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Original Research Article

Lateral crural setback: an analysis on tip rotation

Phillip R. Langsdon, Ronald J. Schroeder*, Hani Rayess, William Clinkscales

Department of Otolaryngology and Facial Plastic Surgery, The Langsdon Clinic and UTHSC, Germantown, Tennessee, USA

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***Correspondence:**
Dr. Ronald J. Schroeder,
E-mail: rjschroeder2@gamail.com

ABSTRACT

Background: Increasing nasal tip rotation is a common objective during rhinoplasty. When ptosis is either totally or partially the result of an excessive lateral crura length, strength, or position, various techniques have been used to shorten the lateral crura in order to reduce its relative inferior ptotic force. Techniques that involve division or amputation of the cartilage have been shown to be effective, but may sometimes weaken the cartilage's shear and horizontal load strength, thus increasing the chances of unwanted sequalae in alar and/or tip contour. We presented our lateral crural setback technique as another option to allow the tip to rotate while maintaining the lateral architectural structure, end to end continuity, and horizontal load and shear strength.
Methods: Retrospective review of 20 patients undergoing cosmetic rhinoplasty who had a lateral crural setback cartilage repositioning maneuver. The primary outcomes measured after one year of follow-up were nasal tip rotation and projection. Nasal tip rotation was assessed by measures of the nasolabial angle using three different methods.
Results: There was a statistically significant increase in nasolabial angle using all 3 methods for measuring nasal tip rotation. The average increase in nasal tip rotation for all methods was 10.7° ($p<0.0001$). There was a statiscically significant decrease in tip projection. No alar distortion or complications were noted.
Conclusions: The lateral crural setback technique can be used to increase nasal tip rotation while preserving the integrity of the lateral crura. No alar distortion or complications were noted from this procedure.

Keywords: Rhinoplasty, Nasal tip, Tip rotation, Lateral crura

INTRODUCTION

Understanding the principles of nasal tip projection and rotation are required when performing rhinoplasty. The length, strength, and configuration of the medial and lateral crura are major structural determinants of tip position. Jack Anderson, MD first described the tripod theory, which conceptualizes how manipulation of the lower lateral cartilages can adjust rotation.[1] Manipulating the position of the nasal tip in space is impacted primarily by the length and strength of the medial and lateral crura as well as by contributing architecture of the nasal septum and upper lateral cartilages. In certain instances tip ptosis is more directly related to long lateral crura that hold the tip defining points in an under-rotated position. Several techniques have been described over the years to effectively achieve ideal rotation in the presence of overly long lateral crura, including division, overlay, or amputation of the lower lateral cartilages.[2–5] Although effective in tip rotation, occasionally there are potential consequences to division techniques including external valve collapse, alar knotching, pinched tip, unnatural appearing alar tip complex, as well as bulky irregularities of the internal or external ala that can occur when resection requires the additional support via lateral crural strut or other grafts. Maintaining the arch of the lateral cartilage, as well as its structural integrity and strength is critical to minimizing the chances of post-operative complications. We want to determine if these

complications would frequently occur with the lateral crural setback, or if a more natural and functional outcome could be regularly obtained by preserving the integrity of the lower lateral cartilage. The objective of this study is to measure the changes in nasal tip rotation and projection when using the lateral crural setback technique and determine if any unwanted sequelae of the technique are observed long-term.

METHODS

This was a retrospective cohort study of patients undergoing cosmetic rhinoplasty at The Langsdon Clinic and Germantown Ambulatory Surgery Center in Germantown, TN, from June 2018, to June 2020. The University of Tennessee Health Science Center Institutional Review Board granted approval and exemption from formal review. Inclusion criteria included patients who underwent rhinoplasty with the lateral crural setback (LCS) maneuver performed as the primary procedure for tip ptosis and at least 12-month follow-up. Exclusion criteria included any patient that had any additional technique to modify tip rotation including but not limited to dome division, lateral crural overlay, lateral crural excision, or lateral crural steal. Occasionally patients had to have a cephalic trim or resection of the caudal aspect of the upper lateral cartilages to provide space to reposition the lower lateral cartilages when the lateral crural setback technique creates a new tip position that overlays the adjacent architecture. Patients were excluded who presented with excessive or inadequate tip projection so that techniques employed for these patients would not confound the interpretation of the impact of the lateral crural setback maneuver by techniques used to either retroset the mesial crura or elevate those cartilages. Patient photographs were obtained preoperatively and at least 12 months following surgery. At the 12 month point patients were assessed for complications including alar nothcing, alar collapse, external nasal valve collapse, change in alar structure from the base view or development of an alar crease in the frontal view. Standard rhinoplasty photographs of the right and left profile, frontal and base views were taken in front of a blue background using a Canon eos rebel t5 with lester dine macro flash and 90 mm f/2.8 lens at 1.5 m by a professional cosmetic medical photographer. Since there is some slight variation in even very stringent photographic practices of facial framing, distance and head position, all photographs were standardized for size and position using Adobe Photoshop version (CC 2018, San Jose, CA) by a professional photographer adept with the photoshop software.

Nasal tip rotation and projection were measured and compared between preoperative and post-operative photopgraphs. Nasal tip rotation was determined using three different methods of measuring the nasolabial angle (Figure 1). Method A measured the angle between the columella and a line perpendicular to the Frankfurt horizontal plane, method B measured the angle between the columella and a line intersecting the subnasale and labrale superius, and method C measured the angle between the columella and a line tangent to the cutaneous upper lip proper.[6] For method B, occasionally the angle vertex (subnasale) postoperatively was not accurately represented in relation to surrounding anatomy due to grafting or alteration of the nasal spine. In this case the vertex was moved in space to the same position as the pre-operative photographs. Nasal tip projection was measured using the distance in pixels from the alar-facial groove to the tip defining points.[7] All photographic analysis and measurement of nasal tip rotation and projection were performed by the same photographer with a degree in photographic art, extensive cosmetic photographic experience, with expertise in the application of angle overlay using Adobe Photoshop (CC 2018, San Jose, CA) who used professional computer analysis processing to measure the angles.

Post-operative photographs, at least one year from the date of the surgery, were assessed for the presence of complications including alar notching, nasal crease development, and static alar collapse. Three facial plastic surgeons (PL, RS, HR) reviewed the images and the presence or absence was recorded in a binary scale (0 or 1).

All surgical maneuvers were documented postoperatively with a Gunter rhinoplasty diagram. These diagrams were reviewed for every patient and all additional tip maneuvers were recorded.

Statistical analysis was performed using Microsoft Excel (Windows 8.1 2013, Seattle, WA). Continuous variables were compared using paired t-tests. A probability value of 0.05 was considered statistically significant to nominally control for type I error.

Surgical technique

After careful analysis of the nasal tip complex and determination of the overall surgical goals, either an endonasal or external approach may be used. Modification of the septum, dorsum, and sidewalls are carried out prior to addressing the tip cartilages. An endonasal approach is defined as using transfixion and intercartilaginous incisions followed by marginal incisions to either fully or partially deliver the lateral crura. Partial lateral crural delivery is performed in cases that do not require dome maneuvers, so that it is occasionally only necessary to free the distal portion of the lateral crus and create a lateral soft tissue pocket in which to retroset the lateral crus.

The degree of needed rotation and thus lateral cartilage repositioning determines how much of the lateral portion of the lateral crus must be freed from its mucosal and anterior soft tissue attachments. In cases that require significant lateral crural setback or in the presence of

large or bulbous lower lateral cartilages that need additional tip/dome alterations, the full lower lateral cartilage (LLC) delivery approach is used in order to provide any additional tip cartilage alteration as well as to ensure separation of the LLC from the upper lateral cartilage. This separation adds more mobility of the LLC because not only are the lateral soft tissue attachments freed from the lateral portion of the crus, but also the upper lateral cartilage-lower lateral cartilage attachments are separated from any fibrous attachments.

In an open approach the lower lateral cartilage is usually intentionally dissected free from the upper lateral cartilage in the scroll region in order to free fibrous attachments (Figure 2). With either the open or endonasal approach, the lateral portion of the lateral crura are then carefully freed from the underlying mucosa, as well as its anterior soft tissue attachments. Infiltration of 1% lidocaine with 100:000 epinephrine in the plane in between the cartilage and the vestibular mucosa facilitates the dissection.

Once the lateral crura are fully mobilized, a pocket is dissected lateral and cephalic to their original position onto the maxilla using Metzenbaum scissors. The lateral crura may then be easily moved into these pockets, allowing a cephalic-lateral movement and rotation (Figure 3).

In most cases the cartilages are simply retroset in the new, more posterolateral position. There is no need to routinely secure the cartilage and the pocket does not have to be a precise fit; the rhinoplasty procedure is then completed as each case necessitates. However, some lateral crura may have significant concavities or convexities that necessitate techniques, such as lateral crural turn-in flaps or Gruber sutures, prior to repositioning the lateral crura.

Additionally, in some instances the cartilages are very long and may tend to infold into the new lateral space. In this case we will secure the lateral crura in their new setback position with a mattress suture and bolster through skin and lateral crura. There are cases in which the lateral cartilage is not as long as anticipated and simply need to be manipulated into a more lateral position. If these cartilages are relatively short of the pyriform region, then a lateral transcutaneous suspension suture is placed over a bolster in the pyriform region to anchor the lateral cartilage into the new position in the soft tissue. The bolster remains for 7-10 days to hold the lateral crura in the new position as healing takes place.

Additional forces may also need to be addressed in order to create room so that the lower lateral cartilages may maintain their planned new position. Excessively long upper lateral cartilages and/or a long caudal septum may resist the superior rotation of the lower lateral cartilages. If there is overlap of the caudal margin of the upper lateral cartilages and the cephalic margin of the lower lateral cartilages, then either the upper lateral cartilages are reduced to compensate for the new rotated position of the lower lateral cartilages and/or the cephalic margins of the lower lateral cartilages are reduced as appropriate. However, sometimes this is not necessary if the lower lateral cartilage can easily overlie the upper lateral cartilage and if this overlap does not contribute to excessive external fullness or abnormal tip-midvault architecture. If the caudal septum is excessively long, then either a tongue-in-groove maneuver or septal shortening may be utilized as indicated to allow the lower lateral cartilages to settle into their new position. These ancillary techniques described were not used to alter rotation, but only to allow the lower lateral cartilages to assume the new position created by the lateral crural setback maneuver. None of the patients had alterations of the alar base.

RESULTS

A total of 20 patients met inclusion and exclusion criteria. The lateral crural setback maneuver resulted in a statistically significant increase in nasal tip rotation using all three nasolabial angle measurements (Table 1).

Table 1: Mean preoperative and postoperative nasolabial angles using methods A, B and C.

Methods		Mean angle (°)	SD	P value
A	Pre-operative	93.3	11.9	
	Post-operative	104.1	9.7	<0.0001
B	Preoperative	98.9	11.7	
	Post-operative	110.9	10.9	<0.0001
C	Pre-operative	92.7	6.7	
	Post-operative	102.2	5.7	<0.0001

Table 2: Mean preoperative and postoperative distance (pixels) from nasal crease to tip defining points used as a measure of nasal tip projection.

Tip-projection	Mean distance	SD	P value
Pre-operative	55.8	7.5	
Post-operative	53.5	6.4	0.001

The average increase in nasal tip rotation across all methods measured was 10.7° (p<0.0001). The use of the lateral crural setback technique resulted in a statiscially significant decrease in projection of the nasal tip on average by 4.1% (p<0.0001) (Table 2). None of the patients had functional breathing complaints 12 months after the procedure.

Table 3: Presence or absence of additional tip maneuvers and complications. ULC: Upper lateral cartilage. AP: anterior posterior.

	Tip maneuver					Complications		
Patient	Graft shield/cap	Columellar strut	Cephalic trim	Intradomal Suture	ULC trim	Nasal crease development (AP view)	Lateral crus structure (static alar collapse base view)	Alar notching
1			1			0	0	0
2			1	1		0	0	0
3			1			0	0	0
4		1	1	1		0	0	0
5			1	1				0
6					1	0	0	0
7					1	0	0	0
8		1	1	1		0	0	0
9				1		0	0	0
10		1		1		0	0	0
11	1	1	1	1		0	0	0
12			1			0	0	0
13		1				0	0	0
14					1	0	0	0
15	1	1			1	0	0	0
16					1	0	0	0
17		1		1		0	0	0
18			1	1		0	0	0
19					1	0	0	0
20				1		0	0	0
Total	2	7	9	10	6	0	0	0

Table 4: Mean preoperative and postoperative distance from nasal crease to tip defining points used as a measure of nasal tip projection.

Tip-projection	Mean distance	SD	P value
Pre-operative	55.8	7.5	
Post-operative	53.5	6.4	0.001

None of the patients developed any alar collapse, knotching, or abnormal alar or tip contour deformities (Table 3).

DISCUSSION

Addressing the under-rotated nasal tip is commonly encountered in rhinoplasty and can be addressed with several effective techniques, including but not limited to lateral crural overlay, dome repositioning (lateral crural steal), lateral crural flap, dome division/dome reduction, lateral cartilage amputation (rim strip procedure); with and without lateral crura grafts (Figure 4).[3-5,8-10] The techniques that involve division of the lower lateral cartilages are very effective at rotating the tip. However, the lateral crural setback is another maneuver that can significantly aid rotation and that may prevent disruption of the native anatomy of the lower lateral cartilages.[2-5]

Any disruption of the previously intact cartilage arch of the lateral crus has the potential to alter the bending stiffness per cross sectional area of the lateral alar cartilage structure and may in some cases result in a weakness in resisting vertical forces as well as torsion unless supported by additional maneuvers or grafting.

Division techniques have the potential to develop weakness of their lower lateral cartilage that may or may not result in long-term collapse of the external nasal valve, pinched tip, lateral knotching, lateral alar collapse, or abnormal tip-alar architecture. While the lateral crural overlay might increase the thickness and potential strength of a segment of the lateral cartilage, there is also the risk of suture disruption and the implementation of this technique requires accurate reconstruction. Sometimes lateral crural strut grafting is effective in adding back support for the lateral cartilage after division or excision.

However, thin-skinned patients can develop obvious bossa or other visible irregularities with division or grafting techniques. While the use of additional grafting can certainly aid in restoring horizontal or torsion support, the potential issues of excess thickness, additional rigidity, potential graft failure or post-

operative displacement must be factored into the specifics of each patient.

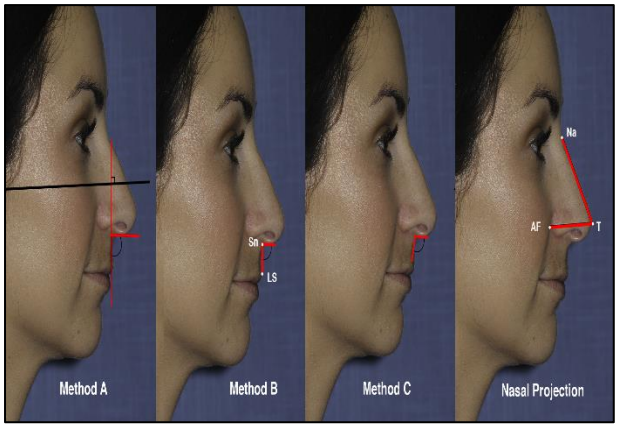

Figure 1: Method A for measuring nasal tip rotation and projection- angle between columella and line perpendicular to the Frankfurt horizontal plane. Method B for measuring nasal tip rotation and projection- angle between columella and line intersecting the subnasale (Sn) and labrale superius (LS). Method C for measuring nasal tip rotation and projection- angle between columella and line tangent to the cutaneous upper lip proper. Nasal projection measured using the distance from the alar-facial groove (AF) to the nasal tip (T).

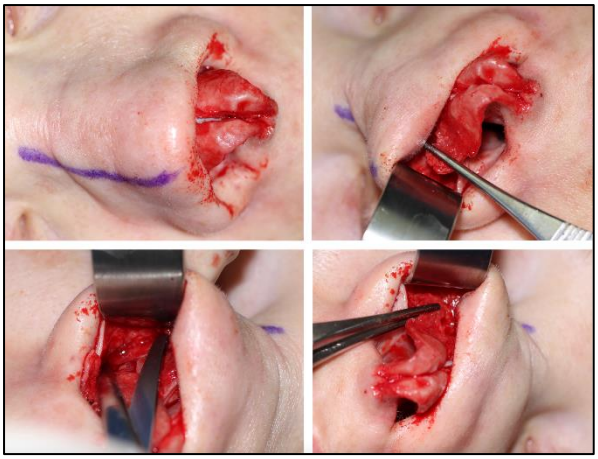

Figure 2: (Top left) External rhinoplasty approach with lower lateral cartilage dissected free from the upper lateral cartilage in the scroll region in order to free fibrous attachments (top right). The lateral crura are fully mobilized (bottom left). A pocket is dissected lateral and cephalic to their original position onto the maxilla using Metzenbaum scissors (bottom right). The lateral crura moved into the pocket.

Aside from the fact that any surgical maneuvers with the lower cartilages has the potential to disrupt inherent soft tissue attachments, the lateral crural setback technique can maintain the native shape, bending stiffness and shear strength of the lower lateral cartilages, while avoiding the potential cartilage structural issues encountered with lateral crural division or excision techniques. The term "lateral crural setback" has been previously described by Sazgar, but his technique is better described as a lateral crural overlay that is used in conjunction with lateral crural turn-in.[11]

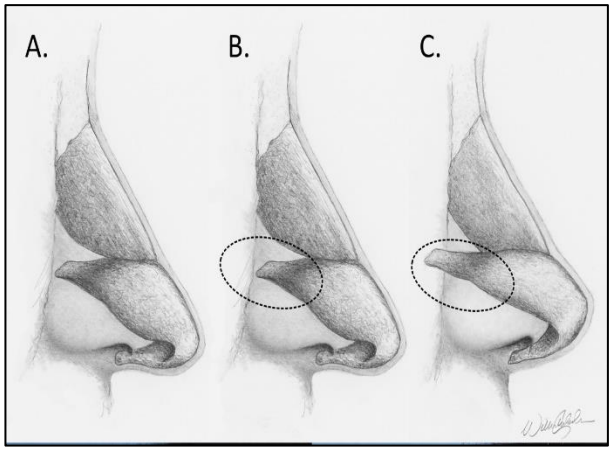

Figure 3: Lateral crural setback technique- (A) native position of lower lateral cartilage; (B) pocket dissected (dotted oval) lateral and superior to lateral crus; (C) lateral crus placed in setback position resulting in rotation and deprojection of the nasal tip. Below left, preoperative photo showing acute nasolabial angle. Below right, postoperative photo showing increase in nasal tip rotation after lateral crural setback.

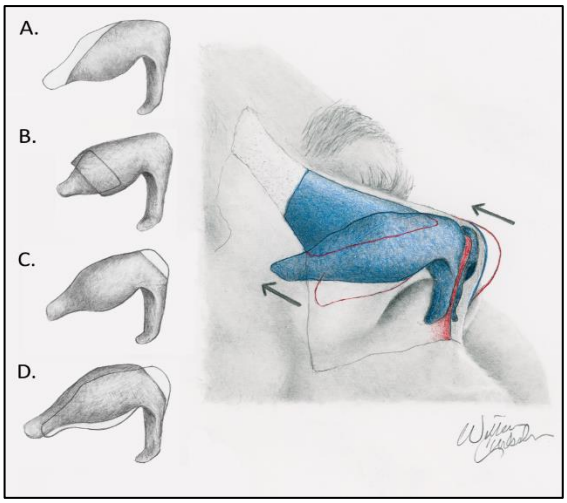

Figure 4: Comparison of rotation and deprojection techniques- (A) rim strip technique; (b) lateral crural overlay; (d) dome truncation/division; (e) lateral crural overlay. Shortening the caudal septum (or tongue-in-groove suture) and upper lateral cartilages may reduce additional inferior forces in order to allow the tip to maintain it's new position.

Lateral crural retrodisplacement described by Webster and Smith is similar to our technique except that the lateral crura are rotated more inferiorly after cephalic trim and secured to the caudal border of the upper lateral cartilage.10 Our technique is also similar to lateral crural

repositioning except that no lateral crural strut grafts are used and the native angle of lateral crural divergence is preserved.[12-13] We previously reviewed 20 random lateral crural setback patients from past decades before digital photography and computer cataloguing was available.[14] All 20 of these patients demonstrated statistically significant tip rotation. However, because we could not find all previous patients, we undertook this study to evaluate 20 recent patients that were consecutive rather than random, in order to verify the consistency of findings from the previous analysis.

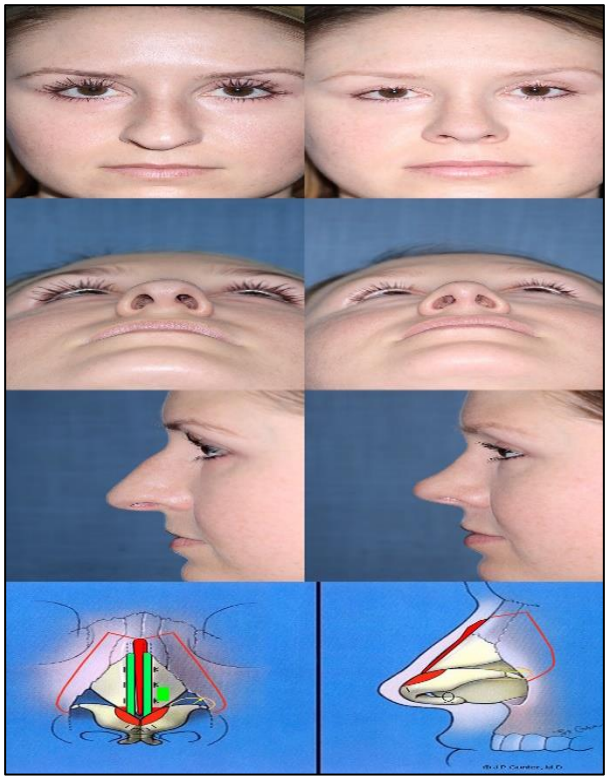

Figure 5: Before (left) and after (right) photos of patient #2. This patient underwent an open rhinopasty with lateral crural setback. Nasal diagram (bottom) showing additional techniques including dorsal reduction, medial and lateral osteotomies, spreader grafts, left sidewall crushed cartilage graft, cephalic trim, intradomal binding suture, and medial crural footplate suture.

Ideal candidates for LCS have an under-rotated nasal tip in the presence of strong lower lateral cartilages. Unlike the lateral crural steal this procedure does not alter the tip defining points and does not preclude the surgeon from performing additional maneuvers to enhance the appearance of the tip.

By allowing the lateral crura to be repositioned onto the pyriform region, the effective length that contributes to tip ptosis is decreased. In our study this led to a significant increase in tip rotation that was validated using three different measures of tip rotation (Table 1).

There were no cases of external nasal valve collapse, alar collapse, alar knotching, alar weakess, or anatomic distortion (Table 2).

LCS maintained native alar architecture in all patients (Figure 5 and 6).

Figure 6: Before (left) and after (right) photos of patient #12. This patient underwent an endonasal rhinopasty with lateral crural setback. Nasal diagram (bottom) showing additional techniques including dorsal reduction, medial and lateral osteotomies, cephalic trim, caudal septal shortening, and tongue-in-groove. Of note, the tongue-in-groove maneuver in this patient was used to stabilize the positioning of the lower lateral cartilages once the inferior tension of the lateral crura was removed by the lateral crural setback.

Although not an objective of our study, projection was measured as a point of completeness because techniques modifying nasal tip rotation can impact nasal projection. Our results demonstrated a significant decrease in nasal tip projection using this maneuver (Table 3). This was expected as placing the lateral crura over the pyriform aperture, decreases their effective length, and based on Anderson's tripod theory this would be expected to decrease projection. In patients who require an increase in projection, the surgeon has numerous options including placing a large columellar strut or securing the medial crura to the anterior portion of the caudal septum. Although typically in patients who have a counter rotated tip due to long lateral crura, a decrease in projection is also possible.

The keys to success with this technique are ensuring that the lateral crura are fully released from the adjacent tissues to the extent needed for planned rotation and the creation of a pocket for the new position, as well as the proper analysis of upper lateral cartilage and septal forces that might prohibit rotation of the lower lateral cartilage unless the opposing force is addressed. Occasionally the new position of the lower lateral cartilages may have additional overlap of the upper lateral cartilages, and a cephalic trim may be indicated, but not always. A cephalic trim was performed in 9 out of the 20 patients for this reason and an upper lateral cartilage trim was performed in 6 out of 20 patients (Table 2). These maneuvers were performed to accommodate the newly positioned tip cartilage, not as primary maneuvers to increase rotation. Sometimes the slight overlap of the lower lateral cartilage over the caudal portion of the upper lateral cartilage may add structural strength as well as the occasional need for mid vault fullness. At the end of some procedures a tongue-in-groove maneuver is performed or a columellar strut is placed to counteract any post-operative scar contracture. In our cohort, 60% (12) patients had a TIG and 35% (7) patients had a columellar strut. Two patients had shield grafts performed and nine patients had domal sutures primarily to emphasize tip defining points, not to alter rotation. It is important to note that none of the patients had cephalic malposition, nostril asymmetry or valve collapse post-operatively (Table 3).

Alternative techniques have been described to increase tip rotation that do not transect the lateral crus such as the lateral crural steal. This technique can alter rotation by using suture fixation to move the dome position lateral from the native tip defining point, to a new position incorporating the lateral cartilage, which usually requires suture fixation of the new dome. Kridel showed that lateral crural steal increases rotation by about 3.22 degrees, while subtly increasing nasal tip projection (Goode ratio increase by 0.06).[15] In addition, the mean change in rotation was 10.9 degrees using the LCS method indicating it is a substantially powerful method for addressing the ptotic tip. There are instances when lateral crural steal is an excellent option, but there are other situations when dome fixation is not needed or might alter the desired outcome or when excess cartilage length must be addressed in some fashion.

The tongue-in-groove maneuver is a reliable and versatile method for adjusting tip rotation and projection, which may be needed along with the LCS. However, when this method is used alone it cannot adequately compensate for the inferior force in cases that have an overly long lateral cartilage. In these cases the cartilage will buckle or fold unless the stress points are removed by freeing the lateral aspect of the cartilage. It can also cause stiffness of the nasal tip and in some cases columellar retraction.8 Moreover, this maneuver does not function well in patients who have a short caudal septum.

There were a number of limitations with this study. As a retrospective review, this study is inherently prone to selection bias compared to randomized prospective studies. Ideally, a comprehensive evaluation of the different techniques would include a randomized controlled trial comparing the lateral crural setback technique to other isolated techniques, but this is unrealistic since most patients require multiple techniques to achieve optimal results. Additionally, there are limitations in how nasal tip rotation is measured. For method A, it is important to note that there are inherent variations in developing the Frankfort horizontal plane. Never-the-less, our determination of the Frankfort Plane was reviewed by the photographer and three facial plastic surgeons. With method B, the vertex of the angle (subnasale) can produce misleading analysis since this point is impacted to a greater or lesser degree by the nasal spine region and thus misrepresent the true planes of the tip-lip complex. The simple application of plumping grafts or alteration of the nasal spine can alter this angle without the slightest actual movement of the tip in three dimensional space and will skew results. Therefore, the actual vertex used in our calculations followed as close to the exact position in space as determined by adjacent anatomy of the ala and lip. Regarding the upper lip line used in method C, it is noted that all lips do not present as a straight line.

Additonal confusion is possible when considering the upper limb of the nasolabial angle in all methods. A truer assessment might be based upon overall arch of the columellar-tip complex rather than either the mid-point of the nostril technique or the use of the columellar line. Further, the presence of an infratip break might also interfere in the determination of the true columella line. Additionally, whatever method is used, a false analysis of true tip rotation might be calculated since the final tip position is not always consistent with the true cephalic repositioning of the tip defining point. Although there are several methods of measuring the nasal labial angle, any can be misleading.[6,16-19] For this reason, multiple methods were used to assess nasolabial angle in order to accommodate for the inherent error within each individual method. Additionally, before and after analysis was obtained in our study with as much consistency as possible within each of the three methods studied. Further studies could also benefit from functional patient reported outcomes.

CONCLUSION

The LCS technique can significantly increase nasal tip rotation with a significant decrease in nasal tip projection while preserving alar strength and architecture. By decreasing the amount of grafting and manipulation, the native cartilage strength and architecture is better preserved compared to alternative techniques. The senior author has utilized this technique for over 30 years either alone or along with multiple other tip techniques and, in this analysis, there were no instances of external valve

collapse, cartilage migration or blunting of the alar sulcus.

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REFERENCES

1. Anderson JR. A reasoned approach to nasal base surgery. Arch Otolaryngol. 1984;110(6):349-58.
2. Constantinides M, Liu ES, Miller PJ, Adamson PA. Vertical lobule division in rhinoplasty: maintaining an intact strip. Arch Facial Plast Surg. 2001;3(4):258-63.
3. Kridel RW, Konior RJ. Controlled nasal tip rotation via the lateral crural overlay technique. Arch Otolaryngol Head Neck Surg. 1991;117(4):411-5.
4. Goldman IB. The importance of the mesial crura in nasal-tip reconstruction. AMA Arch Otolaryngol. 1957;65(2):143-7.
5. Kridel RW, Konior RJ. Dome truncation for management of the overprojected nasal tip. Ann Plast Surg. 1990;24(5):385-96.
6. Harris R, Nagarkar P, Amirlak B. Varied Definitions of Nasolabial Angle: Searching for Consensus Among Rhinoplasty Surgeons and an Algorithm for Selecting the Ideal Method. Plast Reconstr surgery Glob open. 2016;4(6):e752.
7. Goode RL. Proportions of the Aesthetic Face. New York, NY: Thiem-Stratton. 1984.
8. Kridel RW, Scott BA, Foda HM. The tongue-in-groove technique in septorhinoplasty. A 10-year experience. Arch Facial Plast Surg. 1999;1(4):246-56.
9. Salyer KE. Primary correction of the unilateral cleft lip nose: a 15-year experience. Plast Reconstr Surg. 1986;77(4):558-68.
10. Webster RC, Smith RC. Lateral crural retrodisplacement for superior rotation of the tip in rhinoplasty. Aesthetic Plast Surg. 1979;3(1):65-78.
11. Sazgar AA. Lateral crural setback with cephalic turn-in flap: a method to treat the drooping nose. Ach Facial Plast Surg. 2010;12(6):427-30.
12. Toriumi DM, Asher SA. Lateral crural repositioning for treatment of cephalic malposition. Facial Plastic Surg Clin North Am. 2015;23(1):55-71.
13. Gunter JP, Friedman RM. Lateral crural strut graft: technique and clinical applications in rhinoplasty. Plast Reconstr Surg. 1997;99(4):943-52.
14. Langsdon P, Schroeder R, Rayess H, Clinkscales W. Lateral Crural Setback: A Preservation Technique to Increase Tip Rotation. Facial Plastic Surg Aesthet Med. 2021.
15. Foda HMT, Kridel RWH. Lateral crural steal and lateral crural overlay. An objective evaluation. Arch Otolaryngol - Head Neck Surg. 1999;125(12):1365-70.
16. Powell N HB. Proportions of the Aesthetic Face. New York, NY: Thieme Medical Publishers. 1984.
17. Fitzgerald JP, Nanda RS, Currier GF. An evaluation of the nasolabial angle and the relative inclinations of the nose and upper lip. Am J Orthod Dentofacial Orthop. 1992;102(4):328-34.
18. Armijo BS, Brown M, Guyuron B. Defining the ideal nasolabial angle. Plast Reconstr Surg. 2012;129(3):759-64.
19. Kim DW, Egan KK. Metrics of nasal tip rotation: a comparative analysis. Laryngoscope. 2006;116(6):872-7.

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