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Telerehabilitation After Zone 1 and 2 Flexor Tendon Repairs: Comparison With In-Person Therapy

Zeynep Emir[1], Sedanur Güngör[1], Kadir Çevik[2], and Egemen Ayhan[2]

Abstract

Background: Telerehabilitation (TR) gained prominence during the COVID-19 pandemic, showing promising outcomes for remote hand therapy tendon repairs. This study compares remote and in-person hand therapy outcomes for flexor tendon repairs. **Methods:** This prospective, nonrandomized comparative clinical study included 23 patients, 25 fingers with flexor tendon repairs in zones 1 and 2. Participants were divided into 2 groups: telerehabilitation (TR) group, 9 patients (10 fingers), and in-person therapy (IP) group, 14 patients (15 fingers). All surgeries were performed under wide-awake anesthesia, followed by early controlled active motion therapy with a dorsal blocking orthosis. Telerehabilitation sessions were conducted via a smartphone video conferencing app. Total active motion (TAM) and disability levels (the Disabilities of the Arm, Shoulder, and Hand Questionnaire [DASH]) were evaluated at 6, 8, and 12 weeks postoperatively. Groups were compared based on TAM scores, DASH scores, and extension deficit degrees. **Results:** The TR group included 3 women (33.3%) and the IP group did 6 women (42.9%) while median age was 27 years in TR and 33 years in IP group. Both groups showed significant improvements in TAM and DASH scores over time ($P < .001$). There were no significant differences between the TR and IP groups at each assessment in DASH scores, TAM scores, and extensor deficit degrees ($P > .05$). **Conclusion:** Clinical outcomes indicate that remote and in-person hand therapy provide similar results for patients with flexor tendon repairs in zones 1 and 2. Telerehabilitation is a viable alternative to traditional hand therapy and can be integrated into clinical practice due to its comparable results.

Keywords: telerehabilitation, flexor tendon, hand therapy, WALANT, controlled early active motion

Background

Telerehabilitation (TR) has become popular in parallel to the stunning innovations in technology. Furthermore, due to the physical restrictions during the COVID-19 pandemic, the health care systems converted to alternative remote ways to ensure the safety of health care workers and patients and the reduction of face-to-face health care.[1] Restricted access to health care has significantly impacted treatment and rehabilitation services, particularly hand therapy.[2] Since then, remote hand therapy has been one of the most accelerated professional areas because of the high risk of infection as hand therapy requires very close physical contact between the patient and the therapist.[3] Telerehabilitation methods in hand therapy have markedly improved as alternatives to in-person therapy were sought.[4] Like most of the world, our hand therapy center was closed down during the pandemic months to decrease the risk of infection due to the very close physical contact between the therapists and the patients. Accordingly, we had to deliver postoperative therapy to patients through telecommunication methods, which also constituted the basis of this study afterward.

Clinical observations indicated that patients treated remotely achieved satisfactory outcomes comparable to those of patients who had received in-clinic treatment before the pandemic.[5] However, as the physical distance was obligatory during the process, physical evaluations like the range of motion measurements were not possible. Besides, a comparative in-person therapy group (IP) was not available as face-to-face therapy in the clinic was not allowed due to the

[1]Gazi University, Ankara, Turkey
[2]Başakşehir Çam and Sakura City Hospital, İstanbul, Turkey

Corresponding Author:
Sedanur Güngör, Department of Physiotherapy and Rehabilitation, Faculty of Health Sciences, Gazi University, Ankara 06560, Turkey.
Email: sedanurgungor@gazi.edu.tr

physical distance restrictions and risk of infection. As the pandemic restrictions were finalized, performing such comparative study became possible as in-person therapy served as the control group, and in-person assessments became available. Besides, the results of TR in patients with zone 1 and 2 flexor tendon repairs have not been analyzed so far. Therefore, the aim of this study was to compare the results of patients who received TR to those who were treated face-to-face in the clinic after zone 1 and 2 flexor tendon repairs.

Materials and Methods

This study was conducted in collaboration with a hand therapy and a hand surgery outpatient clinic. The study design has a prospective, nonrandomized clinical study design, and was approved by the university ethics committee (No: 2022-335). All patients were informed about the study and gave their written consent before enrollment in the study. The study considered the ethical standards stated in the Declaration of Helsinki. This study complies with ethical standards regarding human rights. All human participants provided informed consent, and no animal subjects were used in this study.

Patients

Adult patients with flexor tendon repairs in zone 1 and 2 between May 2022 and July 2023 were included in the study. The patients are consulted for hand therapy within the first postoperative week in our clinical routine. Patients with thumb and wrist injuries were excluded from the study. Patients with concomitant peripheral nerve injuries, fractures of the phalanges or metacarpals, amputations or subamputations, and patients with arthritis involving the hand, like rheumatoid arthritis and osteoarthritis, were also excluded from the study. Patients with concomitant digital nerve and artery injuries were not excluded, as it was assumed that these injuries would not result in major motor deficits. Patients whose native language was not Turkish were excluded from the study. Patients who did not comply with the postoperative hand therapy program or who did not complete the assessments were also excluded from the analysis. All the patients were operated on under Wide-Awake Local Anesthesia No Tourniquet (WALANT) and followed by controlled early active motion protocol in the postoperative period. Details of both methods are given below.

Details of Surgical Repair

All the patients were operated on by 2 surgeons with over 5 years of experience in hand surgery. Wide-Awake Local Anesthesia No Tourniquet is the routine method of anesthesia in primary flexor tendon repair in our hand surgery clinic. However, pre-operative preparation for both the general anesthesia and the secondary tendon reconstruction was also completed in all patients considering any case of necessity during the operation.

The typical surgical repair method employed in the clinic to promote early active rehabilitation involves a robust 4- to 6-strand core suture repair, which results in slight bulkiness at the repair site.[6,7] In addition, running and locking peripheral sutures are incorporated to reinforce and smooth the repair. For core suturing, 3:0 or 4:0 nonabsorbable Prolene or absorbable polydioxanone (PDS) is utilized, while 5:0 or 6:0 Prolene or PDS is employed for peripheral suturing. Following the repair, patients are instructed to actively flex and extend their fingers to assess free tendon gliding and any potential gapping at the repair site.[8,9] If any gapping is observed, the repair is reinforced with additional core sutures, and any constricting pulley hindering smooth tendon gliding is carefully vented up to 1.5 to 2 cm. For zone 1 flexor tendon repairs, pull-out repair techniques utilizing a button on the nail are employed when the distal tendon stump is insufficient for a robust repair.

Postoperative Therapy

In their first postoperative visit to the hand surgery clinic, patients were informed about the study and the TR option for their treatment. The therapists who performed the evaluation and treatment had 12 and 5 years of experience in treating patients with hand injuries. Demographic information (age and gender) and information about the injury (injured finger and tendon(s), dominant and injured side, injury site) were recorded at the first visit. At the end of the interview, patients were asked to choose the group for their follow-up: IP or TR. After the decision, the surgeon recorded each patient's group according to the patient's preference and reported it to the hand therapist who would treat the patients.

All patients were called by telephone before their first hand therapy. In the IP group, the first therapy session was scheduled on the phone, and hand therapy started face-to-face in the clinic at this scheduled time. The differences in treatment delivery may have influenced patient preferences, as in-person therapy could have been perceived as more effective or reassuring due to the immediate physical feedback and therapist intervention. This factor should be considered when interpreting the patient distribution between the 2 groups.

In the TR group, patients were questioned about their internet connection and smartphone/tablet/computer use. Patients were informed about the available remote hand therapy applications and asked to choose one. Also, the patients in this group were informed about the environmental preparation before each remote therapy session. Patients were instructed to position themselves on a chair in a quiet environment, facing a table. Patients were advised to have a holder for their device or provide a heavy object that could support the back of their device during the session. This could provide the patient's both hands to be free and it was important as patients would need the uninjured hand during the session for orthosis removal and performing exercises.



Figure 1. Anterior and posterolateral view of dorsal blocking static orthosis.

Patients were also instructed to complete the microphone and camera controls before the first session. Patients were informed that their privacy would be protected as no videos would be recorded during the treatment process, and their consent would be obtained if any video recording were done at any time.

Both groups were followed by a controlled early active motion regimen described by Tang[10] in the postoperative period. Patients were followed up in a dorsal blocking orthosis. The wrist was in neutral position, metacarpophalangeal joints were in 40° to 50° flexion, and interphalangeal joints were in full extension (Figure 1).[11] The exercises initiated on the postoperative 3 to 5 days to minimize the work of flexion due to the excessive edema in the first days.[9,10] Exercise therapy always started with a warm-up period consisting of at least 30 to 40 repetitions of passive composite flexion. Active exercises started with distal interphalangeal (DIP) flexion only in the first therapy session and progressed to combined DIP and proximal interphalangeal (PIP) flexion in the second week. Half-fist was targeted in the third week and the unloaded full fist was targeted at the fourth postoperative week. The exercise therapy steps were scheduled according to "the safe area for active motion" described by Tang.[10] After 4 weeks, the orthosis

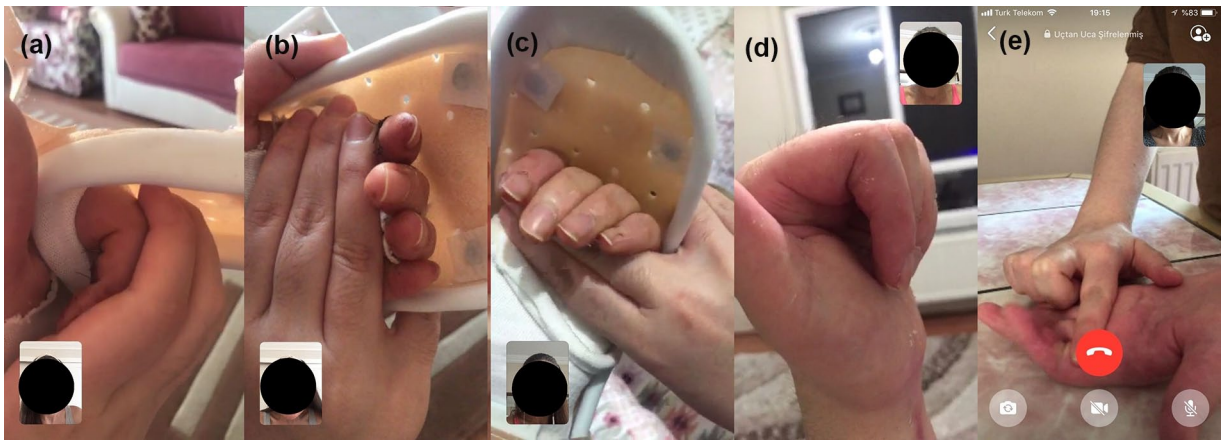


Figure 2. Exercise program of a patient in the telerehabilitation group who underwent left index finger zone 2 flexor digitorum profundus repair. (a) Warm-up period consisting of at least 30 to 40 repetitions of passive composite flexion before starting active movement within the orthosis. (b) Active flexion of only the DIP within the orthosis during the first week after surgery. (by 3 finger-blocking). (c) DIP and proximal interphalangeal active flexion within the orthosis in the second postoperative week. (by 2 finger-blocking). (d) Active full fist in the third week within the orthosis, in the fourth week outside the orthosis. (e) Active blocking exercises outside the orthosis at sixth weeks postoperatively.
Note. DIP = distal interphalangeal.

was removed during the day but continued during the night until the sixth week while flexor tendon gliding exercises were instructed too. After the sixth week, the orthosis was totally removed, and active tendon-blocking exercises were started. Patients were also allowed to use their hands in daily life activities after sixth week; however, they were instructed to avoid resistive and heavy activities for up to 3 months.

In routine clinical practice, patients were discharged after 8 weeks and instructed to perform resistive exercises using rubber bands and exercise putty. At discharge, the visit for the final assessment on the 12th week was scheduled. In this final visit, heating (eg, hot packs) and slight stretching exercises were instructed for the home program if needed (eg, in case of any extension deficit).

Figure 2 shows the exercises given during the treatment process for a patient in the TR group who underwent left index finger zone 2 flexor digitorum profundus (FDP) repair.

Clinical Assessments

Patients were assessed at sixth, eighth, and 12th weeks postoperatively. Patients in both groups were invited to the clinic for all assessments. Total active motion (TAM) of the injured fingers was measured, and disability was assessed using the Disabilities of the Arm, Shoulder, and Hand (DASH) questionnaire. Total active motion scores were recorded for each injured finger. Also, the injured fingers were classified according to the Modified Strickland classification based on the 12th-week assessment and an extension deficit was also noted in this final assessment.

Total active motion. A metal finger goniometer was used to measure the range of motion of the metacarpophalangeal (MCP), PIP, and DIP joints. During measurements, the forearm and wrist are in a neutral position.[12] In the Modified Strickland classification, the total extension deficit was subtracted from the active flexion sum of the PIP and DIP joints, divided by 175, and then the result was multiplied by 100 to calculate the percentage value. The resulting score was classified as excellent (75%-100%), good (50%-74%), fair (25%-49%), and poor (0%-24%).[13]

Disability level. Disabilities of the Arm, Shoulder, and Hand Questionnaire (DASH) is used to evaluate the disability levels of patients. The DASH is a valid and reliable questionnaire developed by the American Academy of Orthopedic Surgeons based on the World Health Organization model and used to evaluate the level of disability in the upper extremities. The DASH questionnaire consists of 30 items. These items include statements about pain, stiffness, weakness, occupational functions, daily activities (dressing, eating, sleeping, etc.), family, and self-care. For all statements, the patient was asked to mark the appropriate answer on a 5-point Likert system (1 = *no difficulty*, 2 = *mild difficulty*, 3 = *moderate difficulty*, 4 = *extreme difficulty*, 5 =

not able to do it at all). According to the results of the DASH questionnaire, a result between 0 and 100 was obtained from each section. A low score indicates good functional status, while a high score indicates poor functional status.[14] The Turkish adaptation of the DASH questionnaire, which has demonstrated validity and reliability, was used in the evaluation of disability level.[15]

Statistical Analysis

The researchers recorded the research data in the SPSS 26.0 program and analyzed using appropriate methods. In small samples, it may be difficult to verify the assumption of normal distribution, in which case the results of parametric tests may not be reliable. Based on this information, the data were analyzed, assuming that they did not conform to a normal distribution due to the small number of patients included in the study. Quantitative variables were given as median and interquartile range (IQR). Qualitative variables were given as percentages and numbers. The evaluation results of the patients were compared at 3 different times (sixth, eighth, and 12th). While extensor deficit, injury information (such as injured tendon(s) and zone of injury), and TAM scores analysis were analyzed based on the number of fingers, the DASH score and demographic features were analyzed based on the number of patients. The measurement results made at 3 different times (sixth, eighth, 12th weeks) within the group were compared with *the Friedman test.* After a significant difference emerged between the 3 times, pairwise comparisons were made with the Wilcoxon test (sixth-eighth, eighth-12th, sixth-12th). The *Mann-Whitney U test* was used to compare the groups. $P < .05$ was accepted for statistical significance.

Post hoc power analysis. The sample size in this study was relatively small, so post hoc power analysis was performed using the TAM scores data in the 12th week. The analysis showed that the power of this study was 85%, with a margin of error of 0.05 and an effect size of 0.44. G*Power 3.1 was used to calculate the power analysis.

Results

A total of 38 patients were examined for the study. Seven patients were excluded because they did not meet the inclusion criteria. The remaining 31 patients were followed-up in the TR (14 patients, 15 fingers) and IP groups (17 patients, 18 fingers). During the follow-up period, 5 patients from the TR group and 3 patients from the IP group were excluded from the data analysis because they did not comply with the treatment process.

A total of 23 patients (TR n = 9, IP n = 14) and a total of 25 fingers (TR group n = 10; IP group n = 15) were analyzed (Figure 3). Three patients (33.3%) were female in the TR group and 6 (42.9%) patients in the IP group. The median age (IQR) was 27 (25-31) years in the TR group and 33 (31-40) years in the IP group.

In the TR group, 7 patients were dominant on their right side. The injured side of 5 patients was on the right side. The dominant side was injured in 3 patients. Of the 10 injured fingers, 7 had only FDP injuries, while 3 had flexor digitorum superficialis (FDS) and FDP injuries (FDS + FDP). This group had injuries to 4 index, 3 rings, and 3 little fingers. The injury was on zone 1 in 2 fingers and on zone 2 in 8 fingers (Table 1).

In the IP group, 13 patients were dominant on the right side. Seven patients were injured on their right side. Eight patients were injured on their dominant side. Of the 15 injured fingers, 12 had only FDP injuries, while 3 had FDS + FDP injuries. This group had injuries to 4 index, 1 middle, 5 ring, and 5 little fingers. The injury was on zone 1 in 4 fingers and on zone 2 in 11 fingers (Table 1).

The groups were similar in terms of all demographic and clinical characteristics ($P > .05$) reported above (Table 1).

Outcomes, Deficits, and Complications

In the TR group, median (IQR) TAM scores at the sixth, eighth, and 12th weeks were 207.5° (195°-220°), 230° (220°-240°), and 255° (250°-260°), respectively (Table 2). Median (IQR) DASH scores at the sixth, eighth, and 12th weeks were 15.83 (14.20-23.33), 8.75 (5.49-14.45), 4.20 (0.86-8.33), respectively (Table 2). Significant differences were observed in TAM and DASH scores between 3 different time points ($P < .001$). Pairwise comparisons also showed significant differences between the sixth-eighth, sixth-12th, and eighth-12th weeks ($P < .05$) (Table 3). At the end of the 12th week, according to the Modified Strickland classification, excellent results were obtained in all fingers in this group (Table 2). At the end of the 12-week treatment period, 10° of extension loss was observed in 2 fingers and 20° in 1 finger.

In the IP group, median (IQR) TAM scores at the sixth, eighth, and 12th weeks were 200° (190°-230°), 215° (200°-260°), and 250° (220°-270°), respectively. Median (IQR) DASH scores at the sixth, eighth, and 12th weeks were 28.35 (12.9-42.7), 15.81 (7.95-22.94), and 7.5 (1.65-13.33), respectively (Table 2). Significant differences were observed in TAM and DASH scores between 3 different time points ($P < .001$). Pairwise comparisons also showed significant differences between the sixth-eighth, sixth-12th, and eighth-12th weeks ($P < .05$) (Table 3). At the end of the 12th week, according to the Modified Strickland classification, excellent results were obtained in 12 fingers (85.7%) and good results in 2 fingers (14.3%); the TAM score of 1 finger was not available (Table 2). At the end of the 12-week

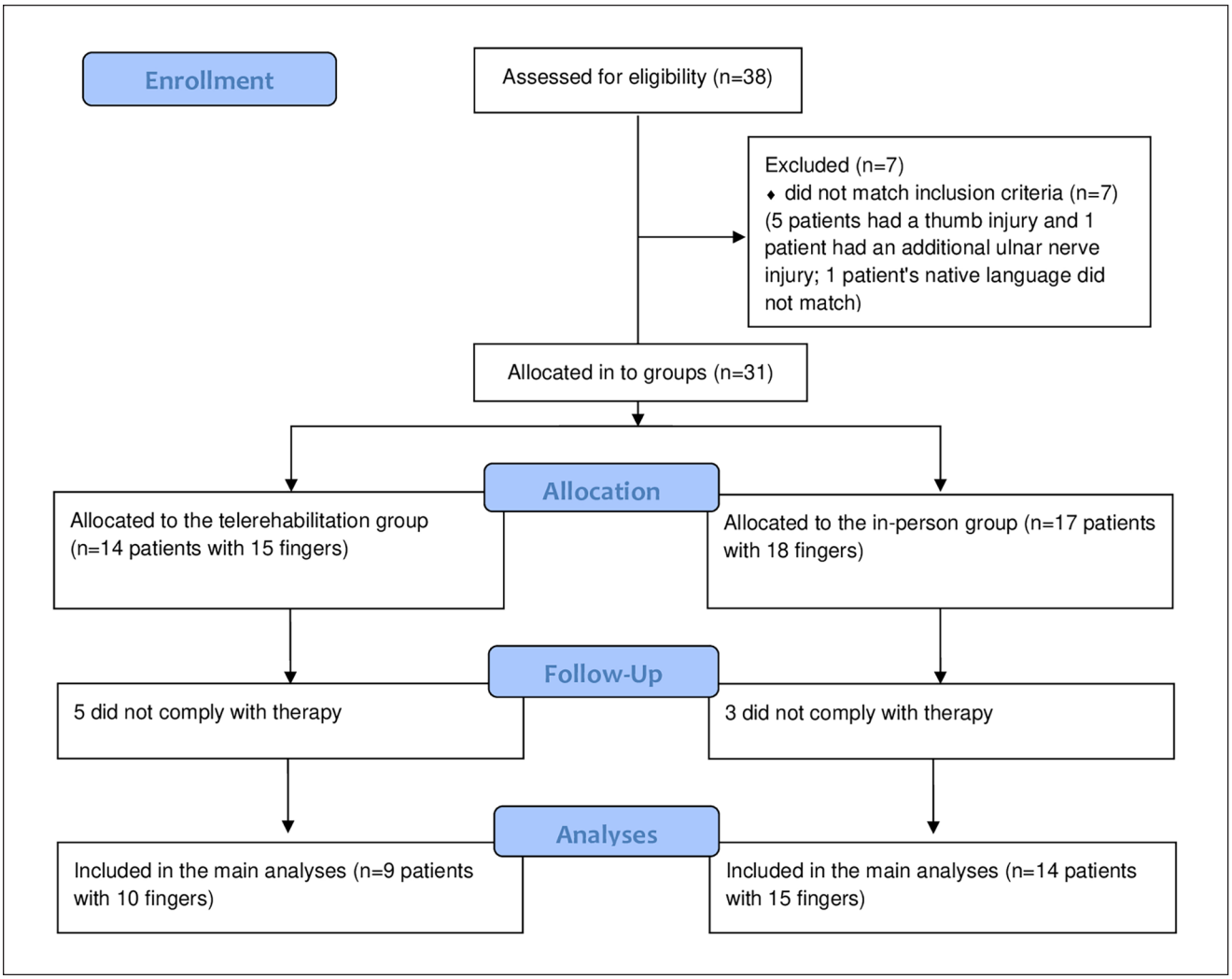


Figure 3. Consort flow diagram.

treatment period, 10° of extension loss was observed in 2 fingers and 20° in 1 finger.

Both groups demonstrated comparable improvement in TAM and DASH scores over time ($P < .05$). Likewise, the number of patients who had extension deficits and the range of the extensor deficit in those patients were also similar between groups at the final assessment ($P > .05$) (Table 2).

No ruptures were seen in the groups during the study.

Discussion

The results of this study reporting the outcomes of TR after flexor tendon repairs showed that those patients benefited from TR as well as in-person hand therapy. While patients in both groups demonstrated comparable total active motion degrees in the injured fingers and similar disability levels at the end of the postoperative third month, the higher dropout rate in the TR group suggests the need for careful monitoring and individualized support. Also, the number of patients with extension deficits at the final assessment was similar between the 2 groups.

Physical restrictions during the previous pandemic triggered hand therapy professionals to apply remote methods of treatment. Similarly, flexor tendon repair patients were treated remotely. It was observed that TR was better than no intervention during the postoperative period in these patients. However, no results could be reported, as physical assessments such as TAM measurements were not feasible during that restricted period. In addition, including a control group for in-person therapy was not possible. In this study, treatment was applied remotely in the experimental group and face-to-face in the control group. All patients were assessed in the clinic to ensure maximum standardization. These results are believed to contribute to the understanding of telehealth services, particularly in hand therapy.

Similar findings were reported by Seven et al, who observed no significant difference in functional outcomes

Table 1. Baseline Characteristics.

Demographics and baseline characteristics	Telerehabilitation group (n = 9) (f = 10)	In-person therapy group (n = 14) (f = 15)	*P* value
Age (years) (Median-IQR)	27 (25-31)	33 (31-40)	.058
Sex (n) (%)			.648
Female	3 (33.3%)	6 (42.9%)	
Male	6 (66.7%)	8 (57.1%)	
Dominant side (n) (%)			.295
Right	7 (77.8%)	13 (92.9%)	
Left	2 (22.2%)	1 (7.1%)	
Injured side (n) (%)			.795
Right	5 (55.6%)	7 (50%)	
Left	4 (44.4%)	7 (50%)	
Dominant hand injured (n) (%)			.265
Yes	3 (33.3%)	8 (57.1%)	
No	6 (66.7%)	6 (42.9%)	
Injured finger (f) (%)			.791
Index	4 (40%)	4 (26.7%)	
Middle	0 (0%)	1 (6.7%)	
Ring	3 (30%)	5 (33.3%)	
Little	3 (30%)	5 (33.3%)	
Zone of injury (f) (%)			.702
1	2 (20%)	4 (26.7%)	
2	8 (80%)	11 (73.3%)	
Injured tendon (f) (%)			.566
FDP	7 (70%)	12 (80%)	
FDP + FDS	3 (30%)	3 (20%)	

Note. n = number of patients; f = number of fingers; IQR = interquartile range; FDS = flexor digitorum superficialis; FDP = flexor digitorum profundus.

Table 2. Results of Comparisons Between Groups.

Parameters	Telerehabilitation group (Median-IQR)	In-person therapy group (Median-IQR)	*P* value
DASH score	(n = 9)		
Sixth week	15.83 (14.20-23.33)	(n = 14) 28.35 (12.9-42.7)	.270
Eighth week	8.75 (5.49-14.45)	(n = 12) 15.81 (7.95-22.94)	.142
12th week	4.20 (0.86-8.33)	(n = 13) 7.5 (1.65-13.33)	.349
TAM score	(f = 10)		
Sixth week	207.5 (195-220)	(f = 15) 200 (190-230)	.329
Eighth week	230 (220-240)	(f = 13) 215 (200-260)	.367
12th week	255 (250-260)	(f = 14) 250 (220-270)	.638
Modified Strickland Classification (f) (%)			
Excellent	10 (100%)	12 (85.7%)	.212
Good	0 (0%)	2 (14.3%)	
Fair	0 (0%)	0 (0%)	
Poor	0 (0%)	0 (0%)	
Extensor deficit degree (f) (%)			
No	7 (70%)	2 (80%)	.848
10°	2 (20%)	2 (13.3%)	
20°	1 (10%)	1 (6.7%)	

Note. IQR = interquartile range; DASH = Disabilities of the Arm, Shoulder, and Hand Questionnaire; n = number of patients; TAM = total active motion; f = number of fingers.

Table 3. Results of Week-to-Week Change Within the Groups.

	Telerehabilitation group (n = 10) (f = 10) *P* value	In-person therapy group (n = 12) (f = 13) *P* value
DASH score		
Sixth and eighth week	.012*	.012*
Sixth and 12th week	.008*	.001*
Eighth and 12th week	.012*	.002*
TAM score		
Sixth and eighth week	.005*	.002*
Sixth and 12th week	.005*	.003*
Eighth and 12th week	.011*	.001*

Note. n = number of patients; f = number of fingers; DASH = Disabilities of the Arm, Shoulder, and Hand questionnaire; TAM = total active motion.
*Statistically significant ($P < .05$).

between patients receiving TR and those undergoing in-person therapy after tendon repairs. However, higher levels of kinesiophobia were noted in the TR group.[16] Their study included a heterogeneous sample of patients with flexor and extensor tendon repairs, and the evaluation relied solely on 2 patient-reported questionnaires: the TAMPA Scale for Kinesiophobia and the DASH questionnaire. The scores from these questionnaires reflected the functional level of the patients. In contrast, this study evaluated finger movement ranges using TAM scores and measured extension deficits, which are among the most critical and standardized functional assessments following flexor tendon injuries. In addition, the study sample was more homogeneous, consisting only of patients with zone 1-2 flexor tendon injuries, all operated on by the same 2 surgeons using the same anesthesia method (WALANT). Furthermore, unlike the previous study's passive protocol, this study implemented controlled early active motion for all patients in both groups. Finally, the patients were evaluated at 3 different time points (sixth, eighth, and 12th weeks postoperatively) when compared with the previous study, which only assessed patients at the eighth week.

The benefits of TR include eliminating travel costs, enabling individually tailored session schedules, and minimizing time away from work. In a study including 207 physiotherapists and 401 patients, it was shown that most patients stated that the video conference physical therapy program was of the same quality or better than the face-to-face physical therapy program because it was easy to access and implement and had no waiting time for treatment. In addition, that study demonstrated that most physical therapists and patients are willing to use telehealth methods.[17] Similarly, Worboys et al[18] reported that patients with chronic condition hand injuries (>8 weeks) had very good satisfaction levels with telehealth, with 83% of patients preferring TR over in-person treatment. Considering that the results were similar between both groups in this study, TR may be a preferable method as it eliminates the difficulty and expense of accessing treatment in patients with flexor tendon injuries and enables postoperative therapy to start as early as possible, especially for the patients with difficulties, ie, who live in the rural areas.

Telerehabilitation services in the hand therapy field that were reported in the previous studies were generally limited to pre-prepared digital application-dependent methods.[19,20] In a study by Suero-Pineda, the TR group performed disease-specific exercises via the tablet application, while the control group performed the exercises programmed on paper as a home program in a sample with hand soft tissue injuries.[20] Similar to this study, researchers also invited the patients to the clinic for the assessments. Researchers reported that the outcomes of the TR group patients improved significantly compared with the control group. The results of the Suero-Pineda study show that patients can continue their treatment if researchers cannot reach the clinic or when researchers prefer follow-up at home.

Telerehabilitation is not without disadvantages. It requires good quality internet access besides a smart device (eg, a smartphone) and basic knowledge of using technology.[21,22] Patients should also visit the clinic for physical assessments such as range of motion, grip strength measurements, and dexterity tests. Therefore, even if the treatment is delivered online, those evaluations require a face-to-face meeting with the patient.[23] In addition, close follow-up of the patients is more critical in TR as the patient and the therapist are at a distance. In this study, 5 patients in the TR group did not continue the program during to follow-up. The higher dropout rate in the TR group can be attributed to several interrelated factors. Technical challenges such as difficulties in accessing the platform or unreliable internet connectivity may have caused frustration, ultimately leading to disengagement. Although technical challenges such as internet access may have played a role, other factors such as patient-perceived lack of need for therapy or dissatisfaction with progress could have influenced the higher dropout rate in the TR group. This highlights the importance of individualized patient selection and structured follow-up strategies in TR programs. Furthermore, adherence to the intervention could have been impacted by the lack of direct, in-person interaction, which some participants may have found crucial for maintaining motivation. While TR offers comfort, it may not entirely substitute the hands-on approach and personal interaction inherent to

face-to-face treatment. Finally, contextual and individual factors may have influenced participants' ability to complete the program, including varying levels of comfort with technology or personal circumstances. From an opposite view, it should be noted that those patients' initial preference of TR instead of regular clinic visits may already indicate that their motivation was relatively low. These findings highlight the need for tailored strategies to enhance engagement and overcome barriers in TR interventions.

Conclusion

Clinical results in this study indicate that while remote and face-to-face hand therapy yielded comparable functional outcomes in patients who completed the program, the higher dropout rate in the TR group highlights the necessity of structured follow-up and patient engagement strategies. Despite this limitation, TR remains a viable alternative to traditional hand therapy, particularly for patients with limited access to in-person treatment. Given its effectiveness, TR can be recommended not only in exceptional circumstances such as pandemics but also for patients in rural or remote areas who face challenges attending in-person sessions. However, successful implementation requires close monitoring and strong communication between the surgeon, therapist, and patient to ensure adherence and optimal recovery.

Limitations

The number of patients included in this study was relatively small. This may not be a limitation as more patients preferred to receive face-to-face treatment instead of TR because physical restrictions had been finalized before the beginning of this study. As more and more patients preferred the in-person therapy, the researcher had to cease to enroll patients in the study to minimize any risk of bias originating from the unbalanced number of patients between the study groups. Besides, the patients who preferred TR in this study were all from rural areas, making actual randomization in group allocation unfeasible. Differences in treatment delivery may partially explain the preference for in-person therapy, as hands-on guidance and direct therapist supervision in the clinic might have been perceived as more effective or reassuring than remote sessions. In future studies, larger samples with full randomization are needed to further validate these findings.

Ethical Approval

Ethical approval for the conduct of the study was obtained from the university ethics committee (No: 2022-335).

Statement of Human and Animal Rights

All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Statement of Informed Consent

Informed consent was obtained from all individual participants included in the study.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author. Restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available.

Declaration of Conflicting Interests

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ORCID iDs

Zeynep Emir https://orcid.org/0000-0001-5139-2401
Sedanur Güngör https://orcid.org/0000-0002-3943-5365
Egemen Ayhan https://orcid.org/0000-0002-0324-3126

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