty-two patients (13 male/49 female), mean age 56.5 years (SD 7.0), in the Elektra group and 66 patients (10 male/56 female), mean age 57.9 years (SD 7.7), in the Moovis group completed the study. The two groups were comparable apart from preoperative DASH score, that was significantly higher in the Moovis group ($p = 0.002$). At 12 months, the patients in both groups had significant improvement in all areas compared to the preoperative measurements. However, at 12 months, the Elektra group had significantly better grip strength ($p = 0.036$), extension of the thumb (mean 1 cm, $p = 0.037$), VAS at activity ($p = 0.048$) and DASH score ($p = 0.015$) compared to patients in the Moovis dual mobility group. We found no significant difference in the rate of improvement in DASH score, grip strength, Karpandji score, extension of thumb or VAS from preoperative to 12 months postoperative in the two groups. No dislocations were recorded in the observation period.

Conclusion: Dual mobility cup in total trapeziometacarpal arthroplasty does not result in better mobility or functional outcome than a standard cup. No difference in dislocation rate was recorded.

A-0964 Twenty-five-year experience of microsurgical thumb reconstruction in children

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Function restoring of the thumb is one of the most important conditions for the normal development of the child, because the thumb participates practically in all kinds of the pinch due to the opposition factor.

Congenital defect of this segment leads to the impairment of the workability of the hand on 40–50%. It also delays the process of the social and intellectual development of child.

One of the most effective methods of the thumb reconstruction is microsurgical toe-to-hand transfer. But, according to the literature, this surgical procedure is very rarely used in children with congenital hand pathologies. To apply this operation, there must be strict indications. An effective alternative to this method is operation of pollicization and the transposition of other fingers of the hand.

In the past 25 years, 128 toe-to-hand transfers, 355 pollicizations, 28 finger transpositions for various congenital malformations and post-traumatic diseases of the hand and foot have been performed at the Turner Institute for Children's Orthopedics, St. Petersburg, Russia (Department of Reconstructive Microsurgery and Hand Surgery). As autografts for the thumb reconstruction we used second toe of the foot – in 109 cases; the fifth finger (from congenital cleft foot) – 16 cases; the thumb (also from the cleft foot) – 2 cases; additional great toe with its congenital duplication – 1 case. In 28 cases, the graft was taken with a fragment of metatarsal bone.

We did not use great toe principally because of the profound damage of the donor site in this case.

Six grafts (4.7%) did not survive because of the disturbance of the blood supply. Among them, five were fifth toes and one was second toe. In cases of unfree finger movements during pollicization and transposition, the survival rate of grafts is 100%.

The analysis of the results showed good and excellent functional and cosmetic results in 76.5% of cases. As for the child's best age for such operations, it should be noted that an early reconstruction of the thumb will provide the fastest restoration of the hand function. The formation of the thumb feeling is completed before the 12-month age, so we consider this age to be optimal for the reconstruction of thumb for children.

X-Ray studies showed the continued growth of the toe, which was transferred to the hand, we observed both acceleration of growth and its slowing down. I think that this effect should be investigated in the future.

Conclusion: Microsurgical toe-to-hand transfer to the thumb position is the most effective method of treatment, because it provides a strong, moving, sensitive and stable thumb. The method of choice is the pollicization or transposition of other fingers of the hand.

A-0967 The use of RegJoint in first CMC joint arthrosis, Eaton 2°–3° stages: A review of 50 cases with personal technique

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RegJoint is a biodegradable joint scaffold, in polylactic acid bioabsorbable in 20–24 months. It consists of a porous biodegradable polylactide copolymer implant (BPI) that is round and disc shaped, with a diameter that varies from 8.0 mm to 18 mm and a thickness that ranges from 3.6 mm to 4.5 mm.

The function of scaffolds is to create and maintain a space between the bone ends. The surrounding tissue preferably invades the pores of the scaffolds and fills in the empty space. The tissue will later function as a neo-joint.

I reviewed the first 50 cases, 36 women (four bilateral case) and 10 men, aged 45–77 years, average 64 years women and 68 years men.

They were affected by thumb carpo-metacarpal arthritis (Eaton-Littler stage 2°–3°), with a follow-up from 46 to 6 months (average 20 months)

The scaffold replace, the space created cutting the base of 1° metacarpal and the saddle of trapezium, then I pass one third of FRC in the holes created in the base of trapezium, in the RegJoint spacer and from the base to the diaphysis of 1° metacarpal.

Then, the split was used to restore the dorso-radial ligament, besides the abductor tendon attached on the base of 1° metacarpal, was fixed dorsally on the new joint.

So it lost the subluxated action on the 1° metacarpal and transfers this action on the new joint.

This technique restores the high on the first ray, reduces and stabilizes the joint and decreases the sublussante action of the abductor pollicis longus.

I reviewed clinically at 15, 30, 60 and 120 days, 10 patients with pain or casually, were submitted at RMN study, the first 20 cases did an rx after 2 years minimum.

The results were Kapandy 8-10 (average 9).

Pain: VAS 1.5 average (range 1–4), was 5.5 before surgery.

Pinch 4.6 (was 3.4 before surgery because of pain) similar to the other hand.

Grip: average 20 kg (was 16 before surgery), 22 kg the value of the other hand.

All patients compiled the quick-DASH (Short disability of Harm-Shoulder and Hand) questionnaire, the average value was 17.5 point (from 13 to 28).

All patients reached their best range of motion and were able to restart the normal work-related activities in 2 to 4 months (average 2.4 months).

Only four patients have had pain insurgent at 4–8 months from surgery, without outward signs clinically evident. Their RMN and rx showed intensive inflammatory reaction in RegJoint place.

The pain disappeared slowly in 2 months, only with rest, thermal therapy and painkillers. The preliminary results are highly encouraging despite the low number of patients treated. The better results without fail may be favorable from stability of the scaffold and the stability of joint, which resist to the strength developed during thumb activity.

A-0972 One-to-thirteen-year follow-up of total wrist arthroplasty

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Introduction: The aim of this study was to review our short-term results to long-term results of wrist-arthroplasty from two centers.

Methods and Materials: Remotion implant is a modular total wrist joint prosthesis. Un-cemented technique used except for two cases.

Patients evaluated pre- and postoperatively with ROM, grip strength, visual analogue scores of 0–100 mm (VAS) of pain and satisfaction. Functional and general outcomes were evaluated using the Quick-DASH and PRWE questionnaires. Radiographs were obtained pre-operatively and at follow-up.

One hundred and sixty-two prostheses performed in 147 patients and 15 patients had a bilateral prosthesis, 40 men and 110 women. Mean age was 59 years (24–86). Diagnosis was rheumatoid arthritis (RA) in 101 cases, degenerative arthritis in 34 and posttraumatic arthritis in 25. Mean follow-up was 6 years (range 1–13).

Results: Wrist extension and flexion was preoperatively 35/35° and at follow-up 35/30. Radial/ulnar deviation was 10/25° versus 10/30 postoperatively. Grip strength, in kgF, was preoperatively 13 (range 0–64) and at follow-up 17 (0–50), $p < 0.01$. Key pinch, in kgF, was preoperatively 4.4 (range 0.8–10) and at follow-up 5.2 (0.5–5.2), $p < 0.05$. VAS pain was preoperatively at rest/activity; 41/68 and at follow-up; 14/28, ($p < 0.01$). Quick DASH and PRWE scores were preoperatively: 58 respectively 67 and at follow-up: 37 and 31 ($p < 0.01$). VAS satisfaction preoperatively was 17 mm (0–100) at latest follow-up 73 mm (0–100), $p < 0.01$. Overall estimated survival 10–13 years is 87%, in RA 88% and in OA 81%.

One superficial infection and one deep infection encountered. Twelve prostheses were revised. Arthrodesis performed in five cases and in seven cases some or all of the components were revised to new components.

Conclusions: The short-term to long-term outcome indicates that total wrist arthroplasty is a viable option with unchanged ROM and improvement of pain, grip strength, Quick DASH, PRWE and satisfaction. Complication rate is acceptably low.

A-0976 Effects of various selective nerve transfers on the adult and neonatal motor unit

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Objective: Selective nerve transfers (SNTs) have been used extensively for the past decade to treat slow nerve regeneration, neuroma pain and improve prosthetic control. SNTs change the motor unit extensively by connecting motor neurons to new functional targets. Good outcomes have been reported. Even though frequently applied in clinical routine, little is known of the structural and functional effects following SNTs. Our laboratory has conducted several experimental studies to investigate the effects on the different motor unit levels. Therefore, an overview of the latest results shall be presented.

Methods: In male Sprague-Dawley rats, the ulnar nerve (UN) was selectively transferred to the long head of the biceps after neurotomy of the biceps motor branch. In another experimental group, an even more selective fascicular group, the deep branch of the ulnar nerve, was used to restore elbow function. These transfers were not only performed in 20 adults but also in 20 neonatal rats within 24 h after birth applying different anaesthesia methods. Additionally, the equivalent nerve transfers were conducted in 15 Thy1-GFP (neonates: $n = 5$, adult: $n = 10$) rats to analyze formation of neuromuscular junctions. After 12 weeks of nerve regeneration, neurophysiological effects were explicitly assessed on each level of the motor unit by tetanic muscle force, MUNE (Motor Unit Number Estimation), retrograde labelling, muscle fibre typing and neuromuscular junction staining. Furthermore, sensory and motory axon quantification was performed by immunhistochemical staining.

Results: The various nerve transfers successfully reinnervated the biceps muscle in all animals, as indicated by muscle force and neurotomy reaction. Dropouts only occurred in the neonatal group due to dam cannibalization. Compared against the ulnar nerve transfer in the fascicular nerve transfer group (deep branch), equivalent regeneration was found. Retrograde labeling, muscle fibre typing and neuromuscular junction staining revealed impressive changes on all levels of the motor unit. Most interestingly, functional and structural hyperinnervation of the muscle was thereby evaluated. Sensory and motory axon quantification of the ulnar nerve and its deep branch covered valuable clues on how much donor nerve is needed to restore elbow function.
Conclusion: Transferring not only a high capacity donor nerve but also an even more selective fascicular group and exploring the effects on the motor unit provides us with a deeper understanding of the neuronal plasticity of the peripheral nervous system. Especially when comparing the neonatal to the adult rat model, a glimpse of the enormous plasticity can be catched. As selective nerve transfers play a major role in extremity reconstruction, findings of these studies might further help to improve clinical approaches.

A-0978 Arthroscopic management of painful dorsal wrist ganglion

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Objective: The dorsal ganglion of the wrist is a common pathology that has long been neglected. A recent study has proven the value of arthroscopic management. In the light of anatomical work, the dorsal capsulo-ligamentous complex septum (DCSS) has been demonstrated as an anatomical structure. Painful ganglia appear to be related to a lesion of this DCSS, after trauma or not. It therefore seemed legitimate to repair this lesion by arthroscopic dorsal capsuloplasty. This study presents the results of this technique.
Methods: This retrospective study reported the patients operated for painful dorsal wrist ganglion. The ganglion was resected and capsulo-ligamentous suture was performed under arthroscopy. Range of motion, pain, strength and DASH score were reported before and at the last follow-up between February 2011 and April 2017.
Results: Thirty four patients (10 men and 24 women) had the surgery, one patient on both side, mean age 24.9 years old (15-41). Only three were manual worker but most of them had contributing factors, especially sports. All but five had RMI before the surgery. A splint was worn on average 6.2 weeks (5.5 to 8) after surgery. The average follow-up was 8.4 months (2.5 to 48.5). Range of motion and strength improved. Pain decreased from 1.4 at rest (0 to 6) and 6.3 on stress (3 to 9) before surgery, to 0.1 at rest (0 to 2) and 0.8 on stress (0 to 6). The average DASH went from 27.3 (6.81 to 68.18) to 6.7 (0 to 29.54). There was only one recurrence.
Conclusions: The dorsal capsule-ligamentous repair associated with resection of dorsal wrist ganglion is a simple technique reliable. It allows repairing a lesion of the DCSS causing the pain, associated with the ganglion. Arthroscopic technique avoids stiffness. Our promising results still require a larger series and longer follow-up to ensure that the results are sustainable.

A-0992 Use of second dorsal metacarpal artery skin flaps for treating retractions in the first hand commissure

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Purpose: To describe and present the results of a surgical technique that uses the second backflow dorsal metacarpal artery skin flap to treat retractions in the first hand commissure and, when necessary, apply longer flaps to cover the palm of the hand.
Methods: The surgery was performed on 16 patients with retraction of the first commissure. Six of these patients also had scar retraction of the palm in addition to the commissure. Preoperatively, the opening angle of the first commissure was measured, and the degree of retraction was divided into three categories: mild, moderate and severe. Eleven cases were considered severe and five moderate. The surgical technique used is described in detail.
Results: All 16 flaps (100%) survived. Three cases experienced transient ischemia with partial suffering of 10% of the distal flap area, and two cases experienced epidermolysis, but these issues were all satisfactorily resolved. On average, the dimensions of the flaps varied by 10 cm in length and 2.2 cm in width. There was complete closure of the donor area in 14 cases (87.5%). The opening of the first commissure ranged from 51° to 83° (mean, 73.5°).

Conclusion: The skin flap from the second dorsal metacarpal artery can be reliably and successfully used to treat retractions of the first commissure. It can be considered a good option for cases that present with palm retraction in addition to commissure retraction.

A-0993 Polydactyly: Putting together development, evolution and pathologies

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Objective: Evolutionary Developmental Pathology, or Macroevolutionary Medicine, a new biological field, aims to connect study of evolution, development, and human pathologies. An original component of this subfield is the focus on both the study of model organisms to illuminate human pathologies and study of humans themselves to test current developmental and evolutionary theories. Access to human anatomical data is crucial. Information about soft tissue anatomy of polydactyly in humans is scarce. We present a collaborative study of preaxial radial polydactyly examining clinical anatomical findings from the perspective of Evolutionary Developmental Pathology.
Methods: A detailed study of 68 anatomical operative records of pre-axial polydactyly of hands and feet is discussed in the context of current models of limb development based on theoretical studies and studies of model organisms, including ideas on predictable topological muscle attachment and derived similarity versus serial homology of upper and lower limbs. Findings are tabulated and also presented as schematic models.
Results: We identified a decoupling between the skeletal level of duplication and muscle/tendon anatomy, as predicted by current Evo-Devo models. Contrary to these models, the topology of muscle attachment is highly variable even within the same polydactyly groups.

In hands, abductor pollicis brevis insertion favoured the radial duplicate but also inserted on both duplicates/ulnar only. While extensor pollicis brevis (EPB) inserted more frequently on the radial duplicate, insertion on both duplicates/ulnar only was also observed. EPB insertion on the ulnar duplicate only was observed in 3/14 triphalangeal radial polydactyly and 1/40 non-triphalangeal radial polydactyly. Greater overall complexity of anatomy was recorded in the triphalangeal cohort vs non-triphalangeal cohort.

In feet, abductor hallucis insertion favored the medial duplicate, and insertion on the lateral duplicate was observed in 1 of 14 feet.

In bilateral cases of pre-axial polydactyly, lower limbs displayed more symmetric patterns than upper.
Conclusions: Application of clinical anatomical knowledge to test current models/theories of limb development lends support to some models, challenges/contradicts others. This collaborative work reinforces the need to include detailed clinical anatomical data to address implications for medicine but also for development and biological evolution in general. These data provide a unique opportunity to further our understanding of complex subjects.

A-0998 Dynamic MRI at 3T can determine the viability of the lunate bone in patients with Kienböck's disease

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Background and Objectives: The basic abnormality of Kienböck's disease is thought to be an impaired vascular supply to the lunate. Thus, a diagnostic modality capable of assessing vascularity in the lunate would probably improve both the diagnostic capability and the possibility of monitoring the effects of different treatment regimes. Radiographic examinations are unreliable in assessing vascularity. MR with contrast has identified three different patterns of contrast enhancement of the lunate in patients with Kienböck's disease. These were areas with necrotic bone without enhancement, a hypervascularized repair zone, and areas of normal bone. The hyper-enhancement, seen in the repair zone, has been suggested to indicate areas with a good healing prognosis, whereas areas with hypo-enhancement are thought to indicate non-viable bone with a poor

prognosis. Dynamic contrast-enhanced (DCE) MR imaging at 3T has been successfully used for assessment of perfusion in normal carpal bones. However, DCE MR imaging has not been used to assess perfusion in patients with Kienböck's disease.

The aim was to investigate perfusion in the lunate bone in patients with Kienböck's disease, using dynamic contrast-enhanced (DCE) MRI, and to compare the perfusion pattern with histopathology in patients operated with lunate excision in order to determine whether increased perfusion indicates viability.

Methods: DCE MR examinations at 3T and radiography were performed in 14 patients (8 men and 6 women, mean age 45 years; range 21–66) with Kienböck's disease. One patient had Lichtman stage I, two had stage II, and 11 had stage III (4 stage IIIa and 7 stage IIIb). Six patients all with stage IIIb were operated with lunate excision, allowing histological examination of the entire lunate bone. Features of the enhancement curves, time to peak (TTP), maximal slope (MS), and maximal intensity (MI) were assessed and compared with those in 19 healthy volunteers in a control group.

Results: Our results indicate that patients with Kienböck's disease have a higher degree of perfusion in the lunate bone than healthy controls. Significant differences in the perfusion parameters of the lunate bone were seen in patients with Kienböck's disease compared to the control group regarding TTP ($p = 0.024$), MI ($p = 0.0001$) and MS ($p = 0.0001$). Histopathological examination showed a diverse picture; in the border of the fragmentation, new bone formation and resorption, central fatty bone marrow with necrotic areas, and peripheral, more normal bone trabeculae were seen. The perfusion was increased both in the area of bone repair and in the areas of necrosis.

Conclusions: DCE MRI at 3T can diagnose pathological perfusion in patients with Kienböck's disease. The perfusion was increased in areas of bone repair and bone necrosis, whereas normal bone structure showed sparse perfusion. Using DME, it was possible to demonstrate that the increased perfusion compared to the normal carpal bones corresponds histologically not only to areas of bone remodeling but also to areas of fibrous osteoid and necrosis. Increased perfusion is therefore not a marker of viability.

A-0999 Poor surgical outcomes in camptodactyly correction using total anterior teno-arthrolysis or osteotomies

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Objectives: The surgical management of camptodactyly is poorly described with little data to support a variety of surgical techniques. The aim of this study is to correlate functional results of total anterior teno-arthrolysis (TATA) or osteotomies for camptodactyly correction.

Methods: We performed a retrospective review of a prospectively maintained database comprising of all patients presenting consecutively to a tertiary centre for paediatric hand surgery for the surgical management of camptodactyly. All patients were clinically assessed by the senior author at the John Radcliffe Hospital, Oxford University Hospitals Trust between 1997 and 2012. Each patient fulfilled indications for surgery including contracture greater than 50°, functional loss, symptomatic, progression, and failure of conservative therapy. Duration and severity of symptoms, previous failed treatment including splinting and surgery, X-ray changes were considered when deciding the optimal procedure for each patient. Starting mean contracture, improvement of contracture (extension angle), loss of flexion and complications were assessed.

Results: Twenty-eight patients ($n = 28$) underwent TATA or osteotomies for camptodatyly correction. In this cohort, there was an equal number of male and female patients; 16 had an isolated little finger camptodactyly. The mean starting contracture was 81° (60–100°). N = 24(86%) had an improvement in extension angle but $n = 22$ (79%) had a loss of flexion. N = 4 (14%) were lost to follow-up. N = 8 (29%) patients (or parents of patients) found there was no improvement in camptodactyly. Complications were common including $n = 6$ with pinsite infection, $n = 2$ wound infection, $n = 4$ wire loosening, $n = 2$ bone loss, $n = 8$ bone stiffness.

Conclusions: Camptodactyly is a complex multifactorial problem with a range of affected biology. Outcomes in this series are worse than in reported literature, but mean starting contracture was also larger. There is an observed change in function from a predominately flexor grip to greater extensor strength in the operated finger. Outcomes are worse in the older patient, fixed PIPJs, X-ray changes, those with multiple digit involvement, finger involvement other than the little finger or syndrome-related

syndactyly. A single surgical solution is not suitable, and an individualized approach must be considered.

A-1000 Pirodisk in first CMC joint arthrosis: 120 cases, follow-up from 1 to 9 years

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I used Pirodisk scaffold in 102 patients, (18 bilateral cases) with thumb carpometacarpal arthrosis (stage 2°–3° Eaton-Littler classification), 86 women (4 bilateral), 16 men (4 bilateral), aged 36 to 74, average age 61 years.

Pirodisk is a round pirocarbonic disc, with a diameter that varies from 14 mm to 18 mm and a thickness that ranges from 5.5 mm to 8 mm.

Pirodisk surgery technique, a Pellegrini–Eaton modified technique, entails the reconstruction of palmar oblique and dorsoradial CMC ligaments, so we can obtain joint alignment and first ray high restoring and maintenance.

After surgery, I used splint with thumb in, for 15 days, than they started therapy.

I reviewed clinically at 15, 30, 60 and 120 days and some at 180 days, all patients reached their best range of motion and were able to restart the normal work-related activities in 2.5 to 4 months (average 3 months).

Results: Of the 95 hands, 85 reached a full range of motion (Kapandji 9–10) and 25 only 7–8 Kapandji.

Pain: average VAS 2.5 (range 1–6), VAS was six before surgery, 3 patients reporting pain during work-related activities (1 cook and 2 waiters).

Pinch average 4.8 kg (3.5 kg before surgery), similar to other hand.

Grip average 20 kg (16 kg. before surgery), 4 kg more than the other affected hand and 1 kg less the non-affected one.

Eighty patients compiled the quick DASH (Disability of Harm-Shoulder and Hand) questionnaire, the value was 22 points (from 14 to 51)

All patients reported mild pain for 1 to 6 months (average 2.5 months).

Only 12 cases had joint low-middle-pain during the movement at all.

All patients reached their best range of motion and were able to restart the normal work-related activities in 2 to 4 months (average 3 months).

Eight patients had sensitive problems on dorsal skin for 6 months caused by sensitive radial collateral nerve compression.

Eight patients had one more surgery for click thumb after a period of 3 to 8 months from first, and three other patients had surgery for de Quervain tendinitis in the same wrist.

I had 10 cases of moderate instability and one case of mobilization with painful sub-luxation, 44 years old.

Reoperated with RegJoint scaffold interposition.

I think that Pirodisk used, in middle-old age patients, with carpometacarpal arthrosis stage 2°-3° Eaton-Littler, with an active work, is to be preferred to trapezium excision arthroplasty, because of it preserve the trapezium and maintain first ray high. Besides the use of Pirodisk leave the arthroplasty salvage treatment open in case of failure.

The limit is represented by its cost.

A-1003 Can subjective patient-reported outcome predict objective timed Sollerman Hand Function Test?

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Background/aim: Patient-reported outcome measures (PROMs) and objective functional tests in hand surgery are central to assess health-related quality of life along with patient's estimation of disability, pain, overall satisfaction, the natural history of disorders and monitor improvement after treatment, especially surgery. Currently, data are limited to support how these assessment scores correlate with each other. The main aim of this study was to quantify whether subjective Michigan Hand Questionnaire (MHQ) can predict objective Sollerman hand function test (SHFT).

Methodology: We conducted a retrospective review of completed MHQ and SHFT for 34 adults aged 18 and older, right hand dominant with post traumatic wrist arthritis underwent four-corner arthrodesis. Rheumatoid hands, neuropathic disease and acute trauma were excluded. Pearson coefficient was used to test strength of correlation between these two hand tests.

Results: Mean time to complete 20 tasks in SHFT was 3.76 (SD, 0.8) and 3.79 (SD, 0.6) min for the right and left hands, respectively. Average MHQ was 85.02 (SD, 12.2; range 49.1–100) for the right hand and 82.9 (SD, 14.7; range 53.4–100) for the left hand. Average of MHQ raw hand function test (assessing volar, diagonal and transverse grip along with pulp and lateral pinch) was 76.03 for the right hand (SD, 15.9; range 50–100) and 73.8 (SD, 16.7; range 30–100) for the left hand. These tasks in MHQ were compared to similar tasks in SHFT. The correlation

between SHFT and MHQ for right (R: −0.1986) and left (R: −0.2051) hand was weak (Pearson coefficient).
Conclusion: Our study shows that Michigan Hand Questionnaire could not predict SHFT. Patient-reported outcome measures could introduce bias in terms of patient perception and inaccurately estimate function despite the convenience of its use.

A-1015 Do two venous anastomosis decrease free flaps complications in anterolateral thigh flap for limb reconstruction?

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Objective: The question of how many veins in free flaps surgeries for limb reconstruction and how does it influence the results is still unanswered. In this report, we evaluate the results of one versus two venous anastomoses in anterolateral thigh flaps for limb reconstruction.
Methods: A cross-sectional study was conducted with consecutive inclusion of all patients undergoing anterolateral thigh (ALT) flap for upper and lower limb reconstruction at our institution, between July 2014 and July 2017. Patient demographics (age, gender and comorbidities), location and indications of wounds were studied. Perioperative information was recorded and groups were divided in two groups according to number of venous anastomosis: group 1 (one venous anastomosis) and group 2 (two venous anastomoses). Intraoperative and postoperative complications were studied. Statistical analysis was performed with SPSS 20.0 (SPSS Inc®, Chicago, IL, USA). All tests were two-tailed, and statistical significance was defined as $p < 0.05$. Qualitative data were analyzed by Pearson χ^2 test or Fisher exact test. Mann–Whitney U test was used for quantitative nonparametric data.
Results: Thirty-eight patients were included in this study. Thirty-two patients were males. The mean age was 33 years (15–69 years). The indication was trauma in 35 patients and tumor in three patients. The most common accident was motorcycle accident (25 free flaps), followed by three patients run over by a car, three patients had work-related accident, and two patients had a car accident and others. According to mean hemoglobin levels in immediate preoperative was 10.88 g/dl (SD 1.88 g/dl) and postoperative was 9.85 g/gl (SD 1.46 g/dl). The mean platelet count levels in preoperative was $372.34 \times 103/mm^3$ (SD $166.7 \times 103/mm^3$). The mean intraoperative ischemia time of microsurgical flap was 113.7 min (SD 44.5). Group 1 included 17 patients and group 2 included 21 patients. The mean ischemia time (which was defined as the time between the section of the pedicle in the donor area and the release of clamps of the artery and at least one vein) was similar in both groups ($p = 0.245$) and complications were more common in one venous anastomosis with 47% of complications versus 24% in group 2, but not statistically significant ($p = 0.065$). No risk factor for complications or total flap loss was identified. Revision of the anastomosis was performed in five patients (five cases of group 1) and three were successfully revised. The overall success rate was 92% with ALT flaps for limb coverage for extensive wounds that could not be covered with local flaps.
Conclusion: We concluded that two venous anastomosis in ALT free flaps for limb reconstruction had lower rates of complications but not statistically significant.

A-1017 A cadaveric study on the accuracy of an individualized guiding template to assist placement of scaphoid screws using computed-assisted design and three-dimensional printing technique

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Purpose: The aim of this study was to evaluate feasibility and accuracy of scaphoid screw placement using computer-assisted design and three-dimensional (3D) printing surgical guiding template. We described a procedure by using virtual planning system to select an appropriate position for the screw guide wire in the scaphoid surface model. Based on further calculations, a surgical template with guiding holes was generated in the system and this simulation was transferred to the patient by using 3D printing technique.
Methods: Eight fresh-frozen cadaveric upper extremity specimens were utilized. The DICOM data of the preoperative CT scans of the wrist were imported into surgical planning system. A 3D surface model of guiding template with holes was generated by Boolean calculations in this system. A screw guide wire may be placed in the central area in the scaphoid through these holes. This 3D model was printed and then put back to the wrist cadaver. A screw guide wire was inserted through the palmar guide hole and then the wrist received post-operative CT scan. These postoperative data were introduced

into the surgical planning system. Angular and linear deviations between the preoperative guide wire simulation and postoperative guide wire were measured in the system to assess the drilling accuracy.
Results: Mean angular deviation was 3.58 ± 1.52(1.56—5.18), and linear deviations of eight specimens were less than 1.1 mm. No specimen required a repeat drilling of the scaphoid. All the screw guide wires considered to be centrally placed in the scaphoid.
Conclusions: The use of computer-assisted 3D printing surgical guide template to assist screw placement for scaphoid fracture showed acceptable accuracy in cadaver wrists.
Clinical relevance: Our technique may provide a simple and effective method for the guidance of screw insertion in scaphoid fracture surgery.

A-1021 Outcomes of distal radius fractures associated with triangular fibrocartilage complex injury

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Objective: Clinical studies that evaluate the correlation between associated lesions of triangular fibrocartilage complex (TFCC) and outcome of distal radius fractures expressed with the patient-rated disability are missing.

The aim of this study was to evaluate the outcomes of distal radius fractures associated with or without an injury of the triangular fibrocartilage complex.
Methods: Patients undergoing operative treatment for distal radius fracture were prospectively enrolled ($n = 70$). TFCC was examined by wrist arthroscopy and injuries classified according to Palmer. Comparative analyses were performed on 45 patients with TFCC injury (injured group) and 25 patients with intact TFCC (intact group). The outcome measures included the Patient-Rated Wrist Evaluation (PRWE) and the Disabilities of the Arm, Shoulder and Hand (DASH) questionnaires, 3 and 12 months after injury.
Results: TFCC was injured in 45 (64%) patients. In patients with intact TFCC mean total PRWE score was 27 (3 months) and 16 (12 months), compared to patients with TFCC injury with 40 (at 3 months) and 24 (at 12 months). Mean DASH scores were 26 and 13 at 3 and 12 months for the intact group and 39 and 27 for the injured group. PRWE and DASH results showed significant difference at 3 and 12 months when compared with the Mann–Whitney test.
Conclusions: Disability outcomes were worse in distal radius fracture patients where TFCC was injured. TFCC injuries are important co-factor affecting the outcome of distal radius fractures.

A-1022 Lumbrical plus or paradox finger extension syndrome: Case report and review of the literature

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The lumbrical plus phenomenon produces a paradox extension of the interphalangeal joints during attempted finger flexion. The underlying mechanism is thought to be a contraction of the injured or scarred deep flexor tendon transmitted via the lumbrical muscles towards the extensor system.

We present an impressive case of this rare syndrome with a review of the only 30 cases to be found in the literature to date.

A 26-year-old plumber suffered a severe contusion of his left hand causing a fourth metacarpal fracture. He developed a functionally disturbing extension phenomenon of the adjacent little finger whenever flexion was attempted. This phenomenon persisted despite three surgical procedures (neurolysis and transposition of the ulnar nerve, flexor tendon tenolysis) and repeated occupational therapy. The patient had been off work for almost 4 years.

To exclude voluntary extension of the finger, we used a proximal radial nerve block. Then we performed resection of the fourth lumbrical muscle and additional tenolysis of the fifth superficial and deep flexor tendon under local anesthesia with epinephrine (wide awake). Already intraoperatively, the patient was able to fully close his finger again. Rapid work place reintegration followed.

A review of the literature revealed that the lumbrical plus syndrome mostly occurs after rather simple hand injuries, such as contusions or repetitive mild trauma. Notably, in our case, the diagnosis was significantly delayed by various clinicians, leading to multiple unsuccessful surgeries and several years of unemployment until simple resection of the lumbrical muscle solved the problem.

In conclusion, although the lumbrical plus syndrome is rare, every hand surgeon should be aware of this posttraumatic disorder in order to avoid treatment delay and unnecessary surgeries.

A-1025 Saddle deformity: A case report

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Adhesions between the interosseous and lumbrical muscles involving the deep transverse metacarpal ligament (dTML) can be a cause of chronic pain and reduced range of motion. New reports on this condition are rare, even though two large studies were performed in the 1970s and 1980s, first describing this condition as ''saddle deformity.'' Adhesions mostly occur after direct trauma to the hand, but there are also post-infectious or inflammatory cases. The lack of objective findings may prolong making the diagnosis. Average time between trauma and surgery is often long. The Chicarilli report shows an average of 19 months. MRI might in some cases be helpful. We present a case of saddle deformity that was recognized and operated 6 months after the first presentation in our clinic with an optimal final outcome.

We present a 50-year-old woman with chronic pain on the dorso-ulnar aspect of the third metacarpal head and a concomitant flexion deficit. Symptoms occurred 1 year after suffering from a closed mallet injury on the DIP joint of this finger, which was treated conservatively. Eleven years earlier, she was also treated conservatively for a closed rupture of the radial extensor hood of the MCP joint on this finger. Ultrasound and MRI only showed a slight synovitis of the flexor tendons. Physiotherapy and local cortisone infiltrations did not show major improvement. We eventually performed a surgical exploration and found interosseous–lumbrical adhesions involving the dTML. The dTML was resected, the adhesions were released and hand therapy was started immediately after surgery. The patient gained full active range of motion 3 months postoperatively and was pain-free.

Adhesions of the interosseus and lumbrical muscles are probably more common then thought, but often not recognized. It is important for physicians to keep it in mind and look for it in cases with chronic intermetacarpal pain. MRI might help to exclude differential diagnosis, but it is mostly diagnosed by clinical examination. Major causes are posttraumatic (contusion or crush injuries), inflammatory and also infectious conditions. The surgical procedure is simple and seems to lead to good results.

A-1026 Culture and transplant of human fibroblast cells (allograft) on amniotic membrane for treatment of epidermolysis bullosa

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Background: Epidermolysis bullosa (EB) is a genetic disease with skin fragility and instability at the junction of dermis to epidermis. Severe deformity of hands because of scars and adhesions leads to lose the proper function of hand which affects the quality of patients' life. Covering the wound after opening adhesion is the major problem in the way of reconstructive surgeons. Our purpose in this study is to use allogeneic fibroblasts amnion after surgery as a cover in patients to prevent further adhesion.
Materials and Methods: This is an interventional study on six patients who suffer from epidermolysis bullosa with deformity and adhesion. We took a skin sample from back of one of parents' ear. Then fibroblast was separated, cultured and transferred to the amniotic membrane. After separating the full adhesion, all parts without skin were covered with the allogeneic fibroblast amnion. Furthermore, speed, quality, recovery time of wound were examined as well as range of motion in finger joints and the pressure on the skin.
Results: The results showed us wound healing improved and time of healing varied between 15 and 29 days. The average time of treatment was 23.1 days with the standard deviation of 77.3. Restored skin could perfectly tolerate the pressure of rehabilitation activities and splint.
Conclusion: Allogeneic fibroblast with a scaffold like amnion can reduce the need for skin graft in patients with epidermolysis bullosa. Normal allogeneic fibroblast and disability of releasing collagen seven in these patients can be considered as an effective factors in wound healing and show better results than autogenic fibroblasts.

A-1030 Non-operative management of fingertip injuries with the IV3000 dressing

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Objective: The optimal management of fingertip injuries is controversial with multiple surgical and non-surgical options. Conservative treatment with dressings is one such management option and the IV3000 dressing, being semi-occlusive with a high reactive moisture vapour transmission rate (MVTR), has been found to be comparable to other alternatives. We present our findings with the use of the IV3000 dressing to treat adult and paediatric finger tip injuries with good outcomes.
Method: Patients were recruited from the trauma patients presenting to the Department of Plastic Surgery at NHS Tayside in the 2-year period between July 2015 and July 2017. The study was prospective but not randomized. Patients were counselled regarding their injuries and if conservative management was considered feasible, they were given the choice of the IV3000 dressing. Inclusion criteria were a fingertip injury with loss of part or whole of the pulp, nail bed, nail plate and a patient that wanted conservative management. There were seven patients with exposed bone that were included in the study based on patient choice. All patients were followed up in a nurse led dressing clinic and were followed up for a least a month after healing was complete.
Results: Sixty-four fingertip injuries (61 adult and 3 paediatric patients) were treated with the IV3000 dressing and included in the analysis. The treatment outcome of 40 injuries was rated as 'excellent' by the patients, 19 as 'satisfactory', while 5 were rated as 'indifferent'. No patient reported their outcome as 'unsatisfactory'. On complete healing of the digit, five patients had cold intolerance, two had some degree of hypersensitivity and three had a nail deformity.
Conclusion: At 7 pence per piece, the IV3000 dressing provides an affordable option to conservatively treating finger tip injuries. Patients can be taught to apply this dressing easily and this reduces dressing clinic attendance rates. Overall, the IV3000 dressing provides satisfactory outcomes when used to treat fingertip injuries in our cohort (which included its use for diabetic patients as well as children), and there was a 60% reduction in total costs and an average return to work in 1 week across injuries.

A-1031 Three-dimensional versus two-dimensional preoperative planning of corrective osteotomy for extra-articular distal radius malunion: A multicenter randomized controlled trial

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Objective: Malunion is the most common complication of distal radius fracture. It has previously been demonstrated that there is a correlation between the quality of anatomical correction and overall wrist function. The primary aim of this study was to compare patient-reported outcome measures (PROMs) after corrective osteotomy for malunited distal radius fractures with and without three-dimensional (3D) planning and use of patient-specific surgical guides.
Methods: From September 2010 to May 2015, 40 adult patients with a symptomatic extra-articular malunited distal radius fracture were randomized to 3D computer-assisted planning or conventional two-dimensional (2D) planning for corrective osteotomy. The primary outcome was the Disability of the Arm, Shoulder, and Hand (DASH) score. Secondary outcomes included the Patient-Rated Wrist Evaluation (PRWE) score, pain and satisfaction scores, grip strength and radiographic measurements at 3, 6, and 12 months postoperatively.
Results: From baseline to 12 months follow-up, the reduction in mean DASH score was -30.7 ± 18.7 points for the 3D planning group compared to -20.1 ± 17.8 points for 2D planning ($p = 0.103$). Secondary functional outcome by means of the PRWE resulted in a similar reduction of -34.4 ± 22.9 points for the 3D planning group compared to -26.6 ± 18.3 points for 2D planning ($p = 0.226$). There were no significant differences in

pain, satisfaction, range of motion and grip strength. Radiographic analysis showed significant differences in mean residual volar angulation (3.3, $p = 0.04$) and radial inclination (2.7, $p = 0.028$) compared to the templated side; in favor of 3D planning and guidance. Time of pre-operative planning and surgery as well as complications rates were comparable.

Conclusions: Although there was a trend towards a minimal clinically important difference in PROMs in favor of 3D computer-assisted guidance for corrective osteotomy of extra-articular distal radius malunion, it did not attain statistical significance due to (post hoc) underpower. Despite the challenge of feasibility, a trial of large magnitude is warranted to draw definitive conclusions regarding clinical advantages of this advanced, more expensive technology.

Level of evidence: Level-I.

A-1038 Injuries of the soft tissues in intra-articular distal radius fractures: Arthroscopic assessment and correlation with various fracture classes

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Objective: The aim of this study is to analyse the prevalence of soft tissues injuries associated with intra-articular wrist fractures by arhroscopic assessment and to correlate theses injuries with various fractures classes.

Methods: From January 2013 to April 2017, 57 intra-articular radius fractures, whether or not associated with an ulnar styloid fracture, were operated on with arthroscopy. Each injury was documented by a preoperative radiographic and CT scan. After osteosynthesis of the radius fracture, a soft tissue arthroscopic testing was performed: radiocarpal and mid-carpal testing (TFCC, scapholunate (SL), lunotriquetral). The lesions were repaired. There were 23 women and 34 men. The mean age at surgery was 43 years (range 18–64 years). The classification of fractures was based on CT analysis and DOI classification.

Results: Osteosynthesis was performed in 32 cases with a volar plate, 14 cases with plate + pins, 9 cases with pins, one case with screws and one case with external fixator + plate + pins. In 39 cases (68.4%), there was at least one ligament injury. Preoperative radiographs had no predictive value for interosseous ligament injury. Indeed, 25% of SL tears having normal preoperative X-rays, including for severe lesions (EWAS 3).

No significant correlation was found between the various fractures classes and the incidence of soft tissues injuries.

In 72.7% of cases of pure two-part fracture vertical rim, there was an associated SL tear. And in 60% of cases (15/25 cases) of fractures with at least one lateral vertical rim component, there was an associated SL tear. TFCC lesions were associated in 28% of cases (16/57 cases) with an intra-articular radius fracture and in 52% of cases (14/27 cases) with an ulnar styloid fracture.

Ulnar styloid fractures (base or tip) and TFCC lesions were statistically significant relationship ($p < 0.0001$). Palmer 1d TFCC lesions were associated in 100% of cases (6 cases) with both a styloid fracture and a radial avulsion.

Among 42 patients assessed in consultation by an independent examiner: 24 (57%) were free of pain; the others reported episodic pain of a mean 2.27/10 on VAS (range 1–4). The average quick-DASH score was 6.3 (range 0–22.7). Patients were very satisfied with the result in 14 cases (33.5%) and satisfied in 28 (66.5%). In all cases, the SL and TL stress testing was painless. For one patient, the TFCC test was painful, and it was initially a repaired lesion 1b.

Conclusions: The prevalence of soft tissue injuries associated with intra-articular radius fractures is 68.4%. However, there is no statistically significant relationship between various radius fractures classes and ligaments tears. On the other hand, an ulnar styloid fracture is predictive of a TFCC tear.

A-1045 Effect of knot position in Adelaide flexor tendon repair

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Objective: Core suture failure in flexor tendon repair most commonly occurs around the knot, by suture breakage or unravelling of the knot. The purpose of this study was to investigate the effect of suture knot location on Adelaide flexor tendon repair strength and mode of failure.

Methods: Twenty-four FDP tendons (index, middle, ring and little) were harvested from 6 fresh frozen cadavers and randomly assigned to one of two treatment groups. All tendons were sharply transected and repaired with a 4-strand, 1-window Adelaide configuration as the core suture, using a 4-0 Ticron suture. No epitenon suture was used.

In Group 1 ($n=12$), the knot was positioned in the repair site; in Group 2 ($n=12$), the knot was positioned away from the repair site.

The repaired tendons were secured in an Instron pneumatic clamp (80 psi) and were loaded at 40 mm/min (250 N load cell) until pull-out. A camera captured images at a frequency of 1 Hz.

The force (N) at failure was recorded. The mechanism of failure was documented by inspecting the tendons during and after testing and reviewing the captured images.

Results: The mean force at failure of repair in Group 1 (internal knot) was 42.85 N (SD: 5.89). In all 12 tendons, the repair failed due to the suture snapping at the knot site.

The mean force at failure of repair in Group 2 (external knot) was 65.68 N (SD: 7.23), statistically significantly higher than that of Group 1 ($p<0.05$). Two repairs failed at the knot, 7 failed elsewhere within the suture construct, and 3 sutures pulled out.

Conclusions: This study demonstrates that placing the knot away from the repair zone generates a stronger construct. The knots placed externally had a lower incidence of failing at the site of the knot, suggesting that the placement protects this weakest component of the repair.

With the Adelaide repair configuration gaining popularity, this knowledge could influence clinical practice when treating flexor tendon injuries.

A-1050 Perioperative risk factors for complications of free flaps in traumatic wounds

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Purpose: Despite the good results of microsurgical free flaps, a higher incidence of complications is expected when treating traumatic wounds. Few articles have examined the perioperative risk factors of the complications of free flaps for these wounds, prompting us to describe and find possible risk factors.

Methods: From July 2014 to January 2017, patients who received microsurgical free flaps at a single hospital were consecutively included in this study. Data on personal medical history, intraoperative microsurgical procedure, and laboratory tests were collected. Patients were followed until the final result.

Results: A total of 62 free flaps for the treatment of traumatic lesions in 60 patients were studied. We observed a higher rate of complications in patients who underwent surgery 7 or more days after the trauma ($p=0.017$), patients with obesity ($p=0.038$), when used recipient veins from the superficial system for drainage of the flap ($p=0.035$) and in those in whom the ischemia time of the free flap was higher ($p=0.011$). The presence of thrombocytosis was associated with partial flap loss ($p=0.037$).

Conclusions: We identified the use of veins from the superficial system for drainage, obesity, ischemia time of the flap greater than 2 h, and a delay in definitive microsurgical treatment after 7 days as perioperative risk factors for complications of free flaps for traumatic wounds. The time between the traumatic lesion and microsurgical flap should be as short as possible to minimize complications.

A-1051 Results of anatomic ligamentous reconstruction of post-traumatic subluxated ulnar head using half strip flexor carpi ulnaris tendon

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Objective: Instability of ulnar head usually results from traumatic rupture of ligamentous stabilizers of the joint especially and ulnocarpal (ulno-lunate and ulno-triquetral) ligaments and triangular fibro-cartilage (TFC). Patients usually present with dorsally prominent ulnar head, little if any pain, limited prono-supination especially the latter and marked weakness of hand grip strength. This study aims at surgical reconstruction to rebuild both components of TFC and Ulnocarpal (specifically ulno-triquetral) ligaments using half strip of flexor carpi ulnaris (FCU) tendon distally attached to the pisiform as the latter is closely related to the triquetrum to easily mimic the ulno-triquetral ligament.

Methods: Sixteen patients with post-traumatic dorsally subluxated ulnar head were treated through ligamentous reconstruction using FCU tendon. They had an average age of 23 years. Average total wrist dorsi-palmar flexion was 70°. Average prono-supinaton range was 50°. In all patients, ulnar head was dorsally prominent and grip strength had an average of 30% of normal side. Through a dorsal approach, the capsule was opened and the fibrous remnant of TFC was excised. With a very small drill bit, a drill hole was made in the triquetrum from dorsal to volar exiting through the pisiform. Other two drill holes were made through the distal ulna with a common opening distally at the fovea and two separate openings proximally at the ulnar neck. Through another

volar skin incision along FCU tendon and after isolation and protection of ulnar nerve and vessels, the radial half of the tendon was stripped and left attached distally to the pisiform. This FCU half tendon was passed with a twisted stainless steel wire through the piso-triquetral tunnel and was retrieved in the dorsal wound. The FCU tendon was passed through common opening of the two tunnels in the distal ulna, coming out proximally at the ulnar neck to be passed through the other tunnel from proximal to distal to be retrieved at the fovea thus reconstructing the Ulno-triquetral ligament. The ulnar head was reduced manually to the radial sigmoid notch with the hand almost fully supinated and pinned to the radius with two K-wires. The FCU half tendon was split into two equal halves; one half was passed through a drill hole made through the dorsal ridge of the radial sigmoid notch and the other half was retrieved into the volar wound and passed through a drill hole made through the volar ridge of the same notch. The arm was splinted in a long arm slab for 6 weeks followed by K-wire removal and gradual mobilization.

Results: Patients were followed up for an average of 34 months. Average post-operative total wrist movement was 90°. Average prono-supinaton range was 85°. Grip strength had an average of 70% of other side. Mayo modified wrist score improved from an average of 45 points preoperatively to 80 postoperatively ($p = 0.05$).

Conclusions: Anatomic reconstruction of post-traumatic ligamentous disruption of DRUJ using FCU tendon half strip results in a stable reduced ulnar head with reasonable prono-supinaton and improved hand grip strength.

A-1052 Distal scaphoidectomy and radio-scapho-lunate arthrodesis using multiple Herbert screws as a motion preserving procedure in radiocarpal arthritis

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Objective: Arthrosis limited to the radio-carpal joint is uncommon and is amenable to radio-scapho-lunate arthrodesis rather than total wrist fusion. Use of Herbert screws rather than Kirschner wires was suggested to increase compression forces at the fusion site. This also enhanced fusion mass healing rate and allowed early wrist movements to avoid stiffness. Resection of distal scaphoid was suggested to improve motion at the midcarpal joint as the joint was converted into a simple C shaped articulation rather than an S shaped complex one.

Methods: Seventeen patients (seventeen wrists) with an average age of 28 years and radio-carpal arthritis were treated surgically. Nine wrists were rheumatoid, two were villonodular synovitis and six wrists were post distal radial fracture. Average dorsiflexion was 16° and average palmar flexion was 24°. Grip strength had an average of 35% of contralateral side. Through a dorsal approach, distal half of scaphoid was resected followed by cartilage debridement of distal radius, proximal surfaces of lunate and remaining scaphoid. Two Herbert screws were inserted across radio-lunate and radioscaphoid joints in a retrograde fashion. Raw surfaces were packed with cancellous bone graft from iliac crest. Splinting was done for 3 weeks postoperatively, followed by gradual active wrist movements.

Results: Average follow-up period was 29 months. Average dorsi-flexion was 27° and 30° for average palmar-flexion. Grip strength had an average of 58% of contralateral side. Joint fusion was confirmed radiologically within 8.6 weeks. Modified May wrist score improved from an average of 48 points preoperatively to 72 points post-operatively.

Conclusions: Radio-scaphoid-lunate fusion using Herbert screws with distal scaphoidectomy yielded mobile strong painless wrist.

A-1053 Extensor aponeurosis – bone–tendon connection. New insights into the extensor digitorum communis insertion: A cadaveric study

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Introduction: The mid-line position of the extensor digitorum communis tendon on the four ulnar digits is stabilized by the bony insertion to the base of the first and second phalanx, by the sagittal bands (SB) over the MCP joint and by the conjoined aponeurosis of the intrinsic lumbrical and dorsal interosseous muscles.

The aim of this study was to clarify whether there is any additional bone-to-tendon connection from the proximal phalanx to the central slip of the extensor tendon; and if so, what its function may be.

Methods: Forty fingers from 10 fresh-frozen upper limbs were dissected. The central slip was divided just distal to the MCP joint and just proximal to the PIP joint and were cut free along their lateral margins from the SB and from the conjoined aponeurosis, thus isolating the 2–3 cm of the central tendon, spanning the dorsal side of the shaft of the proximal phalanges. In one of the specimens, the radial and ulnar artery was cannulated and injected with blue dyed VasQtec Pu4ii diluted with 1.5 volumes of methyl-ethyl-ketone to lower the viscosity. Ten milliliter was injected simultaneously in each artery under high manual pressure applied to the 10 ml syringes. Fingertips turned blue and filling was observed in dorsal veins of the palm. The specimen was dissected after 4 h curing of the injectate.
Results: A bone-to-tendon connection was consistently found in all 40 fingers. The connections had the shape of a vinculum attached to the full length of the shaft of the proximal phalanges and to the midline of the tendons. The isolated slips were free to slide 4–6 mm in distal direction, but only about half as much in proximal direction with a distinct stop in both directions indicating the oblique orientation of the collagen fibers in the mesotendinum. The vascular injection showed small vessels passing from the periost to the tendon, but no vessels were found on the dorsal (cutaneous) side of the tendons.
Conclusion: We consistently found a vinculum connecting the central slip of the extensor digitorum tendon to the shaft of the proximal phalanx of the four ulnar digits. The vinculum adds to stabilization of the tendon and provides vascular supply to the tendon and its insertion.

A-1054 DIP joint arthrodesis with headless cannulated screw: A review of 24 cases

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Objective: End-stage distal interphalangeal joint (DIPJ) arthritis, instability, and/or deformity are commonly treated with arthrodesis. DIPJ arthrodesis requires stabilization of the middle and distal phalanges until fusion occurs, usually within 6 to 10 weeks after surgery. Current techniques include Kirschner wire (K-wire) fixation, headless compression screws, mini-plates, and tension-band wiring.

We report our experience of 24 cases with a follow-up from 6 to 48 months treated with cannulated headless screws.

Materials and Methods: From January 2013 up to July 2017, we treated 18 patients for an account of 24 fingers with arthrodesis with cannulated screw.

In four patients, fingers were multiple even no more than two in a single operation. The indications were primary and secondary osteoarthritis, rheumatoid arthritis, defect lesions, septic joint destruction, post-traumatic joint deviation, fatal joint instability, fatal tendon lesions after failed treatment for mallet finger.

All cases were performed with a dorsal little incision on the DIP joint and a minimal bone resection of both articular faces, and then fixated with a cannulated K wire-guided screw under fluoroscopy, in local anesthesia.

Finger splint in a Stacks fashion is taken for 4–5 weeks after arthrodesis.

Patients were referred for clinical evaluation, for preoperative and postoperative pain evaluation by VAS scale, and clinical outcome was assessed by DASH score; X-rays were performed routinely after 6 weeks and after 3 months.
Results: We had one infection; two mild and transient infections, one delayed healing of the arthrodesis, obtained after 6 months; one radiologically non-union, without any clinical findings as well as pain or instability. In only two cases, we noted a mild rotation of the nail.

During the first 3 weeks, commonly mild swelling of the DIPJ was reported, healing spontaneously within few further weeks. The outcome parameter DASH (disabilities of arm, shoulder and hand) score was on average 26 (range 1–60). VAS scale showed a significant decrease of the pain from 8 up to 0-1 in mostly cases.

The patients answered to a simple question: would you do it again? 17 answered yes.

The majority showed relief from symptoms within 2–3 months.
Conclusion: Among several techniques, the arthrodesis proved to be reliable and safe with a low complication rate and a good functional outcome: The use of the K-wire cannulated screw requires a more demanding technique and intraoperative care but reveals to be safer and faster in recovery.

A-1065 Joint survival analysis and clinical outcome of total joint arthroplasties with the ISIS implant in the treatment of trapeziometacarpal osteoarthritis: Multicenter prospective continue case series

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Purpose: The new generation of ISIS TMC total joint arthroplasty is a modular, semi retentive, uncemented ball-and-socket hydroxyapatite-coated implant. It was introduced in 2007 for the treatment of symptomatic trapeziometacarpal (TMC) osteoarthritis. The primary outcome of this retrospective study is to report the medium- to long-term joint survival of this prosthesis. Our secondary outcomes are the clinical and functional results.
Methods: This multicenter retrospective study involved 89 patients who underwent 107 ISIS TMC prosthesis implantations from November 2006 to September 2009 and who had a minimum of 1-year follow-up. Indications for the procedure were painful TMC joint osteoarthritis affecting activities of daily living and a failure of at least 6 months of nonsurgical treatment. Clinical and radiological assessment was recorded prospectively: before surgery and in the first year by the surgeon, and at 5 years or more after surgery by an independent operator. We compared the means of the Kapandji index (assessing the thumb range of motion and opposition), the grip strength, the pinch strength, ADL, q-DASH, before surgery and at the latest follow-up. Clinical and radiological complications were registered. The Kaplan–Meier method was used to estimate implant survival over time.
Results: We included 107 prostheses in the survival analysis with a mean follow-up of 45.6 months (range 12–120 months). No prostheses required revision surgery and no implant failed. No dislocation was pointed. For the survival analysis, we made two survival curves; in the first curve, survival means that the prosthesis has not been removed; the survival after a mean of 45.6 years was 100% (95% confidence interval 90-97). In the second curve, indication for revision was the marker of failure; the survival after a mean of 45.6 years was 86.9%. A total of 107 arthroplasties from 89 patients were included in the clinical analysis. The mean age at surgery was 63.1 years (range 42–84 years) and the median follow-up was 76 months (range 60–102 months). At 5-year follow-up, the mean quick disabilities of the arm, shoulder, and hand score improved from 61.3 ± 17.1 to 17.5 ± 16. The mobility of the thumb was restored to a range of motion comparable with that of the contralateral thumb. Opposition, defined by the Kapandji score, was almost normal (9.2 of 10; range 6–10), as was the final mean key pinch and grip strength, which improved by 26% and 43%, respectively.

Among the 26 preoperative reducible Z-deformities, only 5 (19.2%) were not totally corrected after surgery.
Conclusions: In our series, the ISIS prosthesis of the thumb TMC joint has proven to be a reliable and effective implant. Mean motion and strength increased, whereas pain decreased after surgery and these results remained constant within the follow-up period.

A-1067 Intraneural electrodes in bionic hand reconstruction and their effects on nerve and muscle architecture

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Objective: The interface between man and machine is an essential part of current research. Intraneural electrodes could thereby help to improve prostheses control and provide sensory feedback for patients. The aim of this study was to evaluate longitudinal intraneural thin film electrodes and their effects on nerve and muscle architecture.
Methods: In 20 Sprague-Dawley rats, longitudinal thin film electrodes were implanted into the sciatic nerve and compared to standard cuff electrodes. Various groups were assessed over a time period from 4-12 weeks for impedance, muscle force and histological analyses of nerve and corresponding muscles.
Results: Histological assessments show significant changes in muscle and nerve architecture. Muscle weight and maximum force is decreased compared to healthy controls, due to histological verified muscle atrophy. Analyses of the nerve show fibrosis at the insertion point and over the whole length of the electrode within the nerve. Assessed biocompatibility showed no immunological problems.
Conclusion: Intraneural electrodes are a sophisticated possibility to interface with the peripheral nervous system of a patient. However, shown histological and functional effects after insertion and chronic stimulation should be considered for possible clinical implementations and in combination with emerging high-density EMG control.

A-1068 Scapholunate ligament reconstruction: One-year follow-up using the SLAM procedure in 22 patients

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Objective: To evaluate scapholunate ligament reconstruction using the ScaphoLunate Axis Method (SLAM) in patients with a dynamic or reducible static scapholunate ligament tear.
Methods: Between June 2014 and March 2017, 22 consecutive patients have been operated using the ScaphoLunate Axis Method (Arthrex) for reconstruction of a scapholunate (SL) ligament tear. Average time from the initial injury to the reconstruction procedure was 11 months (range 0.5–36 months). All the patients had undergone X-ray investigations of the injured and contralateral wrist. The SL lesion was identified by wrist arthroscopy, as the scaphoid reducibility was identified prior to final open ligament reconstruction in a single session. Twenty men and two women underwent surgery, mean age 27 years (range 16–40). Seventeen patients underwent surgery of their dominant hand and five of the non-dominant. All patients were immobilized post-operatively for 6 weeks in a dorsal splint, whereupon they were referred to hand therapy with lightweight-bearing exercises started. Full weight-bearing activity was allowed at 6-month follow-up. Follow-up was 12 months. Evaluation preoperatively and at 3, 6 and 12 month after surgery included assessment of range of motion (ROM), grip strength and Disabilities of the Arm, Shoulder and Hand (quick-DASH) Score.
Results: There were three complications during surgery, the operative procedures or the recovery/hand therapy. All patients improved in the patient-reported outcome measure at 12 month as quick-DASH values improved significantly ($p < 0.05$). Mean quick-DASH value pre-operatively was 38 (range 12–78), and 21 (range 0–34) post-operatively. ROM and grip strength were unchanged at 12 months compared to preoperative measures. Mean grip strength was 42 kilogram-forces (kgF) preoperatively, and 43 kgF postoperatively (80% strength of the contralateral side).
Conclusions: Short-term results of the SLAM procedure for patients with a dynamic or reducible static scapholunate ligament tear provided satisfactory results with a few observed complications. The presented technique using a tendon autograft (PL or part of the FCR) placed along the axis of rotation of the SL joint, fixated in both the scaphoid and the lunate, minimize loss of the obtained SL reduction and reconstruct the critical dorsal SL ligament.

A-1070 Total wrist fusion and total wrist arthroplasty in patients with end-stage osteoarthritis: A qualitative analysis of expectations, involvement and appraisal of results

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Objective: For patients with painful and advanced wrist osteoarthritis (OA), total wrist fusion (TWF) is the standard surgical treatment, although total wrist arthroplasty (TWA) has become a plausible alternative. The aim of the present study was to explore patients' own experiences of living with a painful wrist, expectations, involvement in surgical decision, appraisal of results and adeptness to a TWF or TWA.
Methods: Thirteen surgically treated patients (between 2009 and 2014) with end-stage wrist OA (seven TWF and six TWA) were selected using purposive sampling with a variation in gender (eight men and five women) and age (range 38–75 years). Semi-structured interviews were conducted and the transcripts were analysed using content analysis.
Results: Unbearable, constant pain forced the participants to a breakpoint where surgery was their only option and to become pain free was the primary expectation. To be involved in the discussion regarding different surgical options was highly desired. Most participants who received a TWF expressed that becoming pain free was worth more than trying to preserve some of the motion. Participants who still had a significant range of wrist motion before the TWF surgery and participants who were never offered TWA as an option were more concerned by the loss of motion. Heavy activities caused pain in a majority of participants who received a TWA, but was expressed as something they could control. Having a TWF was seen as an end station and all participants with a TWA appreciated the motion they still had left, although not at any cost. If the pain would increase, a TWF was seen as the better alternative. The participants developed a variety of different problem-and emotion-based coping strategies to manage their every-day life, including compensatory movement patterns, switch of handiness, asking for help but also avoidance and protective behaviour. A positive

and open mind-set, stubbornness and to be able to accept the situation were pointed out as important abilities.

Conclusion: To patients with painful and advanced wrist OA who were susceptible for surgery, the main expectation was to get rid of the pain, which made anticipations on range of motion secondary although preserved motion was seen as being closer to a normal life. Having reasonable expectations and involvement in the discussion regarding surgical options affected the patients' expectations and appraisal of the results.

A-1071 Evaluation of finger proximal inter-phalangeal joint fusion using mini Herbert screws

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Objective: Proximal inter-phalangeal (PIP) joint of the most pivotal joint in a finger as it is the central joint with the greatest movement range compared with the other finger two joints. Painful stiff PIP joint especially in a dominant hand can be a serious handicap. PIP joint arthrodesis is an appealing option for those patients as it eliminates pain and corrects any finger deformity due to PIP joint pathology with more efficient work of other finger joints and improvement of hand function as a whole. Ideal method of joint stabilization till fusion should allow maximal compression so there is no need for bone graft and the patient can move other finger joints as soon as possible. The use of two mini Herbert screws seem to fulfill these requirements.

Methods: Twenty-three fingers in 19 patients with post-traumatic painful stiff PIP joints were operated upon in the form of arthrodesis using mini Herbert screws. Average age of patients was 27 years old and the dominant hand was involved in 16 patients. Of the fingers involved, 10 fingers were the middle ones, 9 fingers were ring and 4 indices. Average hand power grip was 70% of the other hand. All patients were neurologically intact. Through dorsal approach, the joint was opened and the cartilage covering both sides of the joint was removed. The joint was immobilized in a partially flexed posture (40°–80° flexion) comparable to that of the finger in the same position in the other hand. Two almost parallel mini Herbert screws were inserted across the joint in an antegrade fashion. No bone graft was needed. Active movement of the fingers was permitted as soon as pain was tolerable typically within few days.

Results: Average follow-up of the patients was 40 months. All patients were pain free and 90% of them returned to their previous jobs. Average hand power grip improved to 92% of the other side. All the patients were happy about the cosmetic appearance of their operated upon fingers. PIP joint fusion was confirmed radiologically in all patients within an average of eleven weeks.

Conclusions: PIP joint fusion using mini Herbert screws is an easy technique that allows efficient compression at the fusion site to obviate the need for bone grafting and to allow early finger mobilization.

A-1075 Extensor tendons adhesions: The role of different anti-adherent agents. Preliminary evidences from an Italian multicentric study

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Tendon gliding after injury and surgical repair is essential to produce the best functional recovery. Adhesions are one of the major postoperative complications in extensor tendon repair and may be produced by suture techniques, contact with mortified tissues, infections, loss of substance, bone fractures and loss, use of plates and screws. The aim of this study is to point out the importance of the use of anti-adhesion materials in complex injuries involving the extensor apparatus together with skin and soft tissues and/or the underlying bone. We reviewed the literature and did not find any paper about this subject; indeed, several papers had been published showing promising results about the use of anti-adhesion materials in both flexor tendon and peripheral nerve repair.

In the period 2013–2017, we treated 22 (3 Insubria, 4 Messina, 10 Turin, 5 Padua) complex lesions of extensor apparatus complicated by bone fracture and/or soft tissue mortification/infection. The injuries

occurred in zone 2 (1 case), in zone 3 (1 case), in zone 4 (15 cases), in zone 5 (4 cases), and in zone 7t (1 case). Repair was performed in finger and dorsum of the hand with horizontal mattress together with epitendinous continuous sutures; in the first extensor compartment of the wrist, a modified Kessler suture was performed.

We used different anti-adhesion materials: carboxymethylcellulose film (CMC) (10 cases, zone 4), cross-linked hyaluronate (2 cases one zone 2, one zone 7t), collagen–glucosaminoglycans (GAG) template (5 cases, one zone 3, four zone 5), CMC and polyethylenoxide (PEO) (5 cases, zone 4).

After surgery, all patients were treated with a static immobilization regime for 3 weeks.

All patients were examined blindly by another senior surgeon and administered a quick DASH questionnaire in each center at 15, 30, 60, 90 days and after 4 years. In a long-term follow–up, our results were satisfying in most cases, even if not statistically relevant. Gel-treated tendons showed a better functional recovery than those treated with collagen; in one case, in an anti-platelet administered patient treated with collagen wrap, important adhesions occurred due to post-operative bleeding, producing a significant extensor lag ($>25^{\circ}$). This adverse event was treated removing the tendon segment and placing a tendon graft, while wrapping avoided bleeding producing a better scar and less adhesions in 10 cases.

Some anti-adhesion materials seem to contrast extensor tendons adhesions, especially when tendon repair is associated with a trauma involving bones. The role of collagen (whether added or induced by other materials such as CMC or hyaluronate) looks to be important in producing a soft and gliding peritendinous tissue after repair and avoiding scars. Further researches will focus, starting from the experimental field, on early and late collagen deposition and on the type of collagen involved. CMC and PEO gel looks perhaps among the most handling materials in topical application and remains in situ 4 weeks before degradation, protecting tendon repair in the critical third week of strongest collagen deposition.

A-1076 The scapholunate gap increases with forearm supination: A laboratory study

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Objective: Under axial load of the carpus in scapholunate ligament deficient wrists, the scaphoid bone rotates into pronation and flexion while the tandem lunate-triquetrum moves into supination and extension; this scapholunate misalignment provokes the scapholunate gap seen on PA radiographs view. Forearm rotation may modify the carpal bones alignment and distance between bones through forearm muscles and ligaments action.

Is there any forearm rotation able to accentuate the degrees of scaphoid and lunate misalignments in scapholunate ligament incompetence?

The purpose of this cadaveric biomechanical study is to analyse scaphoid and luno-triquetral behaviour during forearm rotations to find out a simple radiological stress scapholunate joint view, with maximal scapholunate gap, to improve the radiological diagnosis in dynamic scapholunate dissociation.

Methods: The kinetic effect of forearm rotation on carpal bones was analysed on eight fresh normal cadaver arms, before and after sectioning the scapholunate ligament, in two forearm rotations: 45° of supination and 45° of pronation. A custom-designed testing apparatus was used to hold the wrist in neutral position. A 6 degree-of-freedom electromagnetic motion tracking device with sensors attached to the scaphoid, triquetrum and capitate monitored spatial changes in bone alignment. The rotation and elevation sustained by the scaphoid and the triquetrum were measured in each condition.

Kolmogorov–Smirnov and Shapiro–Wilk tests were applied to check the probability of normal distribution of the measured data.

Analysis of variance and Wilcoxon signed-rank tests were used to compare the average rotation and elevation sustained by scaphoid and the triquetrum in different forearm rotations. Statistical significance was set at $p < 0.05$.

Statistically significant results: In forearm pronation, all proximal carpal row bones rotate into

supination and flexion, whether the scapholunate ligament is sectioned or not:

- Intact scapholunate ligament: scaphoid supination $\overline{x}$: 2.28 SD: 4.16; scaphoid flexion $\overline{x}$: 2.96 SD 2.55; triquetrum supination $\overline{x}$: 1.43 SD: 2.48.
- Sectioned scapholunate ligament: scaphoid supination $\overline{x}$: 3.44 SD: 4.12; triquetrum supination $\overline{x}$: 2.50 SD: 2.67; triquetrum flexion $\overline{x}$: 3.35 SD: 2.2.

In forearm supination, scaphoid rotates always into pronation whether the scapholunate ligament is sectioned or not, while the tandem triquetrum-lunate moves into supination and extension when the scapholunate ligament is sectioned:

- Intact scapholunate ligament: scaphoid pronation $\overline{x}$: 1.18 SD: 2.75
- Sectioned scapholunate ligament: scaphoid pronation $\overline{x}$: 2.36 SD: 3.48; triquetrum supination $\overline{x}$: 1 SD: 2.84; triquetrum extension $\overline{x}$: 0.33 SD: 1.1.

Conclusions: Forearm pronation reduces the scapholunate misalignment secondary to a scapholunate ligament incompetence; so, an unloaded PA wrist radiograph probably will not put on evidence a dynamic scapholunate dissociation although the ligament is completely torn.

Conversely, active forearm supination generates distraction forces to the scapholunate joint, accentuates the degree of scaphoid pronation and lunate supination/extension malposition and, consequently, widens the scapholunate gap; so, a simple active AP wrist radiograph may put on evidence a dynamic scapholunate dissociation.

Based on these data, an AP view of the wrist taken while the patient is actively supinating the forearm is another form of scapholunate joint stress.

A-1077 Global brachial plexopathy: High-level upper limb amputation and prosthetic rehabilitation after surgical improvement of the biotechnological interface

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Objective: Primary and secondary reconstructions may restore sufficient shoulder and arm function in the majority of patients with global brachial plexopathies including nerve root avulsions. In a few patients, however, function is not improved. The concept of bionic reconstruction, which includes the elective amputation and prosthetic replacement of the functionless limb, has already been described for the transradial level. Here we present for the first time functional outcome data after elective transhumeral amputation and prosthetic arm reconstruction in patients, in whom residual myoactivity had not been found in the forearm but instead more proximally in the upper arm and shoulder girdle, which could be used to control a prosthetic arm.

Methods: Since nerval supply and functional muscle tissue are sparse in patients with multiple nerve root avulsions, the identification of myosignals needed for prosthetic control may be complicated. To improve prosthetic usage selective nerve and, in some cases, muscle transfers were performed. Objective outcome data included global upper extremity function, which was assessed using the Southampton Hand Assessment Procedure (SHAP) and the Action Research Arm Test (ARAT). Subjective disability was assessed with the DASH questionnaire. Deafferentation pain was evaluated with the visual analogue scale (VAS). Baseline measurements were performed with the impaired plexus arm before amputation. Follow-up measurements were performed after final prosthetic fitting.

Results: Preliminary data in five patients treated with bionic reconstruction at transhumeral level will be presented at this year's FESSH congress.

Conclusions: The more distal the amputation, the more limited the prosthetic control. The reconstruction, however, of simple prosthetic functions such as elbow flexion and hand closing represent major improvements for patients who have lived without any arm function for years or even decades.

A-1078 Predicting complete finger extension after surgery for patients with Dupuytren's disease

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Objective: In an era where shared decision-making and personalized medicine are becoming the hallmark of the patient-centered care, reliable and accurate information about treatment options and their outcome are of great importance. For patients with

Dupuytren's disease, complete extension of the finger after surgery is one of the most important treatment outcomes. Knowing which patients will achieve complete extension of a finger after surgery is likely determined by pre-operative characteristics, such as extension deficit and number of affected fingers, which vary widely among patients. Insight in these processes is important in shared-decision-making and will be helpful in managing expectations. Therefore, the aim of this study is to explore to which extent patient characteristics prior to surgery can reliable predict the change of postoperative straightness of a finger in Dupuytren's disease.

Methods: Patients undergoing limited fasciectomy or percutaneous needle fasciotomy for Dupuytren's contractures between 2011 and 2016 were selected from a prospectively collected database. Patients were included if they had pre-operative goniometry and post-operative goniometry 3months after surgery. Patients who were treated because of recurrent disease were excluded. If multiple fingers were treated, the most affected finger was selected. The number of affected fingers and the most affected joint were determined in each patient. Furthermore, patient characteristics, such as age and medical history, and pre-operative MHQ scores were retrieved from the database.

Based on the bivariate logistic regression analysis, significant determinants ($p \leq 0.10$) were selected for the subsequent development of a multivariate logistic model predicting complete active extension of a finger postoperatively, which was defined as less than 5° of extension deficit at 3 months post-surgery. The final model was evaluated for goodness-of-fit with the Hosmer and Lemeshow goodness-of-fit test and for discrimination with the area under the ROC-curve (AUC).

Results: A total of 1150 patients were included in the study of which 253 achieved complete active extension of their finger after surgery. The predictors at baseline in the final model were the extension deficit of the most affected finger, the most affected finger, the most affected joint and the age of the patient. Addition of any more predictors, such as MHQ scores or type of surgery, did not significantly improve the model. As an example of the model, an 60-year old patient with a 20° contracture in the MCP-joint of the ring finger has a 65% chance of achieving complete active extension of a finger after surgery, compared to a 23% chance for a similar patient but with a 70° contracture. The Hosmer and Lemeshow goodness-of-fit test had a p-value of 0.57, indicating a good goodness-of-fit and AUC of 0.81.

Conclusions: This study demonstrates that with a limited set of readily available baseline characteristics, a reliable prediction can be made whether complete active extension of a finger can be achieved post-operatively. Most notably, type of surgery and baseline MHQ scores had no significant influence on this prediction. The results of this study can be used in shared decision-making when informing patients about their treatment options and post-operative outcome in Dupuytren's disease.

A-1079 Interactive mobile training app after nerve transfer or amputation of the upper extremity

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Objective: Conventional rehabilitation methods after nerve transfer or amputation of the upper extremity are based on performing repetitive exercises during which the patient's long-term motivation and effort are difficult to sustain. To keep patients engaged and even increase their performance during training, they can receive EMG biofeedback enveloped in a game-based smartphone app. This kind of engaging rehabilitation intuitively trains those muscles needed for proper motor control.

Methods: A clinically oriented, mobile virtual environment has been developed that trains and evaluates the patient's neuromuscular capacity pre- and post-interventionally for (1) maximum voluntary contraction, (2) proportional fine muscle control, and (3) isolated activation of different muscle groups. Data were analyzed using a Bonferroni corrected paired samples t-test for multiple comparisons on the same data. Contrary to previous studies, participants not only conducted repetitive flexor and extensor motions but also trained continuing muscle contraction over varying periods of time, perform precisely timed contractions and execute simultaneous contractions of both muscle groups. Because of the mobile aspect of the intervention, so far two patients and two able-bodied participants could train at home for a period of 4 weeks, training 5 days a week. The app's modularity serves patients with upper and lower arm deficits alike as it operates not only the patient's own prosthesis but also commercially available electrode arrays. In addition, motivation, effort, and patient performance were collected during the study and compared to a standard myoelectric rehabilitation training device, the MyoBoy.

Results: All participants achieved a significant improvement in all motor control evaluation criteria: maximum voluntary contraction ($p < 0.01$), proportional control ($p < 0.01$) and muscle separation

($p = 0.02$) over 40 measurement instances. Motivation, effort and performance were higher during the mobile training compared to the MyoBoy.
Conclusions: This study represents the first long-term intervention in rehabilitation of nerve transfers or after amputation of the upper extremity using a mobile game-based app. The integration of virtual elements into the rehabilitation process has a positive effect on the motivation of the patients as well as their motor performance during and after the intervention. Since the mobile game-based app is more engaging than using a standard tool for training myosignals and patients invest more effort while doing so, this study shows the potential for mobile apps to establish a new standard in motor rehabilitation.

A-1080 Long-term implant of intramuscular sensors and targeted muscle reinnervation for natural wireless control of prosthetic arms in above elbow amputees: A prospective case series

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Background: Prosthetic fitting in transhumeral amputees is challenging. The conventional 2-signal control limits speed and natural fluency of movements. Additionally, myoelectric signals picked up from the skin surface are susceptible to noise introduced by the environment, movement between the electrode and the skin as well as cross talk between different muscles as well as changes in the skin impedance due to perspiration. Therefore, the Alfred Mann Foundation has designed a fully implanted myoelectric sensor system (IMES) for wireless control of the prosthetic device.
Methods: Three transhumeral amputees were implanted with IMES sensors while undergoing routine TMR surgery to demonstrate functional benefits of intramuscular recorded EMG used as signals in prosthetic control. Global upper extremity function was evaluated using the Southampton Hand Assessment Procedure (SHAP), the Clothespin-Relocation Test (CPRT) and the Box and Blocks Test (BBT), which monitor hand and extremity function closely related to activities of daily living.
Results: Successful implantation of the myoelectric sensors combined with targeted muscle reinnervation was performed in the three participants. Full use of the implanted system with 5–6 myosignals was achieved already at 4 months postoperatively. The clinical evaluations were done over a period of 2.75 ± 0.25 years, during which the participants showed a mean improvement in Southampton Hand Assessment Procedure from 33 ± 7.94 to 47.00 ± 4.36, in clothespin relocation test from 84.45 ± 33.88 to 27.58 ± 13.76 s, and in Box and Block Test from 7.67 ± 5.13 to 12.33 ± 2.52. Additionally, outcome scores using the implanted system were superior to those obtained with surface electrodes.
Conclusion: This is the first report of a longitudinal analysis of implanted myoelectric sensors together with targeted muscle reinnervation to reach natural control of multiple degrees of freedom in above elbow amputees. The implanted system does not have a percutaneous interface, thus eliminating the constant risk of infection and was tested over a 2.5-year period. The outcome measures demonstrated the superiority of implantable intramuscular sensors compared to standard surface pickup.

A-1081 Arthroscopic classification of scapho-lunate and luno-triquetral tear

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Objective: The development of wrist arthroscopy has lead to the early identification of intracarpal ligament injuries that are underdiagnosed by standard X-rays and MRI.

While diagnostic imaging can be mute, the patient is frequently symptomatic with pain, reduction of grip strength and inability to do manual work or sports activities.

Partial and complete ligament lesions have been treated in different ways as shrinkage, capsulodesis

(open or arthroscopic), reconstruction techniques with pinning or screw fixation. Anatomical studies have identified different parts of SL and LT interosseous ligaments (anterior, proximal and posterior parts) that have different resistances to strength.

It is well known that lack of early diagnosis of these injuries can develop a chronic instability leading to degenerative arthritis of the wrist.

Arthroscopic examination allows early identification of acute and chronic injuries that can be severe and more challenging for the surgeon to treat. The aim of this study is to obtain a thorough definition acute and chronic injuries, identifying different kinds of partial and complete tears of scapholunate and luno-triquetral tears using the European Wrist Arthroscopy Society Classification (EWAS) developed since 2009.

Materials and Methods: Ninety eight symptomatic patients underwent arthroscopy of the wrist. Scapholunate injuries were present in 80 patients and lunotriquetral injuries were present in 18 patients. The mean age of patients was 44 years (range 16–72 years old). There were 67 males and 31 females.

There were 36 sports injuries, 4 road traffic injuries, 30 accidental injuries, 23 working injury, and 5 unknown. The lesions have been identified and classified according to EWAS classification: Stage I attenuation, stage II, partial injury to membranous portion, stage IIIA partial tear of anterior part of interosseous ligament, IIIB partial tear of dorsal portion of interosseous ligament, IIIC complete tear, Stage IV passage of arthroscope between the bones; stage V interosseous gap visible on X-rays. The dominant hand was involved in 66 cases.

Results: The acute lesions were 13, while the chronic were 85.

The arthroscopic findings showed a scapho-lunate injury as follows: 1 stage I, 10 stage II, 13 stage IIIA, 16 lesions stage IIIB, 27 lesions were stage IIIC, 7 lesions stage IV and 6 stage 5. Statistical analysis revealed significant differences ($p < 0.001$) between stages II and IIIA-B between stages IIIA-B and IIIC, between stages III and IV.

The lunotriquetral injuries were identified as follows: no stage I-II, 1 stage IIA, 10 stage IIB, 2 stage IIIC, 5 stage IV, 2 stage V.

No lesions lacked classification nor hesitation in classifying were reported by the authors.

The authors propose treatment option in each stage.

Conclusions: The EWAS classification can be used to classify a variety of acute and chronic scapho-lunate and luno-triquetral tears, improving definition of partial and complete injuries. This allows a better understanding of the complexity of traumatic and post-traumatic injuries and possibly treats them early addressing a proper treatment in each stage.

A-1083 Management of distal radius and ulnar fractures: ORIF versus external fixation of distal ulna

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Objective: Fracture of the ulnar head and neck can be rarely associated with distal radius fractures in severe trauma of the wrist. This is an additional instability factor to the distal radius fracture. Different surgical options exist for stabilization of distal ulna as internal fixation with plate and screws or external fixation. The aim of this retrospective study is to evaluate the clinical results of the patients operated between 2006 and 2016 in our department with this fracture association with different techniques and if possible describe advantages and disadvantages of internal fixation versus external fixation of the distal ulna in addition to distal radius fixation.

Methods: Of the 1298 patients affected by distal radius fracture (DRF), we studied our cohort of 45 patients affected by distal radius and ulnar fracture retrospectively by means of Mayo wrist score, DASH score and PRWE. Mean age was 65 years (range 26–89), 39 were females and 6 males. Fracture pattern is stated by means of Biyani classification. Internal fixation with plate and screws of distal radius and ulna was performed in 29 patients (group I) (Synthes, Mikai, Acumed, Martin). In 11 cases, internal fixation of distal radius was performed with K-wires stabilized with external fixation of distal ulna (Joshi fixator) (group II). We recorded the operating time of all procedures and immobilization period after surgery. All patients were followed at 30, 60, 90 days postoperatively and then at a mean follow-up of 21 months (range 1–6 years).

Results: All patients of the first group (internal fixation of distal radius and ulna) obtained excellent results at the Mayo score, with quick recovery of full ROM and absence of pain. In two patients, a slight reduction of grip was recorded (of 15%), mean DASH was 5.3 (0–10.8), and mean PRWE was 10 (0-38). Mean operating time was 95 min (90–115). In group II, excellent results were obtained in 10 cases at and good in 1 case according to the Mayo score. Mean DASH was 9 (5–18). Mean PRWE was

13.5 (2–19). Rehabilitation was delayed until 50–60 days postoperatively. Mean operating time was 70 min (65–80). Immobilization was removed at 30 days in the first group, at 50–60 days in the second group. One non-union occurred in group II that was treated with a distal ulnar hemiarthroplasty and in one case mobilization of pins was observed and pins removed.

Conclusions: Modern treatment options allow stabilization of the fractures of distal radius and ulna. Early mobilization is possible with double plating, while the use of pinning or external fixation delays the rehabilitation up to 50–60 days but have a shorter operating time. The indications of the two techniques are not always the same and we developed some suggestions on this topic. If the head is multifragmented, it is not always easy to fix and in those cases plating is not stable and external fixation is advised, while if ulnar diaphysis is involved or multifragmented plating is preferred.

A-1084 The myth of the 'uninjured' side after hand injury

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Objective: The change of the peripheral organs may cause changes in the cortical map as well. The somatosensorial cortex and motor cortical map are reorganized on the affected (hand) side due to conditions such as long-term immobilizations or motor or sensory loss. The changes in the cortical map are not limited with the affected hemisphere. The changes of cortical map in one hemisphere are reflected in the contralateral hemisphere. On the basis of this theory, especially in stroke patients, it is shown that not only the lesioned side is affected but also the non-lesioned side. However, there is no study about the functional status of the unlesioned side in the orthopedic hand conditions. The purpose of this study is to assess the hand function of unlesioned side in patient with hand injury.

Methods: There were 85 patients (42% female and 58% male) with hand injury and 162 healthy (60% female and 40% male) subjects. Subjects' hand function were assessed by using Purdue Pegboard Test (PPT). PPT unilateral subset scores were compared with PPT unilateral subset scores of healthy subjects using independent t-test.

Results: Mean age was 37 years (range 18–64; standard deviation, 13.4) in subjects with hand injury; 47 patients had dominant hand injury and 38 patients had non-dominant hand injury. Mean age of healthy subjects was 38 years (range 20–65; standard deviation, 10). A statistically significant difference was found between the uninjured (dominant) hand's PPT score of nondominant hand injured subjects (mean of peg, 14; standard deviation, 2) and the PPT dominant hand scores (mean of peg, 15; standard deviation,2) of the healthy subjects ($p < 0.001$). A statistically significant difference was also found between the uninjured (non-dominant) hand PPT score of dominant hand injured subjects (mean of peg, 11; standard deviation, 3) and the PPT scores of non-dominant hand of the healthy subjects (mean of peg, 15; standard deviation,1) ($p < 0.001$).

Conclusions: Our data demonstrate changes in the function of the unaffected side after hand injuries. This change may be interpreted either as a modulatory influence of the affected hemisphere on efferences of the unaffected side or as a modulation of the unaffected hemisphere itself. For this reason, it should be kept in mind that the therapist should not only focus on the injured hand. They should have some intervention strategies for the uninjured hand in rehabilitation sessions as well.

A-1087 Scapholunate realignment using local tendon grafts: Qualitative vector analysis of the two potential donors (FCR and ECRL)

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Objective: Reducible scaphoid subluxations are often treated by threading a distally based strip of Flexor Carpi Radialis (FCR) tendon through an anteroposterior tunnel across the distal scaphoid. The goal is to create a volar-distal tether that constrains the scaphoid tendency to rotate into flexion.

Another alternative consists of using a strip of extensor carpi radialis longus (ECRL) passed across an oblique tunnel from the anterolateral corner of the scaphoid tuberosity to the posteromedial edge of the scaphoid. In this case, the tenodesis aims at preventing both flexion and pronation of the subluxing scaphoid.

We have performed a three-dimensional qualitative vector analysis of the two options (FCR or

ECRL) to ascertain which of the two is more likely to prevent scaphoid flexion and pronation.

Methods: Sixteen X-rays (eight posteroanterior and eight lateral) and eight axial tomograms were randomly selected from the files of our institutions.

We measured the angle of attack of the two tendon strips in the three orthogonal planes, assuming the tunnel for FCR option to be parallel to the sagittal plane and perpendicular to the frontal plane. The tunnel for the ECRL tendon was set to connect the radial most point of the scaphoid tuberosity and the ulnar most point of the dorsal rim of the scaphoid.

We statistically compared the average angle determinations in the three orthogonal planes using analysis of variance, followed by a Tukey HSD test of the values obtained for each plane. Statistical significance was set at $p < 0.05$.

Results: ECRL is better set to resist flexion (sagittal plane), radial inclination (frontal plane) and pronation (transverse plane) than the FCR tendon.

The average $\pm$ standard deviation (SD) angular measurements for the two surgical alternatives were as follows:

Frontal plane: FCR: $168.7 \pm 8.7^\circ$, ECRL: $104.8 \pm 6.5^\circ$

Sagittal plane: FCR: $61.8 \pm 7.0^\circ$, ECRL: $59.0 \pm 8.1^\circ$

Transverse plane: FCR: $34.6 \pm 2.4^\circ$, ECRL: $13.6 \pm 3.4^\circ$

An one-way analysis of variance compared the attack-angle of two potential donors (FCR and ECRL) ranked by three orthogonal planes (frontal, sagittal and axial). This analysis was found to be statistically significant, $p < .0001$.

Post hoc comparisons using the Tukey HSD test indicated that the mean angle of attack of the FCR was significantly wider than that of the ECRL in all three planes.

Conclusions: Assuming that the lesser the ''angle of attack'' of a tendon into a bone tunnel, the greater is its mechanical advantage, we conclude that a strip from the ECRL is likely to be more efficient in preventing flexion and pronation of an unstable scaphoid than the FCR.

In short, when it comes to decide what tendon is best to stabilize scaphoid instability, a distally based ECRL over the FCR is recommended.

A-1088 Arthroscopic CM arthroplasty with suture-button suspensionplasty short-term follow-up

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Objective: Surgical techniques for CM arthroplasty have developed such as arthroscopic hemitrapziectomy with mini Tight Rope (TR) suspension method recently. The aim of current study is to evaluate the results for more than 1-year follow-up.

Methods: Our technique is shaving only subchondral trapezium and beak osteophyte completely in order to medialization for first metacarpus. TR is inserted from first metacarpal base just volar APL attachment to second metacarpus. Nineteen cases followed over 1 year included 2 male and 15 female were operated arthroscopic hemitrapeziectomy with TR suspension method. Averaged age was 60.8 years and mean follow-up period was 18.8 months. Palmar abduction angle and radial abduction were analyzed compared to contralateral side before operation and final follow-up, respectively. Visual analogue score (VAS), Pulp pinch power, and DASH score were evaluated 3 months after operation and 6 months after operation, respectively, regarding clinical evaluation. Trajectory (distance between proximal joint space to TR insertion point divides length of second metacarpus) was analyzed regarding XP evaluation.

Results: Postoperative palmar abduction and radial abduction were 91.5% and 93.5%, respectively. Preoperative and final follow-up of VAS were 74.5 and 16.0 ($p < 0.001$), respectively. Preoperative and final follow-up of Pulp Pinch (kg) were 3.1 and 4.2 ($p = 0.001$), respectively. Preoperative and final follow-up of DASH score were 41.8 and 21.5 ($p < 0.001$), respectively. Trajectory was averaged 0.35 ± 0.08. Although there was no correlation between trajectory and postoperative ROM ($r = 0.28$), there were weak negative correlation between trajectory and VAS ($r = 0.39$).

Conclusion: This method may change the axis of thumb rotation and make suspension effect and hematoplasty effect for CM joint. There was no correlation between trajectory and postoperative ROM under 1/2 of metacarpus. There was a weak negative correlation between trajectory and VAS in midterm follow-up.

A-1089 Extensor tendon repair and prophylactic extensor retinaculum release for extensor tendon ruptures in rheumatoid wrists

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Background: Extensor tendon rupture is common in advanced rheumatoid arthritis patients. Currently, tendon transfer is the most common procedure for rheumatoid extensor tendon rupture, because of late detection and poor tendon quality. However, we repaired ruptured tendons to their original stumps, even in cases with a long history of extension loss.
Materials and Methods: A total of 12 rheumatoid arthritis patients who were treated surgically for extensor tendon rupture were reviewed. The patients had a history of finger extension loss for up to 1 year. Ruptured tendons were extensor digiti minimi (EDM) in 12, extensor digitorum communis (EDC) (little finger) in 12, EDC (ring finger) in 8, EDC (middle finger) in 5, and EDC (index finger) in 1. All tendons were repaired to their original stumps, while distal stumps of EDM and EDC (little finger) were repaired together to proximal stump of EDM muscle. Palmaris longus tendon interposition graft was used in eight patients. Direct repair was performed for 5 out of 12 EDM-EDC (little finger) repair. In all patients, extensor retinaculum was released and repaired under extensor tendons to prevent further extensor tendon rupture.
Results: All patients recovered active finger extension, including independent extension of the little finger. No further extensor tendon rupture was occurred after the surgery. Although repaired tendons were prominent under the skin due to bowstring phenomenon, no patient reported pain in the prominent tendon and substantial functional impairment was minimal.
Conclusion: Extensor tendon repair and prophylactic extensor retinaculum release is a good option for extensor tendon ruptures in rheumatoid wrists. A muscle with a tendon rupture may work again even after 1-year history of extension loss in rheumatoid arthritis patients.

A-1093 Shoulder partial denervation: Anatomical study of the feasibility and surgical perspectives

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Introduction: Articular denervation of the shoulder has been proposed by few authors in case of shoulder recalcitrant pain. The source of shoulder pain has never been defined but has been assumed to be related to musculoskeletal injuries or arthritis. Twenty percent of shoulder pains have been reported after common surgery. We present an anatomical study to evaluate shoulder denervation and the surgical perspectives.
Materials and Methods: Thirty specimens (15 fresh/frozen cadavers), all had vascular injections with RTV colored silicone. The study was conducted by two protocols:

(1) Extensive dissections for 10 specimens in order to identify: nerve landmark and all articular branches from the ansa pectoralis, axillary and suprascapular nerves.

(2) For the following 20 specimens, three surgical approaches around the shoulder was performed: (1) anterior subclavicular, (2) axillary fossa, (3) posterior at scapular spine.

Results: The nervous articular branches from the pectoral nerves have been well identified by the anterior approach. Capsular branches from axillary nerve varied in numbers, destinated to glenohumeral inferior recess. Articular branches from suprascapular nerve vary according to their number and pattern destinated to acromioclavicular and posterior glenohumeral joints.
Conclusion: The execution of these three routes, not extensive and simple, is possible to identify the articular nerves of the shoulder to practice a partial denervation in case of recurrent pain of the shoulder. Surgical indications are rare but present. Each case must be discussed to provide a surgical program ''a la carte''!

A-1094 Development of a xenogenic hand flexor tendon graft

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Introduction: Hand tendon rupture is a debilitating condition which mostly affects hand flexor tendons. Usual grafting options for tendon reconstruction are autologous tendon grafts. However, autologous tendon tissue is not entirely satisfactory as it is not always available and sometimes not properly fitted

for reconstruction. Less often used, allogenic and synthetic grafts show low biological integration. Additionally, these tendons graft options show low biomechanical properties leading to recurrent surgeries on the long term. More reliable grafting material would be beneficial. Depending on their source, tissue-engineered tendons from animal sources seem to be able to answer these issues. Their higher biomechanical properties can be of high interest for tendon reconstruction. Combined with appropriate human progenitor tenocytes, we want to develop tissue engineered tendon graft that is able to integrate in the human body and to sustain adequate loading.
Method: Equine superficial digital flexor tendon was decellularized with three different protocols: two common protocols using detergents and the third protocol using sodium chloride solution. Each technique was also combined with freeze/thaw cycles to allow optimal cell removal. The decellularized grafts were then sterilized with 70% ethanol. Tendons treated with each technique were then tested mechanically with a tensile machine to look for elastic modulus and ultimate strength and strain. We then assessed the biocompatibility and the migration potential with human progenitor tenocytes.
Results: Each method was able to lower the DNA content thus enhancing biocompatibility of the graft. The method using sodium chloride showed the best results and was selected as the method of choice. Biomechanical assessment showed the sodium chloride treatment to be superior in preserving biomechanical properties. The biocompatibility results showed that progenitor tenocytes could be integrated in the graft and were able to migrate.
Discussion: Here we present a simple decellularization protocol which will be easily implemented in the production of an off-the-shelve hand flexor tendon graft. The origin of this graft will allow shaping it to the desired shape and length. The method is not only simple but also allows preservation of biomechanical properties. The combination of the graft with human progenitor tenocytes allows their combined use for the optimization of our xenogenic graft for in vivo integration.

A-1098 A comparative study of the clinical and functional outcomes Following open autologous bone grafting versus arthroscopic assisted bone grafting for scaphoid nonunion treatment

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Aim: The aim of the present study was to compare the clinical and functional outcomes of patients

treated with open or arthroscopic bone grafted percutaneous screw fixation for scaphoid nonunion fractures.

Materials and Methods: Twenty-seven wrists of 27 patients who underwent open or arthroscopic bone graft and screw fixation for scaphoid nonunion between 2013 and 2017 were retrospectively evaluated. The open approach group consisted of 13 wrists and the arthroscopically assisted group consisted of 14 wrists. After the splint removal, wrist exercises initiated at 6–8 weeks post operation. Pinch strength, power grip and range of motion were evaluated using the contralateral wrist as a control. Functional evaluation was assessed using the patient-rated wrist evaluation score (PRWE), Quick DASH score, VAS score and Mayo wrist scoring system.

Results: All patients were classified as type C and type D according to Herbert and Fisher criteria. Fracture union was observed in all patients. Less restricted range of movement was observed in the patient group arthroscopic-assisted grafting performed compared to the other group. Additionally, it was found that they could use their wrists more functionally in the post-operational period. Wrist flexion was significantly better in the control wrists in both groups. Moreover, intra-operational arthroscopic examinations of 14 patients who underwent wrist arthroscopy were performed. Intra-articular disseminated synovitis was observed in 14 patients and arthroscopically debrided. In addition, chondropathy was detected in one of the patients and chondral debridement was performed. SL and LT instability were detected in two of the patients; in one of them rupture possibility was considered and repaired with open dorsal capsulodesis, and the other patient was followed conservatively. Two patients had both LT and TFCC ruptures together. In these patients, TFCC was debrided, and the LT ligament was repaired by arthroscopic dorsal capsulodesis. In one patient, isolated LT rupture was observed and repaired with arthroscopic dorsal capsulodesis. In one patient, scaphocapitate ligament rupture was observed.

Conclusions: In the cases of Type C and Type D scaphoid fractures fixed by arthroscopic-assisted grafting, patients were more satisfied with functional and clinical outcomes. Percutaneous fixation is a valuable treatment method for Type C and Type D scaphoid fractures. Thanks to arthroscopy-assisted scaphoid fixation, wrist ligaments, synovial and cartilaginous structures can be evaluated intra-operatively. Thus, diagnosis and treatment of carpal instabilities due to damage of ligaments such as scapholunate and lunotriquetral, TFCC ruptures and synovitis can be performed together with scaphoid fixation. These can be considered as the advantages of the wrist arthroscopy-assisted surgery compared to the open surgery.

A-1103 High volume, low rupture rate and good outcomes: Experiences of flexor tendon repair and appraisal of a trainee-delivered service in a university hospital hand surgery unit

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Objective: In common with other university hospital hand surgery units, our department treats large numbers of hand trauma patients; we aim to ensure good clinical outcomes while providing a good training experience to residents and fellows. The literature suggests targets for acceptable flexor tendon rupture rates of 4–17%, and Strickland ''good'' or ''excellent'' scores in 30–50% of patients at a long-term follow-up.

The objective of this study was to review our rupture rates and active motion outcomes and critically evaluate these in the context of our service which is delivered substantially by trainees under supervision, in order to evaluate whether this model is safe and effective.

Methods: We performed a retrospective notes review using operation notes and therapy records for patients seen over 20 months until July 2017. Demographics, details, and timings of injury and surgical particulars were recorded. We recorded therapists' scores of grip strength, and active motion at 6 and 12 weeks and most recent review.

Results: Of 120 patients identified, 108 notes were available for review. One hundred and thirty-two injured digits with 174 flexor tendon injuries were tabulated (approximately 116 tendons per year). Patients were predominantly males (2.4:1) with a mean age of 33. Mean delay to repair was 2.6 days (range 0–33 days). FDP accounted for 106 repairs, FDS for 52, and FPL 16. Most FDP and FPL repairs were in zones 1 and 2, whereas most FDS repairs were in zones 2 and 3. Two thirds of repairs used a four-strand, 3/0 polypropylene core suture with a 5/0 polypropylene epitendinous suture.

Most operations were performed by senior trainees (48%), followed by junior trainees (33%), consultants (14%) and fellows (7%). The overall rupture rate was 3.8% (five FDP repairs) at an average of 4.9 weeks post-repair. Three ruptures occurred out of the thermoplastic splint, and three while lifting.

Four were re-repaired, and the fifth patient declined further surgery.

Attendance rate was 79% at 6 weeks, 48% at 12 weeks, and beyond 16 weeks was 22%, with an average final review of 21.3 weeks. For zone 2 repairs (excluding thumbs), Strickland ''good'' or ''excellent'' results were achieved at 6 weeks by 12%, at 12 weeks by 39%, and at final review by 56%. At 12 weeks, ''good'' or ''excellent'' Strickland scores were achieved in 50% of consultants', 46% of senior trainees', and 30% of junior trainees' repairs.

Conclusions: In our unit, 86% of flexor tendon repairs are performed by non-consultant grade surgeons. Our setup provides direct consultant supervision to junior trainees, with increasing, graded independence for senior trainees. Hand trauma surgery is performed in a barn theatre with elective hand surgery on an adjacent table; senior supervision is available when required.

Along with a unit preference for strong repair techniques, and close working relationships with our hand therapists, we feel that this graded supervision has contributed to our ability to perform repairs in an acceptable timeframe and achieve both a low rupture rate and acceptable active motion scores, both of which are in line with published studies.

A-1104 A palmar bilobed flap for the correction of radial dysplasia

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Objective: The correction of radial dysplasia can be performed using a palmar bi-lobed flap that leaves less visible scar than a dorsal approach.

Methods: This novel modification of the David Evans dorsal bilobed approach is presented, demonstrating the excellent access, redistribution of the ulnar skin and reduced scar visibility. A review of 20 cases performed through the palmar bilobed approach is presented. The aesthetic visibility of the palmar approach scar was compared to the scar in 20 previous cases performed through the dorsal bilobed or dorsal curved incision by collating inter-observer scores in blinded postoperative photos of the cases.

Results: Successful completion of all radial dysplasia corrections either radialization or centralizations, with successful healing of all bilobed flaps. Two cases of 20 palmar bilobed flaps had tip necrosis of one of the flaps requiring dressings until healed, but no operative intervention was required. All observers noted the lack of visible scarring on dorsal views of the wrist in the palmar bilobed approach compared to the visible scars with the other approaches.

Conclusion: We describe a novel modification of the Evans dorsal bilobed incision for radial dysplasia correction that reduces the visible scarring and improves the palmar access.

A-1106 The free vascularized pedicled nerve functioning muscle transfer: A novel concept for brachial plexus reconstruction

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Objectives: Free functioning muscle transfers are limited by the availability and regeneration of neural donors.

We explore the novel concept of a free vascularized but pedicled nerve muscle transfer (using the rectus abdominus muscle) that overcomes the need for neural regeneration and adds to the reconstructive options in brachial plexus pathology.

Methods: Anatomical dissection of the nerve and blood supply of six rectus abdominus muscles in three cadavers showed that it was possible to elevate the rectus abdominus on its intercostal nerve supply and dissect these to the mid-axillary line allowing the muscle to be pedicled on its nerve supply to the arm. We present five clinical cases of reconstruction of elbow flexion in four cases of complete traumatic brachial plexus avulsion injuries (C5-T1) and one case of poliomyelitis.

Results: The cadaveric study demonstrated that neural dissection of the intercostal nerves supplying rectus abdominus was possible to the axilla, and therefore transferable. Five clinical cases were performed using this technique. There were no perioperative complications. Surgical outcomes demonstrated good elbow flexion with M4 – power and shoulder stability regained in four out of five cases. Two patients developed post-operative abdominal wall hernias secondary to denervation requiring subsequent mesh repair.

Conclusions: We describe a novel reconstructive concept of a free vascularized pedicled nerve reconstruction adding to our armamentarium in the reconstruction of brachial plexus pathology.

A-1107 Differences in illness perception in hand surgery patients

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Objective: The Illness Perception Questionnaire evaluates to what extent patients find their disease threatening or benign. Previous research has shown that patients with a negative illness perception have a worse outcome to treatment and that interventions to improve illness perceptions lead to better outcomes. To our knowledge, illness perception in hand surgery patients has not been systematically investigated. Therefore, the aim of the study is (1) to examine the illness perception of patients with common chronic hand disorders, (2) compare illness perception between four major hand surgery populations (Dupuytren's disease, trigger finger syndrome, carpal tunnel syndrome and thumb base OA).
Methods: Between 1 September 2017 and 10 November 2017, patients from the four surgery populations presenting at one of 16 hand clinics were included in the study. Patients were asked to complete the Brief Illness Perception Questionnaire (Brief-IPQ), which is a validated brief version of the IPQ that measures illness perception on eight subscales: Consequences, timeline, personal control, treatment control, identity, concern, coherence and emotional representation. An analysis of covariance was performed to investigate differences in the illness perception between the four diagnostic groups.
Results: Five hundred and fourteen patients were included in the analyses; 87 with thumb base OA, 129 with carpal tunnel syndrome, 152 with a trigger finger and 146 with Dupuytren's disease. Total illness perception score was 34.9 (SD 12.1) on a scale from zero (not threatening or benign) to 80 (maximum score). Worst scores for the different components, all on a range from 0 to 10, were on the consequences (5.8), personal control (6.0) and identity scale (5.6). The components with the largest differences between the different patient populations were consequences, identity and emotional representation with, in all cases, the thumb base OA patients (7.5, 6.9 and 5.2, respectively) reporting the most negative illness perception and the Dupuytren patients (3.5, 3.7 and 2.1, respectively) the most positive. The mean score of a subdomain within each patient group was 4.4 (SD 2.4).
Conclusions: We found that hand surgery patients have a illness perception, comparable to other chronic diseases, such as we found a large variation in illness perception between the patients with thumb base OA, carpal tunnel syndrome, trigger finger syndrome and Dupuytren's disease. Even within these diagnostic groups, we found a large variation in illness perception. Therefore, illness perception might be an important factor to take into account when predicting patient outcome.

A-1108 A bilateral, transmanubrial surgical approach to the caudal brachial plexus and subclavian vessels: Presentation of 10 cases and discussion of surgical technique and indications

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Objectives: Pathology of the caudal elements of the brachial plexus and subclavian vessels is uncommon, and surgical access can be challenging. Supraclavicular and axillary exposure provide a limited surgical field for tumour resection and for adequate vascular control for vessel reconstruction.

We have found that a transmanubrial, transclavicular approach provides wide exposure of these structures, unilaterally or bilaterally. The objective of this work is to describe the surgical technique and its applications and present data on the patients we have treated so far.
Methods: Patients were selected through a joint clinic between hand and vascular surgeons. Informed consent was taken, and the patients were worked up for theatre including pre-operative assessment. Multimodal imaging appropriate to the indication was used to plan the procedures. MRI was used to define the extent of tumour and involvement of plexus elements, and fluoroscopic and CT venography with 3D reconstructions were used to characterize vascular disease.

Through a neck crease incision, osteotomies of the clavicle and the manubrium, followed by division of the first costal cartilage, allow this segment to be reflected cranially on the sternomastoid and strap muscles. This yields excellent exposure for resection of residual rib elements or tumour, or reconstruction of stenosed or thrombosed segments of the subclavian vein with grafts from either internal jugular or superficial femoral veins. Clavicular osteosynthesis

is performed with locking compression plates, and the manubrium is repaired with sternal wires.

Results: Ten patients (five females) were treated over 6 years. The median age was 29 years (range 8–47 years). Two procedures were bilateral.

Indications were

- Tumour of caudal brachial plexus or subclavian vessels (four)
- Unilateral recurrent SCV thrombosis after first rib excision (four)
- Unilateral recurrent SCV thrombosis with contralateral first rib excision (two)

Median follow-up was 31 months (range 2–55 months), with no deaths and no bony non-union. A sinus over a clavicular plate resolved following surgical debridement. Two patients have mildly restricted shoulder movement; no patients have signs or symptoms of plexopathy. No tumours (two sarcomata, one benign chondroid lesion, one fibromatosis) recurred locally. All six SCV reconstructions remained patent on repeat venography at a minimum of 6 weeks post-op.

Conclusion: As a joint procedure between hand and vascular surgeons, this transmanubrial approach permits safe exposure of the caudal plexus and subclavian vessels in the case of retromanubrial tumours affecting the brachial plexus, and for recalcitrant or recurrent subclavian vein thrombosis that has failed surgical or interventional radiology treatment. This procedure appears to have a high degree of success with a low-risk profile when conducted by an experienced surgical team.

A-1111 Long-term results with partial fasciectomy in Dupuytren's disease

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Objective: Local treatments of the cord of Dupuytren's disease, either by collagenase injection or needle fasciotomy leading to the rupture of the cord, have become increasingly used methods.

The aim of this retrospective study is to review patients with Dupuytren's disease treated by the classic treatment of partial fasciectomy, using Iselin–Dieckman or Skoog incision, at our centre from 2004 to 2015.

Methods: We reviewed 51 patients (42 male and 9 female) with a mean age of 68.4 years (range 49–89 years) affected by Dupuytren's disease, at a mean follow-up of 7.7 years (range 2–13 years).

The distribution of the disease showed 62 hands (34 right and 28 left), 101 rays (34 fifth rays, 41 fourth rays, 16 third rays, 7 second rays, and 3 first rays), 127 joints: 75 metacarpophalangeal joints (MPJ), 52 proximal interphalangeal joints (PIPJ).

As defined in the International Consensus Conference of Rome of 2013, we evaluate results of treatment and recurrence rate with the passive extension deficit (PED) of each treated joint, considering each joint as a separate entity, at time 0 (period between 6 weeks and 3 months after treatment) and at the final follow-up. A PED of more than 20° for at least one of treated joints, in the presence of a palpable cord, compared to the result obtained at time 0 represented a recurrence. We evaluate amount of correction with the correction coefficient of Thomine. Intraoperative and postoperative complications were also evaluated.

Results: Surgical treatment was successful in all cases. At time 0, mean PED was 0° at MPJ with a 100% of correction and 6.6° (0–25°) at PIPJ, with a 87.97% of correction. There was only one intraoperative complication: a nerve lesion, treated during the surgical procedure. A scar contracture in one finger was the only major postoperative complication registered.

At follow-up, mean PED remained 0° at MPJ with a 100% of correction; it was 22.9° (0-95°) at PIPJ, with a 58.28% of correction.

Global recurrence was observed in 15 of 127 joints (11.81%), but it was present only in PIPJ (15 of 52 joints – 28.84%).

With the application of a personal staging system was possible to demonstrate a correlation between residual PED at time 0 and recurrence rate.

Conclusions: Although Dupuytren's disease can now be treated quickly with minimally invasive techniques, we still consider traditional surgical procedures, as partial fasciectomy, extremely effective at medium and long-term follow-up.

Recurrence rate at PIPJ remains present, but with lower percentages than those reported in the short term with minimally invasive treatments

A-1113 CT-scans alter treatment in 33% of scaphoid fractures deemed undisplaced by conventional X-rays

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Objective: Displacement is the single most important variable associated with nonunion of scaphoid fractures (SF). As conventional X-rays have been shown to be unreliable in determining displacement in SF, CT scan has been recommended as the diagnostic tool of choice in determining the best treatment in SF. We investigated how CT scans of initially undisplaced SF diagnosed on X-rays affects the treatment plan.
Methods: Seventy X-ray examinations of acute SF comprising AP and lateral wrist radiographs and three scaphoid views were retrospectively evaluated separately by two senior hand surgeons. In 51 cases, the observers agreed in classifying the SF as undisplaced. CT scans of the same SF with reconstruction in the sagittal and coronal plane were evaluated separately and randomly by the same observers for displacement, stability, localization and treatment.
Results: In 17 of 51 SF (33%), the treatment suggested from the conventional X-rays was altered by either one (15 SF) or both observers (2 SF) after evaluation of CT.
Conclusion: CT scans should be routinely employed in the diagnosis and treatment of SF, as the treatment suggested from conventional X-rays may be altered in 33% based on the evaluation of CT scans.

A-1118 Spinal accessory to suprascapular nerve transfer in late cases of obstetrical brachial plexus palsy

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Shoulder abduction and external rotation deficit is the most common problem of children with sequelae of obstetrical brachial plexus palsy (OBPP). The standard method to improve the shoulder function in late cases of Erb's palsy is a latissimus dorsi muscle (LDM) transfer.

However, the strength of latissimus dorsi, teres major muscles and all shoulder adductors, which are spontaneously recovered after middle (C7) and lower (C8, T1) trunks involvement, can be overestimated. In these cases, isolated LDM or combined with teres major muscle transfer can be not effective for shoulder abduction and external rotation. Some of these patients can lose an active internal rotation of the shoulder.

As a cliché, nerve reconstructions at the age of 24 months and older are considered to be not effective due to muscle fibers degeneration. In spite of the clinical presentation of the late Erb's patients, the supraspinatus and infraspinatus muscles in most cases have fair neurophysiological conditions. The EMG needle shows a reduction of frequency and amplitude increase. On one hand, it indicates a decrease in the number of motor units; on the other hand, it demonstrates the increase in the number of muscle fibers in each motor unit due to terminal sprouting. The muscles constructed of enlarged motor units are less effective than the muscles with bigger number of motor units of smaller size. It led to an idea of redistribution of available muscle fibers into a larger number of motor units by providing them with new nerves with bigger number of axons.

Between 2012 and 2016, 72 patients with OBPP underwent spinal accessory (SA) to suprascapular nerve (SS). Twenty-seven of them were 24 months and older on the day of surgery. All patients had an improvement in shoulder abduction and external rotation in 12 months after the surgery. The mean post-operative shoulder abduction was 116° (range 75–170°). The mean post-operative shoulder external rotation was 75° (range 65–110°). EMG study has shown increase in the number of motor units in both supraspinatus and infraspinatus muscles in all cases.

Spinal accessory to the suprascapular nerve transfer is an effective method to improve shoulder function in late cases of OBPP with involvement of C5–C7 or other cases where adductor muscle is not available for transfer. Needle EMG of supraspinatus and infraspinatus muscles has to be used in all cases to establish correct indication for this method.

A-1122 NT visual: Developing a 3D software for nerve surgeons

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Objective: In the last decades, various novel nerve transfer strategies have been described, giving nerve surgeons more possibilities than ever before. Individualized surgical concepts require detailed knowledge of lesion pattern and suitable approaches. The goal of our project was to develop a 3D software that helps clinicians get an overview of complex nerve lesions in the upper extremity, and thereby guide reconstructive decisions.
Methods: A 3D model of the brachial plexus nerves was created in the graphics software Blender and integrated into Unity3D, in which also the user

interface and the program logic was implemented. One major advantage is the possibility of transferring this desktop program to an Android- or iOS-based app. Literature on upper extremity nerve transfer strategies and nerve morphology was reviewed. Information that was deemed helpful for decision-making, such as axon count, fascicular structure and nerve width, was included into the program.

Results: We established a complete and detailed 3D model of the brachial plexus and all major nerves going into the arm, as well as the underlying bone structures. Our program gives the user the possibility to visualize all possible upper extremity nerve injury patterns. In addition, it incorporates up-to-date information relevant to nerve surgery, such as axon count for motor and sensory fibres, nerve width, fascicular structure and nerve function.

Conclusions: Our program provides hand surgeons with a tool to visualize complex upper extremity nerve lesion patterns, as well as further detailed morphologic and functional information to guide their treatment concepts.