



# Straightening the Crooked Nose

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## Abstract

**Purpose of Reviews** The crooked nose is a challenge for all rhinoplasty surgeons as it produces functional and cosmetic deformities which sometimes can be very hard to correct. These deformities frequently compromise the internal and external anatomic structures of the nose. For example, deflection of the nasal septum can result in significant functional alterations of the internal and external nasal valves as well as obstruction within the nasal cavity leading to nasal obstruction at multiple levels. From a cosmetic standpoint, there can be asymmetries, deviations, irregularities of the nasal bones, and cartilaginous structures resulting in deformities of the multiple areas of the nose. A practical way of classifying deformities will be presented, and surgical techniques will be reviewed.

**Recent Findings** It is important to be able to make an accurate diagnosis of the functional and cosmetic deformity of every patient. With this, a stepwise approach is created where techniques are focused on the area of the nose that is being addressed and techniques are tailored progressing from simple direct approaches to more complex reconstructions. The final goal should be to achieve a cosmetically pleasing nose where external deformities are symmetrized (made symmetrical), and function is improved or restored completely.

**Summary** Management of the crooked is a real challenge even for the most experienced surgeons. Deformities are classified according to the anatomical location, and surgical techniques are defined using a stepwise approach progressing from the simpler techniques to more complicated and aggressive ones. The objective of surgery should be a nose with improved results externally which functions properly internally.

**Keywords** Crooked nose · Nasal obstruction · Nasal deviation · Nasal obstruction · External rhinoplasty · Septal deviation · Septoplasty

## Introduction

Straightening the crooked nose is a challenge for all rhinoplasty surgeons. Other terms include “deviated, twisted, scoliotic, or asymmetric,” and it can be defined as the nose that is not vertically in the midline of the face. The causes can be multiple but are generally classified as congenital, traumatic, or iatrogenic. These deformities can compromise

the bony pyramid, the cartilaginous structures, or frequently both. There is also a big difference as to when the trauma occurred. Trauma in childhood is usually associated with developmental growth asymmetries and can be harder to correct. Trauma occurring in adulthood usually is not associated with important facial growth asymmetries. When dealing with the crooked nose, there is frequently a functional and a cosmetic component that must be addressed which depending on the severity of the deformity can be a real challenge [1–5]. The real rhinoplasty surgeon must be capable of correcting not only the functional but also the cosmetic component of the nose, hence the term septorhinoplasty.

The purpose of this article is to review a practical classification that is frequently used by the author and to present the sequence of steps used in planning and executing the surgery. Surgical techniques will be discussed where the objective is to obtain improved cosmetic and functional results.

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## Preoperative Evaluation

The surgeon must have clear knowledge of the nasal anatomy and must clearly understand the interrelationships of the cartilaginous and bony structures. Patient evaluation starts with a complete medical history. It becomes very important to document previous history of trauma, any functional problems, and previous surgeries on the face and or nose including “functional” surgeries such as septoplasty.

The physical examination is just as important as documenting the history. The whole face must be evaluated, and facial asymmetries documented. Palpation of the nose should be done, and findings documented especially when trying to document concavities or convexities of the septal cartilage. Endoscopic evaluation can also help document turbinate hypertrophy, posterior deviations or spurs, and any other changes in the paranasal sinuses. A dynamic evaluation is also performed where internal and external nasal valves are evaluated and documented. All these findings are confirmed with X-ray evaluations such as CT scans and 3-D reconstructions of nasal bones.

Photographs are taken for each patient using all standard views required for rhinoplasty. The author uses computer imaging to discuss not only findings but also to discuss possible surgical options. The frontal view is used to point out facial and nasal asymmetries. The lateral and oblique views are used to evaluate the dorsum, tip projection, nasolabial angle, and the base view is used to evaluate base asymmetries, caudal septal deflections, and tip asymmetries. When morphing images, it becomes important to present realistic changes. It is here that the surgeon

can really evaluate what the patient expects from his/her surgery and in an objective fashion show the patient what can be achieved in a more realistic and down to earth fashion. It becomes important not to generate over expectations or show unrealistic results.

## Classification of the Crooked Nose

The crooked or deviated nose encompasses a series of deformities that oblige the surgeon to diagnose them in an accurate fashion, formulate an appropriate surgical plan, and execute the surgical maneuvers expertly if adequate correction is going to be obtained. Many classification systems have been proposed over the years some more complicated and more elaborate than others [6–9, 10••, 11–14].

The crooked nose needs an external and internal evaluation, keeping in mind that what happens externally on the nose does not always correlate with what is happening in the internal portion of the nose. The findings are then related to the interrelationship of the nasal bones with the nasal septum allowing the surgeon to synthesize an accurate understanding of the individual’s nasal form and function. Due to this complexity, externally the nose can be divided into thirds: upper, middle, and lower third (Table 1). The upper third of the nose is composed of the nasal bones. Internal septal deviations usually will not have an important impact on the external appearance in this area. The middle third of the nose represents the relationship of the septum with the upper lateral cartilages. Septal deviations will have an impact on the external appearance of this middle third area.

**Table 1** External components of the nose and surgical options

| Component of the nasal deviation and surgical options   |   |
|---|---|
| Component of nasal deviation  | Surgical options  |
| Upper third of the nose   | Osteotomies (medial, intermediate, lateral)<br>Dorsal management with osteotomes or rasps<br>Dorsal management with powered instrumentation   |
| Middle third of nose <ul style="list-style-type: none"> <li>• Upper lateral cartilages (ULC)</li> </ul>               | Spreader grafts, ULC spreader flaps, extended spreader grafts<br>Spreader flaps<br>Septal crossbar technique<br>Onlay grafts<br>Clocking or septal rotation stitch  |
| Lower third of nose <ul style="list-style-type: none"> <li>• Caudal septum</li> <li>• Nasal tip structures</li> </ul> | Septoplasty<br>Septal extension graft/overlapping septal extension graft<br>Extracorporeal septoplasty<br>Modified extracorporeal septoplasty<br>Nasal spine swinging door technique/fixation of caudal septum to nasal spine<br>Batten or onlay grafts |

The lower third of the nose represents the relationship of the caudal septum with the lower lateral cartilages (alar cartilages). Caudal septal deviations will have a direct impact on the nasal tip. Many classifications have been used to evaluate septal deviations and help define surgical approaches. From a practical standpoint, the quadrangular cartilage (septal cartilage) can be divided into 6 categories where the cartilage is evaluated in its anteroposterior position and cephalocaudal position. Using this classification, septal deviations can be divided into: septal tilt deformity, C-shaped anteroposterior deviation, C-shaped cephalocaudal deformity, S-shaped anteroposterior deformity, S-shaped cephalocaudal deformity, and localized deviations and spurs [10••] (Fig. 1).

**Septal tilt deformity** It is the most common deviation where the septum is straight but tilted to one side internally, and externally it is shifted to the contralateral side. Best seen on an axial CT scan.

**C-shaped anteroposterior deviation** The second most common type of deviation where the septum is curved internally, and the nose is deviated externally in the opposite side of the internal deviation. Can easily be seen on an axial CT scan.

**C-shaped cephalocaudal deformity** The patient presents an external c-shape deformity on the dorsal septum. Easily seen on coronal CT scan.

**S-shaped anteroposterior deformity** The patient presents an s-shape deviation inside his nose but externally presents a deviation to one side. Easily seen on an axial CT scan.

**S-shaped cephalocaudal deformity** The patient presents an s-shape deformity externally on his nose. The external deviation will follow the patient's internal septal deviation. Best seen on coronal CT scan.

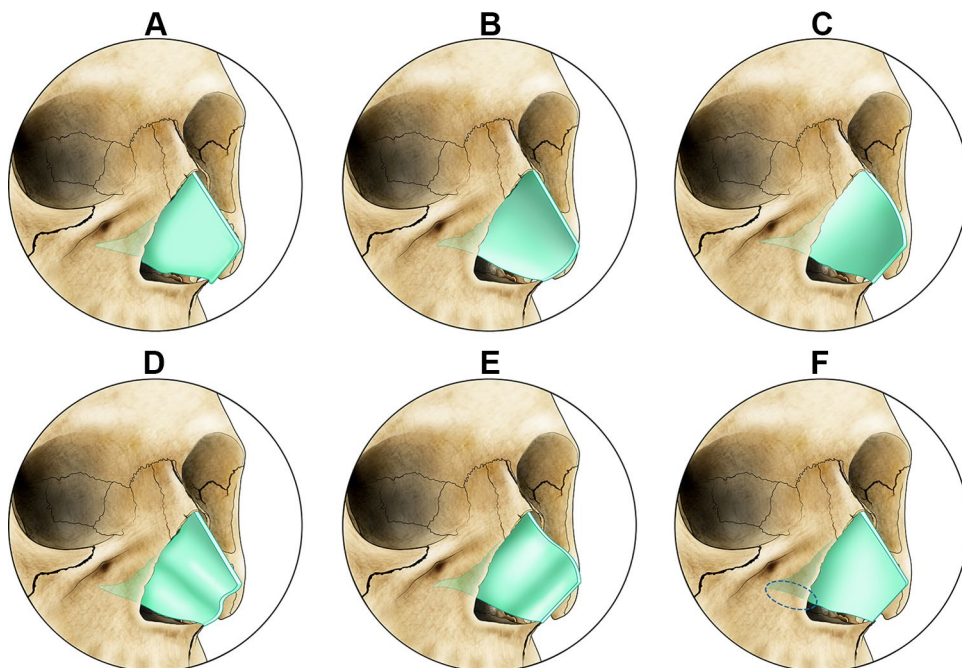
**Localized deviations/spurs** Patients with internal septal deviations and spurs which can cause a functional problem.

## Surgical Approach for the Crooked Nose

Functional and cosmetic alterations must be corrected to be able to obtain satisfactory results when approaching the crooked nose. Some basic steps are always used when treating these patients, and modifications will be made depending on specific problems of each individual patient. The steps are:

1. Access to all deviated structures using the open approach
2. Release of all mucoperichondrial attachments to the bony and cartilaginous external portion of the nose and internally on the nasal septum
3. Subperichondrial dissection of dorsal portion of cartilaginous septum and freeing of upper lateral cartilages (ULC) from dorsal septum. Subperiosteal dissection over nasal bones followed by dorsal bony reduction with rasps or powered instrumentation as needed
4. Correction of septal deviation/preservation of dorsal L-strut
5. Reconstruction techniques of septal L-strut

**Fig. 1** Classification of septal deviations: **A** Septal tilt deformity, **B** C-shaped anteroposterior deviation, **C** C-shaped cephalocaudal deformity, **D** S-shaped anteroposterior deformity, **E** S-shaped cephalocaudal deformity, and **F** Localized deviations and spurs



6. Management of internal components of nose contributing to septal deviation like hypertrophied turbinates/concha bullosa
7. Bony osteotomies
8. Tip refinement techniques/camouflaging techniques/closure

### Approach to the Nose and Septum

Crooked noses usually have a bony and a cartilaginous component, and both should be addressed accordingly. The open rhinoplasty approach is used to access all nasal structures. A midcolumnar inverted V incision is performed, and a skin flap is elevated in a subperichondrial plane in the lower two-thirds of the nose and in a subperiosteal plane over the bony dorsum.

### Release of Mucoperichondrial Attachments

The cartilaginous nasal component has extrinsic (forces arising from upper and lower cartilages, vomer, perpendicular plate of ethmoid, and the maxillary crest) and intrinsic forces (the complete quadrangular cartilage) playing a role in the deviation, and all should be properly released. The medial crura are dissected, and the caudal septum is identified. A subperichondrial plane is carefully dissected using a 15 blade or a Cottle dissector. Once this plane is clearly identified, the quadrangular cartilage is degloved in a subperichondrial plane on both sides in an anteroposterior direction including the perpendicular ethmoid plate and vomer. Anteriorly, a wide dissection is performed on all fibrous connections and ligament structures around the nasal spine, nasal floor, and maxillary crest. Inferiorly, the dissection is continued over the maxillary crest in a subperiosteal plane. This wide dissection permits adequate mobilization of all cartilaginous and bony structures and aids in straightening the deviated structures.

### Freeing of ULC from Dorsal Septum/Dorsal Bony Adjustments

Externally, the dissection is continued superiorly to the dorsal portion of the septum, and the upper lateral cartilages (ULC) are separated from the septum using sharp dissection while preserving septal mucosa. Freeing the septal cartilage completely from all intrinsic and extrinsic forces will let the surgeon objectively evaluate the degree of deviation of the dorsal and caudal portion of the septal cartilage. The ULC are then freed from its attachments to the alar cartilages (AC) at the scroll area.

The author prefers to address the bony dorsum before performing important changes on the nasal septum. The dorsum can be lowered or regularized using rasps or powered

instrumentation to remove the bony cap when necessary. In this point of the surgery, if there is an important osseocartilaginous hump, the height of the dorsum is defined. Osteotomies are performed after septal work has been performed and is defined depending on the patient's individual bony deformity. The septal dorsal height is carefully defined and executed using a 15 blade and taking care to preserve the height of the ULC.

### Correction of Septal Deviation/Preservation of Dorsal L-Strut

After all extrinsic and intrinsic forces have been released, the septum is evaluated. Deviations must be addressed and straightened taking care to maintain and even reinforce dorsal and caudal nasal support. The deviated portion of the septum must be resected leaving an L-strut of at least 10–15 mm dorsally and caudally being careful to round the anterior incision on the L-strut as this will help prevent fractures of this area. Deviations of the perpendicular plate of ethmoid and vomer are resected as well as deviations of the maxillary crest. If possible, it is important to try and preserve the attachment of the L-strut to the perpendicular plate of the ethmoid at the key-stone area and anteriorly to the nasal spine and maxillary crest.

### Reconstruction Techniques of the Septal L-Strut

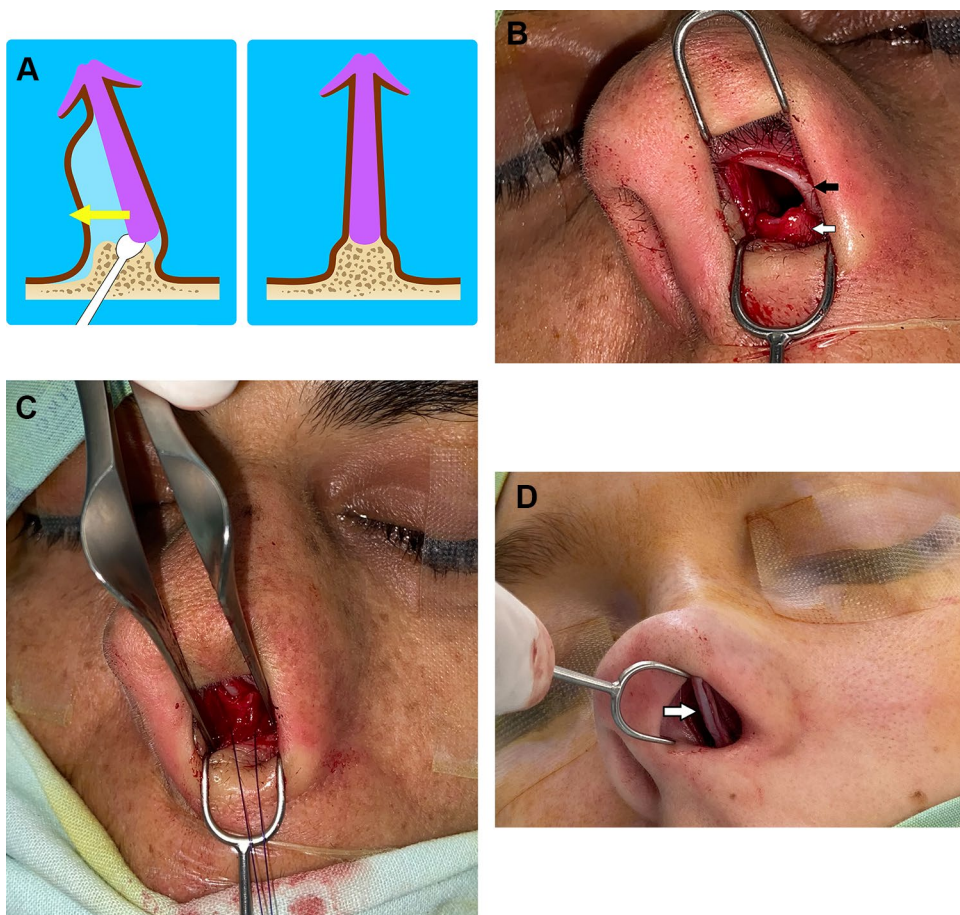
If the dorsal or caudal septum deviations or deformities of the L-strut persist, they should be addressed with more aggressive techniques [15].

### Techniques for the Caudal Septum

When the caudal septum is deviated off the midline anteriorly, it must be released from its attachment to the nasal spine and maxillary crest and repositioned. This many times will require a “swinging door” technique with a small wedge resection of cartilage at the posterior septal angle and, if necessary, extended over the maxillary crest to make sure the inferior portion of the cartilage is correctly aligned in the midline. The caudal portion of the septum must be secured to the nasal spine with a 4–0 PDS suture. This stabilization can be done with a hole through the nasal spine or attached to the nasal spine periosteum and ligament structures. If the anterior nasal spine is fractured or deviated, it must be repositioned in the midline before the caudal edge of the cartilage is fixed to it. If after correction and alignment of the caudal portion in the midline a concavity remains, a small rectangular batten graft can be secured to the concave side thus straightening the septum (Fig. 2).

In cases where the caudal septum cannot be aligned using a swinging door technique the use of a septal extension graft

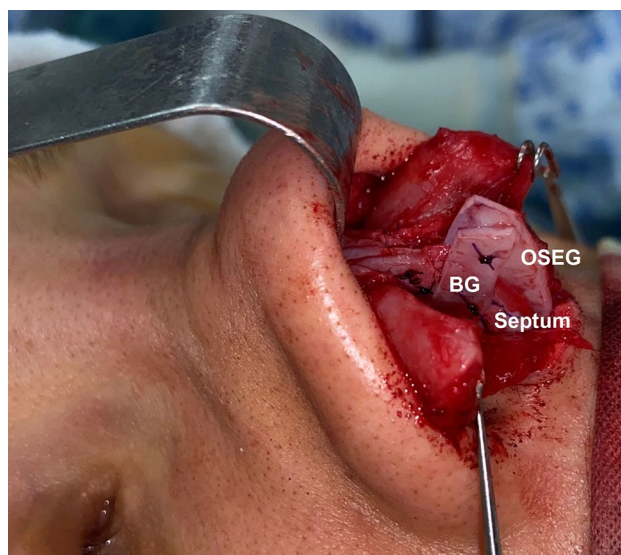
**Fig. 2** Swinging door technique: This is used when the caudal portion of the cartilage is long and deviated to one side of the nasal spine as in the septal tilt. A small wedge of cartilage is resected inferiorly, and the inferior portion of the cartilage is “swung” to the midline and attached to the nasal spine. **A** Schematic diagram of the technique. *Yellow arrow* signals direction where caudal septum will be shifted to be realigned. **B** Image of caudal septal cartilage deviated to the left (*black arrow*). *White arrow* signals nasal spine. **C** Cartilage placed on nasal spine and secured with a 4–0 PDS suture. **D** A batten graft (*arrow*) can sometimes be placed on concave side of cartilage to help straighten any concavities that can remain after aligning the caudal septum



(SEG) or a septal replacement graft (SRG) can be an option to stabilize and give additional support. This graft should be designed using a relatively straight piece of septal cartilage. If septum is not available, conchal cartilage (not ideal) or rib cartilage can be used. The author prefers to use a SEG placed overlapping the concave or deviated side and fixed in place thus realigning the caudal end of the septum. A bolster stabilizing rectangular graft is usually placed on the contralateral side stabilizing the caudal septum in the midline (Fig. 3).

### Straightening the Dorsal Portion of the L-Strut

There are several alternatives to correct dorsal deviations. Scoring and suturing techniques have been described. The clocking suture or septal rotation suture is a mattress suture that is placed cephalically on the convex side of the septum through the ULC and more caudally through the ULC on the concave side of the septum. In this way when it is tied down the septum is straightened towards the cephalic entrance point of the suture [16, 17]. A stronger option is the use of uni or bilateral spreader grafts to realign the dorsal component of



**Fig. 3** Overlapping septal extension graft (OSEG). The OSEG is fashioned from a straight piece of cartilage and placed overlapping the most concave side of the caudal septum and sutured in place. On the contralateral side, it is stabilized with a rectangular piece of cartilage and used as a bolster graft (BG)

the L-Strut. These grafts can be fashioned from septal, ear, or rib cartilage. Septum and rib are preferred choices for this type of grafts as they provide a stronger support. Grafts can be placed on the concave side, bilaterally, in an asymmetric fashion, extended up into the nasal bones, extended caudally to the anterior nasal angle, or used in a crossbar fashion [18, 19]. Spreader grafts have different functions; they can be used to realign the dorsal component of the L-strut, maintain or correct the internal nasal valves, structure, and increase the support of the dorsal component of the septum.

Once the dorsal septum has been realigned, the ULC are sutured back in place using 5–0 PDS. ULC can be folded in as spreader flaps to correct minor asymmetries or trimmed slightly. It is important to properly fix the ULC in place at the proper desired height to prevent posterior asymmetries in this area [20].

### Major Reconstruction of the L-Strut

In cases with a severely crooked nose especially in the dorsal and caudal cartilaginous segments, more aggressive techniques are needed like the septal crossbar graft, an extracorporeal septoplasty, or the anterior septal reconstruction [21, 22–27]. The last two techniques imply resection, reshaping, and reinsertion of the new reconstructed quadrangular cartilage. The extracorporeal septoplasty is a technique where the quadrangular cartilage is resected with part of the ethmoid bone and vomer. The L-strut is reconstructed on the surgical table with straight pieces of septal cartilage and when needed bone. The reconstructed L-strut is then introduced into the nose and fixed in place at the rhinion and anterior nasal spine. Many times, this new L-strut can be reinforced with bilateral spreader grafts. The drawback of the extracorporeal technique is the technical difficulty in stabilizing the implanted L-strut in the keystone area which can result in deformities in this area over time. An alternative technique to the extracorporeal septoplasty is the anterior septal reconstruction (ASR). In this technique, the septal cartilage is resected, but a dorsal strut of 1–2 cm in length is left attached to the keystone area. A new L-strut is created and reattached to the dorsal keystone strut and the nasal spine. In the cases where the quadrangular cartilage is severely deformed or insufficient, the L-strut can be refashioned with rib cartilage that is usually harvested from the 6<sup>th</sup> or 7<sup>th</sup> rib of the patient. The rib offers an important amount of cartilage that if carved properly is an excellent option for creating structure in the nose.

### Management of Internal Components of Nose Contributing to Septal Deviation Like Hypertrophied Turbinates/Concha Bullosa

All internal components should be addressed and treated to guarantee adequate nasal air flow. If previous CT scans

show turbinate hypertrophy or presence of concha bullosa, these are properly treated endoscopically. Compensatory turbinate hypertrophy should be treated surgically as the turbinate will not spontaneously reduce its size when the septum is aligned.

### Bony Osteotomies

Osteotomies should be planned rigorously and should only be performed after the bony dorsum has been evaluated. If any dorsal reduction is going to be performed, the length of the nasal bones should be considered. If there is a clear bony deviation, the sides should be closely examined. Usually, the bony segment on the deviated side tends to be more vertically oriented so this will mean less bony resection or rasping on the deviated side. If this is executed properly, when osteotomies are performed, bony heights will be symmetrical. Currently, the author is executing the dorsal reductions with cutting cylindrical burs and final refinement with diamond burs.

With a deviated bony pyramid, medial and lateral osteotomies are usually performed to be able to align all bony structures. Medial osteotomies are performed initially followed by lateral osteotomies. In the cases where the bone is convex, an intermediate osteotomy is performed. If intermediate osteotomies are going to be performed, they should be done before the lateral osteotomies and on a stable fragment of bones. In this way, comminution can be prevented. Osteotomies should be complete, and bones should be completely loose. It is important to avoid greenstick fractures to prevent re-deviation of bony fragments during the healing period.

### Tip Refinement Techniques/Camouflaging Techniques/Closure

Symmetry must also be achieved in the nasal tip structures. This is done with sutures and grafts keeping in mind we always want to reinforce the support structures of the nasal tip.

Final refinements and camouflaging techniques are used filling in concavities with finely diced cartilage and cartilage paste. Fascia harvested from the temporalis muscle or rectus abdominal muscle can be used as a covering to hide irregularities and create a smooth surface especially over the nasal dorsum. It can also be used as a nasal tip covering.

Skin flap is closed with 6–0 fast absorbing vicryl. Septal mucosa is closed with a running 5–0 fast absorbing quilting suture to eliminate dead space and possible hematoma formation. If needed, nasal splints are used combined with a light nasal packing to eliminate the possibility of hematoma formation. The nose is taped and covered with a thermoplastic splint that is removed on day 7. The nose

is taped for an additional 7 days. After the 2nd week, nasal exercises are started to help keep bony structures aligned in the midline.

## Conclusions

Straightening a crooked nose is always a challenge even for the most experienced surgeon. Usually, functional and cosmetic issues are present, and both should be addressed simultaneously. All extrinsic and intrinsic forces that have an impact on the nasal septum should be freed. The objective of surgery is to properly align all bony and cartilaginous structures. It becomes critically important to end up with a straight, reinforced septal L-strut that is properly stabilized in the midline. This means dorsal stabilization and caudal stabilization at the anterior nasal spine. This is achieved by the author using an open rhinoplasty approach and aligning structures with sutures and grafts. In cases of severe deformity, more aggressive surgical techniques are required like extracorporeal or modified extracorporeal techniques. Once all reconstruction is finalized, dorsal and nasal irregularities or small asymmetries can be managed with finely diced cartilage or cartilage paste and or covered with fascia grafts. Surgical techniques must be planned and executed thinking in long-term results where form, function, and stability are prioritized. The final objective of surgery is to obtain consistent results that will not change over time.

## Compliance with Ethical Standards

**Conflict of Interest** The author declares no competing interests.

**Human and Animal Rights and Informed Consent** This article does not contain any studies with human or animal subjects performed by any of the authors.

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