The Crooked Nose and Major Septal Deviations in Dorsal Preservation

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KEYWORDS

• Dorsal preservation rhinoplasty • Crooked nose • Nasal axis deviation

KEY POINTS

- Dorsal preservation (DP) rhinoplasty can be utilized to improve the nasal dorsal axis for the crooked nose deformity.
- DP rhinoplasty techniques are cartilage sparing and require less grafting in patients presenting with asymmetry of the dorsum.
- Utilization of ultrasonic rhinoplasty can improve both nasal dorsal height and width in the crooked nose.
- Major septal deviations can be addressed using combined preservation and structural grafting techniques.
- Patient-related outcome measures show improvement of both functional and cosmetic results in patients presenting for DP.

INTRODUCTION

First published by Dr Goodale, preservation of the dorsum combines septal strip and boney osteotomies for patients with a dorsal hump while preserving the osseous cartilaginous junction.[1] Foundation techniques have been described to address the overall height and width of the nasal dorsum by addressing hypertrophy of the ascending process of maxilla and nasal boney junction. Incorporating lateral and transverse osteotomies to address dorsal deviations are key elements for dorsal preservation (DP) correction of the crooked nose.[2,3] It has been said, "as the septum goes, so does the nose." Whether of developmental or traumatic origin, the septum and particularly the perpendicular plate of the ethmoid bone are sources of axis deviation leading to the crooked nose deformity (CND). Correcting nasal physiology by addressing septal and boney deformities were a paramount work of Cottle[3–5] in patients with and without septal deviations. The contemporary application of Joseph's composite resection of the hump combined with the Sheen spreader grafts is a traditional approach popularized in structural rhinoplasty. Cartilage grafting techniques are subject to dorsal irregularity, scarcity of material, and widening of the dorsum. The use of spreader flaps helped to address some of these limitations but was not an ideal choice for the crooked middle vault which required much larger grafts to correct asymmetry and depression of the upper lateral cartilage. The spare roof approach as described by Ishida and Ferreira has obviated the need for open roof approaches once deemed necessary.[6] Further, a cartilage sparing approach is considered necessary in patients with crooked noses. The high subdorsal strip approach was first described by Lothrop[7] and contemporized by Saban.[8] Modern DP modifications of the modified subdorsal strip method (MSSM)[9] and Z flap strip methods[10] have furthered the ability to correct the axis deviation in crooked noses by addressing high septal

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deviations, and controlling deviations stemming from the perpendicular plate of ethmoid bone, and the dorsal hump. While septal strip techniques address the intrinsic factors associated with the crooked nose, extrinsic pathology in the foundation of the nose often coincide. These extrinsic factors include the width of the nasal bones, the junctional thickness of the ascending process of maxilla with the nasal pyramid, and the axis of nasal boney dorsum from glabella through columella and dental midline. Both push down osteotomies and let down boney strip maneuvers have been developed in DP to address the boney axis.[2,9,11]

DISCUSSION

Review of the Literature

CND can be differentiated by the external deviation of the nose and/or the internal septal impact on the lower cartilaginous framework. A classification can then be derived from the resulting deviation describing a C-shaped, reverse C-shaped, linear I-shaped, or S-shaped nose.[12] On the frontal view, the dorsum can be delineated as C-shaped nose or reverse C-shaped where by the middle vault is noted to be concave and the other side convex. In a linear deviation, the dorsum and tip may be an I-shaped, thus shifted to one side of the vertical midline of the face.[13] Severely crooked patients can also present with an S-shaped deformity.[14,15] Although I-shaped patients may be improved with a swinging door septoplasty and unilateral spreader grafting, C-shaped deformities often require boney osteotomies to improve this deformity. Further, S-shaped deformities require a combination of cartilage grafting for the nasal tip and osteotomies. Many patients with I-shaped deviations also present with facial asymmetry secondary to maxillary hypoplasia and deviations off the dental midline. Premaxillary augmentation may be a consideration in these patients.[15]

Limited data exist utilizing outcome measures in patients with CND. Patient-related outcome measures (PROMs) have emerged as additional validation tools for assessing functional and cosmetic changes in patients undergoing rhinoplasty.[16] Incorporating outcome measures including the Nose Obstruction Symptom Evaluation (NOSE), Sinonasal Outcome Test (SNOT-22), Standardized Cosmesis and Health Nasal Outcomes Survey (SCHNOS), Epworth Sleepiness Scale (ESS),[17–21] and standardized before and after photographs for patients undergoing DP rhinoplasty have shown significant improvements. The median and total, functional, and cosmetic scores utilizing all 45 PROMs at 1-year follow-up showed no difference in MSSM and Z flap septal strip methods with let down osteotomies.[22]

In contrast, it has been recognized that reductive rhinoplasty does affect the functional and cosmetic results of patients.[23] Morphologic evaluation of the internal valve angle is considered a key anatomic result determining nasal obstruction after rhinoplasty. The internal valve angle is often compromised in reductive rhinoplasty but has been showed to be preserved in preservation rhinoplasty.[24]

Asymmetric dorsal preservation (ADP) utilizes a push down technique for the deviated side and a let down technique for the contralateral nondeviated side. It is an alternative to traditional methods to correct the CND. ADP can be utilized to improve the functional and esthetic outcomes for the CND. Asymmetric boney resections incorporated into the lateral osteotomy in combination with transverse osteotomies have formed the basis for let down preservation techniques for crooked boney foundations. Often considered in axis deviation, a larger asymmetric wedge resection of bone contralateral to the axis deviation can assist in correcting the axis when combined with a transverse osteotomy. The use of ADP techniques have been described in 23 patients with 12-month postoperative results comparing rhinomanometry and SCHNOS surveys.[25] Improvement in total nasal airflow, SCHNOS scores, and deviation angle was noted. In comparing conventional osteotomies with mid-vault spreaders with ADP, mean angles of deviation correction showed no difference at 6 months in a cohort of patients.[26]

Severe septal deviations necessitate a tension-free release of the cartilage and ligamentous supports. Often deemed as the most important pillar of the nasal framework, the septum is paramount in the DP.[27] The Pisa tower concept combines the “swinging door” septoplasty with asymmetric boney wedge resections and let down osteotomy. Using nasal axis deviation as an end point and satisfaction scores, the PISA tower approach demonstrated an alternative to structural techniques alone.[28]

DP rhinoplasty techniques are cartilage sparing and require less grafting in patients presenting with asymmetry of the dorsum. The spare roof technique describes surface approaches which have been validated in CND. The Portuguese version of the Utrecht Questionnaire for Aesthetic Outcome measures showed improvement in subjective nasal function and esthetic in a 12-month prospective, longitudinal study.[29,30]

Utilization of ultrasonic rhinoplasty can improve both nasal dorsal height and width in the crooked nose. Major septal deviations can be addressed

using combined preservation and structural grafting techniques. While preserving the middle vault has its advantages, piezoelectric release of the boney cap and lateral wall can mobilize the boney cap allowing correction of slight asymmetries.

SURGICAL TECHNIQUE

The senior author presents his technique to improve the CND utilizing let down DP rhinoplasty with asymmetric osteotomies where applicable in patients. Dorsal humps of all sizes were able to be addressed as well as mid-vault deviations. A case representation of 3 septal strip techniques is described including: (a) modified subdorsal septal strip (MSSM), (b) Z flap septal advancement technique, and (c) modified low strip Cottle maneuver.

In general, a standard inverted V trans columellar incision combined with marginal incisions are made and the nose opened. The periosteum over the nasal bones is incised and elevated. Stab incisions at the superior head of each inferior turbinate are made, and the periosteum is elevated off the frontal process of the maxilla on each side to prepare for endonasal osteotomies. For asymmetric osteotomies, an open approach is performed. The periosteum is elevated off both the external and internal aspect of the frontal process of the maxilla. The piezoelectric saw is used to make all let down wedge resections staring with lateral low-low-high osteotomies on each side, followed by wedge excisions of nasal-maxillary bone which includes Webster's triangle. Asymmetric wedges are made with larger osteotomies on the concave side of a C-shaped or S-shaped deformity or contralateral side of an I-shaped deformity. These boney osteotomies are made with either a straight piezo blade for endonasal osteotomies or a 90° angle piezo blade for an open approach to the osteotomy. Next, a transverse osteotomy at the nasion is made using the piezoelectric chisel attachment while protecting the undersurface of the soft tissue envelope with an Aufricht retractor followed by an endonasal release of the perpendicular plate of the ethmoid bone. The transverse nasion osteotomy connects with the let down osteotomies on each side.

Dorsal septal cartilage is manipulated in one of 3 ways. Either a high septal strut excision (**Fig. 1**), modified Z flap incision (**Fig. 2**), or a modified low strip septal excision is performed (**Fig. 3**). The techniques are modifications of the Most,[9] Kovacavic,[10] and Cottle[9,10] maneuvers. In the MSSM technique, a horizontal strip of septal cartilage approximately 5–10 mm from the dorsal edge is excised and reserved for future spreader grafting. The septal excision leaves at least a 1.5 cm caudal strut intact to maintain tip support. The width of the excised cartilage depends on the amount of hump let down desired. A vertical releasing incision through the dorsal septum is made inferior to the point of maximum dorsal convexity. This incision is not through and through but rather stops short of the junction between the upper lateral cartilage and septum. This creates a flexion point for dorsum let down. The let down dorsal hump is secured in place with a 4-0 PDS suture passing inferior to the high septal strut excision starting on the left, up through the upper lateral cartilage on the right side of the septum, and back through the upper lateral cartilage on the left side of the septum. A wedge of septal cartilage or complete transection of the septal cartilage through the dorsum at the anterior aspect of the high dorsal strut excision may need to be performed to alleviate buckling of the cartilage. A narrated video of this technique can be accessed via a previous publication.[31] **Fig. 1** depicts the steps made in the MSSM procedure. **Fig. 1** demonstrates osteotomies and septal incisions shown for the high septal strut excision technique with resultant let down dorsal hump.

The Z flap technique is a modification of the Cottle method that has been popularized by Kovacevic.[10] In this method, incisions are made through and through the dorsum in the shape of a triangle with the point oriented inferiorly and this is connected to an osteotomy through the perpendicular plate of ethmoid bone to achieve a modified Z flap incision. First, a vertical releasing incision through the dorsal septum is made inferior to the point of maximum dorsal convexity. The incision is then extended obliquely toward the caudal septum from the inferior point of the releasing incision. A horizontal osteotomy is made through the perpendicular plate of the ethmoid bone connecting to the previously performed transverse osteotomy at the nasion. The triangle of cartilage is mobilized anteroinferior to let down the dorsal hump and is overlapped on one side of the native septum to correct any baseline asymmetry. The mobilized dorsal septum is secured with 4-0 PDS sutures to hold the let down dorsal hump in position. **Fig. 2** depicts the steps made in the Z flap procedure. Osteotomies and septal incisions shown for the modified Z flap technique with resultant let down dorsal hump.

The third technique is a low strip septal advancement flap first popularized by Cottle and described by Kovacavic and Toriumi (see **Fig. 3**).[9,10] The low strip is taken in cases of severe septal deviations. A perpendicular septal incision is then made at the

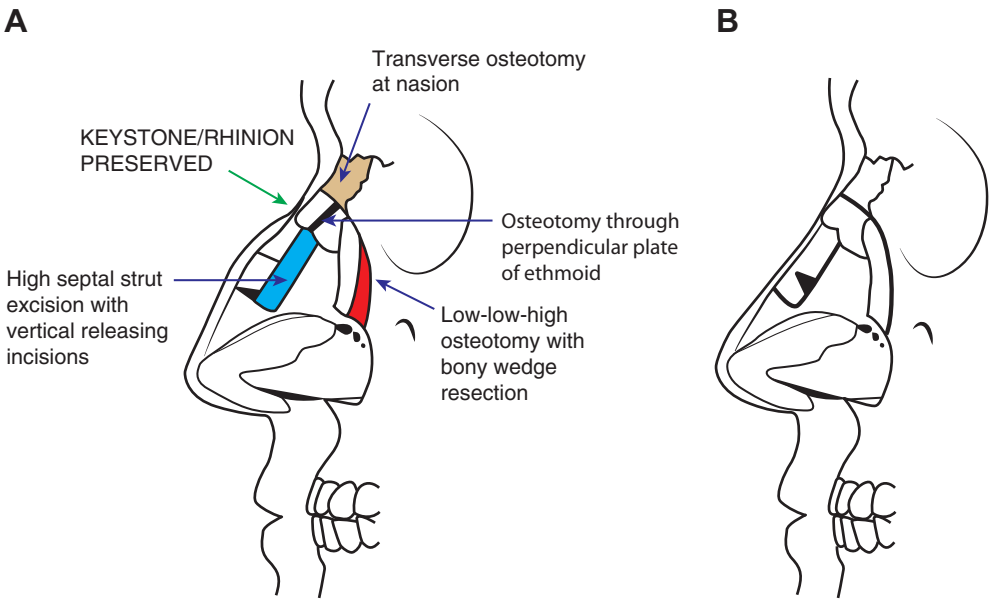

Fig. 1. (*A*) Osteotomies and septal incisions shown for the high septal strut excision technique with resultant let down dorsal hump. (*B*) Postoperative result.

junction of the perpendicular plate of the ethmoid bone extending to the dorsum. Further, subdorsal osteotomies help to release the ethmoid bone underneath the nasal pyramid allowing mobilization and advancement of the septal cartilage. The modified Cottle septal advancement technique often requires additional grafting in the author's opinion due to the severe nature of the septal deformity. If septal cartilage can be salvaged from the low strip, then a septal extension graft (SEG) can be secured on the concave side of the C or S shape or opposite side of the I shape deformity. In all septal cartilage manipulation techniques, the keystone area remains intact and undisturbed. Once the let down dorsal hump is secured in place, the dorsum is evaluated to confirm the desired contour is achieved. Septal or costal cartilage grafting is performed caudally

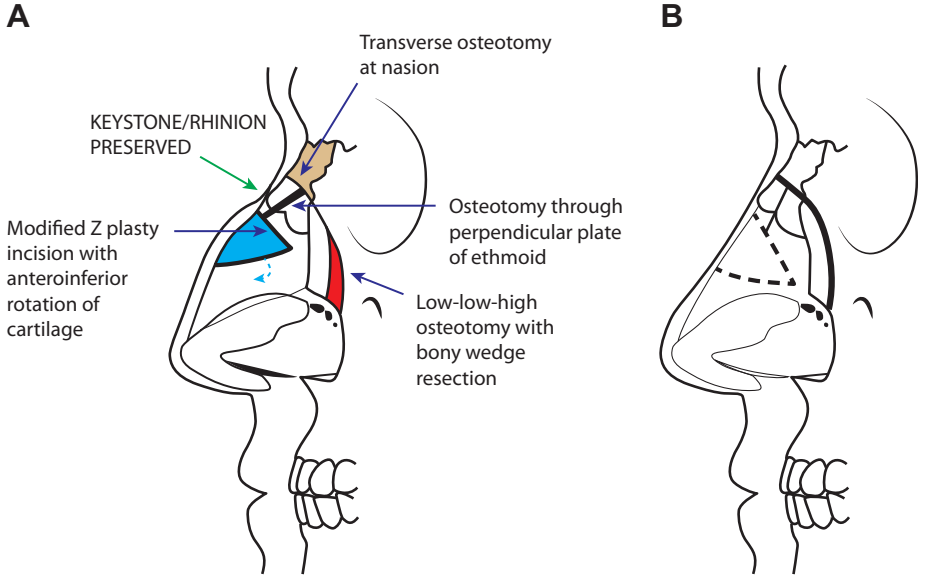

Fig. 2. (*A*) Osteotomies and septal incisions shown for the modified Z flap technique with resultant let down dorsal hump. (*B*) Postoperative result.

in all cases for structural support of the lower one-third of the nose. Tip work is subsequently performed employing traditional practices. **Fig. 3** depicts osteotomies and septal incisions shown for the low strip septal advancement technique with resultant let down dorsal hump.

Case Studies

Fig. 4 shows a before and 16 months after photos of patient with a C-shaped CND who desired a sloped dorsal profile with a more feminine supratip break, implementing the MSSM DP rhinoplasty technique.

- 16 month outcomes in a patient after DP rhinoplasty based on the validated assessment tools:
- Nose Obstruction Symptom Evaluation (NOSE)
- Sinonasal Outcome Test (SNOT-22)
- Standardized Cosmesis and Health Nasal Outcomes Survey (SCHNOS)
- Epworth Sleepiness Scale (ESS)
- Overall percent improvement and average change in patient reported NOSE (10-2), SNOT-22 (37-2), SCHNOS (32-0), and ESS (4-2) scores.

The advantages of the high septal strut excision technique are boney and cartilaginous hump reduction while providing improvement in the axis deviation. In addition, the mid sagittal septal strip allows for additional cartilage for a spreader graft and in most cases a SEG. In our patient, a right sided unilateral spreader graft was placed with a SEG. This technique generally results in a straight dorsum profile although large dorsal humps can still be corrected using this method. The additional cartilage is useful in a C-shaped deformity like the one shown where the mid-vault deviation necessitates a contralateral graft.

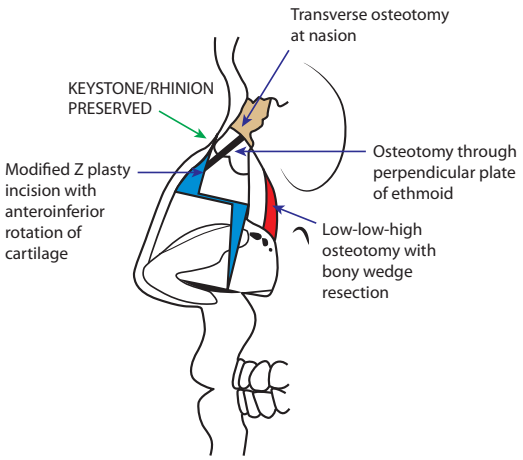

Fig. 3. Osteotomies and septal incisions shown for the low strip septal advancement technique with resultant let down dorsal hump.

Fig. 5 shows before and 12 months after photos of patient with a I-shaped CND who desired a sloped dorsal profile with a more feminine supratip break, implementing the modified Z flap DP rhinoplasty technique.

The case presented herein demonstrates the modified Z flap technique for dorsal septal cartilage manipulation. The Z flap is versatile in that the septal advancement can be utilized as an autospreader on the concave side of the deviation. The Z flap requires less use of additional cartilage grafting compared with traditional component reduction and spreader grafting. The technique allows for a greater arc of dorsal septum movement and thus a more sloped dorsum profile can be achieved. This sloped dorsal profile can be achieved regardless of the initial magnitude of the dorsal hump. In addition, mid-vault deviations can more easily be corrected with the modified Z flap technique by overlapping the triangular dorsal cartilage segment onto the remaining native septum on the side opposite of the deviation without need for spreader grafts. The triangular dorsal cartilage segment essentially acts as a spreader graft and no additional cartilage needs to be harvested.

Fig. 6 shows a patient who underwent a low strip-modified Cottle preservation rhinoplasty to correct an S-shaped deformity of the dorsum. The before and after photos taken at 15 months of patient with an S-shaped CND who desired a sloped dorsal profile with a more feminine supratip break. The modified Cottle low strip DP rhinoplasty technique was implemented.

The patient presents with history of previous nasal trauma. This left her with a severely twisted septum that distorted the mid-vault and tip with deviation to the left and right sidewall depression. She is 15 months postoperative with modified Cottle low strip technique, right SEG with costal cartilage grafting. Asymmetric let down osteotomies with a low strip taken on the right and a push down osteotomy on the left.

The let down DP rhinoplasty technique was intentionally utilized instead of the push down DP rhinoplasty technique. The advantage of the let down osteotomy is to perform asymmetric wedge excision in C-shaped and S-shaped deformities where shifting of the middle and boney vault would be necessary. In many of these cases, a SEG on the contralateral side of the deviation is also utilized to improve the nasal tip midline. It is ideal to place the midline in the dental midline (between

Fig. 4. Before and 16 months after photos of patient with a C-shaped CND who desired a sloped dorsal profile with a more feminine supratip break, implementing the MSSM dorsal preservation rhinoplasty technique. (*A*) frontal before, (*B*) frontal after, (*C*) profile before, (*D*) profile after, (*E*) lateral before, (*F*) lateral after, (*G*) base view before, (*H*) base view after.

tooth 8 and 9), when appropriate. In order to approximate the dental midline, a vertical osteotomy is fashioned with a 2-mm osteotome. A figure of eight suture is placed through the maxillary crest to secure a SEG to the caudal septum. A SEG is then placed opposite of the nasal tip deviation, and the medial crura are secured to the new cartilage graft in a tongue in groove fashion at the level of the maxillary crest. It is important to delaminate the mucosa prior to placement of the 4-0 PDS sutures. Nasal tip sutures can then be placed, and the lateral crus tensioned to the new SEG per the surgeon's preference.

Fig. 7 demonstrates a patient who is 12 months after an MSSM showing correction of the nasal tip deviation utilizing this technique. The before and after photos taken at 12 months after photos of patient with an I-shaped CND and nasal tip deviation.

Fig. 5. Before and 12 months after photos of patient with an I-shaped CND who desired a sloped dorsal profile with a more feminine supratip break, implementing the modified Z flap dorsal preservation rhinoplasty technique. (*A*) frontal before, (*B*) frontal after, (*C*) profile before, (*D*) profile after, (*E*) lateral before, (*F*) lateral after.

A right asymmetric spreader and a left SEG were placed to correct the axis deviation with the MSSM DP rhinoplasty technique.

The use of ultrasonic piezoelectric technology has significantly improved the accuracy of making boney osteotomies and improved patient recovery after rhinoplasty. Utilizing ultrasonic low frequency technology that cuts bone and spares soft tissues results in less bruising and a quicker recovery due to soft tissue preservation. The ability to make precise asymmetric boney cuts when needed is paramount. Given the variety of cutting tips available, ultrasonic rhinoplasty is an ideal adjunct to DP.

Despite the long success of DP techniques, there are limited studies showing long-term outcomes beyond 5 years. However, it is widely accepted that rhinoplasty in general suffers from lack of data in regards to PROMs. Several authors have published on outcomes utilizing these techniques for the CND.[9,12,16,21,29] In regards to nasal valve insufficiency, it has been postulated that the push down technique narrows the internal nasal valve because the nasal bones are displaced medially as the nasal dorsum is lowered. A cadaveric study demonstrated that the internal nasal valve is narrowed in the push down technique but not significantly narrowed in the let down technique.[23] DP push down and let down procedures have not been studied in patients with nasal valve collapse as well as esthetic nasal concerns. The goal of the article was to evaluate the treatment of CND in DP. The author rarely uses push down osteotomies except for ADP as described. Further clinical study is warranted to compare the efficacy

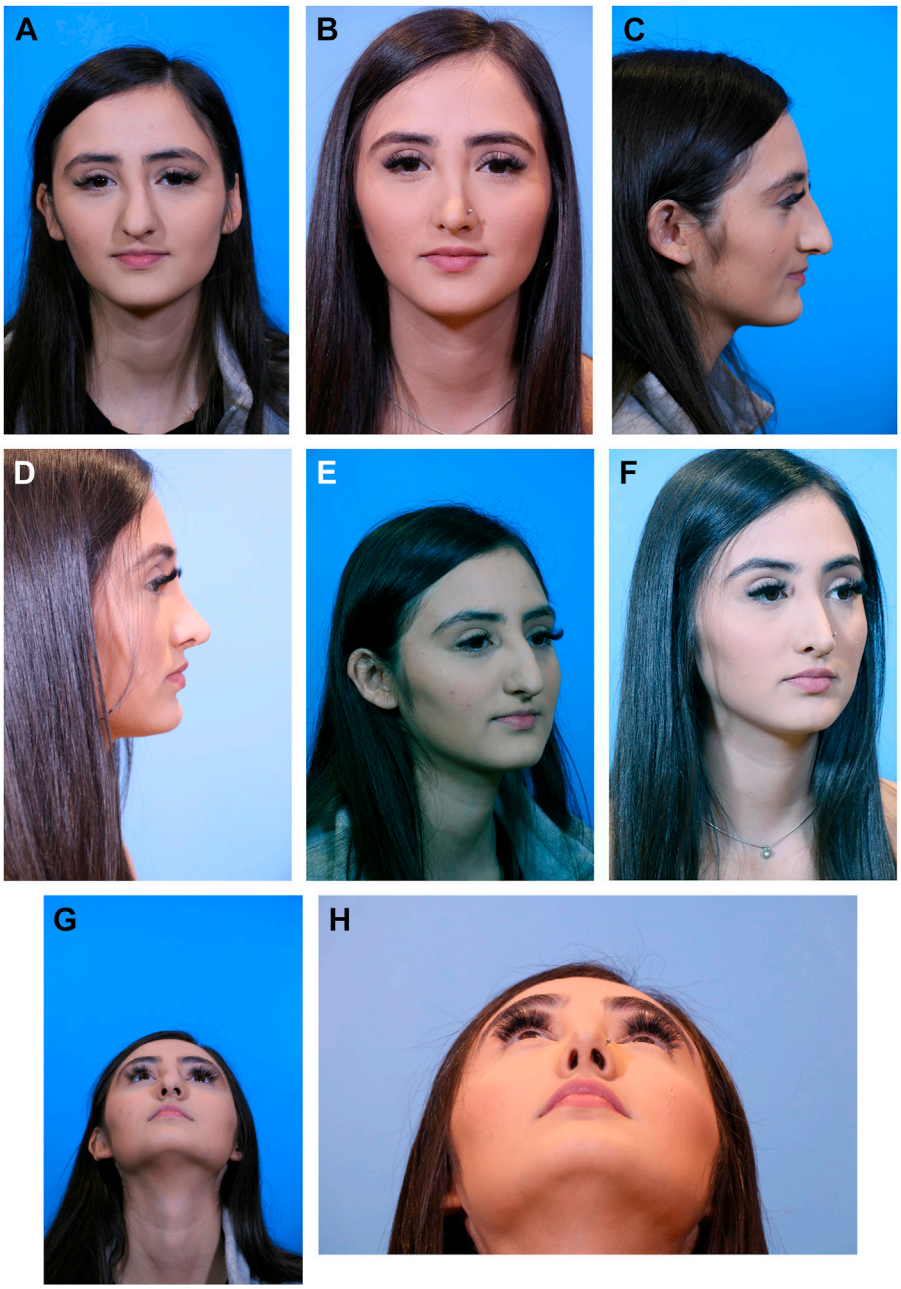

Fig. 6. Before and 12 months after photos of patient with an S-shaped CND who desired a sloped dorsal profile with a more feminine supratip break. The modified Cottle low strip dorsal preservation rhinoplasty technique was implemented. (*A*) frontal before, (*B*) frontal after, (*C*) profile before, (*D*) profile after, (*E*) lateral before, (*F*) lateral after, (*G*) base view before, (*H*) base view after.

of DP push down and let down techniques in addition to structural techniques for nasal valve reconstruction (ie, spreader grafting and/or septal extension grafting). PROMs would be a leading indicator related to patient functional and cosmetic outcomes.

The presence of an anterior or caudal septal deviation can be addressed at the same time as DP osteotomies in patients presenting with external valve collapse and/or CND. The author has published on the patient perceived change after endonasal rhinoplasty using a SEG, as measured by patient-reported outcome measures (PROMs).[32] In this study, the average change in NOSE score, SCHNOS, SNOT-22, and ESS all improved ($P<.001$). The average SCHNOS total, functional,

Fig. 7. Before and 12 months after photos of patient with an I-shaped CND and nasal tip deviation. A right asymmetric spreader and a left SEG were placed to correct the axis deviation with the MSSM dorsal preservation rhinoplasty technique. (*A*) frontal before, (*B*) frontal after, (*C*) profile before, (*D*) profile after, (*E*) lateral before, (*F*) lateral after, (*G*) base view before, (*H*) base view after.

and cosmetic scores were 40.6, 67.9, and 22.4 showing significant improvement. The author combines SEG grafting through and endonasal or open approach to alleviate obstruction, correct nasal tip deviations, or add structural support to the esthetic tip. In the case of nasal tip deviations, a cottle manuever and swinging door repositioning of the septum is applied followed by structural grafting on the contralateral side of the caudally deviated septum. The purpose of structural grafting in addition to the cottle maneuver is supported by our human specimen trial measuring nasal tip support by way of force measurement using tensiometry.[33] The study assessed and quantified change in tip support after several rhinoplasty maneuvers. Minor supporting maneuvers that rely on healing and scar do not significantly alter tip support in a cadaveric model. Caudal extension graft is an important maneuver imparting significant effect on nasal tip support. Therefore, all patients are structurally grafted for nasal tip support during DP rhinoplasty.

Component resection with osteotomies for the CND in "Joseph style" rhinoplasty may exacerbate irregularities at the rhinion and cause widening from cartilage grafts. Resecting the keystone with removal of the bony cap and dorsal septal cartilage after releasing the upper lateral cartilages from the septum can lead to scarring due to removal of a significant amount of native tissue. More so, asymmetry native to the maxillary bone or high nasal boney deviations are often difficult to reach utilizing standard osteotomes. The outcomes for a DP rhinoplasty are reproducible and more predictable as the scarring process in this area is less of a factor because most structures and attachments are preserved. As extensive reconstruction of the mid-vault is not required, quicker patient recovery is likely. Limiting the need for significant cartilage grafting is a benefit for the patient and surgeon alike. Given these advantages, DP rhinoplasty offers viable advantages for patients presenting with CND.

SUMMARY

DP rhinoplasty techniques are successful in the correction of CND. The C, reverse C, I, and S shape deviations can be improved utilizing various DP strip procedures in combination with let down osteotomies. The advantages of osseocartilaginous preservation with nasal tip cartilage correction allow for predictable results which improve function and are esthetically pleasing to the patient. Instrumental to the long-term success of DP is the combination of evaluating PROMs and utilizing piezoelectric technology for patients presenting with CND.

CLINICS CARE POINT

- Major septal deviations and blocking points causing the crooked nose deformity can be addressed with DP rhinoplasty techniques.

DISCLOSURE

The author has nothing to disclose.

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