Concomitant Overlap Steal Tip-plasty: A Versatile Technique to Simultaneously Adjust the Rotation, Definition, Projection, and Symmetry of the Nasal Tip

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Abstract

Background: Tip-plasty is a particularly challenging stage of aesthetic nose surgery. The diversity of nasal tip deformities has necessitated the development of numerous surgical techniques that can be difficult to master and may yield unpredictable surgical results when combined.

Objectives: The authors describe how concomitant overlap steal tip-plasty (COST) can enable surgeons to address all of the aesthetic characteristics of the nasal tip simultaneously. COST involves lateral crural steal followed by medial crural overlap.

Methods: The medical records of 1617 patients who underwent primary open septorhinoplasty with COST were evaluated in a retrospective study. Pre- and postoperative patient photographs were compared for nasal length, nasolabial angle, tip projection, and deviation of the nasal axis.

Results: Pre- and postoperative mean nasal lengths were 5.66 cm and 5.17 cm, respectively ($P < .05$). The mean nasolabial angle was 86.95° preoperatively and 101.8° postoperatively ($P < .05$). The projection of the nasal tip was reduced from 3.09 cm to 2.53 cm, and tip symmetry was achieved by decreasing the nasal axis deviation from 7.76° to 1.71° (both $P < .05$).

Conclusions: COST does not obviate all other tip-plasty techniques for specific situations. Once mastered, however, COST can become the only procedure needed to achieve all of the aesthetic goals of the nasal tip in most cases.

Level of Evidence: 4

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Aesthetic surgery of the nose is important to the establishment of facial harmony. Among all the stages of rhinoplasty, tip-plasty is the most technically demanding. Multiple characteristics of the nasal tip, including rotation, projection, definition, and symmetry must be addressed to achieve an aesthetically pleasing result.[1,2] The complex 3-dimensional (3D) structure of the nasal tip and the essential relationship between the nasal tip and the remaining upper two thirds of the nose have precipitated the development of numerous techniques for tip-plasty. The goal of these approaches is to alter the shape of the nose while preserving or reconstructing tip-support structures. The placement of domal creation sutures,[3] lateral crural steal,[4] and lateral crural overlap and setback[5] have been described to increase tip rotation, whereas the tongue-in-groove technique,[6] insertion of a long columellar strut,[7] placement of shield and cap grafts,[8] and many other surgical procedures

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have been described to increase or reestablish tip projection. Although these techniques are advantageous for the correction of specific deformities, they lack efficacy for the simultaneous correction of coexisting problems. Moreover, when these techniques are performed to address a specific concern, other 3D tip characteristics are inevitably affected, and the overall results may be unfavorable.

Concomitant overlap steal tip-plasty (COST) is a versatile technique that can address most of the deformities of the nasal tip simultaneously. COST is relatively easy to master, and surgical results have been maintained for up to 8 years of follow-up. The primary aim in this study was to evaluate the utility of COST as a technique to rotate and deproject the nasal tip and to reduce nasal length and axis deviation. These 4 variables were compared in preoperative and postoperative photographs of patients who underwent COST. Patients who presented with multiple nasal deformities were analyzed for each variable separately. In our hands, COST facilitates the reconstruction of an aesthetically pleasing tip in most patients, with alternative or adjunctive techniques only warranted in unusual situations.

METHODS

A retrospective analysis was performed on the charts of 1980 consecutive patients who underwent primary open septorhinoplasty with COST from February 2005 to July 2013. A total of 1617 patients who received ≥1 year of follow-up were included in the study. The average follow-up for these patients was 26 months (range, 14-90 months). The authors performed all surgical procedures on study participants in teaching hospitals at the Iran University of Medical Sciences, at the International Branch of Shiraz University of Medical Sciences, and in their private practice. The study was approved by the ethical committees of both universities, and all patients provided written informed consent. Patients were photographed from frontal, oblique, basal, and lateral views preoperatively and at 6 months postoperatively, 1 year postoperatively, and annually thereafter. Digital photographs of patients were analyzed with Adobe Photoshop CS5 (Adobe Systems, San Jose, CA). The nasolabial angle, nasal axis, nasal length, and tip projection were measured from digital photographs of each patient at the preoperative visit and the final postoperative visit. The photographic settings were similar for the 2 offices, including the distance from the camera to the patient, the lens magnification, and the angles of projecting lights to the object and the background. Pre- and postoperative photographs of each patient were taken in the same office to eliminate interpersonal variation. A sewing meter was located in the background of the photos to provide a real metric scale for future measurements and Patient's faces were placed just adjacent to the background to eliminate any magnification error in metric calculations.

The Frankfort horizontal line, which was the basis for the calculation of the nasolabial angle and other analyses, is an anatomic landmark independent of head position. The Frankfort horizontal line passes through the inferior margin of the orbit (ie, the orbitale) and the upper margin of each ear canal or external auditory meatus (ie, the porion). To facilitate the analysis, the patient's head position in lateral photographs was adjusted so that the presumptive Frankfort line was nearly parallel to the floor.

The nasolabial angle was defined in the lateral view as the angle between the line connecting the most anterior and the most posterior points of the nostril and the line perpendicular to the Frankfurt horizontal line. Nasal tip projection was defined as the distance between the tip-defining point and the line perpendicular to the Frankfort horizontal line that passed through the alar facial crease. Nasal length was defined as the distance between the tip-defining point and the nasion (Figure 1). To determine the nasal axis deviation, the midpoint between the 2 medial canthi was determined. One line was drawn from this midpoint to the central tip defining point, and another line was drawn perpendicular to the intercanthal line. The nasal axis deviation corresponded to the angle between these lines (Figure 2).

To measure the nasal length and tip projection, a 1-cm line was drawn on the image of the sewing meter in each patient photograph with the ruler tool in Photoshop. The length (in cm) on the sewing meter that corresponded to this 1-cm ruler line was noted, and subsequent measurements made with the ruler tool were multiplied by this value to scale distances measured in the photograph to the actual nasal measurements of each patient.

All measurements were analyzed with SPSS Statistics for Windows (version 17.0, SPSS Inc, Chicago, IL), and the paired sample *t* test was applied to ascertain the significance of pre- and postoperative differences in nasal metrics. Statistical analyses of each variable (ie, nasolabial angle, nasal axis, nasal length, and tip projection) were restricted to the subgroup of patients who underwent COST to address that variable.

Patients were asked to complete an in-office questionnaire at 1 year of follow-up. The questionnaire addressed patient satisfaction (ie, unhappy with the result, satisfied, or very satisfied) with the final shape of their nasal tip. Patients were not asked to identify themselves on the questionnaire, and all completed questionnaires were placed into the same folder at the end of the office visit (a blank copy of the questionnaire is available as Supplementary Material at www.aestheticsurgeryjournal.com).

Surgical Technique

The decision to perform COST was made intraoperatively when the desired projection, definition, rotation, and

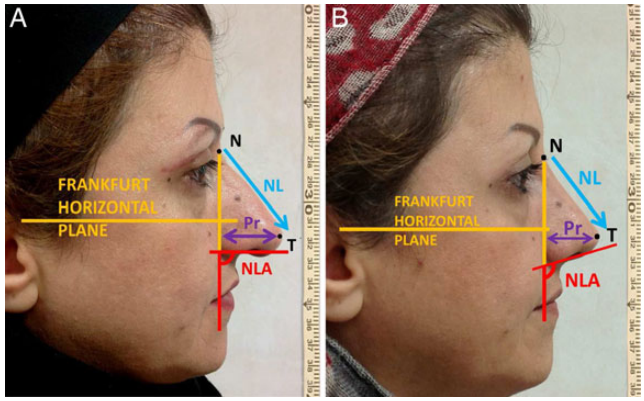

Figure 1. (A) Anatomic landmarks and measurements of this 51-year-old woman who presented for septorhinoplasty with concomitant overlap steal tip-plasty (COST). N, nasion; NL, nasal length; NLA, nasolabial angle; Pr, projection; T, tip-defining point. (B) Eighteen months postoperatively.

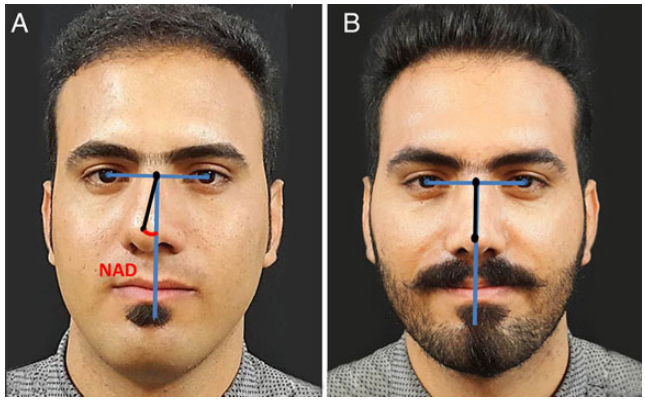

Figure 2. (A) Nasal axis deviation (NAD) from midline in this 28-year-old man, who presented for septorhinoplasty with COST to correct tip asymmetry. (B) Seventeen months postoperatively, tip asymmetry is corrected.

symmetry could not be achieved with transdomal and interdomal sutures or lateral crural steal alone. Patients who underwent COST presented with a nasal tip that required simultaneous adjustments in multiple directions. When it was possible to correct the tip with traditional transdomal and interdomal sutures, there was no need for lateral crural steal or medial crural overlap. For patients with a droopy and underprojected tip, lateral crural steal alone was performed to increase projection and rotation simultaneously.

Under general anesthesia with the patient in supine position, the lower lateral cartilages were exposed in the open approach. Adjustments of the upper and middle two thirds of the nose were made with septoplasty, hump reduction, osteotomies, and reconstruction of the internal valve. Deviations of the nasal bones and cartilaginous dorsum were addressed before tip-plasty. In preparation for tip-plasty, markings were made to indicate (1) the existing dome; (2) the desired position of the new dome, which usually was a few millimeters cephalic to the existing dome; and (3) the excess cephalic portion of the lateral crus. Domal creation sutures (polydioxanone, 5-0) were applied in the position of the new dome. The desired change in rotation determined the amount of lateral crural steal in this procedure.

Tip projection was reevaluated intraoperatively, and when warranted, deprojection was achieved by medial crural overlap, which comprised a transverse cut in the subdomal area of the medial crura on each side and dissection of the proximal stump from the underlying vestibular skinthis would allow excess, curved, malformed, or unequal proximal stumps of the medial crura to slide over the caudal segment freely and in any direction (ie, sagittal overlap). The prepared columellar strut graft then was inserted between the footplates of the medial crura. Tip projection was adjusted by altering the height of the columellar strut, and new domes were sutured to the cephalic end of the strut. The final amount of overlap was determined automatically by the distance that the proximal stumps of the medial crura slid over the distal segment. The overlapping proximal and distal stumps of medial crura were stabilized by attaching them to each other and to the columellar strut graft with horizontal mattress sutures (Figure 3).

In patients with asymmetric nasal tips, the precise reduction and fixation of the caudal septum and the release of other deviating forces was attempted first. If asymmetry persisted and was presumed to be caused by a length discrepancy of the lower lateral cartilages (eg, in patients with crooked noses), equal lengths of the lateral crura were measured from accessory cartilages to the location of the new domes. This would confine the length discrepancy to the new medial crura, and subsequent equalization by different amounts of medial crural overlap in two sides resulted in a symmetric tip positioned at the midline (Figure 4).

The excess cephalic portion of the lateral crus was either resected or overlapped to reinforce the remaining caudal segment. For the latter technique, a split-thickness incision was made through the line drawn on the lateral crus to determine the extent of cephalic excess. The underlying mucosa was dissected from the cartilage, and the cephalic segment was slided to invaginate into the mucosal pocket under the caudal segment. The invaginated cephalic segment could act as a lateral crural strut graft with comparable thickness and consistency to the caudal segment (ie, coronal overlap). Final evaluation was made by redraping the skin flap on the tip, and refinements in the amount of lateral crural steal, medial crural overlap, or equalization

Figure 3. Lateral view of the lower lateral cartilages (A) before and (B) after skeletonization in this 21-year-old woman who presented with a drooping tip, a hanging columella, mild alar retraction, and a bulbous tip. (C) Intraoperative measurement and (D) lateral crural steal procedure. (E) The cephalic segment of the medial crura was dissected from the vestibular skin, and (F) was transposed over the caudal segment. (G) The new domes and medial crura were fixed to the columellar strut. (H) The patient's profile after COST. Dorsal augmentation also was performed with grated cartilage[17] wrapped in fascia.

of the dome levels was performed when needed by changing the location of the sutures. Dog ears (≥3 mm) created in the mucosa as a result of medial crural overlap were resected to create a smooth lining. More details of the surgical technique is provided in an animation and also in a separate video file, both of which can be viewed as Supplementary Material at www.aestheticsurgeryjournal.com.

RESULTS

The average age of the patients was 28.9 years (range, 17-59 years). Of 1617 patients (539 men, 1078 women), 1348 (83.3%) underwent surgical procedures to decrease nasal length and increase tip rotation, 378 (23.3%) underwent tip deprojection, and 928 (57.3%) underwent correction of nasal axis deviation. Differences between pre- and postoperative results for each variable were analyzed only in the group of patients who underwent surgical procedures to address that specific variable at least 12 months postoperatively. In patients with a drooping tip and long noses, the mean (± standard deviation [SD]) preoperative nasal length was 5.66 cm (± 0.24 cm), and the mean postoperative length was 5.17 cm (± 0.26 cm; $P < .05$; Table 1). The differences between preoperative and postoperative nasal lengths ranged from 0.3 to 1.35 cm with an average difference of 0.48 cm (± 0.21 cm). The mean nasolabial angles were 86.95° (± 6.1°) preoperatively and 101.8° (± 6.4°) postoperatively ($P < .05$). The mean difference between pre- and postoperative nasolabial angles was 14.8° (± 2.4°), and the differences ranged from 1.7° to 23.6°. Among patients who underwent deprojection, the mean preoperative tip projection was 3.09 cm (± 0.31 cm), and the mean postoperative projection was 2.53 cm (± 0.29 cm; $P < .05$). The mean difference between pre- and postoperative projections was 0.56 cm (± 0.12 cm), and the differences ranged from 0.14 to 0.87 cm. Among patients who underwent correction of nasal deviation, the mean deviation was 7.76° (± 3.4°) preoperatively and 1.71° (± 0.28°) postoperatively ($P < .05$). The range of differences between pre- and postoperative deviations was 2.3° to 16.2°, and the mean difference was 6.04° (± 3.32°). Pre- and postoperative photographs of patients who underwent simultaneous correction of tip position in different directions are presented in Figures 5-6 and Supplemental Figure 1.

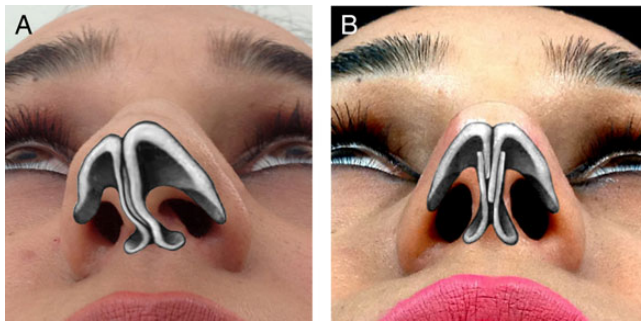

Figure 4. (A) Schematic of lower lateral cartilages overlain on a preoperative photograph of this 23-year-old woman who presented with severe tip asymmetry. The patient underwent COST with different extents of medial crural overlap to correct the length discrepancy of the lower lateral cartilages. (B) At 28 months postoperatively, the nasal tip is symmetric and positioned in midline.

Of 1617 patients in this study, 839 (51.9%) respondents completed the questionnaire. Of these, 784 (93.4%) respondents indicated that they were "satisfied" (513 respondents [61.1%]) or "very satisfied" (271 respondents [32.3%]) with their surgical results. Fifty-five respondents (6.6%) indicated that they were "unsatisfied" with their surgical results.

One hundred and ten of 839 respondents (6.8%) underwent revision rhinoplasty at ≥1 year postoperatively. In general, revision surgery was performed in most of the cases to correct patient concerns with the upper and middle two thirds of the nose, such as a wide bony vault or incomplete correction of a deviated cartilaginous septum in the middle vault. The nasal tip was the reason for revision surgery for 52 (3.2%) patients. Of 52 patients undergoing refinement of the nasal tip, primary concerns included displacement of onlay tip grafts (11 patients [22%]), supratip fullness due to uncorrected cephalic malposition of the lateral crus (8 patients [15%]), mild tip asymmetry (8 patients [15%]), unequal curvature of the lateral crura (19 patients [37%]), and inadequate columellar show (6 patients [11%]).

Table 1. Quantitative Patient Data Preoperatively and After Rhinoplasty With Concomitant Overlap Steal Tip-plasty

	Preoperative Mean (SD)	Postoperative Mean (SD)	Difference, Range	Mean Difference (SD)	*P* Value[a]
Nasal length, cm	5.66 (0.24)	5.17 (0.26)	0.3-1.35	0.48 (0.21)	<.05
Nasolabial angle	86.95° (6.1°)	101.8° (6.4°)	1.7°-23.6°	14.8° (2.4°)	<.05
Tip projection, cm	3.09 (0.31)	2.53 (0.29)	0.14-0.87	0.56 (0.12)	< .05
Nasal axis deviation	7.76° (3.4°)	1.71° (0.28°)	2.3°-16.2°	6.04° (3.32°)	< .05

SD, standard deviation. [a]*P* values indicate the significance of pre- vs postoperative mean values.

Figure 5. (A, C, E, G) Preoperative views of this 21-year-old woman who was also depicted in Figure 3. The patient underwent tip-plasty with COST and augmentation of the radix and dorsum with grated cartilage[17] wrapped in fascia. (B, D, F, H) Fifteen months postoperatively.

DISCUSSION

Tip-plasty is a primary determinant of a successful rhinoplasty. Several methods have been described to treat nasal tip deformities. Because each approach has a corresponding learning curve, mastery of every tip-plasty technique is not feasible. Instead, surgeons who perform advanced rhinoplasty as a routine practice usually seek versatile techniques for the simultaneous correction of multiple nasal tip deformities. Projection, rotation, definition, and symmetry are the major elements that may be addressed by the surgeon to produce an aesthetically pleasing nasal tip.[2] With COST, these elements can be manipulated simultaneously.

As described by Anderson,[9] the lower lateral cartilages form a tripod in their normal resting position such that the 2 lateral crura represent cephalic legs and the 2 adjacent medial crura together represent the third caudal leg. Although some modifications have been proposed,[10] this tripod theory has been the basis of tip-plasty techniques for decades. According to tripod theory, manipulation of each leg has an inevitable effect on the length and resting angle of the other 2 legs. For this reason, tip-plasty techniques developed to correct a specific deformity may simultaneously alter other aesthetic features of the tip, potentially yielding unfavorable results. For instance, lateral crural steal[4] may be performed to rotate the tip, but this procedure also will increase tip projection and the resulting increase in the interdomal distance may negatively affect definition of the tip. Moreover, rotating the tip by resecting or overlapping the lateral crura[5] will lead to tip deprojection. The tongue-in-groove technique[6] may produce a bowing appearance or a bulbous tip deformity if the excess length of the lateral crural cartilage is not addressed when the tip is retracted cephalically to its new position adjacent to the caudal septum.

Popular techniques for deprojection of the tip, such as partial excision or overlapping setback of the medial crura[11] and manipulation of the foot plates,[12] also can derotate

Figure 6. (A, C, E, G) Preoperative views of this 28-year-old man who presented with nasal axis deviation due to trauma in childhood, tip asymmetry, a horizontal septal fracture, and mild tip bulbosity. He underwent septorhinoplasty with COST to address the asymmetry and bulbosity of the tip. (B, D, F, H) Seventeen months postoperatively.

the tip unit. Domal creation sutures,[13] which are placed routinely to define the tip, yield predictable results and are associated with fewer long-term contour deformities compared with older dome-dividing techniques, such as the Goldman procedure.[14] However, when applied to distorted and severely asymmetric lower lateral cartilages without interruption in the integrity of the cartilage, domal creation sutures may fail to correct, or may even accentuate, asymmetry of the nasal tip. Transdomal sutures, when placed in a boxy nasal tip with long, horizontally positioned middle crura, will influence projection or rotation of the tip based on the location of the sutures along the middle crus. Although these techniques have been applied to many successful rhinoplasties, they are limited to the correction of specific deformities. A versatile technique that enables the surgeon to overcome coexisting deformities simultaneously is preferable. COST is a new combination of previously described tip-plasty techniques that makes the simultaneous correction of tip issues achievable. To our knowledge, this study is the first large series describing the advantages of COST. COST is indicated for cases in which the desired aesthetic goals of the nasal tip cannot be reached with simpler techniques, such as transdomal and interdomal suturing. COST includes lateral crural steal, a powerful tool to rotate

the nasal tip. Lateral crura attached to accessory cartilages can function as slings to stabilize the rotated tip in its new position. The excess cephalic segment of the lateral crus can be invaginated beneath the caudal remnant to further reinforce the tip. COST also involves incisions in the cartilages of the medial crura, followed by dissection of the proximal (ie, cephalic) stumps from the underlying vestibular skin. This interruption in cartilage integrity confers several advantages. The surgeon can roll the cephalic segment of the medial crus over the caudal segment and decrease the projection of the tip with precision. This may reverse the concomitant increase in projection caused by lateral crural steal, allowing the surgeon to rotate the tip without substantially altering its final projection. Lateral crural steal also may induce angulation of the lengthened medial crus at the location of the previous dome. The overlapping procedure can camouflage this angulation as needed. However, the surgeon must be careful to preserve an appropriate columellar-lobular angle or achieve a double-break appearance in accordance with the patient's presenting concerns. Overlapping the medial crura is also a powerful and predictable procedure for correcting a hanging columella (Figure 7). Precise determination of the extent of overlap and placement of the sutures can also play a role in correction of the malposition of the footplates.

For success with COST, we advocate maintaining an intact lateral crus to provide a stable sling for predictable positioning of the tip. When the lower lateral cartilage is manipulated in multiple directions, it must be attached to a fixed point to enable the surgeon to stably relocate the tip without concern about malposition during healing. Although the lateral crura can be incised, overlapped, or excised to achieve the desired rotation, these procedures may decrease projection according to the tripod theory and may necessitate other manipulations for reestablishment of the desired projection. Moreover, dissection of the mucosa underlying the lateral crural cartilage makes it freely mobile, eliminating its utility as a sling to maintain tip position.

In the field of functional rhinoplasty, it has become increasingly popular to retain or even augment the texture of the lateral crura to achieve or preserve appropriate angles of the respiratory valve. Nevertheless, lateral crural overlap and setback are valuable surgical maneuvers for tip rotation when performed by an experienced surgeon and any complication associated with loss of projection or weakening of the cartilage may be avoided by means of multiple cartilage grafts or other combinations of tip-plasty techniques.

The combination of lateral crural steal and medial crural overlap in COST is associated with more surgical advantages compared with either procedure in isolation. Lateral crural steal can be applied to rotate the tip, but this procedure may widen the interdomal distance because the cartilages located in the previous dome area have a natural curvature that may resist adequate approximation of the new dome, leading to inadequate tip definition (ie, excessive divergence of tip cartilages). Interruption of the cartilage strip in the medial crura reduces this resistance and produces a more defined tip. Correction of a length discrepancy of the lower lateral cartilages and rotating the tip with an adjustable amount of projection also are achieved much more easily by combining these techniques in COST. COST does not preclude subsequent manipulations of the tip, such as grafting for added definition, camouflage, straightening, or external/internal reinforcement of the nasal valve. COST also can be combined with case-specific surgical maneuvers, including repositioning of the lateral crura, manipulation of the footplates, and premaxillary augmentation.

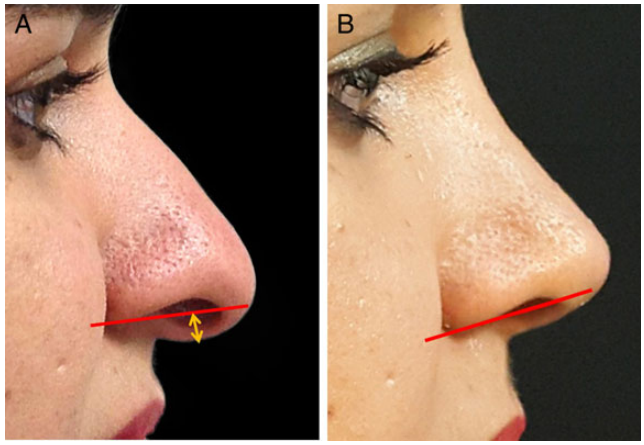

Figure 7. (A) Preoperative and (B) fifteen months postoperative views of this 21-year-old woman who was also depicted in Figure 3. The patient underwent COST to correct a hanging columella.

Although COST is applicable to secondary rhinoplasty when performed by a skilled surgeon, we omitted patients undergoing secondary rhinoplasty from our statistical analyses. The decision to perform COST in secondary rhinoplasty depends on intraoperative findings such as the extent of soft tissue fibrosis at the tip and the ability to dissect cartilaginous subunits separately. COST should be readily adaptable to patients with previous nondelivery closed rhinoplasty in which the medial and middle crura were not manipulated extensively. The senior author of this article (A.M.) has performed COST on patients who previously underwent open septorhinoplasty and has obtained successful results over long-term follow-up.

We modified and improved our surgical techniques during the course of this study to reduce the incidence of unsatisfactory tip shape. In general, operations performed later in the study involved less trial and error to precisely place the tip sutures. We also became more adept at applying COST to create adequate divergence in the dome area of the lower lateral cartilages and we attempted to fix onlay

grafts more tightly to different corners of the dome area to prevent displacement during healing process. We also focused on the symmetry of the tip pyramid by fixating the columellar strut graft to the new domes before suturing the overlapping stumps of each medial crus approximate determination of the extent of medial crural overlap before fixation to columellar strut may produce medial crura of unequal lengths, thereby tilting the tip pyramid toward the shorter side while fixation of the domes to the tip of the columellar strut graft will automatically determine the extent of needed overlap for medial crus of each side.

We found that it was crucial to compare the lateral crura for a difference in resilience. In this study, weak lateral crura were corrected by unilateral or bilateral strut grafts or more commonly by coronal overlap of the excess cephalic segment. We achieved the patient's desired amount of columellar show by suturing the overlapping stumps of the medial crura together and to the columellar strut graft. The double break and sufficient columellar show, which arise naturally by the gentle curvature of the caudal margin of the medial crus, can be lost if overlapping segments are rotated inward and aligned to produce a straight line at the anterior border of the columellar strut graft. Precise placement of mattress sutures can avoid this potential unfavorable outcome.

Although versatile, COST is not a replacement for all other tip-plasty techniques. When cephalic displacement of the lateral crura give rise to the parenthesis or bulbous tip deformity, adequate tip definition depends on repositioning the lateral crura[15,16] irrespective of whether COST is performed. For patients with thick nasal skin, adequate tip projection and definition may only be possible with tip-grafting techniques[8] in addition to COST. A major limitation of this study was the absence of matched control groups to compare the long-term results of COST with those of other tip-plasty techniques. A controlled comparison study is planned.

CONCLUSIONS

COST is relatively easy to master and simultaneously addresses definition, rotation, projection, and symmetry of the nasal tip in most patients. Although COST is an extremely versatile procedure, specific situations may require the combination or replacement of COST with other tip-plasty techniques.

Supplementary Material

This article contains supplementary material located online at www.aestheticsurgeryjournal.com.

Disclosures

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