Rhinology and Facial Plastic Surgery
History of Septoplasty

The first documented attempts to correct nasal septal deformities date back to 1757 when Quelmatz recommended daily digital pressure to the septum for gradual correction (cited in [1]). Surgical methods were not attempted until 1875 when Adams described the practice of blunt fracturing and splinting of the nasal septum [2]. Ingals pioneered more radical techniques in 1882 by removing small sections of septal cartilage en bloc with mucosal flap elevation, which was called “window resection” (cited in [1]). Krieg furthered this technique by removing the entire portion of deviated cartilage and Boenninghaus included the resection of the vomer and perpendicular plate of the ethmoid to address more posterior deviations (cited in [1]). In 1899, Asch attempted to alter the tensile curve of septal cartilage instead of resecting it by the use of full-thickness cruciate incisions [1, 3]. Freer and Killian in 1902 developed the foundation of modern septoplasty techniques with the submucous resection. Killian recognized the septum as being an important support structure of the nasal tip and modified his technique to leave a 1-cm dorsal and caudal “L” strut of supporting septal cartilage (cited in [4, 5]).

The era of modern septal surgery began in the 1940s with Cottle, Goldman, and Smith who recognized the disadvantages of submucous resection [6–8]. They favored a more conservative approach to septoplasty with repositioning and removing minimal bone and cartilage. Long-term follow-up studies of patients who had undergone submucous resection frequently showed loss of the support structure of the nose as evidenced by dorsal saddling, retraction of the columnella, and alar widening [6–8].

Anatomy

The septum serves several important functions. It provides structural support for the external nose and nasal tip, divides the nose into two cavities, and regulates nasal airflow.

The anterior septum is composed of the quadrilateral cartilage. The bony components of the septum include the nasal crest.
of the palatine bone, maxilla, and frontal bone, the vomer, the perpendicular plate of the ethmoid, and the spine of the paired nasal bones.

The septum is covered with mucoperichondrial and mucoperiosteal linings. The ophthalmic branch of the internal carotid artery and the maxillary and facial branches of the external carotid artery provide arterial blood supply to the nasal septum. The upper nasal septum is supplied by the anterior and posterior ethmoid arteries, which originate from the ophthalmic branch. The posterior and inferior septum is supplied by the sphenopalatine artery, a branch from the external carotid artery. The septal branch of the superior labial artery provides blood supply to the columella and caudal septum [4, 9].

Preoperative Evaluation

Deviation of the nasal septum is a common cause of unilateral nasal airway obstruction. Iatrogenic trauma to the septum can occur during birth with either forceps placement or during delivery through the pelvic canal. Early septal birth trauma can manifest in nasal obstruction later in life [9].

The most common indication for septal surgery is to relieve nasal obstruction from septal deviation that hinders airflow through the nose. In severe cases, septal deviations can block the ostiomeatal complex, prevent normal sinonasal drainage, and can underlie recurrent episodes of sinusitis.

Septoplasty is also performed in patients with a history of severe epistaxis. Septal deviation can cause turbulent air flow leading to mucosal drying, crusting, and epistaxis. Correction of the deviation can improve this problem by providing normal laminar flow through the nose. Additionally, the septum is an excellent source of donor cartilage for different otolaryngologic procedures, such as rhinoplasty and reconstruction for transphenoideal approaches to the pituitary [10].

Evaluation of the septum begins with examination of the external appearance of the nose. This examination focuses on the size, shape, symmetry, and alignment of the nose and septum. Observing the patient's nose during normal and effortful nasal breathing is helpful to assess for dynamic obstructions that may be a part of the patient's problem. Anterior rhinoscopy with a nasal speculum allows for internal examination of the septum, the turbinates, and other elements of the nasal valve. The nasal valve is the narrowest area of the airway and its boundaries include the septum, the upper lateral cartilage, and the anterior aspect of the inferior turbinate [9]. These areas may be additional causes of nasal obstruction of which the otolaryngologist should be aware in order to correctly diagnose and treat the patient, as septal deviation may not be the only problem.

Nasal endoscopy with a rigid endoscope can evaluate intranasal structures and assess for polyps or other masses causing nasal obstruction. Additionally, other objective measurements of nasal airway exist, such as rhinomanometry and acoustic rhinometry. However, measurements from these methods do not always correlate with the patient's subjective complaints [4, 11, 12].

Surgical Technique

Today, techniques for septal surgery emphasize conservative resection and preservation of septal cartilage and bone. Derived from a Greek term, septoplasty means "to reshape or mold the septum." While there are different variations, what follows is one method employed by the senior author in performing this procedure for conservative resection.

Topical and local anesthesia is necessary for septal surgery, not only for analgesic effects, but also for hemostatic properties. Minimizing bleeding into the operative field allows for adequate exposure and visualization of the nasal septum.

Prior to injection, the nose should be treated with topical agents designed to vasoconstrict the mucosa. Oxymetazoline is the preferred agent of the senior author (AKD), due to the lower risk of cardiac side effects compared with use of topical cocaine, another well-established agent. With a nasal speculum, the septum and nasal cavity are visualized. Cotton pledges are soaked with oxymetazoline andatraumatically placed in the nasal cavity with bayonet forceps (at least two on each side, one sitting low in the nasal cavity, and one sitting higher).

After decongesting the nasal mucosa, 1% lidocaine with 1:100,000 epinephrine is injected into the submucoperichondrial plane using a 25- or 27-gauge needle. The injection is started at the caudal end of the septum, following a more posterior course until the mucosa is well blanched, or maximum volume based on patient weight is met (Fig. 15.1). Local injection also helps by causing hydrodissection of the mucoperichondrium off the septum. This helps in the development of the mucoperichondrial flap. The contralateral membrane and nasal floor adjacent to the maxillary crest should also be injected.

Several different choices of incisions can be used, each with its advantages and disadvantages. First described by Cottle in 1947, the hemitransfixion incision is made at the caudal-most point of the cartilaginous septum as it adjoins the membranous septum [7, 8]. It is a commonly employed incision as it provides access to both anterior and posterior deviations with only minimal effect on tip support. A no. 15 blade is used to incise the mucosa down to the perichondrium. Identification of the proper subperichondrial layer is essential as it ensures an avascular plane for dissection. Gently scoring the cartilage until one feels its rough surface, after initially lifting the leading edge of the mucoperichondrium, will help reach the proper plane for dissection.

A Killian incision is made more posterior and may be a preferable incision if the anterior septum is straight and the septal deviation is within the posterior third of the nasal cavity [1, 8]. It is created approximately 1–2 cm posterior to the caudal septum and anterior to the septal deviation. Its limitation, however, is that it does not provide access to the caudal septum.

The open rhinoplasty approach can be used to access the septum using marginal and transcolumellar incisions. In the open approach to the septum, the columella is lifted and the medial crura are separated. Tip support can be compromised with this open approach technique and is usually reserved for septal perforation repair or in complex cases in conjunction with an external approach to rhinoplasty [13, 14]. The open rhinoplasty approach is described in further detail elsewhere in this textbook.
Whichever incision is chosen, identifying the proper avascular subperichondrial plane is essential. The Cottle elevator is helpful in elevating the mucoperichondrial envelope under direct vision. It has two dissecting surfaces, one sharp and the other more blunt. The sharper spade-like end is used to begin the dissection in the submucoperichondrial plane. After the dissection is started, the flat and blunt end elevates the envelope anteriorly, posteriorly, and inferiorly, while developing a wide mucoperichondrial envelope.

A nasal speculum is then inserted into the mucoperichondrial envelope to allow for visualization and dissection posteriorly. If displacement of the septum off the maxillary crest is encountered, elevation of the mucoperiosteum along the nasal floor will be necessary to realign the septum. An osteotome may be helpful to dissect the septum off the bony nasal crest. After the inferior floor attachments are released, the septum can swing back toward the midline. The mobile septal segment is then realigned to the maxillary crest groove, and the anterior-most aspect is secured to the periosteum of the maxillary crest with a long-lasting absorbable suture.

To prevent cribiform plate injury, the septum should have its segments neither pulled nor twisted without first having had a superior septal incision to disconnect the manipulated segment from the superior connection to the skull base. To decrease the potential for loss of nasal support, the surgeon preserves at least a 1-cm dorsal and 1-cm caudal septal segment, which has been termed the L-strut (Fig. 15.2) [5]. After the initial mucoperichondrial flap is elevated, the sharp end of the Cottle or no. 15 blade can be used to incise and penetrate through the cartilage at the point ahead of the offending septal deviation. The surgeon should make sure that there is an adequate strut, as noted above. After the cartilage is incised, this creates a window by which the contralateral mucoperichondrium can be elevated. Once this is done, and the cartilage targeted for resection has had mucoperichondrium elevated from both sides, the swivel knife or Cottle can be used to resect this segment, taking care to preserve the septal strut. Resection of a large central septal segment can be done safely, if required, to address severe septal deviations or if a cartilage graft is needed for rhinoplasty.

After excision of the deviated cartilage or septal spur, the cartilage can be removed or morselized and placed back into the membrane pocket between the mucoperichondrial flaps. Morselization is preferred in pediatric patients. In the pediatric population, it has been shown that septrplasty can be safely performed with proper preservation of septal cartilage through morselization and repositioning; patients were followed for up to 60 months without evidence of deformity or alteration in the growth and development of the nose [15].

The mucoperichondrial envelope with any morselized septal cartilage can then be sutured together with a quilting mattress stitch using 4-0 suture plain gut on a small Keith needle. The quilting mattress suture secures any morselized cartilage, reduces the risk of dead space within the septum where hematoma could form, and brings the mucoperichondrium into contact to nourish the underlying cartilage. Finally, the hemitransfixion or Killian incision is closed with a 5-0 plain chromic suture.

Postoperatively, septal perforations can develop if the mucoperichondrial flaps are both torn at the same level. Having

Fig. 15.1 Preparing the nasal septum. Shown here is an anterior rhinoscopic view with pledgets in both nasal cavities. A nasal speculum straddles the nasal septum anteriorly. This helps to identify the septum's caudal edge for injection, and by making the incision for a hemitransfixion approach

Fig. 15.2 Nasal septum. In this cross-section illustration of the nasal septum, the relationship of the nasal septum to the anterior cranial fossa and palate is shown. Also shown in dashed lines is the outline of the nasal septrplasty “L-strut” which is preserved in order to reduce the risk of postoperative nasal deformity. The large arrow shows the caudal edge of the nasal septum, which is the starting point in a hemitransfixion incision. A Killian incision is made posterior to the nasal strut, but anterior to the leading edge of a septal deformity
cartilage interposed between flaps that have tears can prevent perforations from forming. Another method for reducing perforation development in the face of a flap tear is the use of silastic splints to keep the edges in a good position and protect them from further trauma; these are cut to size and sutured to the caudal edge of the septum with a 3-0 nylon. Splints can be removed 5–7 days postoperatively, and the patient should be kept on antibiotic coverage while the splints are in place.

Endoscopic approaches to septal surgery are becoming increasingly common, especially when performed concurrently with functional endoscopic sinus surgery. The deviated bone and septum can be resected under direct endoscopic visualization (Fig. 15.3). When compared with standard headlight septoplasty, the endoscopic technique provides several important advantages. Endoscopic visualization allows for improved evaluation of septal deformities in difficult to visualize areas, such as posterior septal deformities. Smaller incisions can be used and a reduced amount of mucoperichondrial dissection can be employed [16, 17]. Furthermore, it is a natural transition between septoplasty and endoscopic sinus surgery when the two procedures are performed at the same time. An endoscopic approach does require more equipment, and special instruments are available to help facilitate this method. However, when extensive deviation is encountered and a wide plane of dissection required, the advantage of the endoscopes is reduced.

Complications of Septoplasty

Although not common, septal hematoma can be a serious complication in the postoperative period. A hematoma causes separation of the mucoperichondrium from cartilage, causing an interruption in the cartilage's blood supply. Signs and symptoms include intense pain, edema, and complete nasal airway obstruction. The risk of hematoma formation is reduced by the use of septal splints and quilting mattress sutures. Avascular cartilage can be viable for up to 3 days, but without timely evacuation of the hematoma and re-establishment of nutrition to the cartilage, this can be damaging to the septum; this can lead to necrosis, resorption of cartilage, and potential loss of normal nasal form. Management consists of drainage through a mucoperichondrial incision.

Infections after septoplasty are rare, but toxic shock syndrome can occur while nasal packs or septal splints are in place. Patients should be placed on anti-staphylococcal antibiotics prophylaxis until nasal packs and splints are removed. Coating nasal packs with bactroban ointment can help reduce the growth of Staphylococcus aureus.

Cerebrospinal fluid leak is rare after septoplasty and usually the result of damage to the cribriform plate during septal manipulation. It is a serious complication when it occurs. Immediate recognition is important, and repair should be done at the time of discovery in surgery. If there is a delay between surgery and discovery of the leak, a CT scan should be obtained to ensure that there is no sign of an intracranial complication such as pneumocephalus. Management involves surgical means to close the leak, and nonsurgical means with bed rest, nasal packing, and oral antibiotics. A lumbar drain may be needed as well. Cerebrospinal fluid leaks usually resolve spontaneously, but it is imperative to watch for signs and symptoms of meningitis, which include headache, photophobia, nuchal rigidity, and fever [18].

Postoperative Care

Nasal packing is usually not necessary for an uncomplicated septoplasty. If splints are used, these are removed between 5–7 days postoperatively. Patients are instructed to use saline nasal irrigation and avoid nose-blowing. Gentle nose blowing is allowed after 2–3 weeks and patients should avoid strenuous activity for a month.
A septal perforation can be problematic to patients. It can result in nasal crusting, epistaxis, and whistling during nasal respiration, and can require further intervention in order to reduce the patient’s problems.

Failure to maintain an adequate nasal strut through aggressive cartilage resection can lead to nasal deformities. Possible deformities include dorsal saddling, retraction of the columella, and alar widening. Correction of these problems can be difficult and involve extensive reconstructive techniques.

**Septoplasty Outcomes**

Several studies have been performed recently to evaluate the effectiveness of septoplasty and quality of life outcomes after surgery. Stewart et al. studied the outcomes after nasal septoplasty (NOSE study) and showed that nasal septoplasty resulted in significant improvement in disease-specific quality of life, high patient satisfaction, and decreased medication use. Patients who had a higher degree of symptomatic nasal obstruction had larger improvements after surgery [19].

**Tips to Avoid Complications**

- The maximum dose for cocaine is 2–3 mg/kg.
- The maximum dose of lidocaine with epinephrine is 7 mg/kg.
- Preserve at least a 1-cm dorsal and 1-cm caudal septal “L” strut.
- When using forceps, completely free the tissue prior to removing it from the nasal cavity. Pulling on tissue can increase the risk of damage to the cribiform plate and cause mucosal tearing.
- A quilting mattress suture can help to re-approximate septal flaps and help prevent postoperative septal hematoma.
- Avoid perforating the mucoperichondrium. Unilateral perforations are common and usually heal spontaneously. Continuous bilateral septal perforations can lead to a persistent perforation that may need to be repaired.

**Take-Home Pearls**

- Techniques for septal surgery today emphasize conservative resection and preservation of septal cartilage and bone.
- Topical and local anesthesia is necessary for septal surgery for analgesic and hemostatic effects. Minimizing bleeding into the operative field is essential for adequate visualization of the nasal septum.
- Identification of the proper subperichondrial layer is essential as it ensures an avascular plane for dissection.

**References**