Evaluation of aesthetic and functional outcome of different techniques of secondary cleft lip rhinoplasty

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Received 22 March 2018
Accepted 10 December 2018

Kasr Al Ainy Medical Journal 2019, 25:1–6

Objectives
The objective of this article is to evaluate the esthetic and functional outcome of secondary rhinoplasty in patients who have unilateral cleft lip nasal deformity with the help of using costal cartilage as a source of different graft materials.
Background
Although there have been improvements in primary rhinoplasty techniques in patients with unilateral cleft lip nasal deformity, this does not exclude the possibility of later revision surgery. In secondary rhinoplasty for cleft lip patients, the underlying skeletal support of the nose should be addressed to improve projection of the nose. In addition, correction of the hypoplastic lower lateral cartilage requires insertion of cartilage or bone grafts to add better support and symmetry. Costal cartilage is considered a better source of graft material to be used in secondary rhinoplasty.
Patients and methods
This clinical trial included 20 patients who were managed in Plastic Surgery Department, Menoufia University Hospital, from January 2016 to January 2018. All patients had unilateral cleft lip in infancy with residual nasal deformity in adulthood. Costal cartilage rib graft was harvested, carved, and used for maxillary augmentation, columellar strut graft, and lateral crural strut graft.
Results
Three anthropometric measurements (nostril height, width, and gap area) were used for evaluation of esthetic results, and subjective evaluation of nasal obstructive symptoms was used for functional improvement. A significant improvement of both esthetic and functional results was reported in the study and satisfactory outcome for both surgeons and the patients.
Conclusion
Maxillary augmentation beneath the base of the nose is important in cleft lip secondary rhinoplasty for better support of the columella and lower lateral cartilage. Costal cartilage is a good source of nasal grafting materials owing to its strength, availability in large amount, and ability of being carved for different options.

Keywords:
anthropometry, cleft lip, costal cartilage, nose, rhinoplasty

Kasr Al Ainy Med J 25:1–6

1687-4625

Introduction

Cleft lip rhinoplasty is a challenge for all plastic surgeons as there is a very wide range of deformities [1,2]. Nasal asymmetries and deficiencies can include all the components of the nose, skin, mucosal lining, cartilage, and skeletal support [2]. The combination of deformed anatomy and previous surgical attempts with resultant scarring also can affect the facial growth [2,3].

Although there have been advances and improvement of primary repair of nasal deformities during the repair of cleft lip in infancy, this does not exclude the need for revision rhinoplasty in adulthood for complete rehabilitation of these patients [4].

As a rule, maxillary deficiency or hypoplasia is a main feature of cleft lip nasal deformity. The lack of support of the nose leads to a significant loss of protrusion and insufficient angulations. Moreover, the collapsed lateral crura and hypoplastic columella require structural support for good symmetry and projection and more obtuse columella-labial angle [5,6].

Many sources for graft support are available in secondary rhinoplasty, including cartilage and bone and alloplastic materials such as Silastic and Proplast, hydroxyapatite, and Mersiline mesh [6]. However, autologous tissues are preferred as a source of graft materials in secondary rhinoplasty [7]. Because

 DOI: 10.4103/kamj.kamj_12_18

large amounts of cartilage are required, costal cartilage grafts are preferred to septal and auricular cartilages as sources of grafts in secondary rhinoplasty in addition to their strength and ability to maintain long-lasting shape and volume [8].

The aim of this study is to evaluate the outcome of using costal cartilage graft in secondary cleft lip rhinoplasty for both maxillary augmentation and lower lateral cartilage and columellar support.

Patients and methods

This prospective clinical study was conducted at Department of Plastic Surgery, Menoufia University Hospitals, from January 2016 to January 2018. It was approved by the ethical committee on July 2016. It included 20 patients (16 females and four males) with unilateral cleft lip nasal deformity who were operated at earlier ages for correction of cleft lip and/or palate. The mean age was 15.6±1.7 years old for females and 17.2 ±5.7 years old for males. All were subjected to secondary rhinoplasty using cartilage grafts harvested from the costal cartilage.

All the patients signed an informed consent for photography before and after surgical procedures including publication for research issues.

Careful assessment of the skeletal base architecture should determine whether alveolar bone grafting and/or Le Fort I (maxillary) advancement was needed before definitive cleft rhinoplasty. In this case, patients were excluded from the study and directed to maxillofacial reconstruction before reassessment later for rhinoplasty.

Surgical procedure

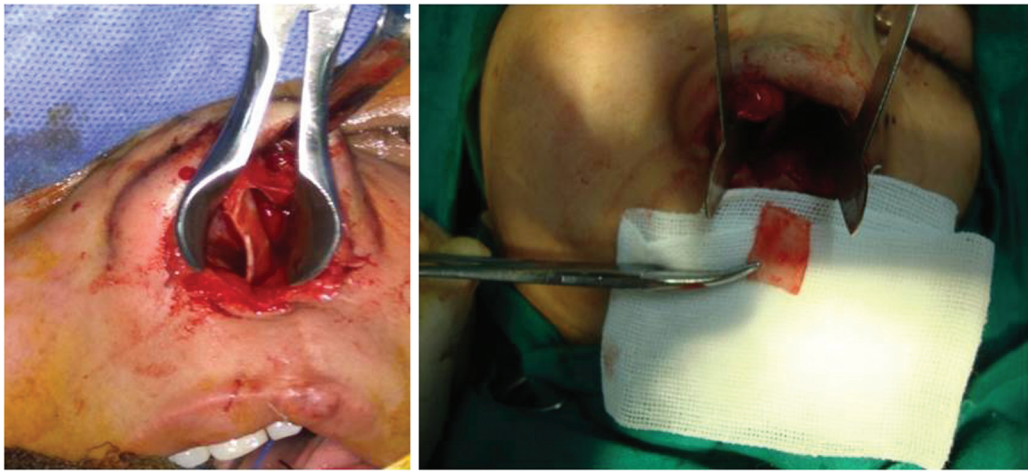
An open approach with V-Y mid columellar incision for the benefit of columellar elongation was applied for all cases. Exposure of the entire septum was achieved through dissection of the mucoperichondrium on both sides allowing visualization of the maxillary crest and nasal spine. Septoplasty is continued by freeing the septum from the maxilla and nasal spine and then removing a quadrangular piece of the septal cartilage leaving an anterocaudal L-strut (Fig. 1). Realignment of the septum and the anterior nasal spine to the midline was done after a horizontal osteotomy and fixation by sutures. If there is a significant hypertrophy of the inferior turbinate, it was managed by turbinectomy.

The lower lateral cartilage was then widely freed from the skin cover and vestibular lining. Costal cartilage graft was then harvested through a 4–6 cm inframammary incision (especially in female patients for more cosmetic results).

The harvested cartilage graft was carved to be applied for maxillary augmentation on the cleft side. Another piece of cartilage was designed to be inserted as a columellar strut, a lateral crural strut, and/or an alar batten grafts.

Through an intraoral superior sulcus incision, a cartilage graft was inserted and fixed over the hypoplastic maxilla using 2/0 prolene sutures. Elongation and support of the columella was achieved through placement of a columellar strut put in a pocket made between the two medial crura (Fig. 2).

Fig. 1



Exposure of the septum and removal of quadrangular piece of the septum.

Fig. 2

Columellar strut inserted between the medial crura and fixed with prolene sutures.

For correction of the hypoplastic collapsed lower lateral cartilage, a lateral crural strut graft measuring 3–4 mm by 28–30 mm was placed in a pocket created by elevating the lining on the underside of the cartilage.

An alar batten graft of residual septum is fashioned to span from the dome out beyond the alar crease. Domal mattress sutures were added to further define the domes. The domes are sutured over the projecting rib columellar strut.

Finally, medial rotation of alar base was achieved by wedge excision of the nasal sill and medial advancement of the alar base using cinch procedure.

The nasal skin is then redraped and the transcolumellar incision is closed in V-Y advancement to aid in elongation of the columella. The two nostrils were then packed by Vaseline gauze to decrease hematoma, which usually were removed after 48 h. External nose dressings were generally removed after 2 weeks. The patients were followed up every month for 6 months to evaluate the results and to detect any complications if present.

Anthropometric analysis on photographs (photogrammetry) was compared preoperatively and postoperatively by applying three measurements: (a) nostril height, (b) nostril width, and (c) nostril gap area. A preoperative and postoperative submentovertical view (basal) of digital photographs of each patient was processed by Photoshop 9.0 (Adobe Systems Inc., San Jose, California, USA).

Statistical analysis

All data were collected, tabulated, and statistically analyzed The descriptive measures of central tendency (mean and median) and measures of dispersion (range, SD, minimum, and maximum), besides frequency and the percentage, were calculated by statistical package for the social sciences (version 20; SPSS Inc., Chicago, Illinois, USA).

Results

The study included 20 patients with unilateral cleft lip deformity (16 females and four females). Data were collected about previous surgical interventions with emphasis on previous rhinoplasty surgery and orthognathic surgery, which would affect our results.

All patients (100%) were subjected to cleft lip repair in early childhood at age 3–6 months but only three (15%) of all were subjected to cleft palate surgery at age of 18–30 months.

Only one (5%) patient was subjected to orthognathic (Le Fort I) osteotomy at the age of 14 years. None of our cases (0%) were subjected to any trial of secondary rhinoplasty before our surgical intervention.

Regarding the mean operative time, our mean operative time was 200 min (range, 190–240 min). It was a single team approach for both rhinoplasty dissection and rib cartilage graft harvest and carving.

For assessment of results regarding symmetry and improvement of nasal esthetics, we included three indirect anthropometric measurements performed on submentovertical (basal) view of digital photographs as described by Nagy and Mommaerts [9].

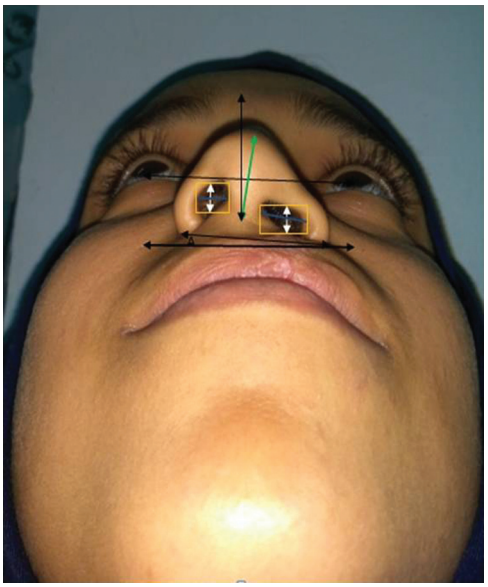
The measurements we applied to assess nostril symmetry were (a) nostril height, (b) nostril width, and (c) nostril gap area. Photoshop 9.0 (Adobe Systems Inc.) was used for processing the images and evaluating the changes in the ratio between the noncleft and the cleft side of the nose.

Nostril height is a perpendicular line from tip of the nostril to the base, and nostril width is a line from narrowest point of the columella to lateral wall of ala. The nostril gap area is a rectangle including these lines (Fig. 3).

Significant improvement in symmetrical outcome and adequate columellar length could be achieved. This was

demonstrated by significant improvement of the ratio of nostril height, width, and gap area between the cleft side and the noncleft side toward the even parameter (P=0.001, 0.002, and 0.004, respectively) (Table 1 and Fig. 4).

Fig. 3



Photogrammetry of unilateral cleft lip and nose patient: (a) nostril width (blue line), (b) nostril height (white line), and (c) nostril gap area (orange rectangle).

Functional outcome of our patients was evaluated by subjective questionnaire of the patients who complained of nasal obstruction symptoms (10 patients). Overall, 90% of these patients confirmed a satisfactory improvement of their nasal airway function. Only one (10%) case continues to have nasal obstruction symptoms that responded to antiallergic nasal spray.

Regarding the postoperative complication, it was minimal that could be managed conservatively. We had one (5%) case of seroma at the rib cartilage donor site and a superficial columellar skin necrosis in another case (5%).

Discussion

Patients with cleft lip have a wide range of nasal deformities with variable degrees of severity; this is related to the extent of cleft lip. A group of elements have a role in these complex nasal deformities,

Table 1 Improvement in the three measurements included in this study

Parameter	Preoperative		Postoperative		*P* value
	Mean	SD	Mean	SD	
Nostril width ratio (cleft/noncleft)	1.38	0.044	1.13	0.04	0.001
Nostril height ratio (cleft/noncleft)	0.59	0.07	0.86	0.05	0.002
Nostril area ratio (cleft/noncleft)	0.66	0.04	0.92	0.04	0.004

Fig. 4

Preoperative and postoperative views of a female patient with improvement of the anthropometric measurements ratio between the cleft and noncleft side.

including abnormal anatomy, scarring from previous surgical procedures needed for these patients, the harmful effect of these surgeries, and altered anatomy of facial growth. The nasal deformity associated with cleft lip includes both soft tissues and skeletal support of the nose [2,3]. Common deformities in these cases are deviated septum, short and deviated columella, drooped nasal tip, acute columello-labial angle, and collapsed and malpositioned ala and its cartilage [4].

The time of correction of nasal deformities used to be controversial in the past, but the advances of the techniques used for primary repair of nasal deformities during the lip repair make it suitable to perform a primary repair with cleft lip surgery [10]. However, minor defects left will be aggravated with growth, and a revision surgery for correction of the residual deformities will usually be needed later for more esthetic outcome [4].

Maxillary retrusion and hypoplasia is a main component of the cleft lip-nose patients and inadequate support for the nasal base adds in the deviated and collapse nasal pyramid. Maxillary augmentation with different materials is necessary for support of the nose at its base and is a main step in secondary rhinoplasty of the cleft lip patients [5,6].

Many types of graft materials are available for usage in maxillary augmentation either autografts or biomaterials. Silastic was the first biomaterial to be used in maxillary augmentation with the disadvantage of being smooth and migrant in the tissues. Medpore, Goretex, Mersiline, and hydroxyapatite also have been used with various problems of infection and rejection [6].

Autogenous grafts are preferred for being nonantigenic with least rejection rate; bone graft is difficult to carve, but cartilage grafts are available from multiple sites and can be carved to suite various needs [11,12].

Costal cartilages are available in adequate quantities and are rigid enough to compensate the soft tissue defect associated with cleft lip nasal deformity [13].

In our study, we used the costal cartilage grafts in both maxillary augmentation and columellar elongation with tip definition using columellar strut graft in addition to insertion of a lateral crural strut graft to elevate the collapsed ala on the cleft side.

Ortiz-Monasterio *et al*. [14] recommended costal cartilage grafts in their study with no problems regarding the biocompatibility and with the least complication rate.

Costal cartilage grafts in cleft rhinoplasty had popularity in the studies published by Foda and Bassyouni [12], Tzvetkov [15], Muzaffer *et al.* [16], and Reddy *et al*. [17].

For evaluation of esthetic outcome of our work, we applied three anthropometric measurements to be compared preoperatively and postoperatively as described by Nagy and Mommaerts [9].The improvement of the ratio of the nostril width, height, and gap area between the noncleft and cleft side toward the even parameter demonstrates the improvement in symmetry between both sides of the nose.

Reddy *et al.* [17] published their study about cleft rhinoplasty and demonstrated the near perfect symmetrical outcome regarding nostril height and gap area with less satisfactory results regarding nostril width.

Functional problems are main features of cleft lip-nose patients and are related to septal deviation, turbinate hypertrophy, and tissue deficiency and scarring. We introduced a simple subjective evaluation of the functional improvement in our cases that had nasal obstruction and functional problems before our surgical intervention. A satisfactory improvement in nasal functions was confirmed by nearly all the patients postoperatively, meaning that secondary rhinoplasty in cleft patients had a valuable effect on nasal functions. Cohen *et al*. [4] stated that functional outcome of the secondary rhinoplasty in cleft patients had little attention by the author, and the benefit of cleft lip rhinoplasty on nasal functions needs more concentration in later studies.

Conclusion

Maxillary hypoplasia below the base of the nose in cleft lip patients forms a major component of their deformity. Lack of skeletal support of the nose contributes mainly in collapsed lower nose. Maxillary augmentation using different graft materials specially the costal cartilage is an efficient procedure to correct this deficiency and is a main component of secondary correction of the cleft lip nasal deformity.

The costal cartilage is a good option when cartilage grafts are used in secondary rhinoplasty with the advantages of being strong enough, easily carved, and maintaining its shape for a long time.

The esthetic and functional outcomes of secondary cleft lip rhinoplasty are satisfactory to both surgeons and the patient when cartilage graft materials are applied efficiently.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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