The Effect of the Columellar Strut Graft on Nasal Tip Position in Primary Rhinoplasty

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Background: The columellar strut cartilage graft has historically been assumed to be a technique that increases tip projection. The purpose of this study was to retrospectively analyze a series of 100 consecutive rhinoplasty cases by the senior author (R.J.R) with a specific focus directed toward the effect of the columellar strut on final tip position, namely, tip projection and tip rotation.
Methods: Medical information and digital images were obtained from 100 consecutive primary rhinoplasty patients. All postoperative images were obtained from 1-year or greater follow-up visits. Preoperative and postoperative digital images were compared using a software application that quantitatively analyzed various facial anatomical features, including the nasofrontal angle, the nasolabial angle, tip projection, and tip translation.
Results: Tip projection (defined as the tip position on the *x* axis) actually decreased in 65 percent, increased in 27 percent, and was unchanged in 8 percent of subjects. Tip translation (defined as the tip position on the *y* axis) was decreased in 59 percent, increased in 34 percent, and unchanged in 7 percent. The nasofrontal angle was increased in 67 percent, decreased in 23 percent, and unchanged in 10 percent of patients. The nasolabial angle was increased in 46 percent, decreased in 34 percent, and unchanged in 20 percent.
Conclusion: Use of the columellar strut cartilage graft does not necessarily imply an increase in tip projection, but rather serves as a means of unifying the nasal tip and helping to control final tip position. (*Plast. Reconstr. Surg.* 130: 926, 2012.)
CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

The role of the columellar strut in aesthetic nasal surgery has been largely overlooked in the literature despite the fact that its use is almost universal in primary rhinoplasty. Our recent publication on the topic explains the importance of the columellar strut in addressing tip asymmetries.[1] Beyond tip symmetry, however, the aesthetically pleasing nose must also exhibit proper tip projection and tip rotation.

Multiple methods have been described to determine whether tip projection is appropriate. Tip projection can be evaluated by drawing a horizontal line from the alar-cheek junction to the tip of the nose and a vertical line tangential to the most projecting portion of the upper lip. At least half of the horizontal line should lie anterior to the vertical line to be considered adequate tip projection. If more than 60 percent of the horizontal line is anterior to the vertical line, the tip is overprojecting. One can also assess nasal tip in relation to alar base width. In the proportional nose, the alar base width and tip projection should be equal. Lastly, as Byrd and Hobar described, the nasal tip projection should extend to a length that is two-thirds of the distance from the radix to the nasal tip.[2]

Tip rotation plays a critical role in the overall aesthetic appearance of the nose as well. Rotation of the tip is determined by the nasolabial angle. This is determined by drawing a horizontal line through the most anterior and posterior points of the nostrils. The angle that exists between this line and the line perpendicular to the natural horizontal facial plane is considered the nasolabial angle. In women, the ideal angle ranges from 95 to 110 degrees; in men, it should be closer to 90 degrees.[3]

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Received for publication February 16, 2012; accepted March 22, 2012.

Doi: 10.1097/PRS.0b013e318262f3a9

Disclosure: *The authors have no financial disclosures related to the content of this article.*

The utility of the columellar strut can only be understood once one grasps the normal form and function of the native columella. The columella must have a balanced position in relation to the adjacent alar rim and medial crura. A retracted columella or too much show is not aesthetically pleasing.[4] Structurally, the columella can help to provide a central scaffold on which the adjacent structures retain support and balance. As such, augmentation of the columella by placement of a cartilaginous strut can provide much needed structural support for the lower lateral cartilage.

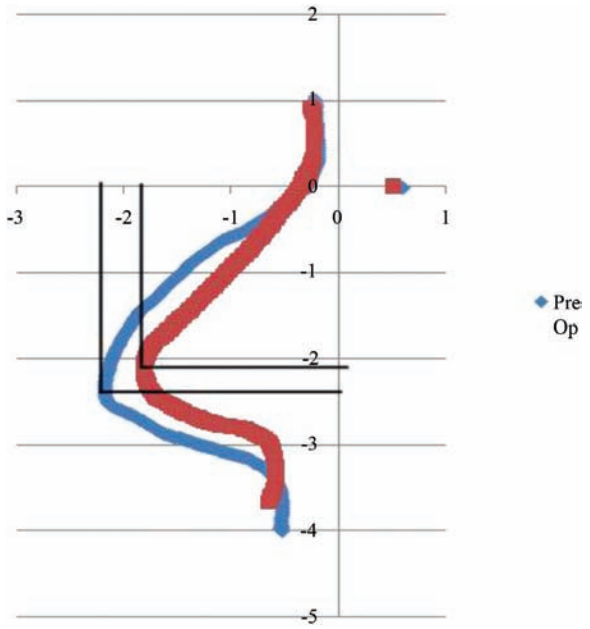

Fig. 1. Example of preoperative and postoperative nasal tracings plotted on a graph with data points along the *x* and *y* axes.

Table 1. Tip Projection Data

	Decrease	Increase	No Variation (±1%)
No.	65	27	8
Tip projection, %			
Mean variation	–6.29	4.90	
SD	0.05	0.04	
Minimum	–24.11	0.23	
Maximum	0.18	18.19	

Table 2. Tip Translation-Rotation Data

	Caudal	Cephalic	No Variation (±1%)
No.	59	34	7
Nasal tip translation, %			
Mean variation	–8.23	6.57	
SD	0.06	0.06	
Minimum	–26.75	0.26	
Maximum	0.31	22.4	

There is a paucity of literature regarding the columellar strut and its indications, specifically.[1] We recently discussed not only the role of the columellar strut in supporting weak lower lateral cartilages but also its function as a central scaffold on which the tip structures can be unified. The goal of this study is to objectively analyze the effect of the columellar strut graft on nasal tip position.

PATIENTS AND METHODS

The institutional review board for human subjects approved the review of medical records and digital images from 100 consecutive primary rhinoplasty patients (85 female and 15 male patients) from January of 2007 to August of 2009. All patients had previously undergone an open rhinoplasty approach with placement of a columellar strut graft in addition to septal reconstruction, tip refinement with suture techniques only, and component dorsal reduction when indicated. No tip grafts were used. They had a minimum of 12 months' follow-up.

Computer Program for Outcome Analysis of Tip Position

A computer software program was developed to quantitate movements of the tip and the variation of nasolabial angle and nasofrontal angle. Data from preoperative and postoperative digital images were analyzed based on graphic representation onto the *x* and *y* axes (Fig. 1).

The measurements included the following: nasofrontal angle, nasolabial angle, location of the most projected point of the tip, contour of

Table 3. Nasofrontal Angle Data

	Decrease	Increase	No Variation (±1 degree)
No.	23	67	10
Nasofrontal angle, degrees			
Mean variation	–4.64	4.7	
SD	3.32	3.04	
Minimum	–14.1	0.14	
Maximum	–0.15	14.1	

Table 4. Nasolabial Angle Data

	Decrease	Increase	No Variation (±1 degree)
No.	34	46	20
Nasolabial angle, degrees			
Mean variation	–3.16	3.75	
SD	3.32	3.04	
Minimum	–16.56	0.29	
Maximum	0	12.45	

Fig. 2. Case 1: aging nose. Preoperative (*left*) and 12-month postoperative (*right*) photographs after open rhinoplasty. The patient underwent 2-mm component

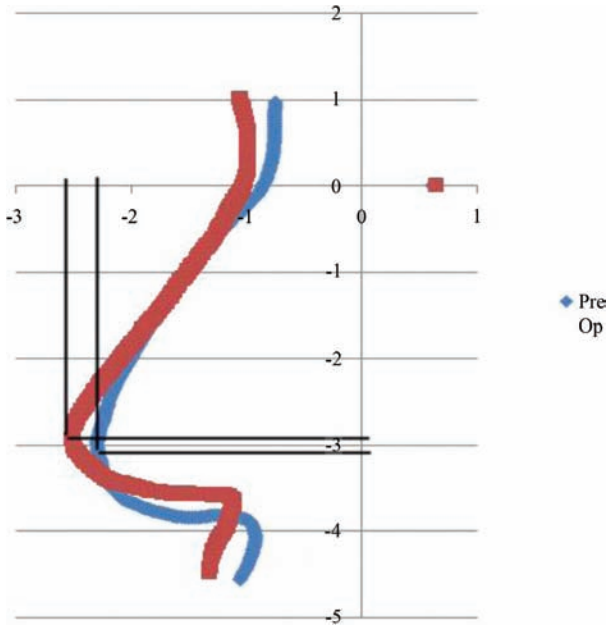

Fig. 3. Case 1: aging nose. The nasal tracing.

the nose on the lateral view, and conchal height. Specifically, a primary point was marked on the center pupil. A horizontal line from this point generated the *x* axis. A second point was marked at the base of the alar groove, and a vertical line from this point generated the *y* axis.

A third set of points marked the height of the conchae. This served as the denominator to analyze all measurements as a ratio to eliminate the risk of error caused by variations in the size of the images. Using a ratio for each subject also allows the analysis of measurements among all subject data sets.

Next, one point was placed at the glabella, and a second one was placed at the lower border of the upper lip. A line following the nasal contour was drawn between these two points to provide the preoperative and postoperative nasal tracings. This computer program has been used previously with no significant interreader variation.[5,6]

All variations of landmark locations were calculated (i.e., postoperative – preoperative/preoperative) and presented as a percentage. This was used for the tip position and the nasolabial angle and nasofrontal angle. This percentage value corresponds clinically to the change in tip projection and to the variation of the nasofrontal and nasolabial angles. Any variation included in ±1 percent was considered as unchanged.

Fig. 2. (*Continued*) dorsal reduction, septal reconstruction, intercrural sutures, and tip refinement with interdomal and transdomal sutures. No osteotomies were completed. Alar contour grafts were used to address alar notching. Her weak but mostly symmetrical lower lateral cartilages were addressed with a long floating columellar strut (type III).

RESULTS

Tip Projection

The nasal tip projection was defined as the *x* axis position of the most projecting point of the nasal tracing. In 100 consecutive patients, this value decreased in 65 patients, increased in 27 patients, and did not change in eight patients (Table 1).

Tip Translation-Rotation

The nasal tip translation-rotation was defined as the *y* axis position of the most projecting point of the nasal tracing. If a cephalic movement of the most projecting point was observed in the context of an unchanged nasolabial angle, it is considered to be a tip translation. If the cephalic movement was observed in the context of an increase of the

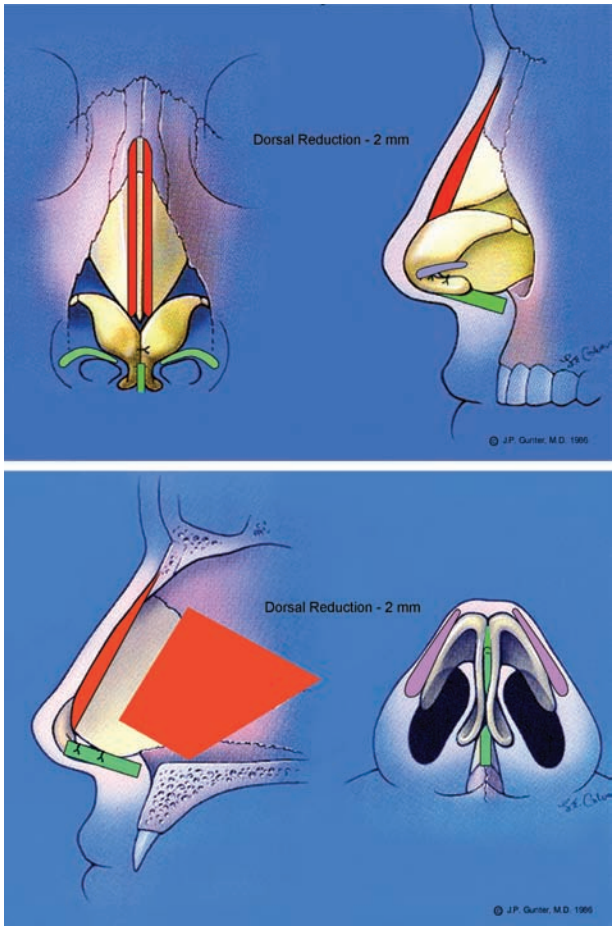

Fig. 4. Case 1: aging nose. The associated Gunter diagrams.

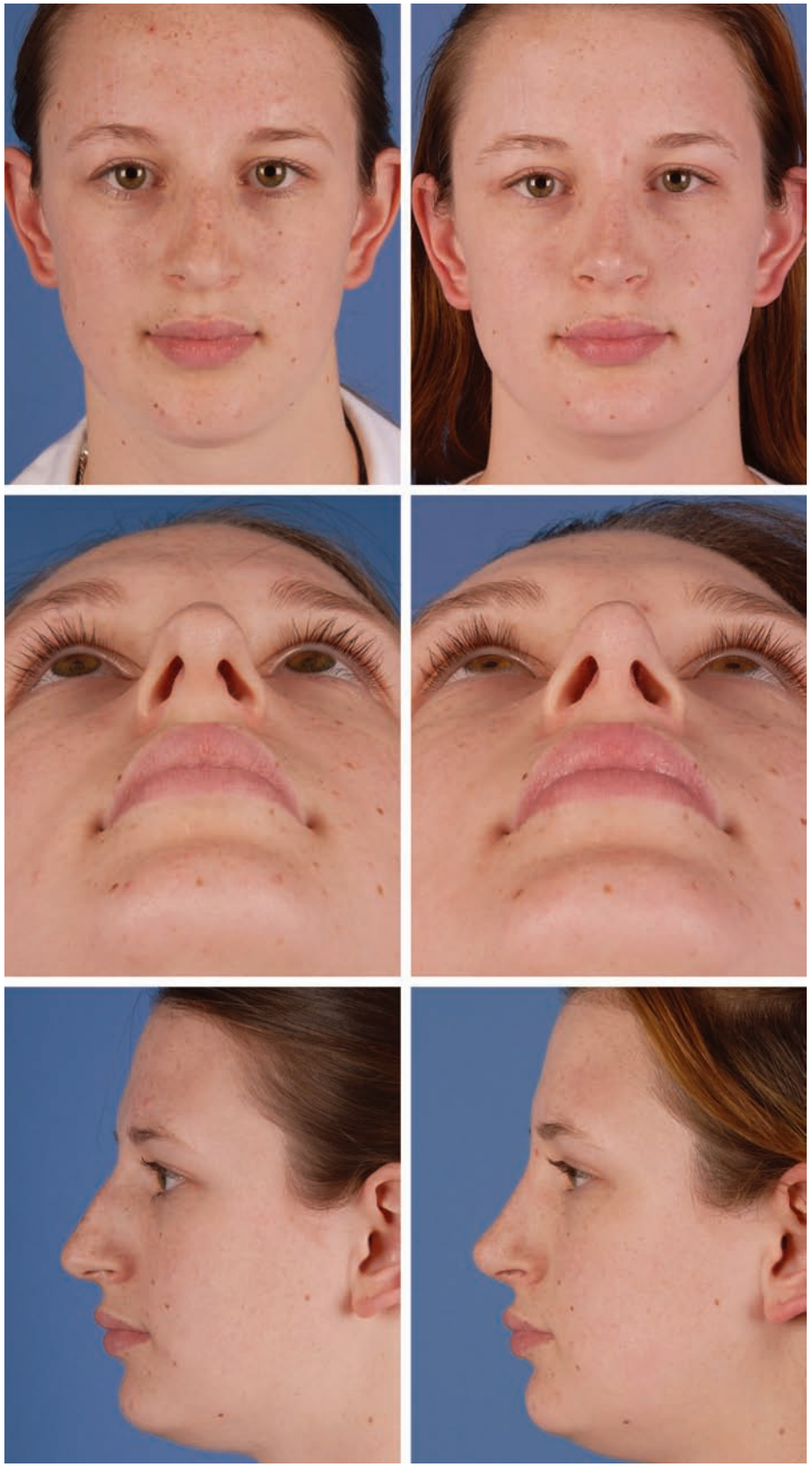

Fig. 5. Case 2: tension nose. Preoperative (*left*) and 20-month postoperative (*right*) photographs after open rhinoplasty. The patient underwent 4-mm component dorsal reduction

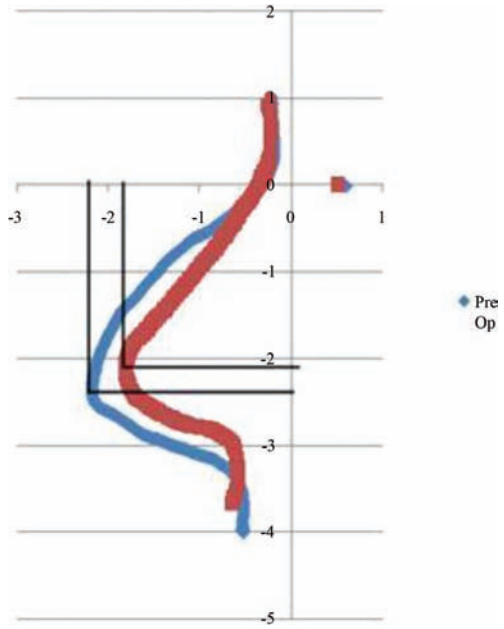

Fig. 6. Case 2: tension nose. The nasal tracing.

nasolabial angle, it is considered to be a cephalic tip rotation. In 100 consecutive rhinoplasty patients who had a columellar strut graft placed, the nasal tip translation decreased in 59 patients, increased in 34 patients, and did not change in seven patients (Table 2).

Nasofrontal Angle

The nasofrontal angle was defined by the angle between the nasal tip, radix, and most projecting point of the forehead. In 100 patients who underwent rhinoplasty with placement of a columellar strut graft, the nasofrontal angle was found to be decreased in 23 patients, increased in 67 patients, and unchanged in 10 patients (Table 3).

Nasolabial Angle

The nasolabial angle was defined as the relationship between the line connecting the most anterior and posterior points of the nostril and a line perpendicular to the natural horizontal facial plane. In 100 patients who underwent rhinoplasty with columellar strut graft, the nasolabial angle decreased in 34 patients, increased in 46 patients, and did not change in 20 patients (Table 4 and Figs. 2 through 7).

Fig. 5. (*Continued*) and tip refinement with two intercrural sutures and interdomal sutures. Percutaneous osteotomies were used. Her weak but symmetric lower lateral cartilages (type III) were addressed with a long floating columellar strut.

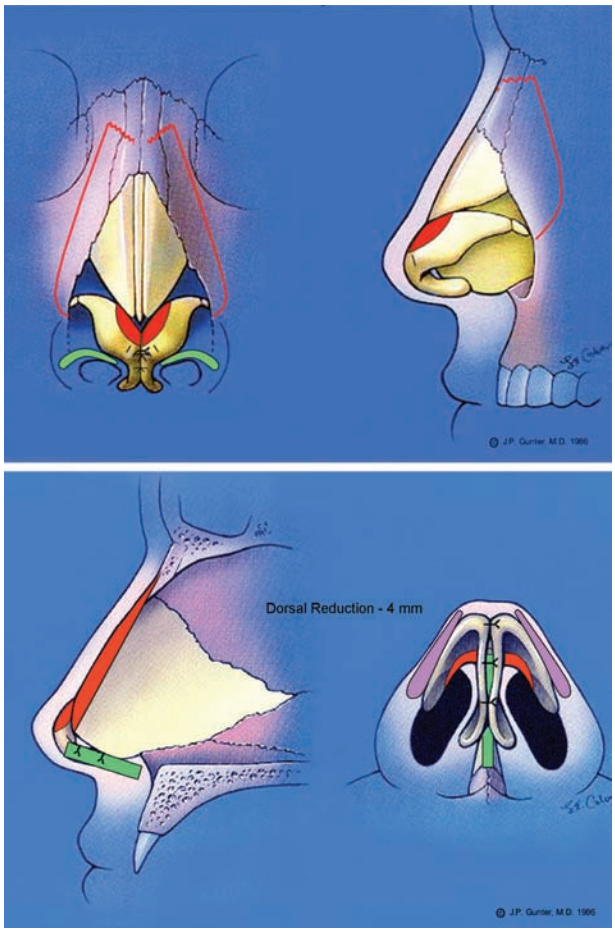

Fig. 7. Case 2: tension nose. The associated Gunter diagrams.

DISCUSSION

The columellar strut graft is undoubtedly a key component available to the rhinoplasty surgeon. Prior publications regarding nasal tip refinement have classified extrinsic and intrinsic factors related to nasal deformities. The columellar strut is neither extrinsic nor intrinsic in nature, yet it allows for correction of deformities attributable to these factors. Previous authors have detailed the elements that are involved in tip deformities, namely, the medial crura, lower lateral cartilages, footplates, and nasal spine.[7] Few publications, however, are dedicated solely to the role of the columellar strut.[1]

All 100 patients underwent primary rhinoplasty with placement of a columellar strut graft in addition to septal reconstruction, tip refinement with suture techniques only, component dorsal reduction, and percutaneous osteotomies when indicated. No tip grafts were used. The impact of these maneuvers on each measured parameter is difficult to isolate. For instance, the nasofrontal angle can be affected by component dorsal reduction in

addition to the effect of the columellar strut. Furthermore, the nasolabial angle and tip position, or its position on the *y* axis, can be affected by a cephalic trim and columellar strut placement.

The nasal tip projection, however, is clearly most affected by the columellar strut graft. As previously mentioned, each patient underwent tip suturing techniques that may increase tip projection only 1 to 2 mm. No patients had any form of tip grafting or septal extension grafts. The tip projection is thus most intimately related to the columellar strut graft because it is the technique used with the most obvious relationship with this measurement. The goal of our study was to elucidate whether or not the use of the columellar strut increased tip projection as previously thought.

Our computer analysis indicates that when a columellar strut graft was used in primary rhinoplasty, the nasal tip projection actually *decreased* more often than it increased, 65 patients versus 27 patients. This observation clearly contradicts the assumption that the columellar strut graft necessarily increases tip projection. A more appropriate characterization may be that the columellar strut actually helps *control* and/or maintain tip position.

Limitations to our study include the fact that we cannot completely isolate the columellar strut graft as the only factor that is affecting nasal tip projection. Future directions would be to explore the interaction of the nasofrontal angle, nasolabial angle, and tip position in patients who have undergone open rhinoplasty to find unappreciated interrelationships.

PATIENT CONSENT

Patients provided written consent for the use of their images.

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