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Rhinoplasty Exclusively Utilizing Autologous Costal Cartilage for Patients with Prior Unilateral Cleft Lip Repair

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Background: Rhinoplasty in patients with previous unilateral cleft lip repair is a surgical challenge due to complex nasal deformities, including a horizontally positioned nasal wing, wide cleft side nostrils, nasal base defects, and a short and deviated nasal columella. To comprehensively address these complexities, we exclusively utilized autologous costal cartilage in rhinoplasty procedures, using various surgical techniques.

Methods: This study presents a comprehensive case series of 39 patients who had previously undergone unilateral cleft lip surgery but still had nasal deformities. Rhinoplasty using autologous costal cartilage was performed at Cho Ray Hospital, Vietnam. Costal cartilage was partially crushed and then finely cut to shape the dorsal area and raise the nasal base on the cleft side. Partially crushed cartilage was also used to shape shield grafts, cap grafts, and alar batten grafts, whereas sliced cartilage was utilized for septal extension grafts. Evaluation was based on improvements in anthropometric indicators, patient satisfaction using Rhinoplasty Outcome Evaluation (ROE) scale and FACE-Q scores.

Results: The average age of patients was 25.13 years. All postoperative anthropometric indicators showed significant improvements. Postsurgery, the total ROE score was three times higher than before surgery ($P < 0.001$), and the total FACE-Q score was 2.26 times higher ($P < 0.001$). No significant intraoperative or postoperative complications were observed.

Conclusions: This procedure effectively addresses complex nasal deformities in patients with prior unilateral cleft lip repair, emphasizing the value of autologous costal cartilage in rhinoplasty for such individuals. *(Plast Reconstr Surg Glob Open 2024; 12:e5941; doi: 10.1097/GOX.0000000000005941; Published online 1 July 2024.)*

INTRODUCTION

Nasal deformities in patients who have undergone prior cleft lip repair are complex and challenging to correct. Selecting the most suitable surgical methods and materials to achieve safe and effective results poses a significant challenge for surgeons. Due to varying clinical conditions, these deformities often lead to severe asymmetry, making the correction process intricate and requiring the coordination of multiple techniques with appropriate materials.[1,2]

Autologous costal cartilage is a preferred option for correcting nasal defects, yet its exclusive use in patients with cleft lip has been limited. Additionally, costal cartilage presents disadvantages such as warping and visibility under the skin.[3–6]

In this study, we exclusively utilized autologous costal cartilage in rhinoplasty procedures, using a variety of surgical techniques tailored to patients who had previously undergone unilateral cleft lip repair. To address the challenges associated with costal cartilage, we partially crushed

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the cartilage to enhance its pliability and malleability when used as a supporting graft or prepared as finely cut costal cartilage.

MATERIALS AND METHODS

Study Subject

This study presents a comprehensive case series of 39 patients which was approved by the Biomedical Research Ethics Committee at Pham Ngoc Thach University of Medicine (No. 489/HĐĐĐ-TĐHYKPNT).

Patients who had previously undergone unilateral cleft lip surgery but still exhibited at least one of the following nasal deformities were included in this study: horizontal and lower positioned alar, wide and horizontal nostril, nasal base defect, short and deviated nasal columella, or deviated nasal tip. These patients underwent rhinoplasty procedure exclusively using autologous costal cartilage. The procedures were conducted at the Department of Aesthetic Plastic Surgery, Cho Ray Hospital, Ho Chi Minh City, Vietnam, from January 2018 to October 2022.

Operative Techniques

Harvest of Autologous Costal Cartilage

A skin incision was made approximately 3.5–4 cm in length, located approximately 1 cm below the fold beneath the breast, offset to the inner edge of the midclavicular line. An electric knife was used to cut through the superficial fascia and fat layer to the rectus abdominis fascia. The rectus abdominis fascia was exposed and harvested as required for enveloping the costal cartilage to sculpt the dorsal region. Surgical forceps were used to elevate the chest wall muscle, whereas Metzenbaum scissors were used to carefully dissect along the muscle fibers within the chest wall muscle layer, exposing the anterior surface of the perichondrium and No. 7 costal cartilage. Wide dissection along the length of the costal cartilage was performed with a blunt dissection technique using fingers. An electric knife was used to incise the perichondrium on one side of the cartilage body along the length of the costal cartilage to create the entrance, a part of the perichondrium on the upper side was harvested. Dissection was continued from both edges along the length of the cartilage, then at its posterior surface. The costal cartilage was harvested. Bleeding was controlled, and the underside of the perichondrium was checked for pleural injury. If there was still a shortage of graft, the costal cartilage no. 6 could be harvested further. The surgical field was closed layer by layer, and negative pressure was applied.

Takeaways

Question: We address complex nasal deformities in patients with prior unilateral cleft lip repair by exclusively utilizing autologous costal cartilage in rhinoplasty procedures, using various surgical techniques.

Findings: This study presents a comprehensive case series of 39 patients. The autologous partially crushed and finely cut costal cartilage were used for rhinoplasty. The postoperative anthropometric indicators, total ROE score and total FACE-Q score showed significant improvements.

Meaning: Rhinoplasty utilizing autologous costal cartilage for patients with prior unilateral cleft lip repair is safe and effective.

Preparation of Sliced, Partially Crushed, and Finely Cut Costal Cartilage

The straightest and longest section of costal cartilage was selected and cut into thin slices (about 1 mm thick) along its length by the Lagrot paring knife and soaked in normal saline solution (Fig. 1A). One or two slices were selected to make septal extension grafts. Another two slices were partially crushed (Fig. 1B) equivalent to Buyuklu level 2 then shaped as supporting grafts (shield graft, cap graft, alar batten graft). The rest, after being partially crushed equivalent to Buyuklu level 3,[7] were finely cut with a Lagrot skin knife, referred to as finely cut cartilage (Fig. 1C). Pieces of finely cut cartilage were put it into a 1-mL syringe to inject into the nasal base and alar base on the cleft side (Fig. 4C) and into the nasal dorsum (Fig. 5C), or wrapped with rectus abdominis muscle fascia to shape the dorsal in cases where the skin was thin and in need of extensive dissection on the nasal dorsum (Fig. 5D).

Tip Plasty, Augmentation of the Nasal Base on the Cleft Side, and Dorsal Augmentation

An inverted V-shaped skin incision was made, extending to both sides of the columella and alar edges; Additionally, an inverted U-shaped incision was performed above the nostril on the cleft side (Fig. 2A, B). After this, the lower alar cartilage was dissected and exposed on both sides. It is

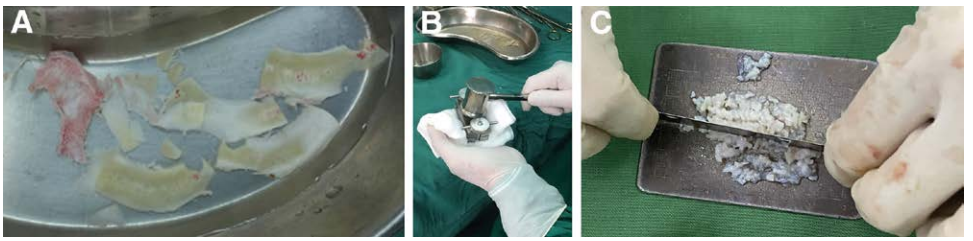

Fig. 1. Preparation of sliced, partially crushed, and finely cut costal cartilage. Costal cartilage was split into thin slices (A) and was partially crushed using the cartilage crushing tool (B), then was finely cut (C).

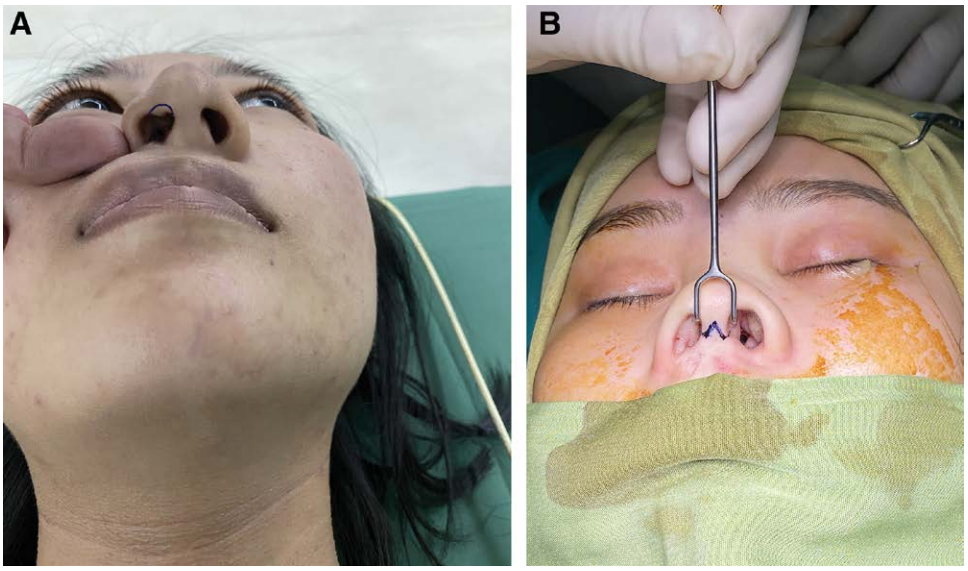

Fig. 2. Skin incisions. A, An inverted U-shaped incision line was designed on the cleft nostril side. B, Inverted V-shaped skin incision line.

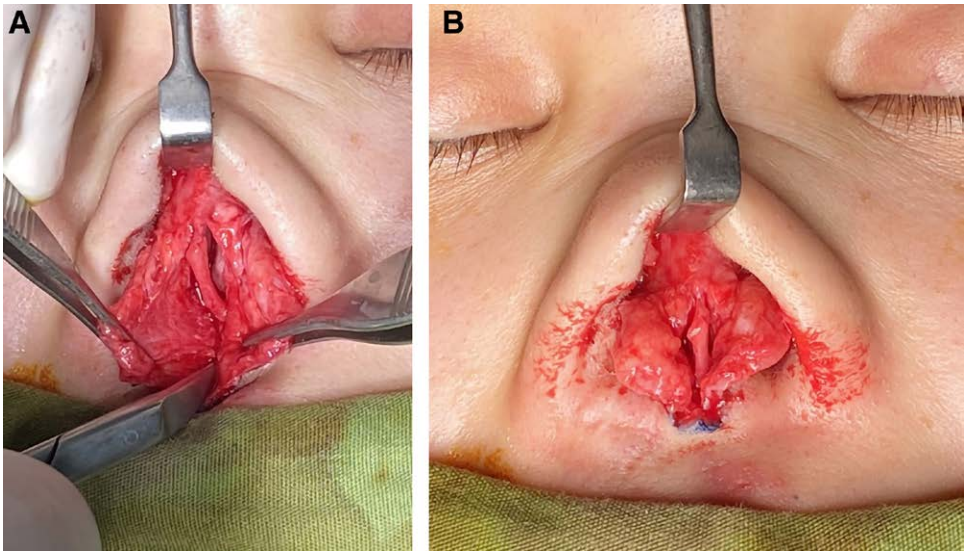

Fig. 3. Realignment of the deviated septum. A, Caudal septum was deviated toward the healthy side (left side) and (B) was straightened.

common for the lower alar cartilage on the cleft side to be positioned lower than on the healthy side. A no. 11 blade was used to gently dissect and release part of the connecting ligament between the lower lateral cartilage and the upper lateral cartilage. Further dissection was performed on the cleft side to enhance symmetry between both sides.

The caudal septum was dissected and exposed. In unilateral cleft lip patients, it was frequently found to be deviated toward the healthy side (Fig. 3A). To address this deviation, a septoplasty procedure was performed to realign and stabilize the caudal septum (Fig. 3B). To address the concavity of the nasal base on the cleft side, scissors were utilized to dissect the skin and subcutaneous tissue, creating a cavity beneath both the nasal base and alar base on the affected side. The width of the dissection cavity was aligned with the amount of cartilage required to adequately fill the cavity and improve the nasal base defect on the cleft side (Fig. 4A). Subsequently, the cavity was filled with the finely cut cartilage graft to achieve a satisfactory result, ensuring optimal contouring and support for the reconstructed nasal base.

For other graft materials, our standard procedure involved estimating the required size, sculpting the graft slightly larger than necessary, and then placing it in position to assess fit. Subsequently, we resized the graft as needed before securing it in place.

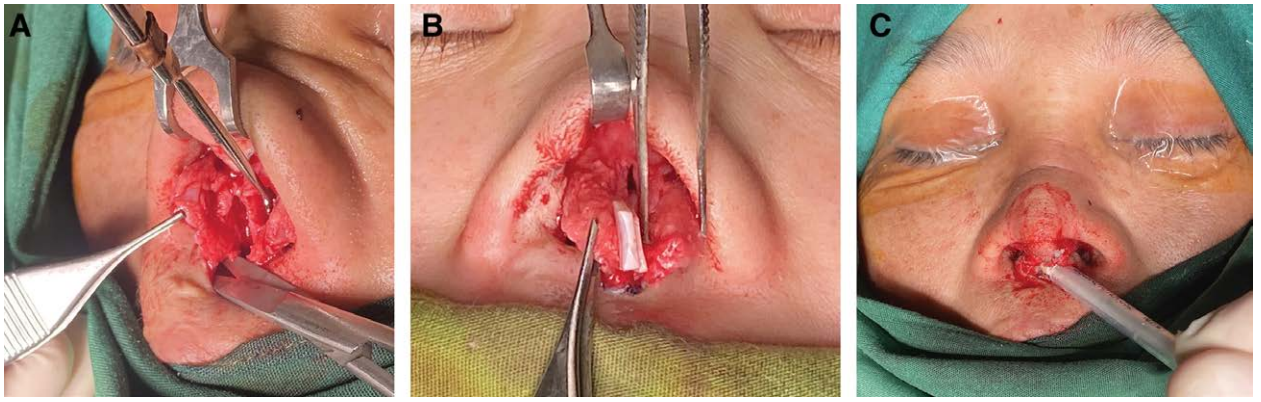

Fig. 4. Augmentation of the nasal base and SEG grafting. A, Cavity under the nose base and alar base on the cleft side was created. B, SEG was placed on the cleft side (right side) and fixed, a second SEG was reinforced to provide additional septal stability, the height of the SEGs were shortened to correspond to the height of the lower lateral cartilage. C, Finely cut costal cartilage was filled in dissection cavity with 1-mL syringe to elevate the nasal base and alar base on the cleft side.

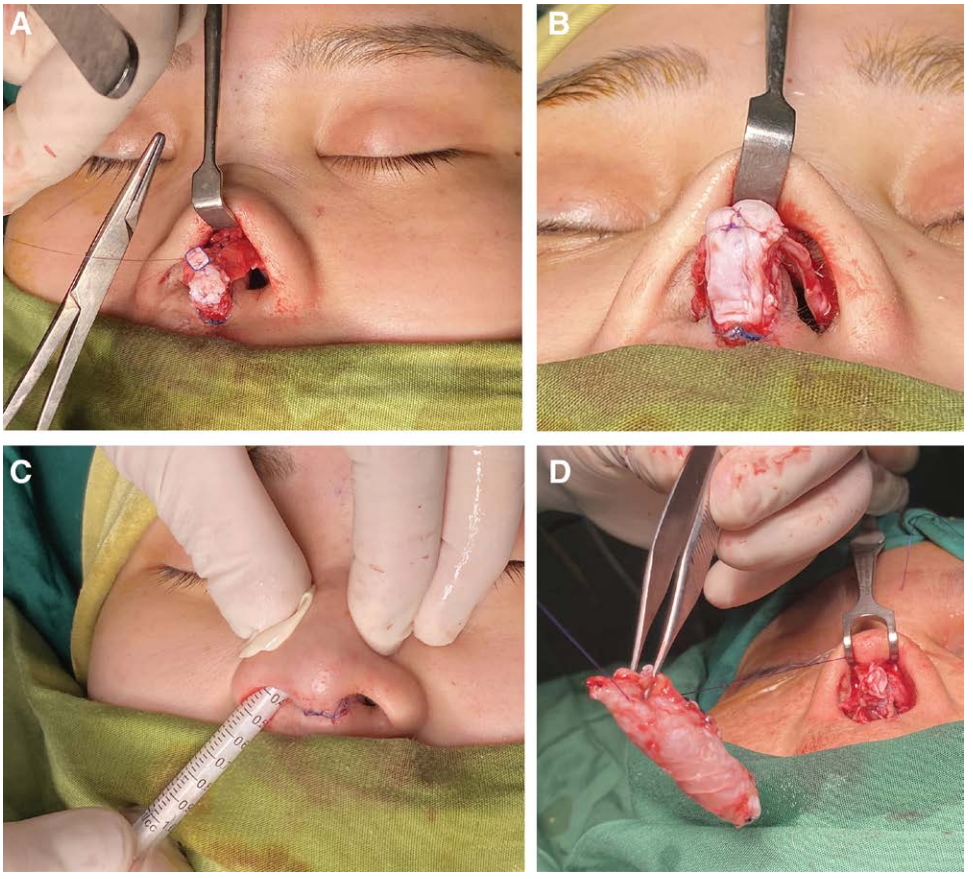

Fig. 5. Tip plasty and dorsal augmentation. A, Shield graft was placed and fixed in the columella area, a cap graft was placed and fixed at the nasal tip, an alar batten graft was placed and fixed on the lower lateral cartilage on the cleft side. B, Perichondrium was used to cover the nasal tip and columella. C, Finely cut costal cartilage was injected to shape the nasal dorsum or (D) wrapped by rectus abdominis fascia for shaping the nasal dorsum (needle was inserted from the top of the nasal radix suturing to one end of the fascia cartilage).

The SEG graft was positioned on the cleft side and inserted straight down the nasal spine at an angle of approximately 90–95 degrees in relation to the upper lip. It was then secured to the septum using continuous stitches back and forth of a polydioxanone (PDS) 5.0 suture. In cases in which the initial graft did not provide

sufficient stability, a second SEG graft could be used on the opposite side of the septum, particularly in situations where the septum is weak and thin.

The alar cartilages were lifted on both sides to the greatest extent possible, marking the corresponding position on the septal extension graft, and the SEG was trimmed to match the height of the top of the alar cartilage dome below (Fig. 4B). The lower alar cartilages were then fixed on both sides to the SEG with a PDS 5.0 suture. The finely cut costal cartilage was filled in the dissection cavity by using a 1-mL syringe to elevate the nasal base defect on the cleft side (Fig. 4C).

The shield graft was placed in front of the nasal columella and fixed with Monosyn 6.0 to the SEG and the lower lateral cartilage at the columella. The first cap graft was placed on the nasal tip, fixed to the SEG and the lower lateral cartilage on both sides (Fig. 5A). A second cap graft can be used to further elevate the height of the nasal tip by placing it on top of the first graft but slightly above it and fixing it to the first graft with a Monosyn 6.0 suture. The alar batten graft was placed into the lower lateral cartilage area on the cleft side to lift the alar concave area (Fig. 5A). The perichondrium was used to cover the graft area at the nasal tip and the nasal columella to prevent the cartilage from being visible or palpable beneath the skin and enhance the natural softness of the nasal tip (Fig. 5B).

The skin pinch test was performed preoperatively to evaluate the skin of the nasal dorsum and estimate the dissection cavity. In cases in which the skin was not thin or tight, the finely cut costal cartilage can be directly injected into the nasal dorsum (Fig. 5C). The nasal dorsum was raised and adjusted after inserting the costal cartilage. In cases in which the skin on the nasal dorsum was thin or tight, requiring extensive dissection, the rectus abdominis fascia was utilized to create a rolled and wrapped configuration for the finely cut costal cartilage, thereby shaping the nasal dorsum (Fig. 5D). We secured the anterior portion of the rectus abdominis fascia into the nasal tip and anchored it at the nasal radix using a thin piece of Merocel placed underneath to prevent any potential skin damage.

Finally, the kin of the nasal columella and nasal vestibule was sutured. Merocels were placed on both sides, and the nose was splinted with tape and an Aquaplast splint.

Evaluation

The assessment of treatment outcomes was determined by evaluating the extent of improvement in clinical characteristics before and after surgery (at 6 mo postoperatively), analyzing changes in anthropometric indicators, and considering patient satisfaction after the surgical procedure through the Rhinoplasty Outcome Evaluation (ROE) scale[8] (**See table, Supplemental Digital Content 1**, which shows the ROE scale. **http://links.lww.com/PRSGO/D322**) and FACE-Q scale.[9] (**See table, Supplemental Digital Content 2**, which shows the FACE-Q scale. **http://links.lww.com/PRSGO/D323**.) The nasal obstruction was assessed using the Nasal Obstruction Symptom Evaluation (NOSE) scale before and after surgery.[10] (**See table, Supplemental Digital Content 3**, which shows the NOSE scale. **http://links.lww.com/PRSGO/D324**.)

RESULTS

Patient Demographics

The average age of patients was 25.1 ± 8.4 years; the female-to-male ratio of patients was 2.9 to 1. Right cleft lips accounted for 38.5%, whereas left cleft lips accounted for 61.5%. Before undergoing surgery, all the patients had the five following common nasal deformities: the nasal alar being horizontal, positioned lower and longer than the healthy side; the nostril on the side of the cleft being wide and horizontally oriented; a defect in the nasal base; a short and deviated nasal columella; and a deviated nasal tip.

All patients were followed up for a minimum of 6 months postoperatively. Sixteen patients underwent follow-up for more than 12 months, with the longest follow-up period extending to 2 years. The average follow-up duration was 1.05 ± 0.69 years.

Characteristics of Surgical Methods

- The most commonly harvested dorsal cartilage was costal cartilage no. 7, utilized in 71.8% of cases; 7.7%, involved the use of no. 6 costal cartilage, whereas 20% of cases utilized both no. 6 and no. 7 costal cartilages.
- The inverted U-shaped incision on the cleft side was used in a majority of cases, 86.4%.
- The caudal portion of the septum was adjusted in all cases.
- The nasal dorsum was shaped using finely cut costal cartilage in all patients, in which five (12.8%) patients had rectus abdominis fascia wrapping.
- The finely cut costal cartilage was inserted into the nasal base on the cleft side to reshape the nasal base in all patients.
- Various grafts were used in rhinoplasty procedures, including SEG grafts, shield grafts, cap grafts, and alar batten grafts. The specific combination and number of grafts used varied depending on the preoperative condition of the patient's nose (Table 1).
- Costal perichondrium was used to cover the grafts at the nasal tip and columella in all cases.

Results of Rhinoplasty Based on Measurements of Improvement after Surgery

After rhinoplasty, all patients had improvement in at least three morphological features of nose deformity. Among them, improving five characteristics accounted for 76.9% (Fig. 6). The nose anthropometric indexes were improved (Table 2).

Table 1. Number of Grafts Used in Rhinoplasty

	No. Grafts Used in Rhinoplasty		
Type of Graft	No Graft (%)	1 Graft (%)	2 Grafts (%)
SEG	0	69.2	30.8
Shield graft	10.3	89.7	0
Cap graft	0	17.9	81.2
Alar batten graft	0	5.1	94.9

Fig. 6. Before and after patient images. Images of the patient before surgery (A and B) and 6 months after surgery (C and D).

Table 2. Nose Anthropometric Indexes before and after Surgery

	Before Surgery	6 Mo after Surgery	*P*
Nasal tip height (mm)	16.86 ± 1.34	19.66 ± 1.02	<0.001
Length of columella (mm)	6.4 ± 0.91	9.77 ± 1.01	<0.001
Nasal columella angle (degrees)	80.26 ± 4.28	85.77 ± 3.54	<0.001
Nasal length (mm)	38.38 ± 1.32	40.26 ± 1.13	<0.001
Ratio of alar length on the normal side/alar length on the cleft side	0.918 ± 0.03	0.946 ± 0.14	<0.001
Nasofrontal angle (degrees)	148.08 ± 3.17	143.85 ± 2.42	<0.001
Nasolabial angle (degrees)	85.9 ± 7.85	89.23 ± 4.66	0.007

Results of Rhinoplasty Using the ROE Scale, the FACE-Q Scale, and the NOSE Scale

Postsurgery, the total ROE score was three times higher than before surgery (median 18 versus 6, $P < 0.001$), and the total FACE-Q score was 2.26 times higher (median 47 versus 20, $P < 0.001$) (Table 3). There was a statistically

Table 3. ROE Scale, FACE-Q Scale, and NOSE Scale before and after Surgery

	Before Surgery	After Surgery 6 Mo	*P*
ROE scale	6	18	<0.001
FACE-Q scale	20	47	<0.001
NOSE scale	6.15 ± 3.71	4.10 ± 3.01	0.001

significant difference in the average score of the NOSE scale before and after surgery (median 6.15 versus 4.10, $P < 0.05$).

No significant intraoperative or postoperative complications were observed.

DISCUSSION

Nasal deformities in unilateral cleft lip patients are highly varied and diverse, often affecting one or more anatomical subunits and causing asymmetry of the nose. These deformities tend to occur in combination rather than in isolation within a single patient. In our study, all patients exhibited a combination of five common nasal deformities: horizontally positioned nasal alar that was lower and longer than the healthy side, wide and horizontally oriented nostril on the cleft side, nasal base defect, a short and deviated nasal columella, and a deviated nasal tip. These findings are consistent with those reported by Sathyabama and Veerabahu[11] and Hoshal et al,[12] who also observed that the primary nasal malformation in cleft lip patients tends to be located in the alar position on the cleft side.

The inverted U-shaped incision helps make the nostrils on both sides more symmetrical, reducing the high and low levels between the healthy side and the cleft side. Additionally, this incision is advantageous for addressing alar concavity deformities.[13,14]

Costal cartilage is a valuable option for nasal reconstruction, despite the fact that harvesting it requires an additional surgical procedure, which can lead to complications at the donor site such as pain, scarring, and even rare but serious complications such as pneumothorax. However, with surgical skill and meticulous techniques, these risks can be minimized. We typically use costal cartilage no. 7, and in cases in which there is not enough quantity, costal cartilage no. 6 is utilized. Certainly, the middle section of the seventh costal cartilage is of sufficient length to serve as both a septal extension graft and a columellar strut, as observed by Rajbhandari and Kao.[15] Our study exclusively utilized costal cartilage without any other materials, and importantly, no noticeable absorption of the cartilage grafts occurred during the follow-up period of 1.05 ± 0.69 years. The use of crushed cartilage has gained popularity in rhinoplasty surgery, particularly for addressing defects and deficiencies. However, there is a lack of consensus among experts regarding the optimal degree of cartilage comminution and the rate at which graft absorption occurs over time. The first is that the grafts must have high flexibility and malleability; the second is that they should not be crushed to such an extent that it affects the survival rate of chondrocytes.[7]

Although Talaat et al[16] used septal cartilage and Wong et al[13] used costal cartilage unilaterally as SEG for nasal reconstruction in patients with cleft lip, we developed a septal extension technique that ranged from purely unilateral grafting with septal cartilage to unilateral or bilateral grafting with autologous costal cartilage, depending on the stability of the septum, because septal cartilage in Asian people is especially very weak in patients with cleft lip. We do not harvest and use septal cartilage as graft due to its inherent weakness. Instead, we preserve it to strengthen the nasal framework.

In our study, finely cut costal cartilage was effectively used to reshape the nasal base without any visible evidence of absorption. This type of costal cartilage was also used to shape the nasal dorsum, either with or without fascia wrapping. Unlike the technique utilizing diced cartilage, we prepare the finely cut costal cartilage by partially crushing the costal cartilage to Buyuklu level 3 before cutting it into small pieces. This innovative approach aims to enhance the pliability and malleability of the cartilage grafts, facilitating their reshaping and integration into the nasal base and dorsum. The use of rectus abdominis fascia to wrap finely cut costal cartilage was beneficial in patients with thin skin (12.8%) to overcome the palpability of the costal cartilage. Additionally, it helped achieve nasal dorsum shaping and prevented the costal cartilage from spreading to both sides when the skin around the nasal dorsum was tight, necessitating wider dissection. In a study conducted by Daniel and Calvert[17] involving the use of diced cartilage grafts in rhinoplasty surgery, patients were divided into three groups: one with SURGICEL-covered diced cartilage, another with fascial-covered diced cartilage, and a third with diced cartilage without any wrapping. Interestingly, the group with SURGICEL-covered diced cartilage exhibited cartilage absorption after 4 months, whereas the other two groups showed no evidence of absorption even after a year.[17] Another study on diced cartilage grafts wrapped in fascia rectus abdominis by Cerkes and Basaran[18] found no major graft resorption during a 19-month follow-up.

We used the shield graft in cases in which we need to create more forward protrusion for the nasal columella and need to strengthen the columella, and then we used the cap graft to shape the nasal tip. The alar batten graft is used to treat alar concavity at the lower lateral cartilage, creating symmetry for the alar on the cleft side compared with the healthy side.

Our procedure aimed to achieve symmetry in the height of the nasal columella on both the healthy and cleft sides, as well as in the length of the nasal wing and the width of the nasal base on both sides. However, difficulties and challenges still remain when patients still have deformities after surgery, although the level of deformity is much lighter than before surgery.

The limitation of our study is its single-center design, conducted without a control group, primarily among the Asian population. This restricts our ability to make direct comparisons with different surgical techniques and graft materials and may not be entirely applicable to the White population.

CONCLUSIONS

The integration of multiple techniques in a single surgical procedure, utilizing exclusively autologous costal cartilage material, has significantly improved nasal deformities in patients with prior unilateral cleft lip repair. Our procedure has demonstrated safety and effectiveness, affirming the suitability of autologous costal cartilage as a valuable material in rhinoplasty procedures for these patients.

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DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

PATIENT CONSENT

Patients provided written consent for the use of their images.

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