



Conchal Cartilage Graft for Correction of Bilateral Cleft Lip Nasal Deformities during Childhood

Hiromu Masuoka, MD*
 Katsuya Kawai, MD, PhD*
 Naoki Morimoto, MD, PhD*
 Satoko Yamawaki, MD*
 Takeshi Kawazoe, MD, PhD†
 Shigehiko Suzuki, MD, PhD*

Background: Various methods for primary repair of bilateral cleft lip have been developed, but they often produce inadequate results, such as an upturned nose or a short columella. We perform primary lip repair with muscle reconstruction to correct depression of the nasal floor and inferoposterior displacement of the alar base. Then, open rhinoplasty to project the nasal tip is performed during childhood. This article describes the methods and results of open rhinoplasty for bilateral cleft lip patients.

Methods: Open rhinoplasty with a modified forked flap is performed. The harvested conchal cartilage is grafted as a strut to strengthen and extend the septum. The lower lateral cartilages are sutured to the grafted cartilage and fixed in the correct position. Before skin closure, the tips of the 2V flaps of the forked flap and the reverse V-flap between the forked flap are trimmed. Three trapezoidal flaps are sutured to the base of the columella. Thirty patients with bilateral cleft lip nasal deformities have undergone surgery. The operative results of 15 of 30 patients were evaluated photogrammetrically.

Results: The nose was refined and more projected. The nasolabial angle and the nasal tip projection were improved. The reformed configuration was well maintained for many years. Photogrammetric analysis demonstrated increases in both the nasal height-to-width ratio and the nostril height-to-width ratio and a decrease in the nasolabial angle.

Conclusions: Open rhinoplasty during childhood using 3 trapezoidal flaps and conchal cartilage graft improves bilateral cleft lip nasal deformities effectively. (*Plast Reconstr Surg Glob Open* 2014;2:e104; doi: 10.1097/GOX.0000000000000051; Published online 6 February 2014.)

Although the nasal contour in bilateral cleft lip patients is relatively symmetric compared with that in unilateral cleft lip patients, the deformities themselves are more severe and repair

has often led to more unsatisfactory results. Nasal alveolar molding may help to reduce these deformities, but they remain after surgery.¹⁻⁴ Various techniques for primary nasal repair of bilateral cleft lip have been developed, but they often leave inadequate results, such as an upturned nose, a short columella, a poorly projecting nasal tip, flared alar rims, wide nostrils, and conspicuous scars. It is very difficult to solve these problems later, especially because of subcutaneous fibrosis. We have applied the concept of a 2-stage method to unilateral cleft lip nose repair.⁵ During the first stage, depression of the nasal floor and inferoposterior displacement of the alar base are corrected by reconstruction of muscle layers. To correct the slanting nasal apex and droop-

From the *Department of Plastic and Reconstructive Surgery, Graduate School of Medicine, Kyoto University, Kyoto, Japan; and †Department of Plastic and Aesthetic Surgery, Yoshikawa Hospital, Kyoto, Japan.

Received for publication August 7, 2013; accepted December 20, 2013.

Copyright © 2014 The Authors. Published by Lippincott Williams & Wilkins on behalf of The American Society of Plastic Surgeons. *PRS Global Open* is a publication of the American Society of Plastic Surgeons. This is an open-access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivatives 3.0 License, where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially.

DOI: 10.1097/GOX.0000000000000051

Disclosure: The authors have no financial interest to declare in relation to the content of this article. The Article Processing Charge was paid for by the authors.

ing alar rim, open rhinoplasty is performed secondarily using conchal cartilage grafts at preschool age. We have also applied this 2-stage concept to bilateral cleft lip repair. Primary lip repair with muscle reconstruction is performed in advance. In many cases, we create a slightly wide prolabial flap in preparation for the secondary rhinoplasty.⁶ Open rhinoplasty is performed around the age of 5, preschool age, using a modified forked, 3-trapezoidal flap design and conchal cartilage grafting. We describe the surgical procedure for rhinoplasty and demonstrate the results of representative cases.

PATIENTS

Thirty patients with bilateral cleft lip nasal deformities underwent surgery between 1996 and 2012. Nineteen patients were male and 11 were female. The age of the patients ranged from 4 to 12 years (mean, 6.5 y). There were 23 patients who had undergone primary lip repair at our institute. They were 19 patients with bilateral complete cleft lip/palate, 1 patient with unilateral complete and contralateral incomplete cleft lip/palate, and 3 patients with bilateral incomplete cleft lip/palate. Seven patients had undergone primary lip repair at another institute (Table 1).

OPERATIVE METHOD

We use a cartilage graft as a strut to strengthen the septum and to prevent nasal tip drooping or turn-up. Cartilage is harvested from the conchal cavity by making an incision in the posterior conchal skin. The harvested cartilage measures about 20×12–16mm. Skin incisions are made in both philtrum ridges, nostril sills, columella rims, and vestibules, modifying a

forked flap (Fig. 1). The lengthwise scars on the upper lip are excised. The tip of the reverse V-shaped philtrum flap is extended across the columella base to the lower area of the columella. In other words, the fork point of the W-shaped flap is located at the midline of the middle to lower columella. In severely deformed nostrils, the vestibular incision line involves drooping alar rim skin, such as in the reverse-U method.⁷ If the prolabium is extremely short, the tip of the reverse V-shaped philtrum flap is designed at the upper part and the V-shaped philtrum flap is advanced backward as a V-Y advancement flap in closing. Dissection is performed to the deep layer of subcutaneous tissue. The lower lateral cartilages are totally exposed above the perichondrium to avoid developmental disturbance. By dissecting the interdomal ligament between the medial crura of the lower lateral cartilages, the anterior end of the nasal septal cartilage is exposed. Both sides of the nasal septum are exposed in an area of about 5mm in width above the perichondrium (Fig. 1). The greater part of the harvested conchal

Table 1. Patients Demographics and Complication Data

Sex	
Male	19 (63.3%)
Female	11 (36.7%)
Age	Mean 6.5
4–6 y	22 (73.3%)
7–10 y	5 (16.7%)
11 y	3 (10.0%)
Primary lip repair	
At our institute	23 (76.7%)
Cleft type	
Complete + Complete	19 (82.6%)
Complete + Incomplete	1 (4.3%)
Incomplete + Incomplete	3 (13.0%)
Others	7 (23.3%)
Complication	
Flap necrosis	0 (0.0%)
Infection	0 (0.0%)
Hypertrophic scar	1 (3.3%)
Wide columella	3 (10.0%)
Flared rims	4 (13.3%)

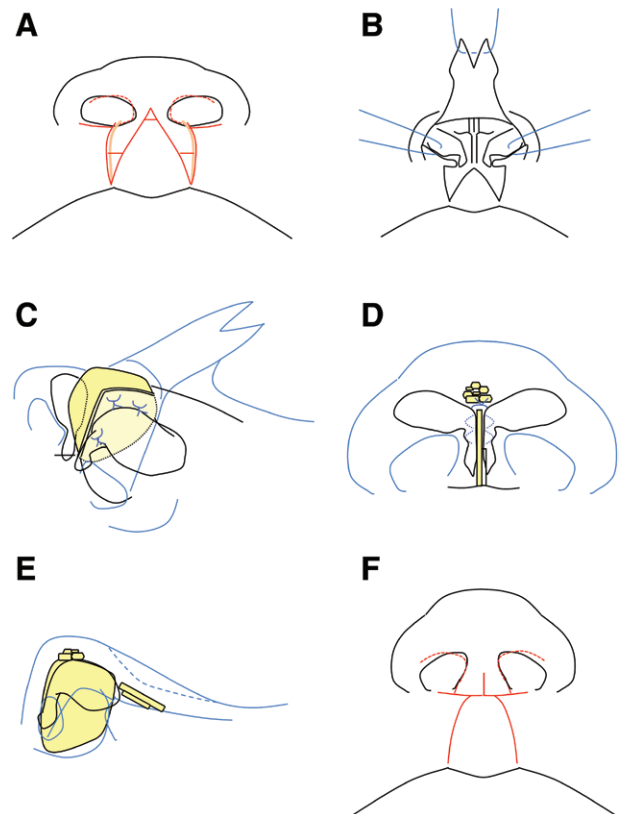


Fig. 1. Schematic diagram of the operative method for conchal cartilage grafting. A, Design of a modified forked flap. B, The nasal septum is exposed above the perichondrium. C, Cartilage is grafted between the lateral lower cartilages. D and E, The lower lateral cartilages are sutured to the grafted cartilage and fixed in the correct position. The remaining pieces of cartilage are placed in the nasal dorsum and nasal tip under the skin. F, After closure of the modified forked flap.

cartilage is cut to a trapezoid and placed between the septal cartilage and mucosa toward the intended position of the nasal apex, with the inferior end placed on the anterior nasal spine, and is then sutured to the septal cartilage (Fig. 1). The lower lateral cartilages are sutured to the grafted cartilage and fixed in the correct position (Fig. 1). The free anterior end of the grafted cartilage is trimmed to the desired level. The remaining cartilage is placed on the nasal bone and the lateral cartilage to correct the dent in the nasal dorsum (Fig. 1). If surplus pieces of cartilage remain, they are transplanted into the nasal tip as necessary.

The nasal skin and the modified forked flap are retracted cranially to lengthen the columella. Before skin closure, the tips of the 2V flaps of the modified forked flap and a reverse V-flap between the prongs of the fork are excised to make the V flaps trapezoids, which prevents the longitudinal suture lines from crossing the baseline of the columella or the suturing points of the tips of all flaps from coming together at the center of the columella base (Fig. 1). To avoid hematoma formation in the dead space and to maintain the correct shape, bolster sutures are added to the nasal dorsum for 1 week, and a nostril retainer is used for 3 months.

POSTOPERATIVE EVALUATION

The appearance of the nose and upper lip is observed more than 6 months postoperatively. The condition of the scars is also checked. To judge the postoperative results objectively, photogrammetric analysis was performed in 15 consecutive patients who were treated by a single surgeon, the senior author (S.S.), between 1996 and 2012. The follow-up period was 8.5 months to 13.5 years (mean, 63 mo). Measurements were obtained from standardized photographs taken both preoperatively and postop-

eratively. The nasal height, nostril height, and columella width on the basilar view of the nose and the columella labial angle on the lateral view were measured (Fig. 2).

Nasal height: Vertical length between the midpoint of the columella base and the highest point of the nasal tip.

Nasal width: Widest horizontal point of the nose (used as a reference length for nasal height).

Nostril height: Vertical distance between the lowest and highest points of the nostril aperture.

Nostril width: Widest horizontal point of the nostril aperture.

Columella width: Width of the midcolumella.

Nasolabial angle: Angle created by the columella and the philtrum.

RESULTS

In all patients, the nose was refined and more projected. The columella and the nasal dorsum were lengthened, the nasolabial angle was less obtuse, the nasal height-to-width ratio and nostril height-to-width ratio were improved, and nasal tip projection was improved. In most patients, the philtrum width was reduced and lip scars became less conspicuous by scar revision. The reformed configuration was relatively well maintained for many years. A hypertrophic scar on the columella base in 1 patient, a slightly wide columella in 3 patients, and flared rims that remained despite improvement in 4 patients were observed among the 30 patients (Table 1).

Photogrammetric analysis demonstrated a significant increase in the nasal height-to-width ratio (0.48 vs 0.34), a significant increase in the average nostril height-to-width ratio (0.97 vs 0.58), and a significant decrease in the nasolabial angle (108° vs 131°). The columella width-to-nasal width ratio was not signifi-

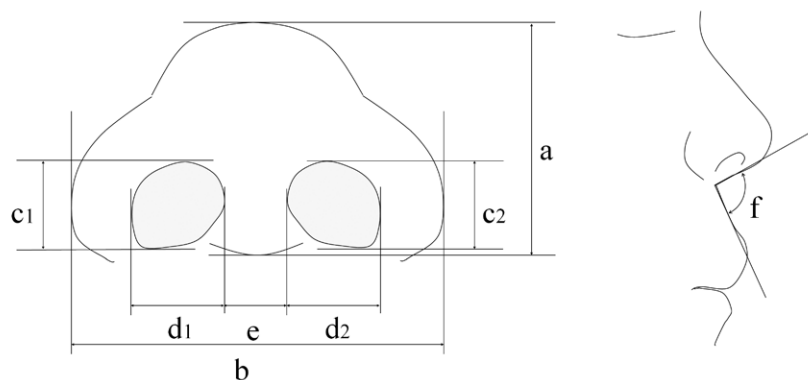


Fig. 2. Photogrammetric analysis. a: nasal height, b: nasal width, c1,c2: nostril height, d1,d2: nostril width, e: columella width, f: nasolabial angle. Nasal height-to-width ratio = a/b , nostril height-to-width ratio = $(c1+c2)/(d1+d2)$, columella width-to-nasal width ratio = e/b .

Table 2. Changes in Nasal Profile after Surgery

	Preoperative	Postoperative
Nasal height-to-width ratio*	0.343±0.047	0.482±0.080
Nostril height-to-width ratio*	0.575±0.108	0.968±0.337
The columella width-to-nasal width ratio	0.224±0.025	0.235±0.027
Nasolabial angle*	131.4±14.2	108.3±18.5

n = 15 patients.

All values are represented as mean ± SD.

*The *t* test revealed that postoperative values are different from preoperative values, with statistical significance (*P* < 0.01).

cantly different (Table 2). Representative cases are shown in Figures 3–5.

DISCUSSION

In the repair of bilateral cleft lip nasal deformities, many surgeons have paid much attention to lengthening a short columella and to sharpening the nasal tip projection. Skin flaps from lip or nasal structures can usually be used to lengthen the short columella.^{6,8–16} Cronin⁸ reported reverse V-Y advancement connected to bilateral bipedicle flaps for columellar lengthening. This method shows columella advancement from the nasal floor. Chen and Chen⁹ reported the 3 V-flap technique, regarded as modified V-Y advancement in the columella. However, sufficient elongation of the V-Y advancement flap tends to cause a narrow columella. We consider that the V-Y advancement method is limited to cases of a slightly short columella. In patients who have undergone sufficient nasoalveolar molding before primary lip repair, or have a narrow prolabium, we some-

times use a V-shaped incision. A short forked flap could also be applied.¹⁰ Cheon and Park¹⁷ reported elongation of the columella using a composite graft instead of a skin flap. They showed excellent results on elongation of the columella by composite grafts, but there remain difficulties regarding graft take, postoperative pigmentation, and color mismatch. Their method seems to be applicable to cases of severe short columella and insufficient prolabium.

It is necessary to compensate for the lack of skin tissue for sufficient lengthening of the columella. Therefore, we applied the concept of a well-established forked flap for columella lengthening. A forked flap and its modified methods are still used in many institutions, because it enables reliable lengthening of the columella and the simultaneous revision of lip scars in the cases of a moderately short columella, although it might leave conspicuous scars around the columella base.^{6,10–13,18} Our modified design seems to resemble the forked flap and reverse V-shaped flap reported by Yan et al¹¹ in the point that the tip of the V-shaped philtrum flap is extended across the columella base to the lower area of the columella. However, in our method, the V-shaped philtrum flap is not advanced backward as is the V-Y advancement flap except in cases of a severely short prolabium. As the tips of V flaps are excised, the final suture lines do not cross the baseline of the columella or do not include points where 4 or 5 suture lines meet. As a result, formation of a hypertrophic scar at the columella base was observed in only 1 patient. We also experienced a slightly wide



Fig. 3. Case 1: A 5-year-old patient with complete bilateral CLA. Preoperative (A) and 2-year postoperative (B) views.



Fig. 4. Case 2: A 6-year-old patient with complete bilateral CLAP. Preoperative (A) and 11-year postoperative (B) views.



Fig. 5. Case 3: A 5-year-old patient with complete bilateral CLAP. Preoperative (A) and 12-year postoperative (B) views.

columella in only 3 cases, but it relieved gradually over the long-term course.

In terms of nasal tip projection, many authors have described that the lower lateral cartilage was remodeled and plicated with sutures between the bilateral medial crura.^{7,9,19-23} Others described columella lengthening with medial and cephalic repositioning of the lower lateral cartilages.^{8,24} However, the higher the na-

sal apex is simply raised by pulling up the lower lateral cartilage using such techniques, the more cranially the apex is located. Although many articles have included statistical analysis, few have referred to the nasolabial angle.^{3,4,21,22} Ozaki et al¹⁴ reported rhinoplasty using a conchal cartilage graft sutured to the medial crura as a columella strut and a V-Y advancement flap from philtrum to lengthen the columella. We consider that a

cartilage graft is needed as a strut and the grafted cartilage should be fixed to the septal cartilage and lower lateral cartilages so that the nasal apex is set in the desired position in the anteroposterior and craniocaudal directions. Furthermore, the dent in the middle part of the nasal dorsum is corrected by the additional cartilage graft. Therefore, we harvest the cartilage over almost the whole conchal cavity because large cartilage is required to prevent an upturned nose. As shown in Table 2, this method could improve the nasolabial angle, in addition to the nasal height.

From these points, our modified forked flap, or 3 trapezoidal flaps in combination with the conchal cartilage graft, seems to be applicable for most cases of bilateral cleft lip nasal deformities.

We do not correct the nasal tip and columella during the primary lip repair procedure because the columella and philtrum are very difficult to lengthen simultaneously at primary lip repair, during which attention must be paid to constructing the nasal floor and bringing the alar base and columella base into their proper positions. After the nasal foundation is stabilized, open rhinoplasty should be performed to correct the nasal framework by using conchal cartilage at preschool age.

CONCLUSION

Our clinical results indicate that open rhinoplasty using 3 trapezoidal flaps and a conchal cartilage graft during childhood is effective for bilateral cleft lip nasal deformities.

PATIENT CONSENT

Parents or guardians provided written consent for use of the patient images.

Correspondence to: Hiromu Masuoka, MD
 Department of Plastic and Reconstructive
 Surgery, Graduate School of
 Medicine, Kyoto University
 54 Shogoin Kawaharacho, Sakyou-Ku
 Kyoto 606-8507, Japan
 E-mail: rommasu@kuhp.kyoto-u.ac.jp

REFERENCES

- Cutting C, Grayson B, Brecht L, et al. Presurgical columellar elongation and primary retrograde nasal reconstruction in one-stage bilateral cleft lip and nose repair. *Plast Reconstr Surg.* 1998;101:630-639.
- Spengler AL, Chavarria C, Teichgraeber JF, et al. Presurgical nasolabial molding therapy for the treatment of bilateral cleft lip and palate: a preliminary study. *Cleft Palate Craniofac J.* 2006;43:321-328.
- Liou EJ, Subramanian M, Chen PK. Progressive changes of columella length and nasal growth after nasolabial molding in bilateral cleft patients: a 3-year follow-up study. *Plast Reconstr Surg.* 2007;119:642-648.
- Garfinkle JS, King TW, Grayson BH, et al. A 12-year anthropometric evaluation of the nose in bilateral cleft lip-cleft palate patients following nasolabial molding and cutting bilateral cleft lip and nose reconstruction. *Plast Reconstr Surg.* 2011;127:1659-1667.
- Masuoka H, Kawai K, Morimoto N, et al. Open rhinoplasty using conchal cartilage during childhood to correct unilateral cleft-lip nasal deformities. *J Plast Reconstr Aesthet Surg.* 2012;65:857-863.
- Millard DR Jr. Columella lengthening by a forked flap. *Plast Reconstr Surg Transplant Bull.* 1958;22:454-457.
- Tajima S, Maruyama M. Reverse-U incision for secondary repair of cleft lip nose. *Plast Reconstr Surg.* 1977;60:256-261.
- Cronin TD. Lengthening columella by use of skin from nasal floor and alae. *Plast Reconstr Surg.* 1958;21:417-426.
- Chen TH, Chen YR. Extended open-tip rhinoplasty with three V-flaps for secondary correction of bilateral cleft lip nasal deformity. *Ann Plast Surg.* 1996;37:482-488; discussion 488-489.
- Carlino F. Modified forked flap for controlling columella length in cleft lip open rhinoplasty. *J Craniomaxillofac Surg.* 2008;36:131-137.
- Yan W, Zhao ZM, Yin NB, et al. A new modified forked flap and a reverse V shaped flap for secondary correction of bilateral cleft lip nasal deformities. *Chin Med J.* 2011;23:3993-3996.
- Rikimaru H, Kiyokawa K, Koga N, et al. A new modified forked flap with subcutaneous pedicles for adult cases of bilateral cleft lip nasal deformity: from normalization to aesthetic improvement. *J Craniofac Surg.* 2008;19:1374-1380.
- Wolfe SA. A pastiche for the cleft lip nose. *Plast Reconstr Surg.* 2004;114:1-9.
- Ozaki W, Chaffoo RA, Vu KC, et al. Comprehensive rhinoplasty technique to correct the bilateral cleft lip nasal deformity using conchal composite grafts. *J Craniomaxillofac Surg.* 2006;34:150-155.
- Cronin TD, Upton J. Lengthening of the short columella associated with bilateral cleft lip. *Ann Plast Surg.* 1978;1:75-95.
- Garri JI, O'Leary K, Gabbay JS, et al. Improved nasal tip projection in the treatment of bilateral cleft nasal deformity. *J Craniofac Surg.* 2005;16:834-839.
- Cheon YW, Park BY. Long-term evaluation of elongating columella using conchal composite graft in bilateral secondary cleft lip and nose deformity. *Plast Reconstr Surg.* 2010;126:543-553.
- Tan SP, Greene AK, Mulliken JB. Current surgical management of bilateral cleft lip in North America. *Plast Reconstr Surg.* 2012;129:1347-1355.
- Matsuo K, Hirose T. A rotational method of bilateral cleft lip nose repair. *Plast Reconstr Surg.* 1991;87:1034-1040.
- Uchida M, Kojima T, Hirase Y. Secondary correction of the bilateral cleft lip nose by excision of the columellar forked flap and nasal remodelling with reverse-U flaps: a preliminary report. *Br J Plast Surg.* 1994;47:490-494.
- Mulliken JB, Burvin R, Farkas LG. Repair of bilateral complete cleft lip: intraoperative nasolabial anthropometry. *Plast Reconstr Surg.* 2001;107:307-314.
- Kim SK, Lee JH, Lee KC, et al. Mulliken method of bilateral cleft lip repair: anthropometric evaluation. *Plast Reconstr Surg.* 2005;116:1243-1251; discussion 1252-1254.
- McComb HK. Primary repair of the bilateral cleft lip nose: a long-term follow-up. *Plast Reconstr Surg.* 2009;124:1610-1615.
- Byrd HS, Ha RY, Khosla RK, et al. Bilateral cleft lip and nasal repair. *Plast Reconstr Surg.* 2008;122:1181-1190.