

Perspective

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Structural rhinoplasty for the persistently twisted nose

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Abstract

Correction of a crooked nose after primary rhinoplasty is a not uncommon and often complex problem encountered by facial plastic surgeons. Adequate and lasting correction of the deformity requires a thorough assessment of the anatomy contributing to the deviation, as well as the application of robust techniques to correct the problem at each subsite, which is reviewed in this article. Finally, risk factors for failure and common pitfalls are discussed.

Keywords: Rhinoplasty, crooked, twisted, nose, structural, deviated

INTRODUCTION

The persistently twisted or crooked nose after primary rhinoplasty is a challenging problem that often presents to the facial plastic surgery clinic. Etiologies can include prior blunt trauma (e.g., motor vehicle collision, sports), iatrogenic (e.g., prior nasal surgery), or congenital deformities. These patients often present with cosmetic as well as functional problems which can be distressing to the patient from both a physical and psychosocial standpoint, particularly when they have already failed prior surgical repair(s). Adequate correction requires a thorough analysis and understanding of each aspect of the deviation. This article details a systematic and level-based approach to achieving this. While a variety of techniques are available and have been previously described in the literature, we will focus on structural correction of more severe deformities affecting multiple levels using basic and advanced techniques for the rhinoplasty surgeon.



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ANALYSIS OF THE TWISTED NOSE

The first step in addressing the crooked or twisted nose starts with a thorough physical examination to understand the factors contributing to the patient's deformity and allow for the creation of an accurate surgical plan. Baseline facial analysis and asymmetry (e.g., hemifacial microsomia) should be assessed and pointed out to the patient, as this may contribute to the perception of a crooked nose. Symmetry in both the vertical and horizontal dimensions should be scrutinized closely. For vertical symmetry, using the midline teeth, lip, or glabella can help to determine any discrepancy and degree of deviation. The patient's skin type and thickness should be noted, since thicker skin tends to better camouflage cartilage irregularities. Noting areas of scarring, contracture, and contour irregularities can give insight into what may have been previously resected or missing from the native structure. Observing both normal and then more forceful inspiration may reveal the presence of dynamic nasal valve collapse^[1]. The external nasal appearance should be analyzed and broken down by upper, middle, and lower thirds [Table 1]. Both the side of deviation and the shape of the deformity can help one to predict the underlying cartilage contour. The base view is then analyzed with attention to nostril asymmetry and the presence of caudal septal deviation. Nostril asymmetry is often a difficult problem to correct and can be the result of soft tissue, lower lateral cartilage crural size or shape, or caudal septal deviation. Manual palpation of the caudal septum aids in identifying the shape and strength of the caudal septal strut. Intranasal examination is useful for analyzing the nasal airway including any septal deviation or nasal valve narrowing that contributes to nasal obstruction. The modified Cottle maneuver is performed by placing an instrument gently under the upper lateral cartilage caudal edge and lifting superiorly and laterally. It should be noted that only gentle support of the nasal sidewall rather than dramatic and overaggressive lateralization should be performed for the most accurate assessment and to provide realistic expectations for improvement with surgical intervention. Patients who subjectively report improved airflow during the modified Cottle maneuver may benefit from grafting to open and/or stiffen the nasal valve. Finally, preoperative photographs should be obtained of the frontal, oblique, lateral, and base views^[1]. These photos may reveal subtle deformities overlooked during the initial physical examination, can be reviewed pre- and postoperatively by the surgeon and/or patient, and are used for medicolegal documentation. The use of anatomic landmarks to ensure photos are taken straight and without slight tilting or turning of the head can aid in determining the degree of asymmetry or deviation. Many patients learn to turn their heads to make photos more favorable, but this can preclude accurate assessment and counseling. Candid discussion and appropriate expectations should be established with the patient preoperatively.

TECHNIQUES TO ADDRESS NASAL DEVIATION BY SUBSITE

Correction of upper third

Correction of the upper "bony" third has been classically based on osteotomies for control and manipulation of the bony pyramid to create smooth brow-tip aesthetic lines^[2]. Thorough evaluation with both visual inspection and palpation of nasal bone contour differences, irregularities, asymmetry, and prior fracture lines can help with planning the osteotomies. When there is a significant discrepancy in the length of the nasal sidewall, multiple lateral osteotomies or an intermediate osteotomy is useful on the longer nasal bone or to correct a convex shape^[3,4]. In our practice, we utilize the "high-low-high" lateral osteotomy technique with subsequent digital manipulation and molding^[5]. The initial "high" cut is started high on the pyriform aperture to preserve Webster's triangle and avoid nasal airway collapse. The angle of the hand is then dropped for the "low" portion which is well within the maxillary groove to avoid palpable osteotomy step-offs. Finally, the last "high" angle is curved superiorly again toward the nasofrontal suture line. Medial osteotomies can be performed in order to control the back fracture and are sometimes completed prior to open septoplasty to avoid destabilizing the dorsal septal keystone region. Occasionally, a percutaneous transverse osteotomy aimed caudally from the nasal root, in addition to bilateral lateral osteotomies, can

Table 1. Techniques for correction of deviation by subsite

| Upper third | Middle third | Lower third |
|--------------------------------|----------------------------|--|
| Medial and lateral osteotomies | Spreader grafts | Correcting a deviated caudal septum <ul style="list-style-type: none"> ● Caudal septum wedge resection ● Caudal septum scoring ● Septal batten graft ● Caudal septal replacement with extended spreader grafts ● Extracorporeal septoplasty |
| | Septal batten grafts | Clocking suture |
| | Extended spreader grafts | Lateral crural strut grafts |
| | Asymmetric spreader grafts | |

mobilize the entire bony pyramid *en bloc*, if necessary, in a technique similar to that used in preservation rhinoplasty cases. Additionally, ultrasonic saws are another option for performing the osteotomies with high precision, although wider dissection is often required to achieve an adequate view.

Correction of middle third

Middle vault asymmetry may be due to factors including dorsal septal deviation, upper lateral cartilage asymmetry, or disinsertion of the upper lateral cartilage from the nasal bones. The mainstay technique for correction of this region includes the spreader graft and its variations to both functionally widen the internal nasal valve and to aesthetically camouflage a middle vault depression^[6-8]. Spreader grafts may be created from various cartilage sources including septal, costal, and auricular; these grafts typically measure 1-2 millimeters thick, 3-5 millimeters tall, and 2-3 centimeters long. They can be placed via endonasal or open approach. Each spreader graft is either inserted into a precise submucosal pocket or suture fixated between the upper lateral cartilage and dorsal septum [Figure 1]. Spreader grafts can even be placed quite caudally into the medial osteotomy sites to help lateralize the mobilized nasal bones and correct persistent deviations in continuity with the bony vault.

Spreader graft modifications include septal batten grafts and extended spreader grafts. Septal batten grafts may be implemented for stabilization of a deviated dorsal septal strut and are typically 1-1.5 centimeters in height with thickness and length similar to typical spreader grafts. They are positioned between the upper lateral cartilage and dorsal septum. Another spreader graft variation is the extended spreader graft. Extended spreader grafts can provide increased caudal septum control for correcting tip deviation and tip position^[9]. These grafts sometimes measure up to 4 centimeters long to span the length from the nasal bones to beyond the caudal edge of the native septum for stabilization of septal extension grafts or septal replacement grafts [Figure 2]^[10]. Traditional spreader grafts, septal batten grafts, and extended spreader grafts all function to increase control of the dorsal septum, improve symmetry, and maintain or restore middle vault stability. We secure these grafts using a horizontal mattress suture and either nonabsorbable (5-0 nylon) or long-absorbing (5-0 polydioxanone or PDS) sutures. Adequate correction of the middle third often serves to improve both functional and aesthetic components of the deviated nose and restore structural integrity and patency to the nasal airway.

Asymmetric spreader grafting is sometimes used to correct the asymmetric middle vault^[11]. Asymmetric grafting can either be executed with a unilateral graft on the depressed side or with a double-thickness graft when using bilateral spreader grafts. Turning in the dorsal aspect of upper lateral cartilage as an auto-spreader graft or flap can be considered in instances with a minimally deviated dorsal septum and insufficient cartilage for grafting.

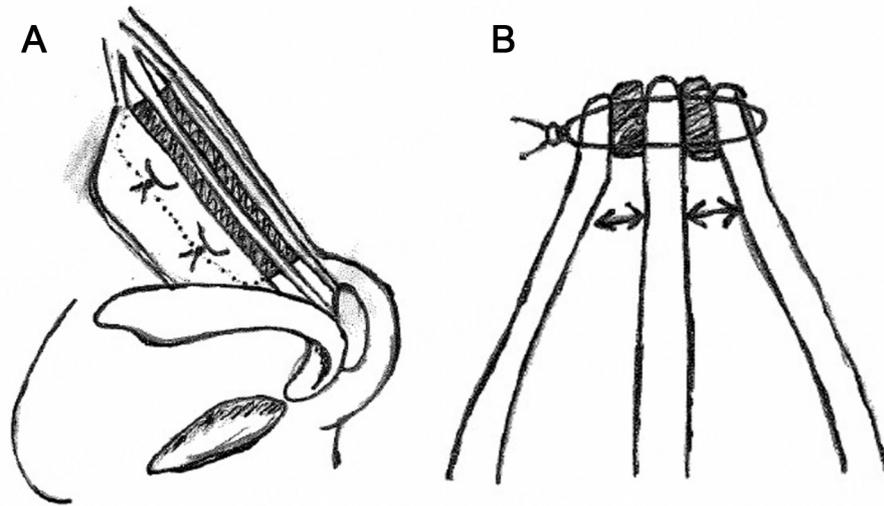


Figure 1. (A) A traditional spreader graft spanning the length of the upper lateral cartilages. (B) Axial view of spreader graft placement functioning to open the internal nasal valve. Image courtesy: Porter *et al.*^[18].

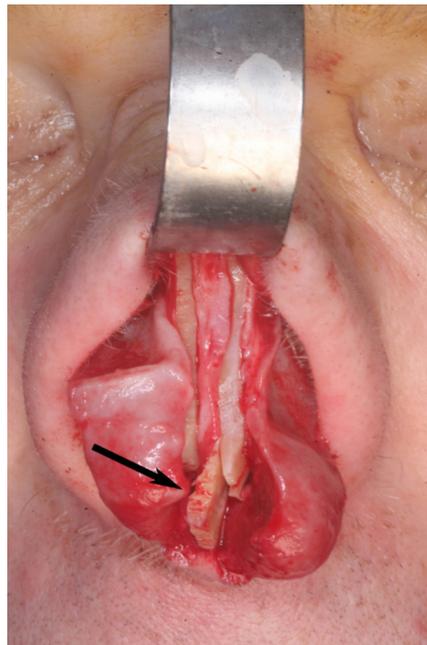


Figure 2. Intraoperative image of bilateral extended spreader grafts. A caudal septal extension graft is shown by the black arrow. Image courtesy: Porter *et al.*^[18].

Correction of lower third

Persistent deviation of the lower third or nasal tip following adequate correction of the middle third and bony vault is secondary to either persistent caudal septal deviation or lower lateral cartilage asymmetry.

Correcting a deviated caudal septum

A persistently deviated septum is a common source of failure following prior surgery to straighten the nose. More conservative, less invasive traditional septoplasty techniques are sometimes insufficient to correct a complex caudal septal deviation. Correcting a caudal septal deviation depends on the area of displacement

and integrity of the remaining native strut. When there is only deviation of the posterior septal angle from the maxillary crest, the septum can be released sharply, repositioned at midline or with a slight overcorrection, and reattached at the new position with 4-0 PDS to nasal spine periosteum^[12]. If there is not enough periosteum for fixation, a fixation hole can be bored at the nasal spine with either a large-gauge needle, a small drill bit, or a piercing towel clamp to anchor the suture.

Correction of a bowed or deviated caudal septal strut can be performed through multiple techniques. When there is excess height of the caudal septum causing bowing, a sliver of caudal septal strut from the posterior angle can be resected to allow for tensionless straightening of the residual caudal strut^[8,12]. Scoring of the concave portion of the cartilage can also help to release tension and allow straightening of the cartilage. However, this technique is rarely effective when used alone as it weakens the cartilage and increases susceptibility to buckling. Septal batten grafting using cartilage or thin bone can be utilized to straighten and reinforce the corrected caudal septal cartilage [Figure 3]^[13,14]. These grafts should span the deviation and are stabilized with mattress suturing with 5-0 PDS or nylon sutures. Bone grafts are often predrilled with multiple small holes using an 18-gauge needle for ease of suture fixation.

Finally, for the most severe nasal septal deviations, advanced reconstruction techniques including extracorporeal septoplasty and caudal nasal septal replacement grafting stabilized with extended spreader grafts may be necessary^[15,16]. For extracorporeal septoplasty, the full cartilage L-strut is resected and rebuilt *ex vivo* prior to reimplantation^[17]. The external rhinoplasty approach is typically required for adequate exposure and fixation to the keystone region. While nasal septal cartilage and bone can be used, costal cartilage is frequently needed to provide adequate structure^[18]. Once the reconstructed L strut is created, it must be fixated at the anterior spine and keystone regions. For the anterior spine attachment, a midline groove can be created using an osteotome and then secured as described above. The newly constructed dorsal septum is fixated to a small area of preserved native dorsal septum in the keystone region or to the predrilled caudal nasal bones using 4-0 PDS or nylon suture in a horizontal mattress fashion. The upper lateral cartilages must then be secured to the newly constructed septal strut. Intranasal splinting is often done for 1-2 weeks postoperatively^[19-21].

Another technique preferred by the authors for advanced septal reconstruction is caudal septal replacement with extended spreader grafting.⁹ Benefits of this technique include preservation of the native dorsal septum and keystone region, which are technically more challenging to reconstruct. This technique requires preserving a dorsal strut measuring at least 1.5 centimeters long and 1 centimeter tall without disruption of the keystone. A caudal septal replacement graft is created from septal cartilage or costal cartilage 2-3 centimeters in length, 1 centimeter tall, and 1-2 millimeters thick. The graft is then fixed caudally at the nasal spine and extended spreader grafts stabilize the graft at the anterior septal angle.

Clocking suture

A clocking suture or septal rotation suture is one technique to correct a mild but persistent deviation of the nasal tip. A horizontal mattress suture is placed obliquely from the upper lateral cartilage cephalic edge (contralateral to the deviated tip) to the caudal septum at the anterior septal angle using a 4-0 or 5-0 nylon or PDS suture^[22,23]. If a spreader is present, the clocking suture caudal component should include both the spreader and septum. The suture is then tightened sufficiently to reposition the anterior septal angle toward the anchoring contralateral upper lateral cartilage [Figure 4]. Minor positioning variations like moving more caudally on the septum and cranially on the upper lateral cartilage can increase the tension and cause the septum to move laterally and cranially.

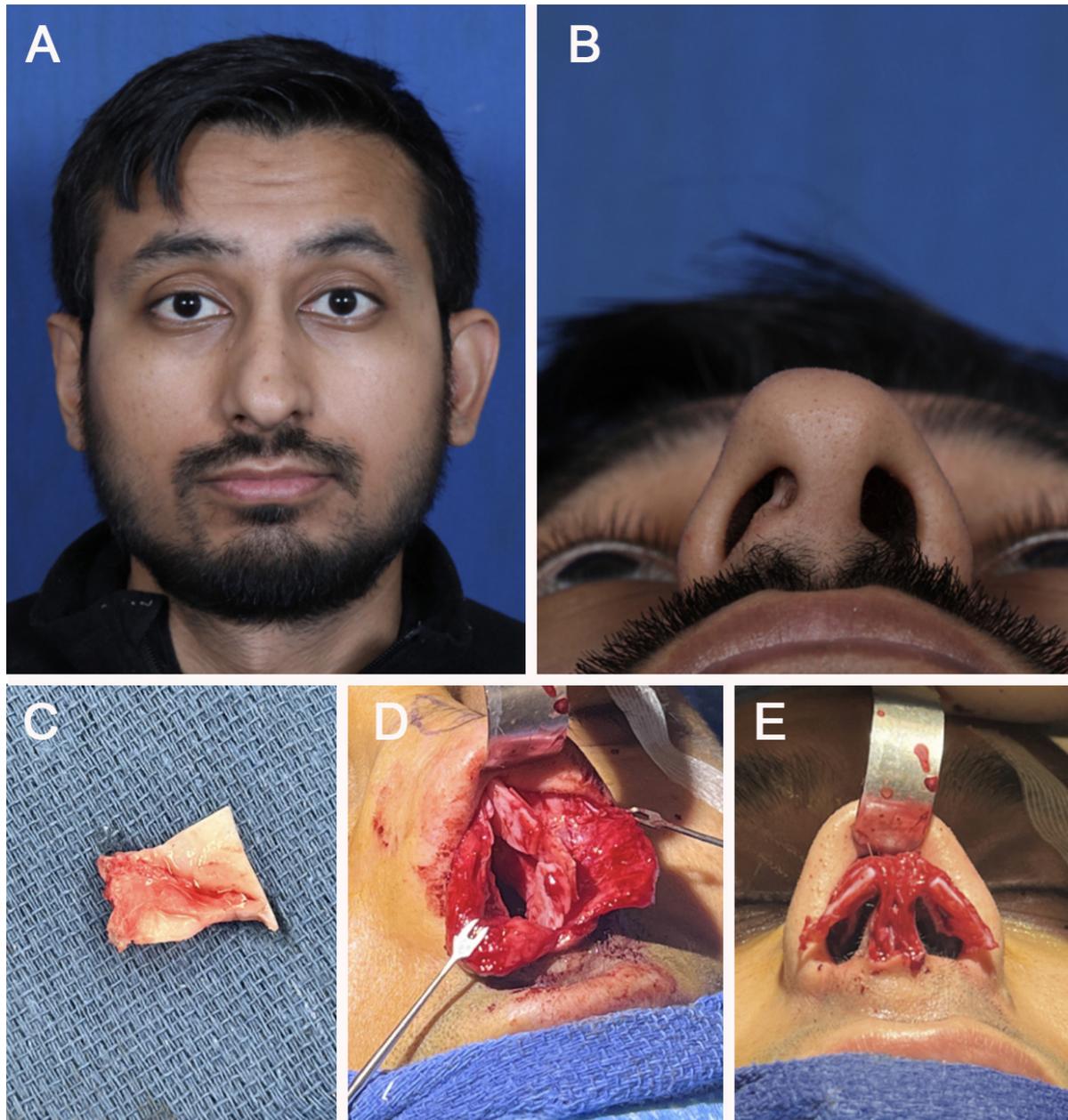


Figure 3. (A, B) Patient with a history of prior nasal trauma and severe right-sided nasal obstruction due to caudal septal deviation and nasal collapse. (C) The severely deviated caudal septum required excision. (D) Septal cartilage and the perpendicular plate of the ethmoid bone were used for L-strut reconstruction in vivo. (E) Additional lateral crural strut grafting was performed for external nasal valve support. Image courtesy: Oliver et al.^[16].

Lateral crural strut grafts

A technique often utilized to correct lower lateral cartilage asymmetry is lateral crural strut grafting [Figure 5]^[24]. This can be particularly helpful when there is a significant discrepancy between the two sides in contour, shape, or size. First, a dissection plane is created between the lateral crura and its vestibular lining with hydrodissection using local anesthetic. A precise pocket is then bluntly dissected laterally within the alar soft tissue or under the alar crease for placement of the graft laterally. A more caudal placement of this graft can correct alar retraction. This graft is secured to the overlying lower lateral cartilage with horizontal

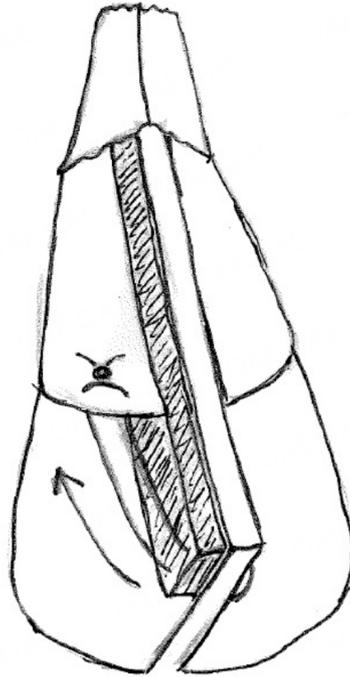


Figure 4. A clocking suture and unilaterally extended spreader or septal batten graft for correction of a deviated middle vault and nasal tip. Image courtesy: Porter et al.^[18].

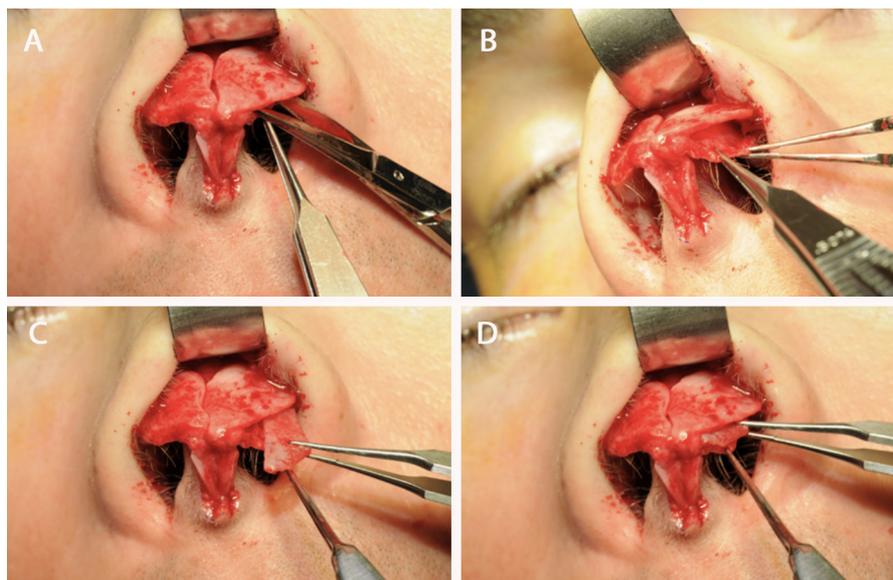


Figure 5. (A) Meticulous dissection of the vestibular lining off of the lateral crus. (B) The pocket is complete once the vestibular lining is fully released. (C) The lateral crural strut graft is inserted into the pocket. (D) Final graft placement prior to suture fixation. Porter et al.^[18].

mattress sutures. Asymmetric crura may necessitate asymmetric lateral crural steal or suturing techniques in addition to lateral crural strut grafting for adequate correction of the lower lateral cartilages.

RISK FACTORS FOR PERSISTENT DEVIATION

Many risk factors can predispose patients to a persistently twisted or crooked nose. Assessment of baseline facial asymmetry should be performed and, if present, should be discussed with the patient to establish appropriate expectations prior to surgical intervention. Congenital or acquired irregularities of the nasal bones, cartilage, or soft tissue envelope make the deviated nose more challenging to correct. Severe deviation of the dorsal or caudal septal strut that is not adequately released and reinforced will often succumb to the memory of its native state and is a common site of failure in primary rhinoplasty due to the use of more conservative techniques.

Postoperative infection or wound healing issues may lead to an increased risk of graft failure or insufficiency; infections are often more severe in revision surgeries with poorly vascularized wound beds and plentiful cartilage grafting. Meticulous postoperative care and aggressive treatment of early post-surgical infection should be performed to avoid compromise of the underlying structure. Postoperative infection can be observed as early as a few weeks after surgery and, in our practice, is most often seen in high-risk patient populations such as healthcare workers with increased risk for colonization by drug-resistant microorganisms or in patients requiring copious costal cartilage grafting. These patients are started on early oral antibiotic treatment, with the most severe, resistant infections possibly necessitating intravenous antibiotics and additional surgical intervention for infection debridement and drainage.

CONCLUSION

Failure to recognize the true site and degree of nasal deviation often leads to inadequate release and reconstruction of the deviated portions of the nose. While an endonasal approach for intranasal septal deviation may suffice in most patients with nasal obstruction, open approaches are frequently preferable for more complex, and particularly revision, situations. The authors strongly advocate for the use of costal cartilage that expands graft options and increases rigidity. Treatment of the crooked nose tests the skills of the surgeon and frequently requires multiple techniques to achieve success.

DECLARATIONS

Authors' contributions

Conception and design of the manuscript, writing of the manuscript: Morisada MV

Conception and design of the manuscript, reviewing and editing of the manuscript, contribution of images: Humphrey CD

Conception and design of the manuscript, reviewing and editing of the manuscript, contribution of images: Kriet JD

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All authors declared that there are no conflicts of interest.

Ethical approval and consent to participate

Not applicable. Given that this article is not a research study but rather an overview of techniques incorporated, IRB approval was not obtained prior. We have obtained explicit written and verbal approval

from the patients included in this manuscript for the use of their photographs.

Consent for publication

Explicit written and verbal approval was obtained from all patients of whom their photographs were used.

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