The Tripod Graft
Nasal Tip Cartilage Reconstruction During Revision Rhinoplasty
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IMPORTANCE Nasal tip revision remains one of the most challenging surgical procedures for facial plastic surgeons to perform.

OBJECTIVE To describe preoperative and postoperative findings related to nasal tip functional and aesthetic aspects following revision rhinoplasty using the “tripod” technique.

DESIGN, SETTING, AND PARTICIPANTS A retrospective descriptive study was performed in patients who underwent revision rhinoplasty between 2007 and 2012 at a clinic in Bogota, Colombia. A preoperative diagnosis of nasal tip deformity was made on the basis of photographic records and compared with postoperative nasal tip findings in patients who required the tripod technique. Photographs were evaluated before and after surgery every month for the first 3 months, and after 6, 9, and 12 months postoperatively.

MAIN OUTCOMES AND MEASURES Nasal projection, tip rotation, columellar and alar retraction, alar pinch, lack of tip definition, and nasal tip asymmetry.

RESULTS Sixty-four of the 69 patients who received revision rhinoplasty using the tripod technique during the study period were enrolled in the study. The tripod technique improved all of the following aesthetic and functional parameters (all P < .001). Nasal tip definition improved in 43 of 49 patients (88%). After surgery, projection was normal in 28 of 40 patients (70%) who had underprojection and overprojection preoperatively, and rotation improved in 29 of 38 patients (76%) who had overrotation or underrotation preoperatively. Columellar retraction improved after surgery in 18 of 24 patients (75%). The alar region improved in 41 of 52 patients (79%) who had alar retraction and/or pinch preoperatively, and inspiratory collapse improved in 49 of 50 patients (98%).

CONCLUSIONS AND RELEVANCE The tripod technique is an efficient surgical alternative for nasal tip reconstruction during revision rhinoplasty. This technique allows the destroyed cartilaginous framework to be recreated and returns original nasal tip appearance with stable results.

LEVEL OF EVIDENCE 4
Nasal tip revision remains one of the most challenging surgical procedures for facial plastic surgeons to perform. Changes in the support mechanisms, which are commonly disrupted by previous operations, and alterations in normal anatomical structures make this procedure difficult for many surgeons. Manipulation of the nasal tip to restore tip contour and nose function is one of the most difficult tasks to achieve.

The deformities that most frequently occur are external valve dysfunction, alar pinch, alar retraction, and lack of tip definition and projection, due to overresected lower lateral cartilages. To correct these deformities, the surgeon must not only restore but also replace the tip framework.

Toriumi reported the importance of reestablishing tip support by stabilizing the nasal base with a columellar strut, suturing the medial crura to the caudal septum, or using a caudal extension graft to maintain projection postoperatively.

Alar and tip asymmetries and contour deformities have been addressed with multiple graft types, for example, batten grafts, lateral crural strut grafts, composite grafts, alar rim grafts, shield grafts, and suture techniques.

Although numerous techniques to restore nasal tip structure have been proposed, to our knowledge, no single structured graft is capable of solving all of these major problems simultaneously has been described. The “seagull wings” technique described previously by one of us (F.P.) and colleagues is designed to replace the lower lateral cartilages and restore nasal tip contour. This graft technique has been found to improve tip projection, tip rotation, alar pinch, alar collapse, and alar retraction, but less improvement has been observed for columellar retraction. According to our results, columellar retraction was still present in 64% of the patients after surgery.

In search of a graft structure that corrects major aesthetic aspects of the nasal tip contour, including columellar retraction, we propose the creation of a structured graft that we have named the “tripod.”

The tripod graft is made by adding a complementary shield graft to the seagull wing graft, giving it the appearance of a tripod like those used in photography; just as Anderson explained, it has the most similar structure to the normal cartilaginous nasal tip. The tripod graft replaces the total cartilaginous structure of the nasal tip in patients who lack support mechanisms because of overresection of nasal cartilages in previous rhinoplasties.

The aim of this study was to assess the results of the tripod technique in terms of improvement of nasal tip projection, tip rotation, alar pinch, alar retraction, and columellar retraction.

**Methods**

**Medical Record Review**

A retrospective medical record analysis was performed in patients who required revision rhinoplasty between January 2007 and March 2012, using the tripod technique. One investigator (F.P.) performed 465 revision rhinoplasties during that time; the tripod technique was performed in 69 patients, 64 of whom were included in this study. The remaining 5 patients did not meet the inclusion criteria, either because they did not agree to participate (3 patients) or because they could not complete a minimum follow-up period (2 patients who lived outside the country). All patients included in the study completed follow-up of up to 1 year postoperatively. Institutional review board approval and informed consent were waived because of the study design.

Three specialists (E.F., M.T.A., F.B.) reviewed all medical records from patients in whom the tripod technique was used for revision rhinoplasty. Data regarding age, sex, and number of previous operations were collected. Patient measurements were obtained by photographic analysis to compare aesthetic parameters before and after surgery. The same photographer photographed all patients before and after surgery.

**Outcomes and Measures**

The following measures were considered in the frontal and lateral photographs and analyzed with specialized software. Nasal projection was based on the Byrd coefficient; tip rotation, as defined by Powell and Humphreys; and columellar and alar retraction, based on the Gunter classification. Alar pinch, lack of tip definition, and nasal tip asymmetry were assessed subjectively.

Photographs were evaluated before and after surgery every month for the first 3 months, and after 6, 9, and 12 months postoperatively. All measurements were taken in the same way every time.

Outcomes were assessed by comparing the different measures before and after the tripod technique surgery. The 12-month postoperative photograph was used for analysis, and different aesthetic parameters were compared objectively. A qualitative comparison was made to address improvements.

**Surgical Technique**

The tripod technique consists of 4 steps: (1) marking the nasal tip, (2) harvesting the ear cartilage grafts, (3) sculpting and molding the grafts, and (4) placing the tripod graft as a single block or as independent grafts (Figure 1).

**Marking the Nasal Tip**

The first step during the operation consists of marking the nasal tip. Determining a patient’s domes and the location of the remaining alar cartilages is essential for surgical planning. The inferior nasal tip is pressed upward to rotate it cephalically to the desired position to define the level of the new dome, and the new dome position is marked. The positions of cartilage grafts and additional rhinoplasty techniques for the patient are also marked.

**Harvesting the Ear Cartilage Grafts**

The anterior surface of the concha cymba and the concha cavity are infiltrated with lidocaine, 1%, and 1:100 000 epinephrine. An incision is made with a No. 15 blade 2 to 3 mm below and anterior to the antihelix, from the anterior crus of the antihelix to the antitragus. A skin-perichondrium flap is elevated on the anterior surface of the concha.

The cartilage incision is made 1 mm below the skin incision to improve wound closure. The posterior perichondrium is harvested together with the cartilage. Removing the concha cymba usually provides a cartilage strip of approximately...
The concha cavum is always removed with the tripod technique to shape the frontal shield graft. A 3-mm-wide cartilage bridge is left between the concha cymba and the concha cavum to maintain good support to the ear. Two small drains are left in the field. The concha is packed with moistened cotton and draped with micropore strips.

Figure 1. The Tripod Technique in Revision Rhinoplasty

A Conchal Cartilage Harvest

Skin incision
Cartilage for the seagull wing
Cartilage for the shield

B Graft Sculpting and Molding

Measuring and sculpting the shield
Sculpting the seagull wing graft
Independent grafts
Tripod graft in block

C Tripod Placement as 1 Block

Precartilaginous incision
Pocket dissection
Placement into the pocket
Fixation of the tripod graft

D Tripod Placement as Independent Grafts

Suture of the seagull wing to the cartilage remnant
Fixation of the right seagull wing
Fixation of the left seagull wing
Suturing the shield
Finalized tripod graft
Figure 2. The Tripod Graft Unit (Seagull Wing Graft + Shield Graft)


Figure 3. Tripod Technique as Independent Grafts

Sculpting and Molding the Grafts

After the ear cartilage is harvested, the concha cymba is divided into 2 equal parts along its longer axis. The domes are marked and sutured with 910 polyglactin mesh (Vicryl 5-0, Ethicon). The final size of this graft, which represents the alar cartilage, has approximately 10 mm of medial crura and 20 mm of lateral crura. The lateral crura is 7 mm wide in the central part and 5 mm at the dome area. Each part of this graft constitutes 1 lower lateral cartilage. The parts are sutured together with 910 polyglactin to form the seagull wing graft.8

Then the shield graft is sculpted from the concha cavum. The approximate measurements depend on the individual patient but usually range from 15 to 20 mm long and from 7 to 8 mm wide at the superior border. Once the shield has been shaped, it is sutured to the anterior part of the seagull wings to form a single block cartilage graft, called the tripod graft (Figure 2).

Placing the Tripod Graft

The whole graft can be inserted via an endonasal or external approach. The usual approach used for patients in this study was endonasal via the precartilaginous or marginal incision. Bilateral precartilaginous incisions were made, and pockets above the remaining alar cartilages were formed. Then the graft was inserted through the incision and fitted into the pockets. The graft was placed anterior and superior to the patient’s own alar cartilages to increase the length of the nose and to improve columnar retraction.
The graft was sutured to the remaining lower lateral cartilages and to the anterior skin of the precartilaginous incision with 5-0 polyglactin sutures. The skin incisions were closed meticulously. If needed, the tripod can be assembled separately; the seagull wing graft can be independently added over the remaining alar cartilages, and then the shield is placed and sutured to the seagull wings (see Figures 3, 4, and 5).

Results

A total of 64 patients were included (55 women [86%] and 9 men [14%]). The mean (SD; range) age was 32.5 (9.6; 19-59) years. All patients had undergone at least 1 previous rhinoplasty elsewhere (Table 1). Results for aesthetic parameters are as follows (Table 2).

Definition

A poorly defined nasal tip was the deformity diagnosed most frequently. Forty-nine of the 64 patients (77%) presented with poor nasal tip definition; this characteristic improved in 88% of patients. Only 6 patients had similar preoperative nasal tip definition after surgery. Success was estimated at 78% to 97%.

Projection

Underprojection was the second most frequently altered parameter; 38 of the patients (59%) had an underprojected nasal tip, and only 2 (3%) had an overprojected tip. We observed improvement in this parameter in 28 patients (70%). The mean projection was 24.7 mm preoperatively and 27.6 mm postoperatively, which was considered a statistically significant improvement.
Rotation
We observed that 76% of the patients with altered rotation, either overrotation (48%) or underrotation (11%), improved compared with their preoperative analysis. Twenty-nine of 38 patients with rotation problems showed a better nasolabial angle postoperatively. Surgical success was estimated at 64% to 88%. The mean underrotation angle was 87° before surgery and 97° after surgery, whereas the mean overrotation angle was 119° preoperatively and 108° postoperatively.

Columella
Columellar retraction was observed in 24 patients (38%). After surgery with the tripod technique, 75% of these patients showed substantial improvement. Although an objective measurement was used to assess improvement, it was necessary to consider cases with severe columellar retraction (>4 mm). These patients had no normal measurements postoperatively but showed an important improvement in columellar retraction when evaluated qualitatively. We found that all patients (100%) improved after surgery on the basis of a qualitative assessment.

Alar Region
Alterations in the alar region were classified as alar retraction, pinched ala, or both. We found alar retraction in 10 patients (16%), a pinched ala in 12 (19%), and both in 30 (47%). We observed an overall improvement in 79% of patients for this parameter. Of the 30 patients who presented both deformities simultaneously, only 1 did not show major improvements after surgery.

Inspiratory Collapse
Before surgery, 50 of the patients (78%) showed inspiratory collapse, but only 1 did so after surgery. Improvements in external valvular collapse were achieved in 98% of the patients.

### Table 1. Principal Characteristics of the Study Patients

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value (N = 64)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Mean (SD), y 32.5 (9.6)</td>
</tr>
<tr>
<td></td>
<td>No. (%)</td>
</tr>
<tr>
<td>≤19 y</td>
<td>1 (2)</td>
</tr>
<tr>
<td>20-29 y</td>
<td>14 (22)</td>
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<tr>
<td>30-39 y</td>
<td>23 (36)</td>
</tr>
<tr>
<td>40-49 y</td>
<td>20 (31)</td>
</tr>
<tr>
<td>50-59 y</td>
<td>6 (9)</td>
</tr>
<tr>
<td>≥60 y</td>
<td>0</td>
</tr>
<tr>
<td>Sex, No. (%)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>9 (14)</td>
</tr>
<tr>
<td>Female</td>
<td>55 (86)</td>
</tr>
<tr>
<td>Previous rhinoplasties, No. (%)</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>36 (56)</td>
</tr>
<tr>
<td>2</td>
<td>18 (28)</td>
</tr>
<tr>
<td>3</td>
<td>8 (12)</td>
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<tr>
<td>4</td>
<td>1 (2)</td>
</tr>
<tr>
<td>5</td>
<td>1 (2)</td>
</tr>
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</table>

### Table 2. Prevalence of Tip Deformities During the Preoperative and Postoperative Periods

<table>
<thead>
<tr>
<th>Deformity</th>
<th>Prevalence, No. (%) (N = 64)</th>
<th>Success Rate, Proportion (% [95% CI])</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preoperative</td>
<td>Postoperative</td>
<td></td>
</tr>
<tr>
<td>Nasal tip definition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Defined</td>
<td>15 (23)</td>
<td>58 (90)</td>
<td>43/49 (88 [78-97])</td>
</tr>
<tr>
<td>Not defined</td>
<td>49 (77)</td>
<td>6 (9)</td>
<td></td>
</tr>
<tr>
<td>Projection</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>24 (38)</td>
<td>52 (81)</td>
<td>28/40 (70 [57-83])</td>
</tr>
<tr>
<td>Overprojected</td>
<td>2 (3)</td>
<td>3 (5)</td>
<td></td>
</tr>
<tr>
<td>Underprojected</td>
<td>38 (59)</td>
<td>9 (14)</td>
<td></td>
</tr>
<tr>
<td>Rotation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>26 (41)</td>
<td>55 (86)</td>
<td>29/38 (76 [64-88])</td>
</tr>
<tr>
<td>Overrotated</td>
<td>31 (48)</td>
<td>9 (14)</td>
<td></td>
</tr>
<tr>
<td>Underrotated</td>
<td>7 (11)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Columella</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>40 (62)</td>
<td>58 (91)</td>
<td>18/24 (75 [60-85])</td>
</tr>
<tr>
<td>Retraction</td>
<td>24 (38)</td>
<td>6 (9)</td>
<td></td>
</tr>
<tr>
<td>Alar region</td>
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<td></td>
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<tr>
<td>Normal</td>
<td>12 (19)</td>
<td>53 (83)</td>
<td>41/52 (79 [67-90])</td>
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<tr>
<td>Retraction</td>
<td>10 (16)</td>
<td>7 (11)</td>
<td></td>
</tr>
<tr>
<td>Pinch</td>
<td>12 (19)</td>
<td>3 (5)</td>
<td></td>
</tr>
<tr>
<td>Retraction and pinch</td>
<td>30 (47)</td>
<td>1 (2)</td>
<td></td>
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<tr>
<td>Inspiratory collapse</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>50 (78)</td>
<td>1 (2)</td>
<td>49/50 (98 [94-100])</td>
</tr>
<tr>
<td>No</td>
<td>14 (22)</td>
<td>63 (98)</td>
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</tr>
</tbody>
</table>
None of the 64 patients included in the study required any further revision procedure; they were all satisfied with the results.

Discussion

The tripod technique was designed by one of us (F.P.) to correct all nasal tip alterations derived from previous surgical procedures, including poor nasal tip definition, tip underprojection, tip overrotation, alar retraction, pinched ala, alar collapse, columellar retraction, and lack of support of the nasal tip. The tripod graft replaces the total cartilaginous structure of the nasal tip, and it therefore provides excellent support to the nasal tip, as well as a pleasing aesthetic appearance, and recovers the functional aspects of the nose. The addition of the shield graft gives more support to the tip by adding strength to the medial crura and columella. It also improves nasal tip definition.

In our practice, of the 1453 rhinoplasties performed between January 2007 and March 2012, 32% were for patients undergoing revision rhinoplasty (n = 465) who had previous operations at other institutions and sought out one of us (F.P.) to correct their defects. Sixty-nine (15%) of the patients undergoing revision rhinoplasty presented nasal tip deformities that required complete nasal tip reconstruction with the tripod technique.

Lack of nasal tip structures, damage to soft tissues, and vascular supply alterations cause most of the problems observed with the nasal tip, which include external valve dysfunction, alar pinch, alar retraction, lack of definition, and columellar retraction. Most revision rhinoplasty techniques promote an open approach to correct these deformities, arguing for better visualization of the structures that must be corrected. However, the tripod technique addresses all nasal tip structural, functional, and aesthetic problems using an endonasal approach, in which the graft can be correctly positioned and sutured to the alar remnants.

Some authors have described techniques intended to solve specific problems, such as an alar spreader graft to address lateral crura alterations or an alar batten graft to correct nasal valve dysfunction. Other authors have suggested that the nasal tip consists of 3 segments: the columella, lobule, and ala, each of which must be addressed, as we also propose. They replaced the weakened lateral crus and sutured the replacement graft to the medial crus stubs and then used a tip graft via an open approach. The tripod technique can be used as a single framework to reproduce nasal tip structure and contour, correcting all the aesthetic deformities and functional problems derived from previous operations, producing a natural-looking nasal tip.

Columellar retraction, which is a common problem in revision rhinoplasty cases, is difficult to correct, and retraction improved in only 36% of cases when the seagull wing technique was used. Adding a shield graft to the seagull wing graft (the tripod graft) corrected the columellar retraction in 75% of cases in the present study, in addition to correcting the other aforementioned nasal deformities.

We believe that conchal cartilage is the best cartilage graft for re-creation of the normal cartilage framework of the nasal tip because of its flexibility and similar thickness to the alar cartilages. It is also easy to sculpt, facilitating reproduction of the shape of the alar cartilages. The only limitation of the tripod graft technique is in patients who lack ear cartilage to harvest because of resection in previous rhinoplasties.

Conclusions

The tripod technique has been demonstrated to be clinically and statistically effective for correction of nasal tip rotation and projection, improvement of nasal tip definition, and correction of columellar retraction and alar deformities such as pinching or retraction. It also corrects functional problems such as valvular collapse. These results suggest that the tripod technique is a reliable method of repairing nasal tip alterations in revision rhinoplasty cases in which cartilage overresection is an issue or in which there is a combination of aesthetic and functional problems that must be addressed.

REFERENCES