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Nuray Bayar Muluk
Editors

All Around the Nose

Basic Science, Diseases and Surgical Management

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Conventional and Powered Instrumentation for Endoscopic Sinus Surgery

76

Recep Karamert, Fikret Ileri, and Anthony Papavassiliou

76.1 Conventional Equipment for Basic Sinus Surgery

76.1.1 Maxillary Sinus

Maxillary sinus approaches are the basic interventions in endoscopic sinus surgery. Identification of the maxillary sinus ostium usually is a simple procedure depending on its localization and easily recognizable surrounding landmarks. Exposure of the ostium starts with uncinectomy under direct visualization with a 0° endoscope. A freer elevator or a ball tip probe is helpful to identify the anterior border of the uncinate process which is mobile (Fig. 76.1). If an anterior to posterior resection is performed, a sickle knife is used to make an incision along the anterior border, and straight through-cutting forceps is used to make the resection. Uncinate process can also be removed from posterior to anterior by a backbiter forceps (Fig. 76.2). Angled endoscopes are more useful in identifying and widening the ostium and exploration or the surgical management of the maxillary sinus (Fig. 76.3). Orientation to the surgical field and the manipulation of the equipment are much more easy under visualization with a 30° endoscope, which provides enough exposure. Further interventions including the floor and the anterior border of the maxillary sinus require more angled visualization with 45° or 70° endoscopes (Fig. 76.4). V. Eicken antrum cannulas are used to irrigate and aspirate the maxillary sinus (Fig. 76.5). Antrum grasping forceps and giraffe forceps are used to excise polyps or retention cysts on the floor or the anterior border of the maxillary sinus (Fig. 76.6). Angled microdebriders can also be used for the widening of the ostium and the excision of the polyps localized in maxillary sinus [1].

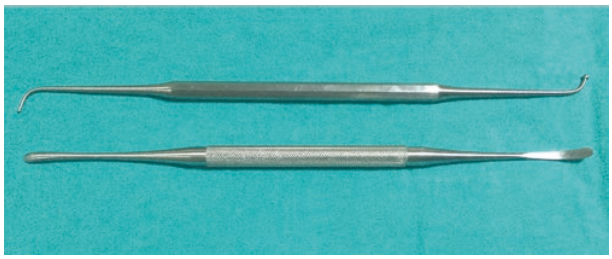


Fig. 76.1 Ball tip probe and freer elevator

76.1.2 Ethmoid Sinus

Ethmoidectomy is started with the resection of the ethmoid bulla under 0° endoscopic visualization. Bulla resection is performed with straight and 45° angled Blakesley forceps (Fig. 76.7) after perforating the inferomedial wall with a straight Frazier suction tube or a J curette. (Fig. 76.8). Through-cutting forceps is used to remove the osseous fragments along the medial orbital wall (Fig. 76.9). Basal lamellae are perforated same way, and ethmoid bony partitions attached to the medial orbital wall are removed with angled through-cutting forceps and a rotating Kerrison. When dissecting the skull base, angled endoscopes provide better view, and curved suction tubes must be used to reach the area. Upbiting through-cutters are used to remove bony partitions attached to the skull base [1].

76.1.3 Sphenoid Sinus

Both transnasal and transethmoid approaches can be used for sphenoidotomy. The 0° endoscopes are used until the natural

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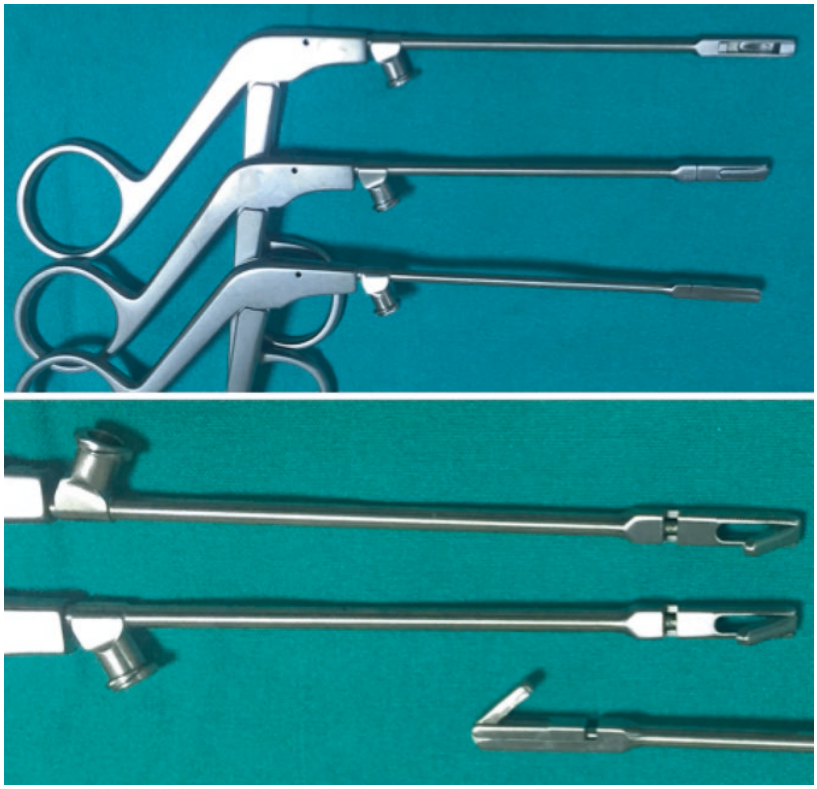


Fig. 76.2 Backbiters (left-biting, right-biting, and upbiting)

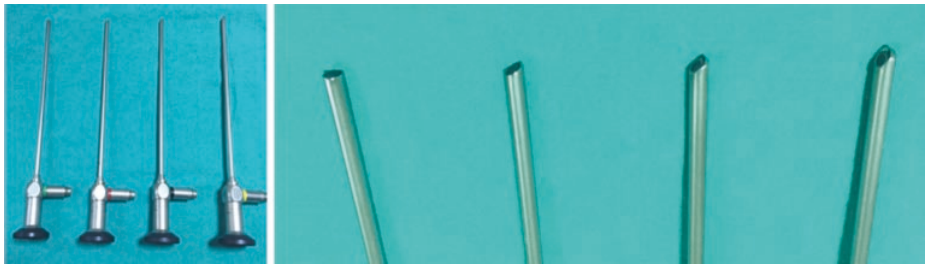


Fig. 76.3 Nasal endoscopes (0°, 30°, 45°, 70°)

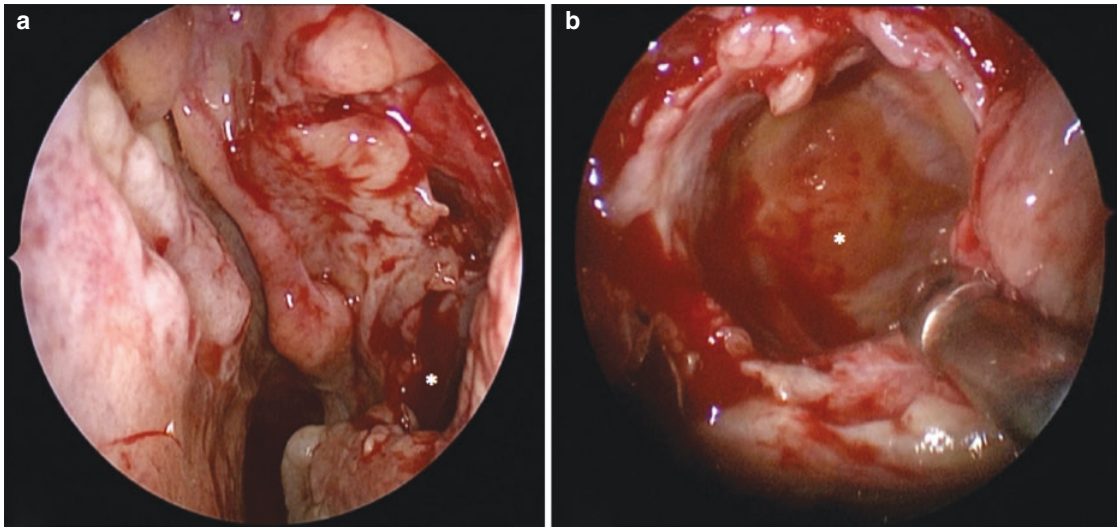


Fig. 76.4 Endoscopic view of left maxillary sinus during a revision surgery, (**a**) 0° endoscopic view, (**b**) 70° endoscopic view of the same patient. ∗Maxillary sinus ostium

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ostium is identified. Once the superior turbinate is seen, the lower portion is truncated with a straight through-cutter to obtain a direct aspect to the sphenoid sinus ostium. In this step, a straight microdebrider is also helpful. Once identified, the ostium must be dilated to visualize the sinus inside. Anterior sphenoid wall is fractured with a J curette, and bony fragments are removed with a Blakesley forceps. Straight mushroom punch (Fig. 76.10) and upbiting through-cutters can also be used for the enlargement of the ostium. Kerrison rongeur (Fig. 76.11) is helpful in removing the thicker parts of the

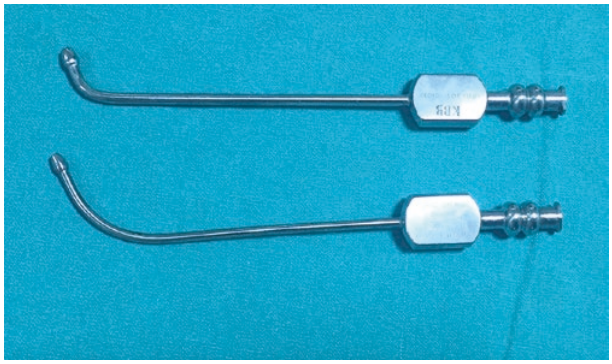


Fig. 76.5 V. Eicken cannulas

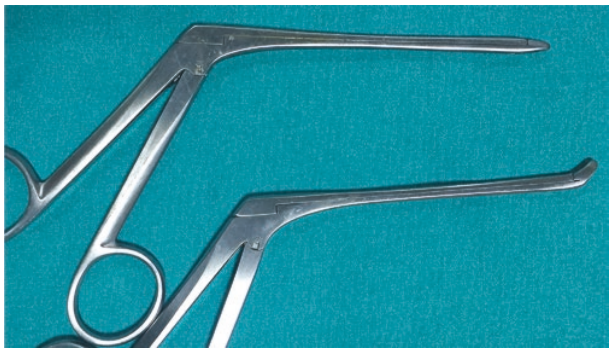
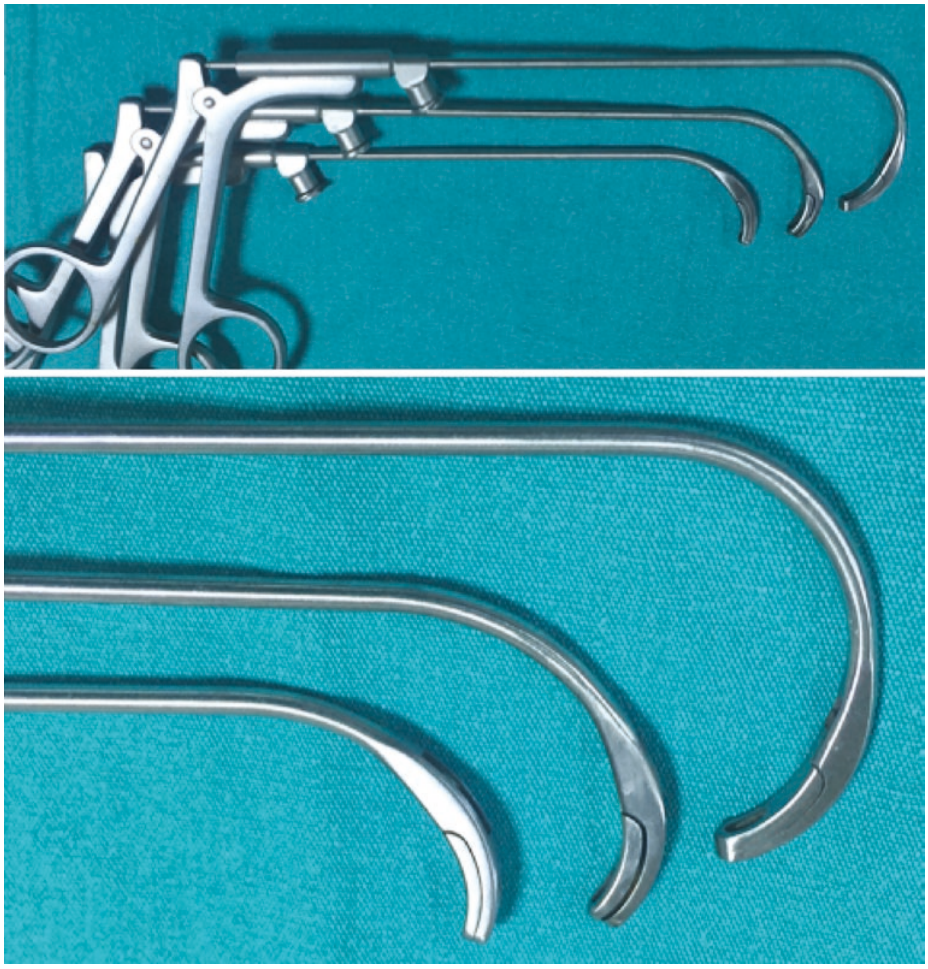


Fig. 76.7 Blakesley forceps (straight and angled)

Fig. 76.6 Antrum grasping forceps



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anterior wall. After removing the anterior wall, sphenoid sinus can be visualized endoscopically. Angled endoscopes are used to examine the lateral or inferior portion of the sinus [1].

76.1.4 Frontal Sinus

Frontal sinusotomy procedures require specially designed instruments because of its hardly accessible localization. Angled endoscopes and giraffe-style instruments (Fig. 76.12) are crucial for successful surgery. A 70º endoscope provides the best visualization to access frontal recess. Ball tip frontal sinus probes are helpful in exploring the frontal recess. Frontal sinus curette and curved suction tubes are used to dissect the skull base and identify the agger nasi cell. The 45° and 90º front to back and side to side through-cutting giraffe forceps is useful in removing the posterior and medial walls of agger nasi cell. Removal of the cap is performed with a Bachert forceps (Fig. 76.13) or a 45° mushroom punch. Through-cutting instruments have the advantage of mucosa protection. Avoiding the stripping of mucosa is important for the healing and prevention of adhesion formation [1].

Image guidance systems provide an exceptional facility in frontal sinus and skull base surgery.

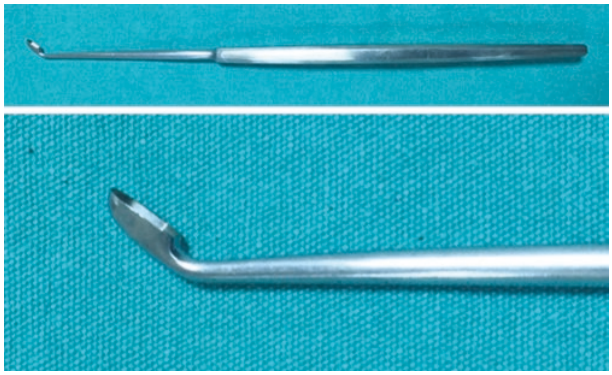


Fig. 76.8 J curette

76.2 Powered Instrumentation for Endoscopic Sinus Surgery

76.2.1 Microdebrider

Microdebrider provides the opportunity to work in a non-bleeding field with simultaneous suctioning and shaving the soft tissue away easily (Fig. 76.14).

Microdebrider is frequently used for soft tissue dissection like submucosal inferior turbinectomy and debulking nasal polyps. While removing polyps near the sphenoid

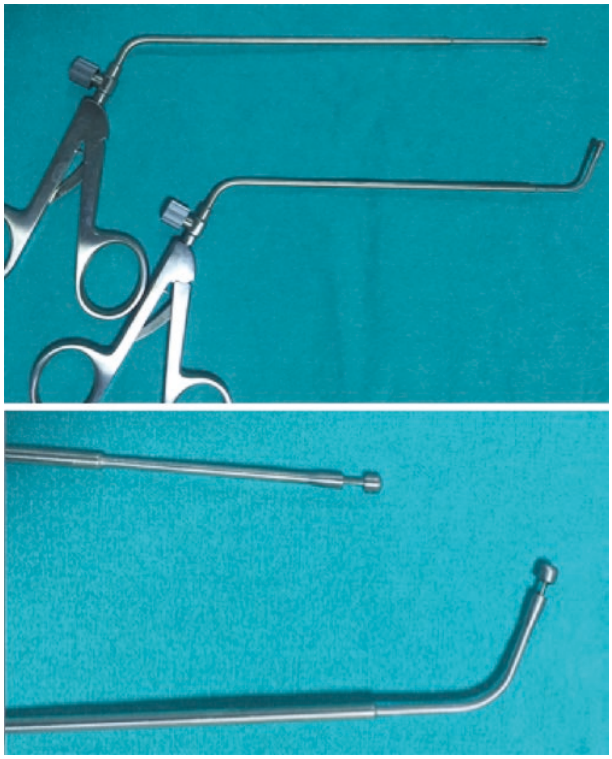


Fig. 76.10 Mushroom punch (straight for sphenoid sinus and angled for frontal sinus)

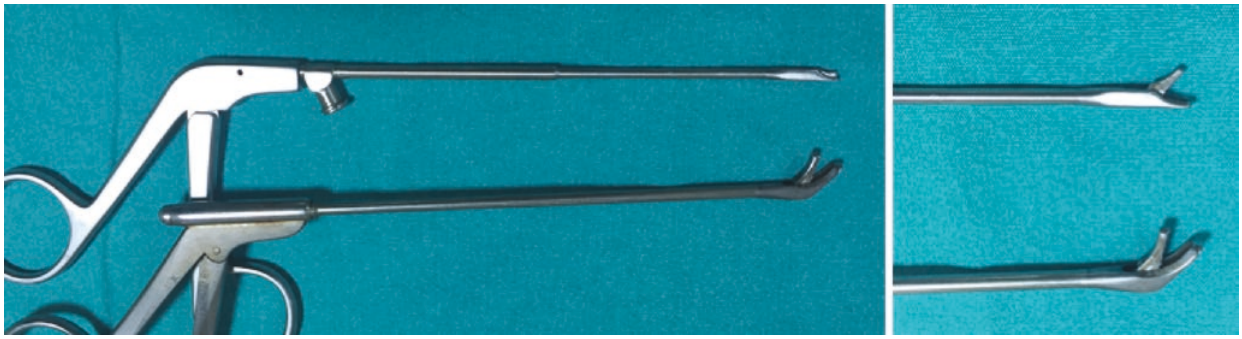


Fig. 76.9 Through-cutting forceps (straight and 45° angled)

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sinus ostium, engagement within the sinus must be avoided. Dissection with the microdebrider must be performed in great care and under proper visualization because of the lack of the tactile feedback for delicate dissection [1, 2]. It is better to use the microdebrider in shaving away the mucosal edges and soft tissues that are visualized certainly. In any doubt of orbital or dural involvement, surgeon must avoid using microdebrider to prevent injuries of the orbit and the skull base [3, 4].

Submucosal turbinectomy with microdebrider minimizes postoperative crusting and synechiae formation compared with cautery [5].

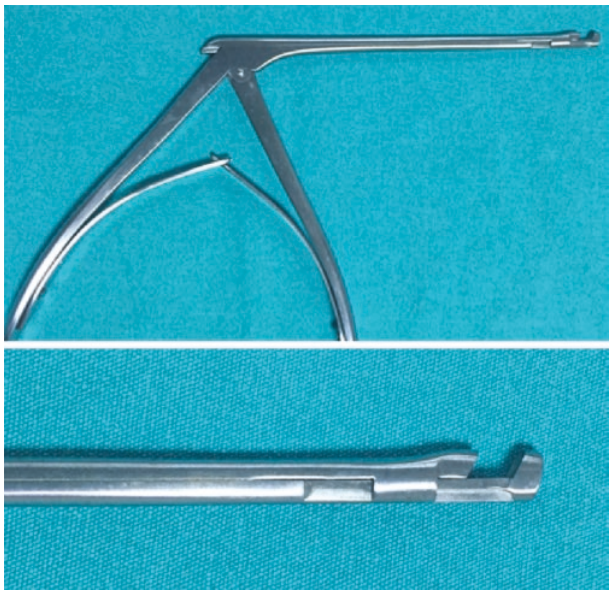


Fig. 76.11 Kerrison rongeur

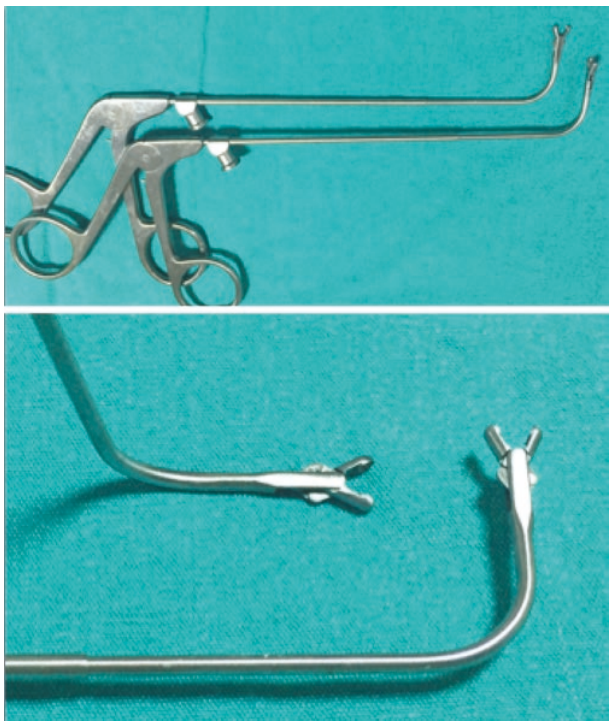


Fig. 76.12 Front to back and side to side giraffe forceps

76.2.2 Drill

Removal of the thick bony structures with forceps or curettes is difficult, and poorly controlled manipulations can lead to injuries

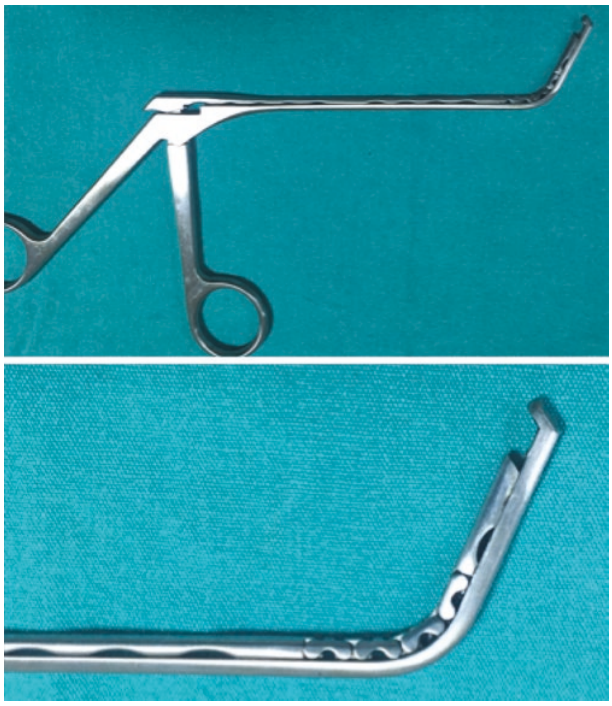


Fig. 76.13 Bachert forceps

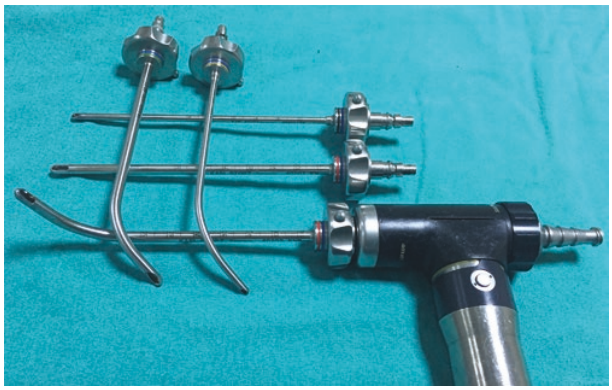


Fig. 76.14 Microdebrider with different styles of tips

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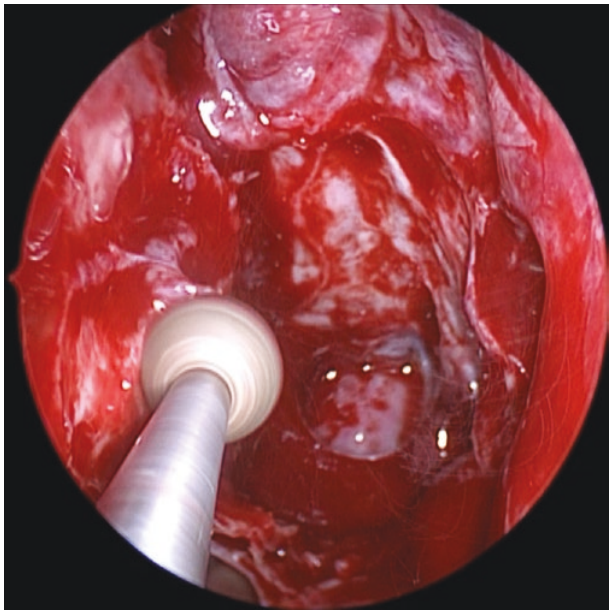


Fig. 76.15 The attacked right medial orbital wall is being drilled in an inverted papilloma case

of the surrounding structures and vessels while intranasal drilling allows controlled removal [2]. Dissection of sinonasal tumors commonly requires the use of drills (Fig. 76.15). When performing medial maxillectomy, drills are very helpful in removing inferior ridge of the medial maxillary wall which is very stable and hard to excise with a curette or osteotome. Drilling the posterior maxillary wall allows to access the pterygopalatine fossa. In extended sphenoid sinus surgery, diamond drills are used to remove the sphenoid septum. Angled irrigating drills are used in extended frontal recess dissections like Draf IIb and Draf III approaches. High-speed drills are used with osteotomes to elevate the anterior table in osteoplastic flap procedures [1, 2].

Drills take an important role in anterior and central skull base surgery performed for the intracranial tumors.

Diamond burs are preferred for a safer dissection, but in extensive bone removal, cutting burs can provide more convenience. Surgeon must use the cutting bur with extreme care to avoid dura and orbit injuries. Care must be taken also to avoid the carotid artery and optic nerve injuries during sphenoid sinus procedures. Extended drilling can cause severe adjacent mucosal damage, and a large exposed bony area can lead to osteomyelitis or healing problems [1, 2].

76.2.3 Image-Guided Navigation

Endoscopic sinus surgery is associated with some risk. Image guidance systems have taken an important role especially in advanced sinus pathologies. Intervention with a guide with high accuracy minimizes the risk in such difficult cases.

Computer-assisted navigation systems facilitate the intervention by showing the relationship between anatomic structures and the instruments used during surgery. Data is acquired from imaging modalities like computed tomography and magnetic resonance imaging. Collected data is loaded onto a computer workstation connected to a position sensor that performs the registration of the images with the patient. Thin-cut scans are reformatted to form a three-dimensional view and correlated with real anatomy [6].

Optical trackers and electromagnetic tracking systems are commonly used to determine the location of the tip of the instrument during surgery. The accuracy with optical systems is excellent (<1 mm, and typically 0.25 mm) [7]. But the tracker size is large, and it has to be visible during the intervention due to need of a direct optical connection between the sensor and the tracked targets that yield to line of sight restrictions. Optical trackers need a constant relationship with the instruments being used. They can only be used with rigid instruments and do not allow the movement of the head or surgical field. Electromagnetic sensors overcome various limitations of the optical trackers. But their accuracy is lower (approximately 0.9 mm) compared with optical systems [7]. Movement of the head and the surgical field is not an obstacle because of the sensors attached directly to the head and the lack of need to a direct line of sight between the probe and tracker. This allows tracking the instruments when the sensor is attached at the tip and also makes tracking of flexible instruments possible. The probe size is also very small comparing with the optical trackers, and they can be attached into several devices being used during the surgery [7].

Image-guided navigation is becoming more popular in advanced sinus pathologies [8]. However, it should be kept in mind that there is still a risk of inaccuracy and surgeon should not rely on the navigation system solely.

Selecting candidates for image-guided surgery is an important issue because of high cost and the time-consuming process of such an intervention. Image guidance is not necessary for the individuals with limited sinus disease and well-defined landmarks. Conventional surgery can be safely performed in basic sinus diseases. Sinus pathologies with distorted anatomy due to disease process, trauma, or surgery are best candidates for image guidance. Diseases extending to parasinus areas like infratemporal fossa, skull base, pterygomaxillary fossa, and orbit require extended endoscopic surgery. Image guidance facilitates such extended intervention and is safer than surgeries performed with conventional equipment [9]. Indications endorsed by the American Academy of Otolaryngology–Head and Neck Surgery for the image-guided surgery are (1) revision sinus surgery; (2) distorted sinus anatomy of development, postoperative, or traumatic origin; (3) extensive sinonasal polyposis; (4) pathology involving the frontal, posterior ethmoid, and sphenoid sinuses; (5) disease abutting the skull base, orbit, optic nerve, or carotid artery; (6) CSF rhinorrhea or conditions

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where there is a skull base defect; and (7) benign and malignant sinonasal tumors. (6) In such difficult cases, real-time localization of the surgical instrument provided by image guidance is crucial and gives surgeon the chance to eradicate the disease completely.

76.2.4 Balloon Sinuplasty

Balloon sinuplasty is an ostium dilatation technique which is performed with a balloon catheter advanced into the sinus via natural ostium under fluoroscopic and endoscopic visualization and inflated to widen the passage, restore the drainage, and improve the ventilation of the sinus [6]. Balloon sinuplasty can be used as an isolated technique without any tissue and bony partition removed or as an adjunctive intervention with endoscopic sinus surgery either. Balloon only procedures can be inefficient in some chronic inflammatory diseases due to lack of inflamed bony partition removal like uncinate process and the ethmoid septations. Hybrid procedures allow inflamed tissue removal, and also ostia are identified more easily. Once the ostium is identified, the dilatation is performed with the balloon catheter without any adjacent tissue removal to prevent adhesions (Fig. 76.16).

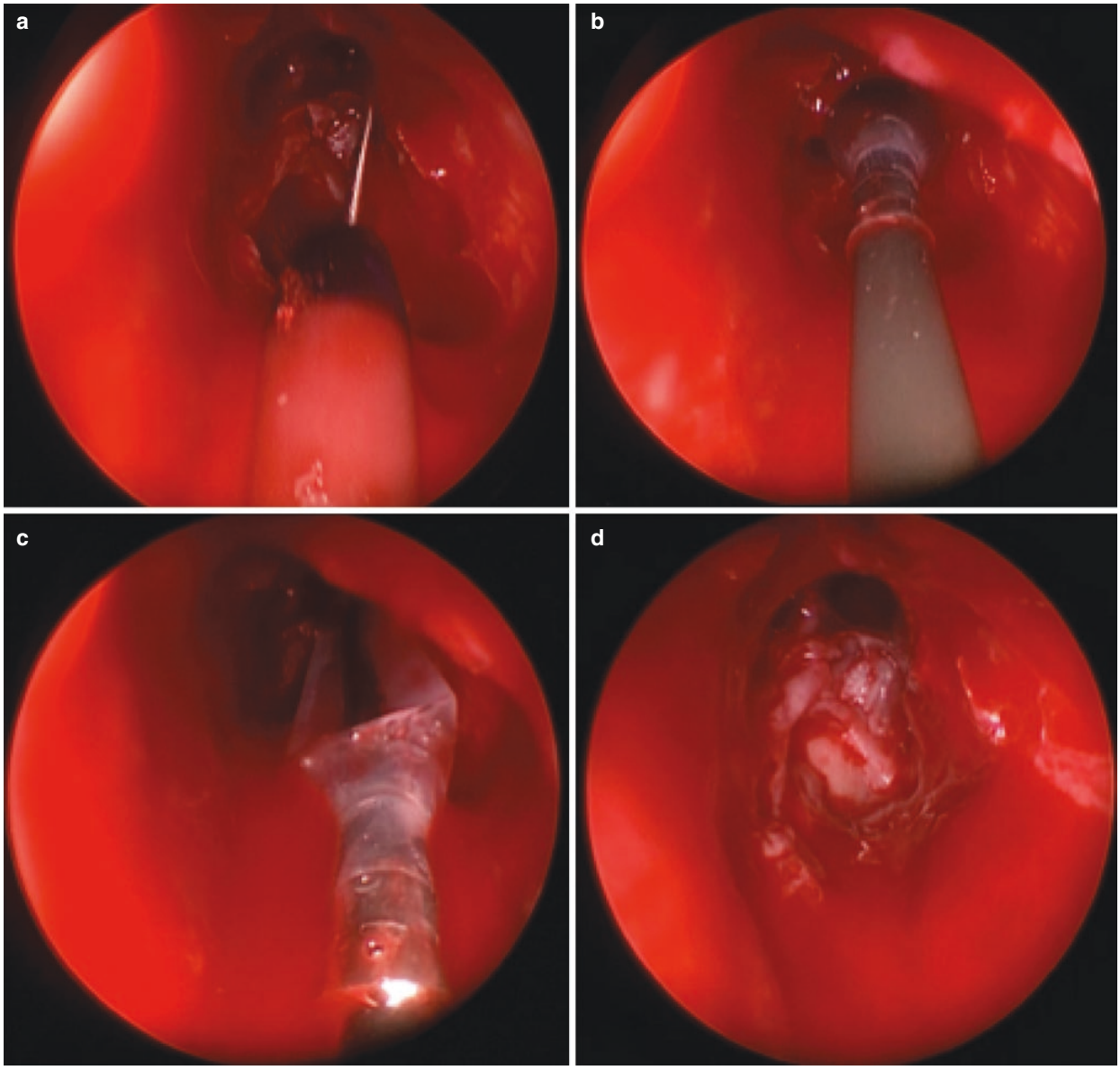


Fig. 76.16 Frontal sinus balloon catheterization combined with the conventional sinus surgery in a hybrid procedure. (**a**) Guidewire is introduced into the frontal sinus. (**b**) Balloon is inflated at the ostium level. (**c**) Deflated balloon. (**d**) Final appearance of the ostium after balloon sinuplasty

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Combined procedures are mostly used in frontal sinus dilatation [1]. Balloon dilatation technique can be applied to all sinuses except ethmoid cells, which have various septations and ostia with a variable drainage system. Maxillary sinus dilatation is less frequently used because the traditional surgery is easy to apply and the required equipment for the dilatation is expensive. In case of chronic inflammation, usually more than one sinus is involved and traditional surgery is required in addition to balloon dilatation especially if the ethmoid cells are affected.

Balloon catheter placement can be performed under fluoroscopy, which results in radiation exposure and high cost, and is a time-consuming procedure. Chandra estimated the tolerable fluoroscopy time as 30 min during balloon sinuplasty, and further exposure may result in lenticular opacity [10]. Friedman et al. published their experience with transillumination procedure performed by a lighted guidewire inserted into the sinus, and transillumination through the sinus walls is observed to identify the localization of the guidewire in frontal and maxillary sinuses [11].

Balloon sinuplasty is suggested as an effective and safe intervention in the literature [12–18].

However, there are a few controlled studies published and the long-term effects are still not clear [19–21]. A recent long-term controlled study by Koskinen et al. showed efficacy of balloon sinuplasty in treatment of chronic maxillary sinusitis equally compared to endoscopic sinus surgery as measured by symptom reduction and patient satisfaction even after 7 years from the surgery. Although acute sinusitis was more frequent in balloon sinuplasty patients, no clinical significance was found [22].

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