

Overview of Dorsal Preservation Rhinoplasty



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KEYWORDS

• Dorsal preservation rhinoplasty • Dorsal hump • Structural preservation

KEY POINTS

- The en-bloc treatment of the nasal vault without disruption of the nasal keystone and dorsal esthetic lines has functional and esthetic benefits.
- Dorsal preservation can be combined with open structural methods.
- Although the push-down (PD) and let-down (LD) are two primary techniques used to manage the osseous nasal vault, several modifications exist.
- The variations in septal techniques in dorsal preservation rhinoplasty (DPR) can be categorized by the location of septal cartilage resection and preserved shapes of subdorsal cartilage.
- Several techniques exist to minimize the stigmata of DPR including hump recurrence, mid-vault widening, and radix step-offs.

INTRODUCTION

Global interest in the preservation rhinoplasty has grown significantly following an editorial by Daniel in which relatively destructive rhinoplasty techniques were called into question.¹ Although preservation has been championed by several surgeons across the world for many years, resective and structural methodology has been pervasive.² Contemporary preservation rhinoplasty involves three primary and independent components: (1) avoiding lateral crural resection, (2) sub-perichondrial dissection, and (3) en bloc lowering of the dorsum (dorsal preservation rhinoplasty [DPR]).^{1,3–5} DPR has gained particular interest among rhinoplasty surgeons, both clinically and academically, over the course of the last 4 years. It should be emphasized that although dorsal preservation is not a new concept, the recent promotion of this ideology has led to valuable analysis and technical modifications.

HISTORICAL CONTEXT

A detailed history of DPR has been described elsewhere.⁶ The earliest description in 1899 by J. Goodale involved lateral and root osteotomies, along with septal resection, to lower the nasal dorsum as a single unit and eliminate a bony-cartilaginous hump.^{7,8} This technique resulted in the displacement of the bony vault into the nasal cavity (medial to the maxilla) and in contemporary DPR is known as the push-down (PD) technique (**Fig. 1**). O. Lothrop, in 1914, added wedge resections at the sidewalls so that the lateral aspects of the bony vault rested on the maxilla rather than being displaced medially to it.⁹ This has become known as the let-down (LD) procedure (**Fig. 2**).^{10–12} As can be ascertained by descriptions by Goodale and Lothrop, dorsal lowering has two requisites: (1) treatment of the external bony vault and (2) resection and mobilization of the underlying septal support.

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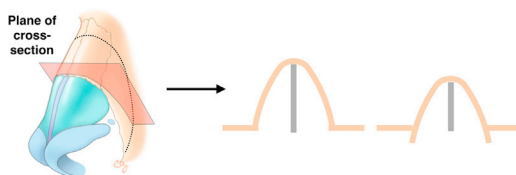


Fig. 1. Push-down (PD) technique. Lateral and transverse (radix) osteotomies combined with septal resection allows for en bloc lowering of the nasal pyramid. The nasal sidewalls are displaced into the nasal cavity.

ANATOMIC AND FUNCTIONAL CONSIDERATIONS

Descriptions of the relationships between the nasal bones, perpendicular plate of the ethmoid (PPE), septal cartilage, and the upper lateral cartilages (ULCs) help elucidate the mechanism and potential benefits of DPR techniques.^{4,5,13–15} As a review, the nasal bones fuse with the frontal bone superiorly, giving rise to the externally described radix. A dorsal hump will start at some distance between the radix and the rhinion (bony-cartilaginous junction). The rhinion consists of a nonrigid fusion of perichondrium and periosteum.¹⁶ Therefore, when the dorsum is lowered, there is flexion at this site and elimination of dorsal convexity. The ULCs attach to the midline septum and the undersurface of the nasal bones (overlap of 4–14 mm), giving rise to the medial dorsal and lateral keystone (**Fig. 3**).¹⁶ This lateral junction is semi-rigid and may hinder complete dorsal lowering.

Importantly, the septal cartilage also extends sub-dorsally under the nasal bones (see **Fig. 3**). The most cranial cartilaginous-bony junction has been variably named either the Ethmoidal (E), Keystone (K), or Junctional (J) point.¹⁷ The reported distance between the rhinion and E-point is 4 to 11 mm.^{17–21} A dorsal hump therefore largely sits over the cartilaginous septum. As high as 97% of humps may start caudal to the ethmoidal point.²¹ These features suggest that when the cartilaginous septum is resected, both the bony and cartilaginous dorsum will descend.

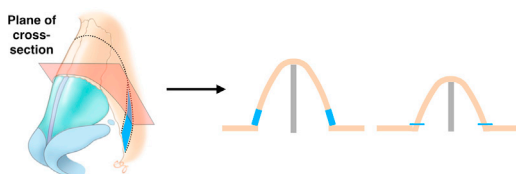


Fig. 2. Let-down (LD) technique. Osteotomies similar to the PD technique are performed with the additional resection of a wedge of bone at the sidewalls. When the dorsum is lowered after septal resection, the nasal sidewalls rest on the maxilla.

The nasal bone profile between the naso-frontal junction and the rhinion may be V-shaped or S-shaped (**Fig. 4**).²² V-shaped nasal bones have a straight contour along its whole course with an apex at the rhinion. S-shaped nasal bones present a curved contour with the most prominent point (kyphion) present cephalic to the rhinion. These shapes have implications for preservation techniques.

The junction between the ULC and nasal septum contributes to the internal nasal valve (INV). Preservation techniques avoid disruption and the need to reconstruct this anatomically sensitive area. However, given the fusion of the ULC with the nasal bone, positional changes in the bony vault will be transmitted to the cartilaginous middle vault in DPR. In a radiological analysis of patients undergoing either PD or LD, an improved INV angle was noted.²³ In a cadaveric radiologic study, the INV dimensions/angle did not change in the LD technique or Joseph hump resection with appropriate midvault reconstruction, but did decrease with the PD technique.²⁴ This is attributed to the medialization of the nasal sidewall into the nasal cavity with the PD technique. The PD technique can be performed with a lateral osteotomy of bone (thinning the lateral nasal wall) to minimize obstructive sequelae.²⁵

INDICATIONS FOR DORSAL PRESERVATION RHINOPLASTY

Although the PD or LD techniques are well recognized as treatment strategies for the bony vault, descriptions of surface modifications ($\pm$ osteotomies) have introduced new partial approaches to DPR. The contemporary definition of DPR does not require preserving the continuity of the bony-cartilaginous dorsum or treating this unit en bloc, thereby expanding DPR indications. Conceptually, two classes of DPR techniques have been forwarded: (1) foundation techniques and (2) surface techniques.^{26,27} The foundational techniques involve impaction of the nasal vault using osteotomies (eg, PD or LD). Surface techniques involve superficial modifications of the dorsal hump without impaction or osteotomies and with optional preservation of the bony cap. What remains true of essentially all DPR cases is that the middle vault is preserved. Surface techniques may help convert patients with suboptimal anatomy into appropriate DPR candidates (eg, bony cap resection or contouring the ULC shoulders).

In general, DPR is limited to primary cases, but may be performed secondarily if similar techniques were used primarily.^{11,28,29} Patients with

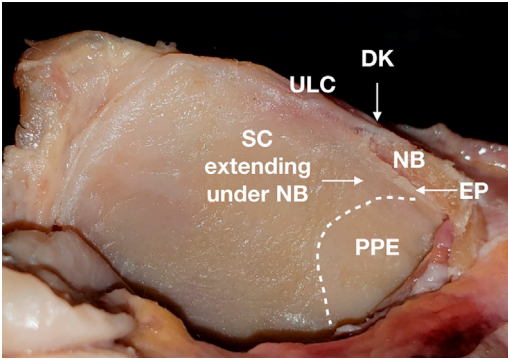


Fig. 3. Dorsal and Keystone anatomy. The dorsal nasal keystone (DK) of the nose consists of the junction of the perpendicular plate of the ethmoid (PPE), nasal bones (NB), septal cartilage (SC), and upper lateral cartilages (ULC). Septal cartilage extends under the nasal bones. Over the dorsum, the perichondrium of the cartilaginous vault and the periosteum of the nasal bones fuse to create a flexible joint.

shorter nasal bones and a larger cartilaginous contribution to the nasal hump are better candidates for DPR.¹⁴ V-shaped nasal bones are better treated with DPR compared with S-shaped bones. The latter group has a higher likelihood of an osseous residual hump without additional contouring maneuvers.^{30–32} Patients with deeper nasofrontal angles are at greater risk of a drop in the radix with DPR techniques.¹⁴ As preservation surgery aims to maintain the shape of the dorsum, inherently deformed bones with irregularities or significant width of either the bones or midvault will result in unsatisfactory outcomes.^{14,30,31} It also follows that DPR should be considered in patients with thin skin to minimize risk of visible

dorsal irregularities. As the middle vault cannot be separated from its pyriform attachments, it will flare as it descends. If there are very wide and prominent ULC shoulders, DPR may predispose to worsening of this appearance. Although deformities of the nasal bones are relative contraindications to DPR, the presence of an axis deviation is not. Asymmetric wedge resections of bone in an LD procedure with more bone removed on the non-deviated side can correct a straight deviation (**Fig. 5**).^{33–35} Alternatively, an LD on the deviated side with a PD on the non-deviated side (“mix-down”) can be used.³⁶ Overlap and suture fixation of subdorsal septum to the lower septum toward the deviated side will help stabilize the corrected position.³⁷ DPR has been reported to reduce revision rates in males compared with other surgical techniques, potentially due to less risk of feminization.³² Higher revision rates may be observed in females due to the desire for greater dorsal height reduction.³²

Although the closed rhinoplasty approach has been used by many preservation experts, DPR can be successfully accomplished with open approaches. The closed approach ensures protection of the dorsal soft tissue and allows for preservation of soft tissue attachments that may be beneficial in the suspension of bone as it descends.³⁰ The open approach provides greater visualization of the dorsal deformity along its whole course and allows for both osteotomies and fine-tuning of dorsal irregularities with the use of powered instruments.³⁸ A graded approach to dorsal soft tissue dissection when using an open approach may be considered.³⁸ In patients with V-shaped nasal bones with well-shaped dorsal

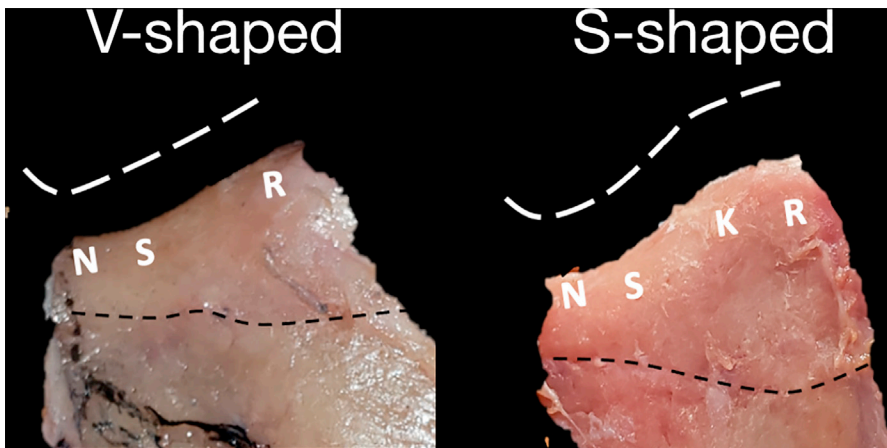


Fig. 4. Nasal bone shapes. Two nasal bone shapes can be appreciated on profile view. V-shaped bones have a straight contour between the radix and the rhinion. S-shaped bones have a curve with a peak (kyphion) between the radix and rhinion.

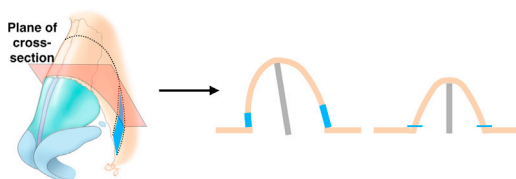


Fig. 5. Deviated nose. Correction of axis deviation in DPR includes asymmetric wedge resections of bone in the LD procedure, with more bone removed on the non-deviated side.

esthetics, preservation of the dorsal soft tissue and ligaments can be performed. In cases that may require osteoplasty (eg, S-shaped bones) or the need to address dorsal irregularities, the dorsal soft tissue is elevated.

Another graded approach in preservation rhinoplasty comes in the form of combination preservation methodology used for the dorsum with structural modifications made to the nasal tip complex.^{39,40} This ideology—termed structural preservation—allows for conventional tip modification techniques with an emphasis on preservation and recontouring of the alar cartilage (lateral crural tensioning, cephalic cartilage turn-in flaps, lateral crural struts). In addition, open approaches with the use of tip supporting mechanisms such as septal extension grafts and columellar struts are used as preferred. The dorsum is lowered with preservation techniques. This hybrid approach allows surgeons confident with open structural techniques the opportunity to incorporate preservation techniques into practice. Importantly, the structural and preservation ideologies should not be considered mutually exclusive, but rather concepts that can be fused to produce an esthetically pleasing and stable result.

APPROACHES TO THE NASAL SEPTUM

Perhaps some of the greatest nuances in preservation rhinoplasty relate to the treatment of the nasal septum. Multiple techniques to resect and mobilize the septum had been forwarded during the 1900s by several surgeons.^{35,41–50} Further descriptions have been advanced over the course of the last 20 years, resulting in several modifications that can be applied in preservation rhinoplasty. In general, these techniques can be classified by the region of septal cartilage resection: high, mid/intermediate, or low. These are briefly summarized here (Fig. 6).

High-Septal/Subdorsal Resection

Following original descriptions by Lothrop, Goodale, and Maurel, contemporary preservation

experts Saban and Gola have championed immediate subdorsal resection of cartilage (see Fig. 6A).^{7–9,14,35,51,52} Two incisions are made: one immediately under the dorsum, following the contour of the dorsal hump and a second cut more inferiorly corresponding to the desired dorsal height. Intervening cartilage is removed (with possible additional subdorsal ethmoid bone), allowing for the dorsum to be lowered and stabilized with suture fixation.

Low-Septal Excision

Sebilleau and Dufourmental described resection of an inferior strip of bone and cartilage to allow for dorsal height reduction (see Fig. 6B).⁴⁸ The septum requires stabilization to the maxillary crest. In 1946, M. Cottle performed a modification of the inferior strip with the additional disarticulation of the cartilaginous septum from the ethmoid plate and resection of PPE immediately under the dorsum (see Fig. 6C).^{49,53} This resulted in a complete vertical split between the bony and cartilaginous septum, with the dorsum being lowered secondary to the high bony and low cartilaginous resection. The Septum Pyramidal Adjustment and Repositioning (SPAR) method described by Dewes similarly involves an inferior removal of cartilage or maxillary crest, a posterior chondrotomy, and resection of a portion of the PPE.⁵⁴ The disarticulation of the whole cartilaginous septum through an inferior release are beneficial in cases of deviated septal pathology as it allows complete repositioning.³⁸ However, this also requires adequate anchoring of the cartilage to the maxillary crest.

Mid-Septal/Intermediate Excision

Intermediate resections between the immediate subdorsal and inferior portions of the septum have been the most variably described. In these methods, some cartilage remains immediately below the dorsum and this can be anchored to lower cartilage with suture techniques, thereby better stabilizing the dorsal position. Ishida and colleagues⁵⁰ described a mid-septal strip excision that extends from the caudal border of the septum to the PPE at the level of the transverse osteotomy (see Fig. 6D). Although nasal bones were resected/treated independently from the middle vault in this technique (thereby differing from traditional DPR techniques), the location of septal cartilage excision is an important modification. Neves and colleagues⁵⁵ have similarly reported on an intermediate strip preservation method (Vitruvian Man Split maneuver) in which the addition of a vertical chondrotomy at the prominent point of the

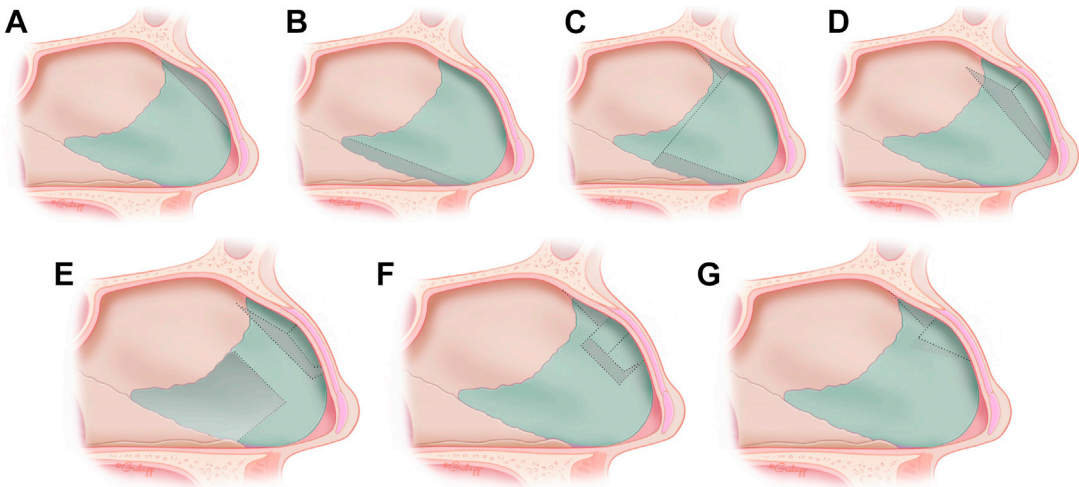


Fig. 6. Approaches to the septum in dorsal preservation rhinoplasty. Dotted lines represent septal cuts and shaded gray areas representing resected segments of cartilage. (A) Subdorsal resection: An incision is made immediately under the dorsum, following the contour of the dorsal hump. A second cut below this level dictates the amount of cartilage resected. (B) Inferior strip: A segment of inferior cartilage at the maxillary crest is resected. (C) Cottle/SPAR method: A segment of ethmoid bone is resected superiorly and cartilage is excised inferiorly at the maxillary crest. The cartilaginous septum is separated from the ethmoid plate. (D) Intermediate septal resection: Septal strip excision is performed closer to the mid-aspect of the cartilaginous septum. A vertical chondrotomy (Vitruvian method) at the prominent point of the hump facilitates dorsal flexion. (E) Modified subdorsal strip method (MSSM): A 3–5 mm subdorsal strut of cartilage is preserved with cuts made posterior to the anterior septal angle, thereby allowing for the preservation of a caudal strut. Vertical incisions can be made into the subdorsal cartilage to facilitate flexion. Additional cartilage is resected inferiorly as needed for grafting/deviation as needed. This results in a remaining “T” strut of cartilage. (F) Split tetris concept: A 5–8-mm “tetris block” is designed in the septum. A segment of cartilage is resected inferior to this and posterior to this (subdorsally). An incision into the tetris block at its mid-aspect helps facilitate dorsal flexion. (G) Kovacevic technique: A high posterior bone resection is performed and a triangular cartilaginous wedge is maintained anteriorly. Under this, cartilage is not resected but instead the triangular wedge overlaps and is fixated to the lower septum.

hump allows for better dorsal flexion. This technique can be applied to several intermediate septal resection techniques that preserve a segment of subdorsal cartilage.

Most have reported on a modified subdorsal strip method (MSSM) in which the septal resection is performed higher than the mid-septal approach described by Ishida (leaving a 5 mm subdorsal strut) (see Fig. 6E).^{28,56} In addition, the septal resections are not carried into the caudal septum and instead start posterior to the anterior septal angle. Inferior cartilage can be removed for grafting purposes. This leaves a “T” strut of cartilage that involves the caudal septum and an intact mid-septal segment. The caudal septum can either be trimmed secondarily or left in its original location to allow for attachment of the tripod complex.

The Split Tetris Concept represents another modification of the intermediate septal resection (see Fig. 6F).^{37,57} A 5–8-mm subdorsal “tetris block” is designed in the septum between the caudal edge of the ULCs (W point) and the apex of the dorsal hump. Under this, a trapezoid

segment of cartilage is excised. Similar to other techniques, the amount of this excision corresponds to the desired dorsal height reduction. To facilitate the lowering process, a posterior triangular wedge of subdorsal cartilage and sometimes bone is also resected to the level of the transverse osteotomy. The combined posterior high bone resection and anterior cartilaginous septal resection shares features with the Cottle method. To allow room for the anterior movement with flexion of the dorsum, an anterior segment of the tetris block may have to be resected. Kovacevic has described a similar modification to the Cottle technique (Subdorsal Z flap; see Fig. 6G).^{4,58–61} Rather than a rectangular subdorsal block, a triangular cartilaginous wedge is maintained. In this technique, whereas a subdorsal bony keel is removed posterior to the cartilaginous triangular wedge, a segment of cartilage is not resected below it. Instead, this subdorsal segment of cartilage is overlapped and suture fixated to the inferior cartilage. The preservation of some amount of subdorsal cartilage is thought to limit the risk of scar contraction that can deform the middle vault over time.⁵⁸

APPROACHES TO THE OSSEO-CARTILAGINOUS COMPLEX

As aforementioned, although the PD and LD techniques have traditionally been the hallmark of preservation rhinoplasty, modifications that may not treat the whole bony-cartilaginous vault en bloc have been incorporated into preservation idealogy.⁵⁹ In cases with extremely kyphotic humps, the use of disarticulation techniques in which the bony dorsum and middle vault are treated independently may use preservation techniques where complete structural approaches would have otherwise been used.³²

For example, Ishida and colleagues⁵⁰ describe a mid-septal cartilage resection with lowering and preservation of the midvault. However, the nasal bones are disarticulated from the ULC, and the osseous hump is treated independently with the use of osteotomes or rasps. Ozturk has described a similar approach in which a subdorsal strip is instead resected to lower the midvault.⁶² No osteotomies are performed. These techniques may only be useful in the setting of smaller dorsal humps and may require grafting at the keystone.

A modification of these techniques aims to preserve the continuity between the bony cap and cartilaginous dorsum (cartilage PD technique with bony cap preservation).⁶³ Separation of the ULCs from the nasal bones as well as disarticulation of the whole septal bony-cartilaginous junction are performed. After resection of septal cartilage, osteotomies along the dorsal esthetic lines that meet in the midline are performed. These osteotomies encompass the bony cap and result in a mobile complex involving the septum and dorsum (including the bony cap), which allows for lowering of a dorsal hump. The remaining bony vault is then contoured as necessary with the use of lateral osteotomies to medialize the nasal bones. This strategy preserves the dorsal cartilage-bony junction and allows for preservation methods to be applied in the setting of larger humps or more distorted bony architecture.

The Spare Roof Technique described by Ferreria and colleagues⁶⁴ represents another middle third preservation technique in which the dorsum is lowered via subdorsal cartilage resection. The bony nasal vault is managed with separation of the pyriform aperture ligaments, an osteotomy of the caudal aspect of nasal bones (to expose the cephalic aspect of the ULCs), and medial and lateral osteotomies to close the open bony roof.

A modified dorsal split preservation technique described by Robotti and colleagues⁶⁵ can be applied in patients with very small bony humps. In this method, the bony hump is minimally rasped

and the continuity of the nasal bones to the cartilaginous dorsum is preserved. In this method, unlike the previously described techniques, the ULCs are separated from the cartilaginous septum. This results in a septal "T" component which includes the upper aspect of the septum and its horizontally flared edges. The combination of subdorsal cartilage resection with a traditional PD/LD technique is performed to lower the dorsum. The septal "T" is then re-sutured to the underlying septum and the ULCs.

In another modified preservation technique (Dorsal Roof Technique), Tas describes the preservation of the dorsal bony-cartilaginous junction, but disarticulation of the ULCs from the septum.⁶⁶ Medial osteotomies (at the dorsal esthetic lines) and a radix osteotomy are performed such that the whole bony-cartilaginous dorsum descends into the nose en bloc. Lateral and transverse osteotomies are then performed to narrow the dorsum and eliminate the space created by descent of the mid aspect of the bony vault. The ULCs are then sutured to the midline.

DORSAL PRESERVATION OUTCOMES

As DPR techniques continue to evolve and their use becomes more prevalent, critical analysis of long-term outcomes will become imperative. Proponents of dorsal preservation techniques cite theoretic benefits that stem from preservation of the keystone area, the ULC attachment to the septum, and the INV. As the native attachments of the dorsum are not violated, DPR should yield superior esthetic outcomes with maintenance of dorsal esthetic lines and minimization of surface irregularities (Fig. 7).^{28,67} Functional benefits compared with conventional hump reduction techniques with appropriate midvault reconstruction may not be as convincing, and studies comparing outcomes with Joseph hump reduction are limited at present.⁶⁸

Nonetheless, multiple authors have reported on positive outcomes with PD and LD DPR techniques. In a series of 320 patients undergoing subdorsal resection DPR, Saban and colleagues¹⁴ have reported good success. Of 30 patients given the Nasal Obstruction Symptom Evaluation (NOSE) questionnaire, 90% of patients reported improvements. Although measures are not reported, similar positive results have been described by Gola (n = 1000) and Tuncel and Aydogdu (n = 520).^{29,69} In 58 patients undergoing either PD or LD DPR and completing the rhinoplasty outcomes evaluation (ROE), long term patient satisfaction and quality of life was improved.⁷⁰ In a group undergoing the MSSM

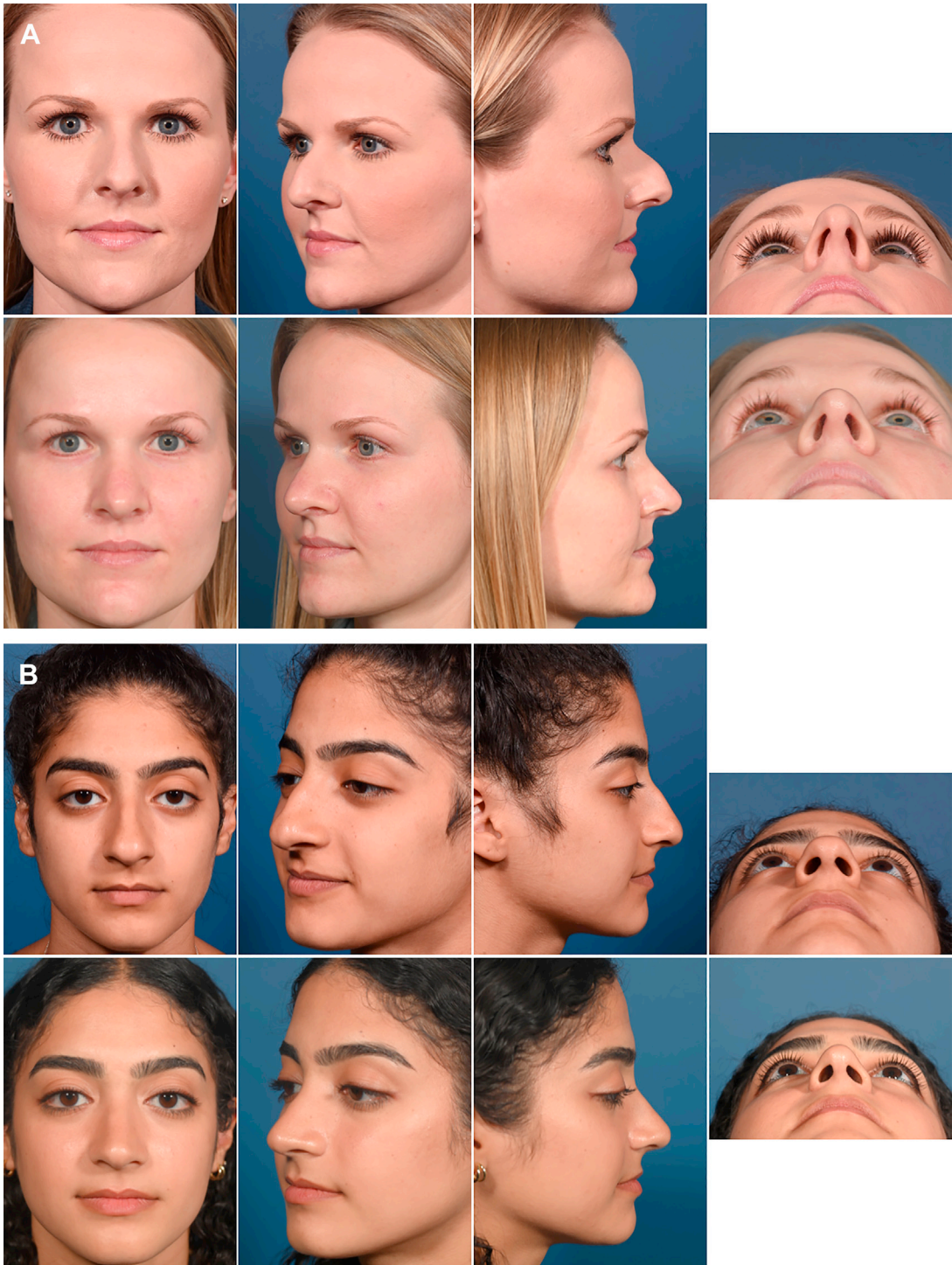


Fig. 7. Structural-preservation rhinoplasty patient examples. (A) This patient underwent dorsal reduction with osseocartilaginous dorsal preservation (let-down, modified subdorsal strip method, two suture fixation, pyriform ligament release) with tongue-in-groove and alar-spanning sutures used to support and adjust the nasal tip position. Pre- and postoperative 18-month photos are shown here. (B) This patient underwent dorsal reduction with osseocartilaginous dorsal preservation similar to the patient in A. The nasal tip was managed with minimal cephalic trims, intradomal, and interdomal sutures, tongue-in-groove/alar-spanning sutures, and a supratip morselized cartilage graft. Pre- and postoperative 6-month photos are shown here.

method, improved patient postoperative Standardized Cosmesis and Health Nasal Outcomes Survey scores and visual analog scale (VAS) scores have been reported.^{28,56} Of 31 patients undergoing DPR, Kosins reports success at 1 year follow up (20% required radix grafts to maintain radix position and 10%, had a very mild residual hump).³ In 153 patients undergoing the SPAR method, Atolini and colleagues⁷¹ similarly report good outcomes with 13 requiring revisions for small residual humps. Kovacevic has also reported success in 205 patients undergoing the subdorsal triangular resection method with less than 10% revision rates.⁶¹ In a meta-analysis of 22 studies representing a cohort of 5660 patients undergoing a variety of DPR techniques, postoperative hump recurrence rates (4.18%), rates of revision surgery (3.48%), postoperative nasal deviation (1.13%) and rates of infection (1.89%) were low.⁷²

Success has also been reported in DPR techniques with modified approaches to the osseocartilaginous complex. In 48 patients undergoing the cartilage PD technique with bony cap preservation, Ishida and colleagues⁶³ found low complication rates: 1 had displacement of the bony cap and 1 experienced a hump recurrence. In 44 patients undergoing the Dorsal Roof technique, positive ROE results were noted at 1 year.⁶⁶ 62 patients undergoing the modified cartilaginous PD maneuver by Ozturk also reported positive ROE outcomes.⁶² In 41 patients undergoing the dorsal split preservation technique and 120 patients undergoing mid-septal cartilage resection favorable outcomes have been reported.^{50,65} An analysis of 1 year postoperative outcomes in 100 patients who underwent the spare roof technique showed improved functional and esthetic VAS scores as well as Utrecht Questionnaire for Outcome Assessment in Esthetic Rhinoplasty scores.⁷³ In a randomized prospective study (n = 250) comparing this technique to component dorsal hump reduction, VAS scores were superior in the former group.⁷⁴

CHALLENGES AND LIMITATIONS OF DORSAL PRESERVATION

Despite the benefits of preservation techniques, there are complications and challenges that are unique to DPR. One of the most cited concerns relates to recurrence of a dorsal hump, with rates ranging between 3% and 12%.^{3,14,29,50,71,75} The maximal tension at the dorsum will exist at the apex of the dorsal hump. Therefore, the risk of hump recurrence is greater with increased prominence of the hump apex and in S shaped nasal

bones. Methods to minimize hump recurrence may include (1) scoring/incising subdorsal cartilage to maximize cartilage flexion, (2) using LD preferentially over the PD, (3) multi-site suture fixation oriented in both cranio-caudal and posterior-anterior dimensions, (4) additional bone contouring in kyphotic humps, and (5) performing a lateral keystone dissection with separation of the ULCs from the nasal bones (ballerina maneuver/lateral wall split maneuver).^{29,37,75,76}

There is also risk of excessive inferior displacement of the upper nasal vault, resulting in a lower than desired dorsal height and/or a step-off at the radix. Unless the patient has a high radix, flexion rather than descent is needed at this location. Methods to minimize excessive descent may include (1) conservative resection of septal bone, (2) a longitudinal cut into rather than resection of the bony septum (3) a triangular shaped subdorsal wedge resection rather than a rectangle, (4) preservation of periosteum and soft tissue over the midline dorsum/radix to provide support at the level of the transverse osteotomy, and (5) transverse osteotomy made obliquely and potentially made endonasally (subdorsal osteotomy).^{19,27,28,30,57,58} Radix grafting may be necessary for camouflage, as was reported in 20% of the patients in Kosins' study.³

Although radiographic studies have confirmed a safe distance between the cribiform plate and the location of the transverse osteotomy site, there is a theoretic risk of propagating forces inferiorly and posteriorly, disruption of the cribiform plate, and a CSF leak.^{19,20,58} Carefully oriented and complete osteotomies, in addition to the use of piezo ultrasonic instruments can help mitigate this risk.⁷⁶⁻⁷⁹ In addition, the ethmoid bone should be carefully resected/incised to the level of the osteotomy before the transverse osteotomy is made.

Supratip saddling is a potential complication of DPR, particularly in low septal approaches.³⁰ This may be related to the persistence of a dorsal convexity (with a drop in the supratip region), greater difficulty in controlling septal height, and inadequate fixation of the septum to the maxillary crest. Another stigmata involves midvault widening.³⁰ Although this may have functional benefits, it can be esthetically displeasing. Lateral keystone disarticulation can release the ULC for tension-free movement of the cartilaginous midvault and help prevent flaring in this region.

SUMMARY

DPR is likely to continue to evolve and become more widely adopted into clinical practice. This ideology emphasizes an appreciation for nasal

anatomy, along with esthetic and functional implications of disrupting this anatomy. Although alar preservation has been promoted for the last two decades in structural rhinoplasty, there is a recognized value in the incorporation of dorsal preservation into similar practice. This fusion, structural preservation, affords the rhinoplasty surgeon a large tool-set to maximize esthetic and functional outcomes. Understanding the foundations of DPR—namely septal resection and the osseo-cartilaginous mobilization—in addition to the anatomic nuances, modifications, and indications as are reviewed here will facilitate the implementation of these techniques into clinical practice. In the process, the critical analysis of long-term outcomes and limitations, particularly as they compare to conventional hump resection, should be pursued.

CLINICS CARE POINTS

- Open structural tip methods can be combined with dorsal preservation techniques
- Although preservation techniques have garnered significant attention secondary to esthetic benefits, conventional hump resection techniques with appropriate midvault reconstruction may yield equivalent functional outcomes
- Not all patients are candidates for preservation rhinoplasty and an understanding of best indications (eg, limited kyphosis and pleasing preoperative dorsal architecture) will maximize positive outcomes and minimize complications
- Different modifications in septal and osseo-cartilaginous DPR approaches are available to the rhinoplasty surgeon—each of which has been shown to yield positive outcomes
- Minimizing stigmata of preservation rhinoplasty including hump recurrence, mid-vault widening, and radix step offs require an understanding of anatomic and technical nuances

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