

How to Prevent Costal Cartilage Graft Warping in Secondary Correction of Cleft Lip Nasal Deformity

Prévenir la déviation d'une greffe de cartilage costal lors de la correction secondaire d'une fente de la lèvre et de la cavité nasale

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Abstract

Introduction: Autologous costal cartilage dorsal onlay graft is widely used for dorsum and radix augmentation in secondary cleft lip nasal rhinoplasty. The most common drawback of costal cartilage dorsal onlay graft is warping. The purpose of this article is to describe our chimeric autologous costal cartilage graft technique, which prevents warping significantly. “Chimeric” means the combination of 2 different tissues (bone and cartilage) to make a single dorsal onlay graft. **Patients and Methods:** From June 2011 to June 2014, 16 cleft lip patients who underwent rhinoplasty and needed dorsal onlay grafts with costal cartilage graft using the chimeric autologous costal graft method were identified. All patients were operated by the corresponding author. Patients’ nasal profiles were documented and photographed preoperatively and postoperatively. **Result:** There were 5 males and 11 females with ages ranging from 20 to 52 years (averaging 29.5 years). There were 14 unilateral and 2 bilateral cleft lips. The average follow-up time was 12.1 months. Six patients received revision surgery, including 1 (6%) warping and 5 (30%) revisions. All patients were harvested rib cartilage graft as cartilage donor and there was no complication with the donor site. **Conclusion:** From the clinical observation of all patients during the follow-up period, this technique is effective for preventing cartilage warping.

Résumé

Historique : L'autogreffe dorsale d'apposition du cartilage costal est largement utilisée pour l'augmentation du dos et de la racine du nez lors de la rhinoplastie secondaire de la fente de la lèvre et de la cavité nasale. La déviation est le principal inconvénient de ce type de greffe. Le présent article vise à décrire la technique d'autogreffe chimérique de cartilage costal, qui évite la déviation de manière significative. « Chimérique » signifie la combinaison de deux tissus (os et cartilage) pour former une seule greffe dorsale d'apposition. **Patients et méthodologie :** Entre juin 2011 et juin 2014, 16 patients ayant une fente labiale ont subi une rhinoplastie accompagnée de greffes dorsales d'apposition de cartilage costal à l'aide de la technique d'autogreffe costale chimérique. Tous les patients ont été opérés par l'auteur-ressource. Le profil nasal des patients a été consigné au dossier et photographié avant et après l'opération. **Résultat :** Cinq hommes et 11 femmes de 20 à 52 ans (moyenne de 29,5 ans) ont subi l'opération, pour un total de 14 fentes labiales unilatérales et deux fentes labiales bilatérales. Ils ont participé à un suivi moyen de 12,1 mois. Six patients ont subi une opération de révision, y compris une déviation (6 %) et cinq révisions (30 %). Le cartilage costal avait été prélevé dans les côtes chez tous les patients, qui étaient leurs propres donneurs. Il n'y a eu aucune complication au site de prélèvement. **Conclusion :** D'après l'observation clinique de tous les patients lors du suivi, cette technique prévient la déviation du cartilage.

Keywords

cleft lip nasal deformity, costal cartilage graft, warping

Introduction

Secondary cleft lip nasal rhinoplasty is a challenging task. The surgeons need to increase tip projection, restore the midline symmetry, and augment the dorsum. Autologous costal

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Table 1. Patient Demographics.

Etiology	Case Number	Gender		Average Age	Combined Procedures		Revision	Warping
		M	F		Cheiloplasty	Fat Graft		
Unilateral	14	5	9	30	8	6	4	1
Bilateral	2	0	2	24.5	2	2	1	0

Abbreviations: F, Female; M, Male.

**Figure 1.** Coronal view, 1 to 5 steps of chimeric autologous costal cartilage graft.

cartilage dorsal onlay graft is widely used for dorsum and radix augmentation. It has many advantages such as sufficient quantities, ease of carving, lack of resorption, more natural, and lower rates of infection, tissue reaction, and extrusion. The most common drawback of costal cartilage dorsal onlay graft is warping. Although initially straight postoperatively, late warping of the graft frequently occurs.

From our previous study,¹ we proved the chimeric autologous costal cartilage graft was shown to be effective for preventing cartilage warping in reconstruction of congenital nasal deformities patients, nasal trauma patients, aesthetic rhinoplasty patients, and nasal deformities after tumor extirpation.

The purpose of this article is to describe chimeric autologous costal cartilage graft technique for cleft lip patients requiring secondary rhinoplasty. “Chimeric” means the combination of costal bone and cartilage to make a single dorsal onlay graft.

This technique is based on strengthening the core of the cartilage with a piece of rib bone that is designed and carved to fit in the cartilaginous graft and to give internal stabilization to the whole framework. According to the study, it prevents warping significantly.

Patients and Methods

From June 2011 to June 2014, 16 cleft lip patients who underwent rhinoplasty were identified. They all needed dorsal onlay grafts with costal cartilage graft using the chimeric autologous costal graft method. All patients were operated by the corresponding author. Patients’ nasal profiles were documented and photographed preoperatively and postoperatively (Table 1).

Surgical Technique

Cartilaginous Dorsal Graft

We harvested the right seventh costal cartilage and partial seventh bone and prepared it for the chimeric autologous costal cartilage graft. The edge of the dorsal graft was beveled carved and the base was carved with the big U-shaped graver. The depth carved depends on the height of the graft (height/2 – 0.5 mm; if the desired height of the graft is 5 mm, then 5/2 – 0.5 = 2 mm). The caudal part (~5 mm) of the graft was not curved in order to fix it to the columellar strut. Another 0.5 mm deeper carving was performed at the base of the graft with the small U-shaped graver. Finally, bilateral 1-mm-height horizontal grooves were carved with the I-shape graver, but at least a 2-mm cartilage column bilaterally should be preserved.

Internal Bony Stabilization

We harvested the anterior surface of the costal bone. The cortical bone was prepared to fit the space created at the center of the costal cartilage graft. The thickness of the bone was 1 mm to fix the bilateral horizontal grooves. The bone was inserted precisely to stabilize the cartilage dorsal graft, then the chimeric autologous costal graft was achieved (Figure 1).

In the open rhinoplasty approach patients, the graft was placed in the nasal pocket. The graft’s upper pole was placed within the subperiosteal plane, and the lower pole was between the medial crura of the lower lateral cartilage. The chimeric dorsal graft was sutured to the septal angle and fixed to the columellar strut. The nasal skin was redraped and the nasal profile assessed.

Because most of the cleft lip nasal deformity patients underwent multiple previous reconstruction surgery, there are many scars over their nasal skin. Scar contracture may cause distorted cartilage framework and loss of tip projection; therefore,

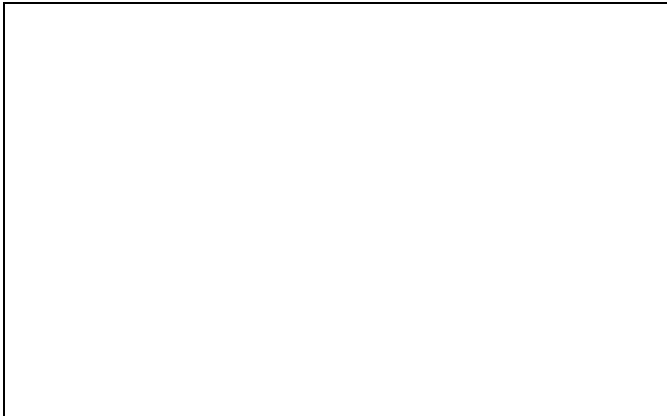


Figure 2. Intraoperative view of case 1.

remaining cartilage was routinely banked into supra-auricular scalp in order to do minor revision in the future.

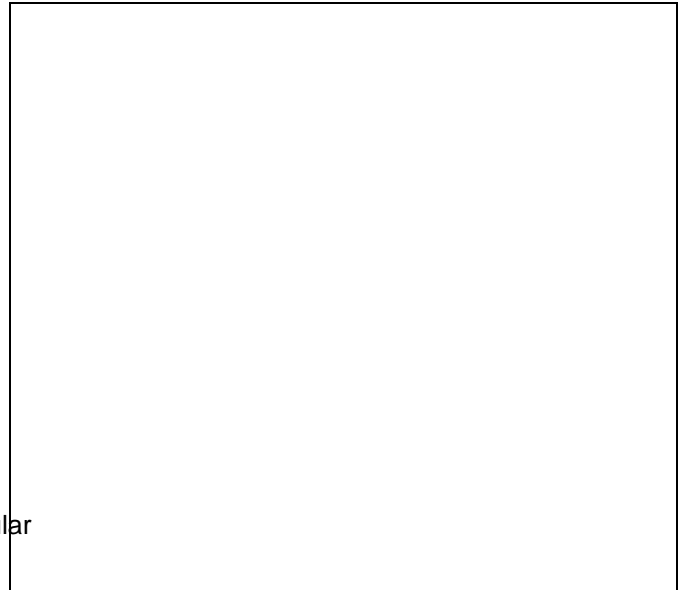


Figure 3. (Above) Preoperative 45 frontal, and lateral views of case 1. (Below) Postoperative 45 frontal, and lateral view after 10 months.

Results

There were 5 males and 11 females with ages ranging from 20 to 52 years (averaging 29 years). There were 14 unilateral and 2 bilateral cleft lips. The average follow-up time was 12.1 months. Six patients received revision surgery, including 4 (67%) warping and 5 (30%) revisions. All patients harvested rib as bone and cartilage donors and there was no complication with the donor site.

Case Reports

Case 1

A 20-year-old male patient had a right unilateral cleft lip. He sustained secondary nasal deformity. Preoperative views showed a deviated nose, low tip projection, and flared right alar. Open rhinoplasty was performed by inverted V-shaped incision at the columella with right Tajima incision. The right lateral crus of the lower lateral cartilage was released completely. Deviated septum and septal bone were removed. Cartilage grafts and bone grafts were harvested from the right seventh rib. Then, cartilage framework including the lateral crural graft, the 2 spreader extension graft, the columellar strut, the shield graft, the tip graft, and the chimeric autologous dorsal onlay graft (10 mm 4 mm 42 mm; width height length, respectively) was placed. All cartilage grafts were fixed by 5-0 Prolene suture (Figure 2). The postoperative photographs show the nasal profile 10 months after surgery (Figure 3).

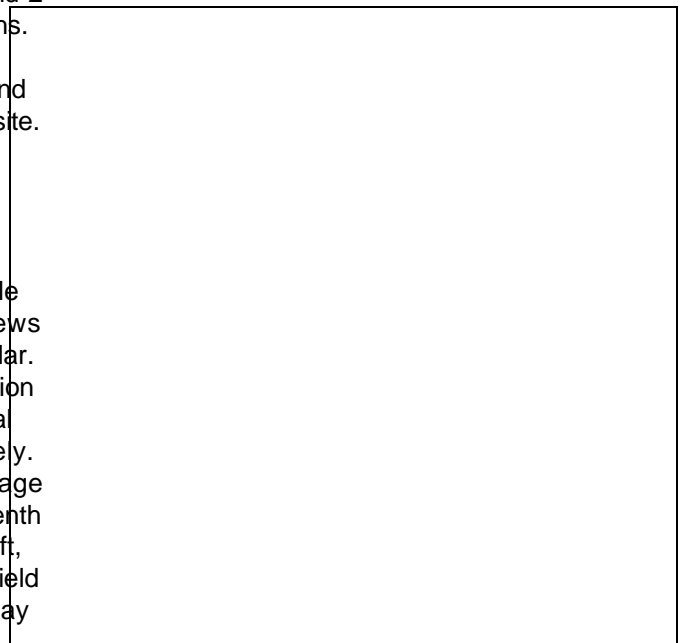


Figure 4. (Above) Preoperative lateral, frontal, and 45 views of case 1. (Below) Postoperative lateral, frontal, and 45 views after 1 year.

Case 2

A 29-year-old female patient had a bilateral cleft lip. She had secondary nasal deformity. Preoperative views showed a flat radix, low tip projection, and right deviated nose (Figure 4). Open rhinoplasty was performed by inverted V-shaped incision at the columella with bilateral Tajima incision. Then, cartilage

the chimeric autologous dorsal onlay graft (10 mm 5 mm 42 mm; width height length, respectively) was placed (Figure 5). The postoperative photographs show the nasal profile 1 year after surgery (Figure 4).

Case 3

A 34-year-old male patient had a left unilateral cleft lip. He sustained secondary nasal deformity. Open rhinoplasty was

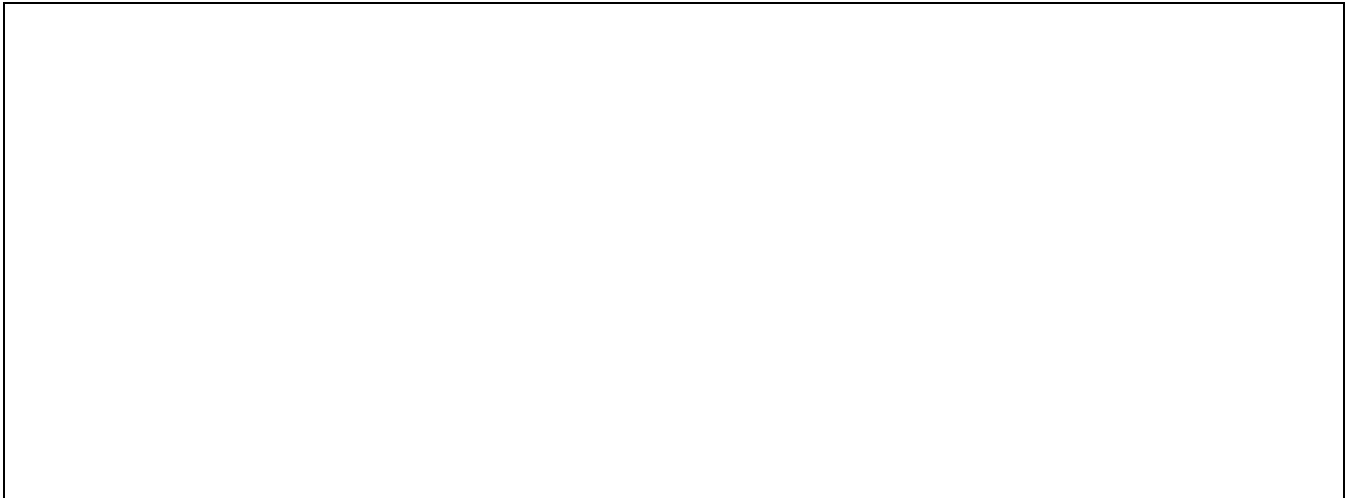


Figure 5. Intraoperative view of case 2.

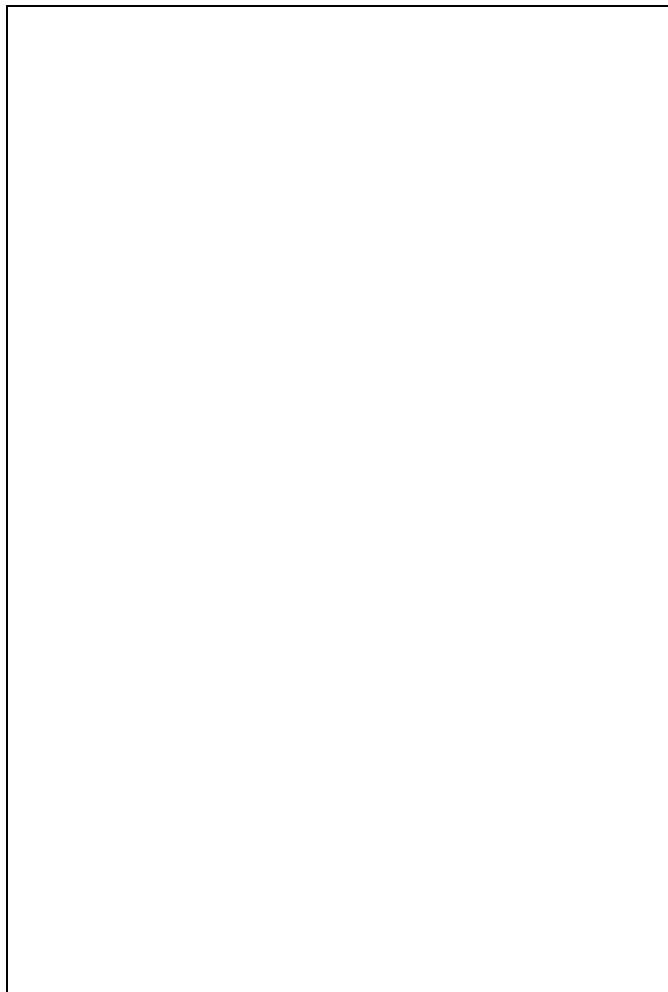


Figure 6. (Above) Preoperative frontal and lateral views of case 3. (Below) Postoperative frontal and lateral view after 2 months.

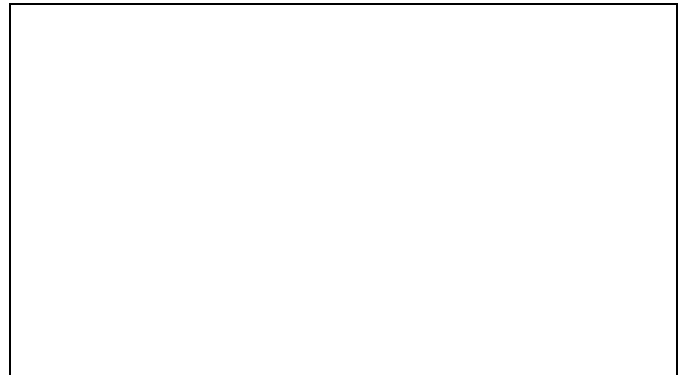


Figure 7. Intraoperative view of case 3.

done. Deviated septum and septal bone were removed. Cartilage framework including the chimeric autologous dorsal onlay graft (12 mm 4 mm 37 mm; width height length, respectively), the columellar strut, and the 2 spreader grafts was set up (Figures 6 and 7).

However, warping was noted 1 month after surgery and gradually became worse (Figure 8). At the very beginning, the internal stabilizer was not put into the adequate position. The bony internal stabilizer was only inserted to the lower and middle part of dorsal costal cartilage graft and there was no internal stabilizer in the upper part. This is the reason that the warping only developed at the upper part of the graft. Because there is bony support in the middle and lower part of dorsal cartilage graft, the warping never noted in these part of dorsal cartilage graft. The patient received revision surgery to correct warping 28 months after the first surgery. The upper warping part of dorsal cartilage graft was cut down and changed it into diced cartilage graft. The warping was not noticed 5 months after revision surgery.

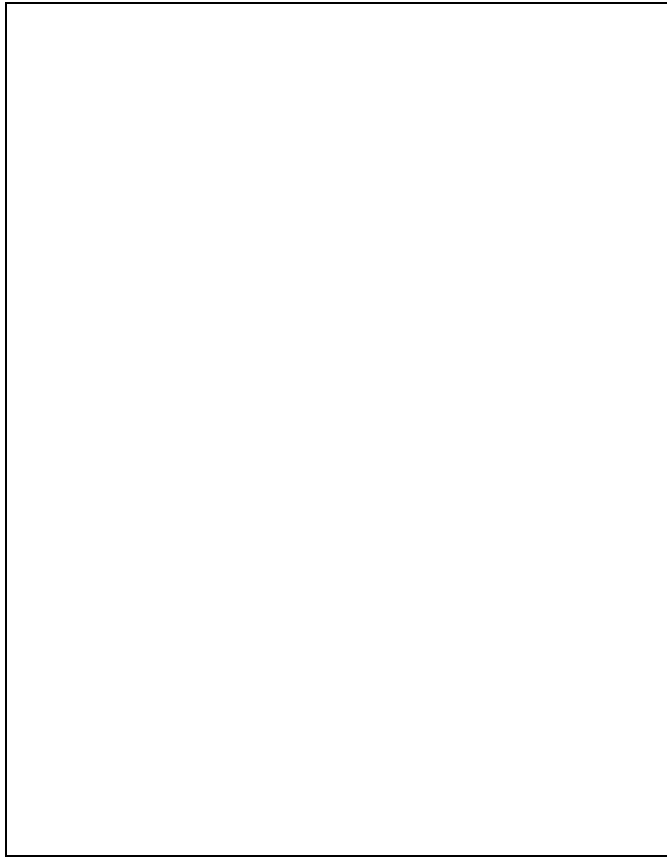


Figure 8. (Above) Frontal and lateral views of case 2, 24 months after surgery. Warping was noted at the upper part of dorsal graft. (Below) Frontal and lateral view 1 month after revision.

Discussion

Cleft lip nasal rhinoplasty is one of the most challenging reconstructive problems. The typical nose of cleft lip nasal deformity is asymmetrical, flat dorsum, broad tip, and wide alar base on the cleft side.² The common clinical features of oriental nose are bulbous nasal tip, broad alar bases, lack of tip projection, and flat dorsum. The definition of nasal beauty varies between different races and cultures. From the studies of Dr Aung, Dr Toriumi, and Dr Kim's, most oriental patients prefer to have higher nasal dorsum.^{3,5}

We noted that it is the same desired among patients with cleft lip nasal deformity.⁶ Therefore, in Asian cleft lip nasal deformity, not only tip refinement but also dorsal augmentation is very important. It is different from the Western cleft lip nasal deformity patients.

Augmentation of dorsum of the nose can be achieved using alloplastic materials, bone, or cartilage. Autologous cartilage is superior over alloplast implants, which carry the well-known significant risks of infection and extrusion.⁷ The costal cartilage shows superiority over both auricular and septal cartilages because of their limited supply. However, the most common drawback of costal cartilage is warping. Tissue warping is directly related to the inherent stresses of costal cartilage and may lead to dorsal deviation when used for augmentation

purpose.⁸ From the study of Park and Jin, the warping rate is * 7.6% in Korean non-cleft lip nose patients.⁹ In a previous unpublished review in Chang Gung Memorial Hospital, Taiwan, the cartilage warping rate with the classic bloc augmentation in cleft lip nose deformity patients could be as high as 4%.¹⁰ Compared to the normal skin patient, the warping rate in cleft lip nose deformity patients is much higher. This may be due to poor skin envelope and scar resulted from previous cheiloplasty and rhinoplasty surgery.

To prevent or delay costal cartilage warping, many methods have been proposed: Gibson's balanced cross-sectional carving,¹¹ Gunter's internal stabilization technique,¹³ diced cartilage technique, and surgical-wrapped diced cartilage technique (Turkish delight).¹² Diced cartilage technique is easily to be mold and shows good results in preventing warping. Our centre has been using a modified diced cartilage technique to correct the nasal deformity of cleft lip patients since 2005 and has greatly reduced the late cartilage warping. No warping was noted in this study. However, some risks, such as extensive necrosis of the graft, then replacement by fibrous tissue, and the reduction in average volume, limit its use. Based on Dr Gunter's internal stabilization technique, we proposed the chimeric autologous costal graft technique. The major difference is the use of a carved piece of costal bone instead of Kirschner pin in Gunter's method. The autologous material for internal stabilization reduces foreign body complications. The internal stabilized bone can provide a rigid support and it allows the chimeric graft to be fixed by a lag screw on the nasal bone.

The main disadvantage of this technique is time-consuming and it needs a learning curve. The average operative time of carving cartilage ranged from 10 to 30 minutes (at the very beginning).¹ However, once the surgeon becomes familiarized with the surgical techniques, the procedure can be performed faster. The average operative time for carving cartilage was 10 minutes. The second disadvantage is donor site complications. Costal cartilage harvest will create a longer chest wound to obtain bony and cartilaginous rib, average length is 3.5 cm, and therefore leave a scar. It is also an invasive procedure and it has the risk of pneumothorax, infection, persistent scar pain, and keloid formation.

There is 1 (6%) warping in this study. In this case, the internal stabilizer was inserted to the lower and middle part of dorsal costal cartilage graft, so warping only happened at the upper part. The phenomenon that warping only developed at the part of dorsal only cartilage graft without internal stabilizer proves that bony internal stabilizer can successfully prevent dorsal only cartilage graft warping. From our previous study,¹ the chimeric autologous costal cartilage graft method can resist different forces of skin contracture without warping in non-cleft lip deformity patients. In this study, the technique was proved to resist the tendency of warping in unhealthy skin, such as in cleft lip deformity patients.

Conclusion

From this study, the chimeric autologous costal cartilage graft method can successfully prevent warping in cleft lip patients

requiring secondary rhinoplasty. This technique not only provides a rigid framework and prevent warping but also avoids the possible complications of foreign body reaction of Kirschner pin internal stabilizer technique and extensive necrosis of diced cartilage technique. Due to its low complication rate and satisfying result, it is our technique of choice.

Declaration of Conflicting Interests

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References

1. Hsiao YC, Abdelrahman M, Chang CS, et al. Chimeric autologous costal cartilage graft to prevent warping. *Plast Reconstr Surg*. 2014;133(6):768e-775e
2. Guyuron B. MOC-PS(SM) CME article: late cleft lip nasal deformity. *Plast Reconstr Surg*. 2008;121(suppl 4):1-11.
3. Aung SC, Foo CL, Lee ST. Three dimensional laser scan assessment of the Oriental nose with a new classification of oriental nasal types. *Br J Plast Surg*. 2000;53(2):109-116.
4. Toriumi DM, Swartout B. Asian rhinoplasty. *Facial Plast Surg Clin North Am*. 2007;15(3):293-307.
5. Kim JH, Song JW, Park SW, Oh WS, Lee JH. Tip extension suture: a new tool tailored for asian rhinoplasty. *Plast Reconstr Surg*. 2014;134(5):907-916.
6. Yonehara Y, Takato T, Matsumoto S, Mori Y, Nakatsuka T, Hikiji H. Correction of cleft lip nasal deformity in Orientals with a cantilevered iliac bone graft. *Scand J Plast Reconstr Surg Hand Surg*. 2000;34(2):137-143.
7. Al-Qattan MM. Augmentation of the nasal dorsum with autogenous costal cartilage using the "edge-on" technique. *Ann Plast Surg*. 2007;59(6):642-644.
8. Gunter JP, Clark CP, Friedman RM. Internal stabilization of autogenous rib cartilage grafts in rhinoplasty: a barrier to cartilage warping. *Plast Reconstr Surg*. 1997;100(1):161-169.
9. Park JH, Jin HR. Use of autologous costal cartilage in Asian rhinoplasty. *Plast Reconstr Surg*. 2012;130(6):1338-1348.
10. Chang CS, Bergeron L, Chen PK. Diced cartilage rhinoplasty technique for cleft lip patients. *Cleft Palate Craniofac J*. 2011;48(6):663-669
11. Gibson T, Davis WB. The distortion of autogenous cartilage grafts: its cause and prevention. *Br J Plast Surg*. 1958;10:257-274.
12. Erol OO. The Turkish delight: a pliable graft for rhinoplasty. *Plast Reconstr Surg*. 2000;105(6):2229.
13. Lin G, Lawson W. Complications using grafts and implants in rhinoplasty. *Oper Tech Otolaryngol Head Neck Surg*. 2007;18(4):315-323.