Importance

Asian patients undergoing cosmetic rhinoplasty often want surgeons to concentrate on the broad nasal tip. Modifying the cartilage framework is considered to be the fundamental strategy; during the modification procedures, the cephalic portion of the lower lateral cartilage is often excised and discarded. However, given the supporting function and volumetric filling properties of autologous cartilage, the cephalic cartilage should and can be salvaged by using our cruciate overlap technique.

Objectives

To introduce a novel technique in modification of broad nasal tip in Asian patients undergoing rhinoplasty and assess its efficacy and safety.

Design, Setting, and Participants

Dissection of 5 fresh cadaver head specimens was performed and the plausibility and reliability of the new procedure were determined at Plastic Surgery Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College. In addition, the cruciate overlap technique was performed in 43 Chinese patients between January 1, 2011, and December 31, 2013, and the surgical results were assessed subjectively and objectively during the follow-up period, ranging from 12 to 36 months, with the final follow-up November 30, 2014. Anthropometric measurements of patients' noses preoperatively and postoperatively were taken and the patients' complications were reviewed.

Main Outcomes and Measures

Cadaveric evaluation, subjective and objective assessments of the surgical results (rated on a scale of 1 to 4, with 4 indicating much improvement from the preoperative level), nasal measurements of the patients, and evaluation of the complications.

Results

The mean size of the cartilaginous flap in the cruciate overlap technique was 12.0 mm long and 3.0 mm wide, allowing for 180° rotation and graft coverage, with the nasal cartilage framework protected from collapse. Mean (SD) scores for the subjective and objective judgment of the outcomes were 3.3 (0.4) and 3.5 (0.3), respectively. Moreover, nasal measurements demonstrated significant postoperative improvement by increasing the mean nasal tip protrusion (from 14.3 [1.5] to 16.7 [2.0] mm) and reducing the mean tip width (from 22.7 [1.7] to 18.2 [1.6] mm) and tip angle (from 101.0° [6.3°] to 87.7° [6.7°]) (all P < .001). Acceptable ranges of edema, ecchymosis, and pain were observed in the early postoperative period and resolved within a short period. No aesthetic or functional adverse effects were reported during the follow-up period.

Conclusions and Relevance

The cruciate overlap technique is an efficacious and reliable alternative for modification of broad nasal tips in Asian patients undergoing rhinoplasty.

Level of Evidence

4.
Recently, increased attention has been devoted to tip refinement during rhinoplasty in Asian patients owing to the prevalence of poor nasal tip projection and/or definition in many Asian individuals. A broad or bulbous nasal tip is one of the most common supratip deformities in Asian patients and is characterized by underprojected, rounded, blunt, or even bifid appearance. Based on anatomic analysis, a broad nasal tip is likely attributed to thickness in the skin and soft-tissue envelope, overextended dome angle and interdomal distance, convexity or concavity of the low-lateral cartilage (LLC), loose ligament connection, or caudal septum deviation. Alternative surgical procedures to tip rhinoplasty include subcutaneous tissue thinning, cephalic trimming, columellar strut, autologous cartilaginous graft, and various suture techniques, such as transdomal, interdomal, and medial crura sutures. However, a plastic surgeon cannot achieve an appealing nose appearance by relying on one surgical procedure; the relationships among nasal supporting structures are far too integrated and intricate. Therefore, combined maneuvers on different anatomic sites should be used during tip rhinoplasty.

Successfully modifying the nose’s cartilage framework is acknowledged to be the most vital and fundamental concern when operating on the broad nasal tip. Cartilage remodeling causes fewer complications (eg, graft warping and donor site morbidity) and thus is recommended as the preferred approach in primary rhinoplasty.

We present our experience in modification of broad nasal tips in Asian patients undergoing rhinoplasty and describe our innovative LLC cruciate overlap technique. We have made numerous efforts to investigate the anatomic basis supporting our technique. Combined with appropriate suture procedures and silicone or cartilage grafting, this new technique can achieve ideal cosmetic results with far fewer complications than other procedures.

**Methods**

To ensure the feasibility and effectiveness of the LLC cruciate overlap technique, we performed dissections on 5 fresh cadaver head specimens (eFigure 1 in the Supplement). The skin and soft-tissue envelope were elevated to expose the bone skeleton and cartilage framework. Measurements of the LLC lateral crura, as well as anatomic evaluations of the dome area and medial crura, were made before surgical intervention. The cephalic portion of the lateral crura was dissected to the dome area, leaving cartilage approximately 5 mm wide to preserve the supporting function of the external valve and the morphology of the nostril. The flexibility and stability of the cephalic cartilaginous flap were evaluated intraoperatively and postoperatively.

Forty-three Chinese patients who underwent primary rhinoplasty with the LLC cruciate overlap technique between January 1, 2011, and December 31, 2013, at the Plastic Surgery Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, were investigated. Thirty-nine patients were women, and 4 were men; the mean age was 28.6 years (range, 20-38 years). Approval for both parts of the study was obtained from the ethics committee of the Plastic Surgery Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College, and written informed consent for the procedure by the patients and for postmortem examination from the families of individuals who had died.

Thirty-one patients underwent the cruciate overlap technique without any implant to narrow and define their tip morphology, and 12 patients received silicone or rib cartilage augmentation rhinoplasty simultaneously to improve the integrated profile of their noses. Visual and tactile analyses were performed preoperatively. Surgical results, the patients’ subjective judgment, and complications (including swelling, ecchymosis, malformation, and malfunction) were reviewed during the follow-up period, which ranged from 12 to 36 months, with the final follow-up November 30, 2014. A 4-grade scale (1, worse; 2, no change; 3, improved; and 4, much improved) was introduced to quantify the subjective and objective assessments of the surgical results. Comparison of nasal tip measurements was performed among the nonimplantation patients preoperatively and 12 to 15 months postoperatively as in previous studies. The measurements of nasal tip width and protrusion were taken on the patients directly, but the nasal tip angle and nasolabial angle were assessed by photogrammetric analysis on the right profile (Adobe Photoshop CS6; Adobe Systems Inc). All measurements were performed by the same author (Z. Yin), who measured each item twice. Statistical analysis was performed using a paired t test, and significance was assumed at P < .05.

The patients who underwent the cruciate overlap technique without grafting had received local anesthesia, whereas general anesthesia was used in the combined rhinoplasty cases. All of the surgical maneuvers were performed through a closed approach using bilateral incisions extending from the columellar margin to the transcartilaginous line inside the nostril. Lidocaine hydrochloride, 1%, with epinephrine was injected subcutaneously and subperiosteally when necessary. Dissections were made beneath the nasal superficial muscular aponeurotic system layer in both sides, and the LLC lateral crura were exposed with intact perichondria. The cephalic portion of the lateral crura was separated, leaving sufficient remaining cartilage for functional support (Figure 1). The excessive soft tissue around the dome area was trimmed off, and the ligamentous connection of the nasal tip was cut off and remodeled by interdomal or medial crura suture techniques. The cartilaginous flaps obtained from the cephalic lateral crura on both sides were rotated to overlap each other in a cruciate position (Figure 2 and the Video). The cruciate cartilages were then anchored to the contralateral medial crura. For patients who underwent combined rhinoplasty, silicone or rib cartilage implants were used, and the double-layer, overlapped cartilaginous flap was transferred to cover the implants and serve as a mattress between the skin envelope and the tip grafts (eFigure 2 in the Supplement). Finally, the incision was closed carefully.

**Figure 1**

The excessive soft tissue around the dome area was trimmed off, and the ligamentous connection of the nasal tip was cut off and remodeled by interdomal or medial crura suture techniques. The cartilaginous flaps obtained from the cephalic lateral crura on both sides were rotated to overlap each other in a cruciate position (Figure 2 and the Video).

**Figure 2**

The cruciate cartilages were then anchored to the contralateral medial crura. For patients who underwent combined rhinoplasty, silicone or rib cartilage implants were used, and the double-layer, overlapped cartilaginous flap was transferred to cover the implants and serve as a mattress between the skin envelope and the tip grafts (eFigure 2 in the Supplement). Finally, the incision was closed carefully.
Results

Anatomic analysis indicated that the LLC cruciate overlap technique is safe and reliable for use in broad nasal tip refinement. The mean (SD) length of the lateral crus was 15.3 (2.1) mm, and the mean width was 8.0 (1.5) mm. To preserve the stability of both the tip and alar structure, we ensured that the remaining lateral crus width was no less than 5 mm. Therefore, the mean size of the cartilaginous flaps was approximately 12.0 mm in length and 3.0 mm in width, allowing for 180° of rotation and graft coverage. Our method requires simple surgical skills, and the operation time for the cruciate overlap technique is less than 1 hour when the endonasal approach is used.

Based on the contrast between preoperative and postoperative standardized patient photographs, objective improvements were graded independently by 2 plastic surgeons who were not privy to the content of our study. The mean score was 3.5 (0.3), indicating significant improvement of tip definition in the patients. The mean subjective judgment of patients, using the same scale, was 3.3 (0.4), which is consistent with the result of the objective assessment. To objectively assess the LLC cruciate overlap technique and exclude the interference of other maneuvers on the surgical results, anthropometric measurements in relation to nasal tip appearance were performed in nonimplantation patients. The results revealed significant improvement by increasing the nasal tip protrusion and reducing the tip width and tip angle 12 to 15 months after surgery (P < .001) (Table).

No cosmetic or functional problems were reported during the follow-up period. Normal ranges of swelling and pain were observed in the early postoperative phases, and controllable ecchymosis around the surgical area occurred only after the combined rhinoplasty. The usual hemostasis and detumescent treatment was administered postoperatively.

Case 1

A woman in her 30s sought a primary rhinoplasty to alter her bulbous nasal tip. Examination noted a broad, fatty nasal tip and alae with normal dorsum width and cartilage symmetry. The operative plan included subcutaneous tissue thinning, interdomal suture, and cruciate overlap cartilage remodeling using an endonasal approach. Photographs were obtained 12 months postoperatively (Figure 3). During our follow-up interview, the patient reported satisfactory improvement. A slim nose and tip were achieved, and the patient had a much more defined tip profile.

Case 2

A woman in her 20s wanted to improve her nasal appearance. She had undergone silicon graft implantation to augment her nasal dorsum 3 years before the consultation. Her major problems were the broad tip morphology that was not harmonious with her nose outline and the poorly located tip-defining point, which made the dorsum appear shorter. The operation was performed through a closed approach. The deformity was modified by the cruciate overlap technique using the cartilaginous flap to wrap the silicone graft, and the tip-defining point was adjusted to an appropriate position. The follow-up period was 36 months, and the patient was satisfied with the outcome (Figure 4). The nasal tip was much more defined and more consistent with the dorsum profile. Moreover, the tip protrusion was improved.

Discussion

Tip refinement is widely accepted as the most important and challenging procedure in Asian patients undergoing rhinoplasty. Aesthetically, the nasal tip is located in a prominent central part of the face, playing a cardinal role in

![Diagrammatic Sketch of the Low-Lateral Cartilage Cruciate Overlap Technique](https://jamafacialplasticsurgery.com)}
Asian patients undergoing cosmetic rhinoplasty frequently ask the surgeons to modify the broad or bulbous nasal tip to improve their facial appearance. The main reasons for the deformity include malformation or malposition of the cartilage framework, ligament connection, and soft tissue, all of which are well documented and were further confirmed by our observation of the cadaveric dissections.

Many surgical procedures have been designed to modify the broad nasal tip: cartilage excision, suturing, soft-tissue thinning, and grafting. Because the broad tip is often accompanied by other cosmetic nose problems (eg, tip ptosis or short columella), combined rhinoplasty is often recommended to achieve excellent surgical results. Currently, the autologous cartilage grafting technique is reported to be used most often in combined rhinoplasty in Asian patients because cartilaginous grafting can provide adequate strength and volume to bolster the aesthetic nasal framework. Various tip grafts, such as the shield graft, the diamond graft, and the columellar strut graft, have been applied in rhinoplasties in Asian patients with satisfactory postoperative outcomes. However, the transplant strategy

<table>
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<tr>
<th>Measurement</th>
<th>Preoperative</th>
<th>Postoperative</th>
<th>P Value*</th>
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<tbody>
<tr>
<td>Nasal tip, mm</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Width</td>
<td>22.7 (1.7)</td>
<td>18.2 (1.6)</td>
<td>&lt;.001</td>
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<tr>
<td>Protrusion</td>
<td>14.3 (1.5)</td>
<td>16.7 (2.0)</td>
<td>&lt;.001</td>
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<tr>
<td>Nasal tip angle, degrees</td>
<td>101.0 (6.3)</td>
<td>87.7 (6.7)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Nasolabial angle, degrees</td>
<td>102.0 (6.5)</td>
<td>100.9 (5.1)</td>
<td>.16</td>
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*P value was assessed by a paired t-test (n = 31).
has had some complications, such as cartilage resorption, warping, and donor site morbidity, all of which could necessitate revision rhinoplasty. In addition, the final tip shape is dependent on the multilayer tip grafting, which does not create a natural appearance that satisfies the Asian patient’s aesthetic requirement.10

In contrast to the tip cartilage grafting technique, we introduce the LLC cruciate overlap technique in the modification of the broad nasal tip in Asian patients undergoing rhinoplasty. The new strategy recruits local pedicled cartilaginous flap in situ, which is turned and fixed to the vault of contralateral LLC, thus avoiding the risk of graft resorption, asymmetry, and donor morbidity while achieving satisfying postoperative improvements similar to those seen with cartilage grafting. Moreover, the cruciate overlap technique can be performed in combination with silicon or cartilage augmentation rhinoplasty, wrapping the implant in the tip area to prevent graft protrusion as a substitute for autologous cartilage grafting.

The nasal tip is architecturally complex and is generally considered to be supported mainly by the nose’s cartilage framework. One possible concern regarding the cruciate overlap technique might be iatrogenic impairment of the stability of the nasal supporting structure. This impaired stability could decrease the supporting force of the lateral crura, which is already weak in Asian individuals.14 The hypothesis, however, does not consider the supporting function of the cruciate cartilaginous flap. According to the tripod theory,15-17 the lateral crura serve as major legs in the nasal tip supporting system, but obstruction of the external valve and/or an alar collapse will not occur unless the remaining width of the lateral crus is less than 4 to 6 mm.1,16,18 Meanwhile, the pronasale area in the tripod structure is improved as a result of the cartilaginous flap crossover fixation, thus functionally intensifying the tip and alar framework.

Several types of maneuvers designed to reuse the cephalic portion of the LLC through open approach have been reported18-20 to yield satisfactory outcomes of improvement in tip definition and projection. However, these procedures are not devised for tip supporting structure intensification simultaneously, which is crucial in successful rhinoplasty in Asian patients. Therefore, the specific method of the cruciate overlap technique through a closed approach and without additional graft maneuvers to support the tip

Figure 3. Preoperative and Postoperative Status: Case 1

Before surgery

12 mo After surgery

Top row, Preoperative photographs of a broad fatty nasal tip. Bottom row, Twelve-month postoperative photographs after use of the cruciate overlap technique without grafting.
area was developed in our practice. Nevertheless, the technique is not recommended in secondary rhinoplasty because the alar cartilage in revision cases usually presents a weaker supporting force in different ranges, and the incremental risk of functional complications, such as obstruction of the external valve, could ensue.

We followed up with our patients between 12 and 36 months after surgery and noted significant aesthetic improvements with elimination of tip bulbosity. No functional problems were encountered except for predictable postoperative complications, such as nose swelling and infraorbital ecchymosis. The surgical results in our practice prove that the cruciate overlap technique performed through the endonasal approach is a practical and efficacious strategy for modification of broad nasal tips in Asian patients. However, it is not known whether the standard procedure of this novel technique is applicable for rhinoplasty in white individuals, whose noses are characterized by thinner skin and a much stronger cartilage framework.

Conclusions

The cadaveric anatomic analysis proved the plausibility of the LLC cruciate overlap technique. Moreover, based on our clinical observation, the novel technique is substantiated to be an efficacious and reliable alternative for modification of broad nasal tips in rhinoplasty in Asian patients.
REFERENCES