Journal of Cranio-Maxillo-Facial Surgery xxx (2012) 1–6

Contents lists available at SciVerse ScienceDirect

Journal of Cranio-Maxillo-Facial Surgery

journal homepage: www.jcmfs.com

Assessment of nostril symmetry after primary cleft rhinoplasty in patients with complete unilateral cleft lip and palate☆

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ARTICLE INFO

Article history:
Paper received 1 May 2011
Accepted 2 July 2012

Keywords:
Rhinoplasty
Dorsal onlay
Strut graft
Nostril symmetry

ABSTRACT

The aim of this study was to assess the nostril symmetry following primary cleft rhinoplasty done with either a dorsal onlay or columellar strut graft in patients with non-syndromic complete unilateral cleft lip and palate. In this retrospective study 30 consecutive patients treated with autogenous or alloplastic dorsal onlay grafts and 30 consecutive patients treated with autogenous or alloplastic columellar strut grafts for complete unilateral cleft nose reconstruction were analyzed for nasal symmetry. The autogenous grafts used were costo-chondral or septal cartilage and the alloplastic graft used was high density polyethylene (Medpore®). Assessment of the nostril symmetry was done using a two-dimensional nasal analysis 24–30 months postoperatively. Ratios between cleft and noncleft side nostril for three parameters were used to assess symmetry namely nostril width, nostril height and nostril gap area. None of the three parameters showed statistically significant changes. A satisfactory, though not statistically significant, difference in symmetrical outcome could be achieved in both the groups with the exception of nostril width symmetry in group treated with dorsal onlay graft.

1. Introduction

Despite a plethora of surgical approaches aimed at correcting the cleft nose defect, no one procedure has been universally satisfactory in the repair of nasal deformities associated with cleft lip abnormalities (Trenite et al., 1997). The various treatment options for the correction of cleft rhinoplasty include columella lengthening, septal repositioning, radix grafting, tip augmentation, tip grafting, lower lateral cartilage repositioning, alar base wedge resections, piriform augmentation and nasal bone osteotomies (Trenite et al., 1997). The typical problem with all the unilateral cleft nasal deformity which must be addressed is the nasal asymmetry. Each of the surgical techniques that have been used to correct the unilateral cleft nasal deformity has attempted to improve symmetry by translocation of the alar cartilage with its attached vestibular lining into a normal position, thereby establishing the normal vault and shape of the cartilage (Bashir et al., 2011). Several methods are reported in the literature to assess cleft lip nasal deformities, but difficulties in standardization make these studies less reproducible (Tanikawa et al., 2010).

The present study is an attempt to quantify and evaluate nostril symmetry achieved after primary rhinoplasty in patients with complete unilateral cleft lip and palate (UCLP) using a dorsal onlay and a columellar strut graft. The effect of these two techniques on the shape of the nostril was studied.

2. Materials and methods

To address the nasal deformity a retrospective study was conducted on patients operated for unilateral cleft nose deformity at our institute between January 2007 and February 2009. Thirty consecutive patients (11 males and 19 females) with dorsal grafting and 30 consecutive patients with strut grafting (11 males and 19 females) were enrolled in the study.

2.1. Surgical technique

Open structured rhinoplasty was performed by a single surgeon on all the patients. After a transcolumellar incision approach, the alar cartilages were exposed and released from their mucosal attachments. A back cut was given in the cleft side nasal vestibular mucosa to ensure a satisfactory lift of the buckled cleft side alar cartilages.

Patients with a depressed nasal bridge, drooping nasal tip and short columella of the nose were treated with a dorsal onlay graft

☆ Sources of support in the form of grants: None.
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http://dx.doi.org/10.1016/j.jcms.2012.07.001

(Fig. 1). The graft was snugly inserted into the pocket created between the skin and the nasal bone over the ridge. This graft was extended into the supra tip area to give tip support and elongation of the columella. The grafts used here were either costo-chondral or high density polyethylene (Medpore®). The alar cartilages were sutured over the graft anteriorly followed by meticulous skin closure (Fig. 5).

Patients with a satisfactory nasal bridge but deficient columella and drooping tip were treated using a columellar strut graft (Fig. 2). Here the medial crura were splinted to a strong columellar strut to increase support to the nasal tip and weak buckled medial crura. Septal, costo-chondral or high density polyethylene grafts (Medpore®) were used for struts. Intercrural suturing was done and the area closed. "VY" advancement at the base of the alar cartilage on the cleft side was done to lift it to the level of the normal side. Interdomal suturing was done to elevate the cleft side alar cartilage. After securing the graft in place, the cartilages were stabilized by using transcartilaginous sutures (Fig. 6).

All patients were instructed to use antibiotic soaked soft nasal packs in the cleft side nostril for 3 months to prevent scar contracture in the early postoperative healing phase.

2.2. Photographic analysis

Submento-vertical photographic views were used for analysis (Mommaerts and Nagy, 2007, 2008). They were obtained by a standardized method. Photographs were taken with a Nikon D100 digital camera (Nikon corp., Japan).

For evaluation of surgical results, measurements were taken on standardized photographs using the analysis as described by Mommaerts and Nagy (2007, 2008). Indirect anthropometric measurements were performed on the digital photographs processed by Photoshop 9.0 (Adobe Systems Inc, San Jose, California) with the help of Scion Image Software (National Institute of Health, Maryland, USA) (Mommaerts and Nagy, 2007, 2008).

The measurements that were done to quantify nostril symmetry were the (1) nostril width, (2) nostril height (Figs. 1,3) and (3) nostril gap area (Figs. 2,4). Nostril width is marked by a perpendicular line from narrowest part of the columella to lateral wall of ala, nostril height is marked by perpendicular line from highest part of the nostril sill to the base of the nostril (Fig. 1). The nostril gap area is marked along the perimeter of the inner wall of the external nares (Fig. 2).

The parameters on the photographs were measured using line and angle tool for linear measurements and angular measurements respectively using the Scion Image software. The area measurements were carried out with the help of magic wand tool of Adobe Photoshop 9 as described by Mommaerts and Nagy (2007, 2008).

The values on the cleft side were divided by the value on the noncleft side. A ratio of 1 indicated perfect symmetry, and any deviation from 1 was a measure of asymmetry. The student's *T* test was applied to test for statistically significant differences between the preoperative and the postoperative values.

All statistical analyses were performed using SPSS 16.0.

3. Results

The patients enrolled in the study were in the age group of 14–28 years and had a follow-up ranging from 24 months to 30 months.

For the dorsal onlay graft group, costo-chondral cartilage was used in nine patients (four males and five females) and high density polyethylene (Medpore®) implant was used in 21 patients (seven males and 14 females).

For the columellar strut group septal cartilage was used as a strut in 18 patients (seven males and 11 females) and high density

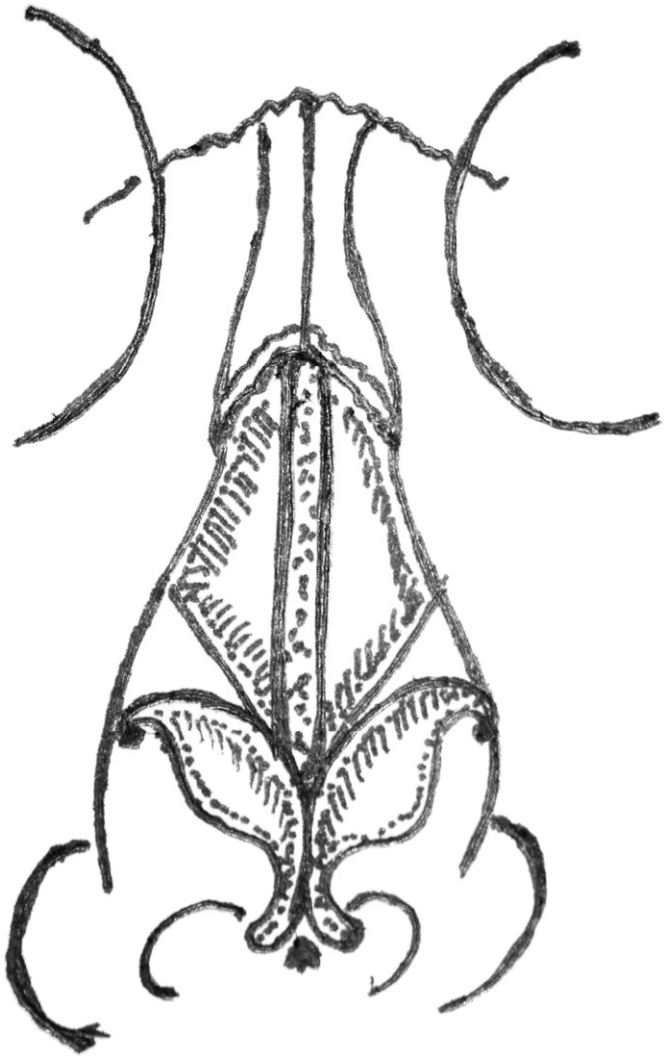

Fig. 1. Measurement of nostril width and height. Dorsal onlay grafting diagrammatic illustration.

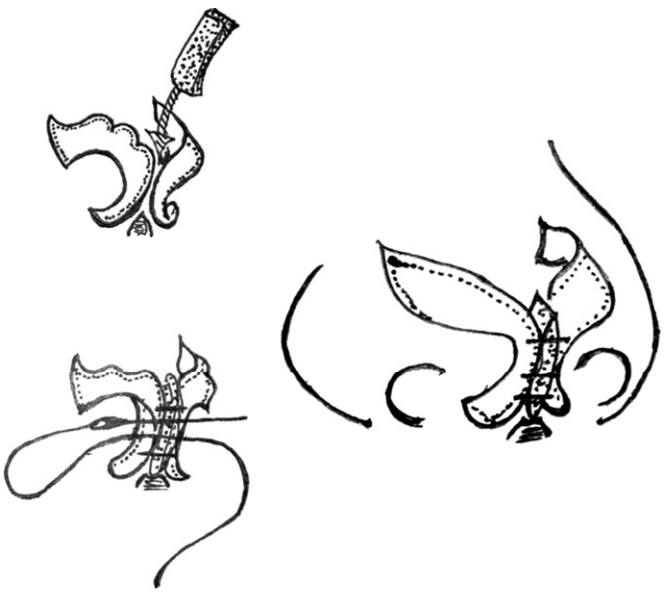

Fig. 2. Measurement of nostril gap area. Strut grafting diagrammatic illustration.

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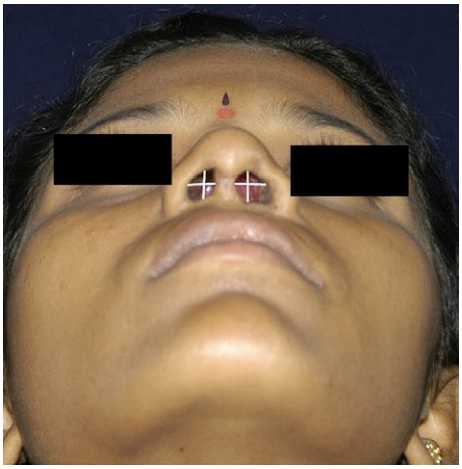

Fig. 3. Dorsal onlay grafting – diagrammatic illustration. Measurement of nostril width and height.

Fig. 4. Strut grafting – diagrammatic illustration. Measurement of nostril gap area.

polyethylene (Medpore®) in 12 patients (four males and eight females).

Table 1 shows the levels of asymmetry in a dorsal graft with the mean pre and postoperative ratios between the cleft and noncleft side for the three parameters. There is an improvement in the nostril height and nostril gap area symmetry. However this procedure resulted in nostril width asymmetry.

Table 2 shows the descriptive statistics with levels of asymmetry after columellar strut grafting. There is an overall improvement in the symmetry of nostril width, nostril height and nostril gap area postoperatively.

Table 3 shows the results of the Student's *T* test for statistical significance. In the dorsal graft group nostril height shows significantly higher symmetry ($p = 0.0035$). The change in symmetry of nostril gap area and nostril width was not significant.

In the group treated with columellar strut grafts there was an improvement in all three parameters but the change in symmetry was not statistically significant.

4. Discussion

The visual perception of human faces is influenced by a complex combination of various factors such as appearance, symmetry and expression (Marcotty and Eisenhauer, 2009). Studies have shown that when faces are assessed there is a proportional relationship between symmetry and attractiveness, whereby a positive perception is accompanied by greater social acceptance and thus influencing an individual's quality of life (Marcotty and Eisenhauer, 2009). The nose, being the central and prominent landmark of the face, is the focal point of attention, along with representing the individual identity. Hence, the nose, despite being a tiny organ, affects the overall facial appearance (Arnnop et al., 2011). The nasal deformity associated with the cleft lip has been viewed as one of the most challenging reconstructive problems in the rhinoplasty. The challenge to correct this deformity is a result of a combination of altered anatomy, surgical scarring from previous reconstructive attempts, and the inevitable effects of growth (Foda and Khaled, 2000; Kawamoto et al., 2008).

Fig. 5. Dorsal onlay grafting – preoperative & postoperative photographs.

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Fig. 6. Strut grafting – preoperative and postoperative photographs.

Table 1
Descriptive statistics of dorsum graft.

Parameter	Group	Mean ratio Cleft/non cleft	Variance	SD	S.E. mean
Nostril width	Preop	1.13	0.07	0.27	0.05
	Postop	0.59	0.02	0.12	0.02
Nostril height	Preop	0.77	0.05	0.22	0.04
	Postop	0.92	0.02	0.15	0.03
Nostril gap area	Preop	0.92	0.09	0.29	0.05
	Postop	1	0.02	0.13	0.02

Level of asymmetry $N = 30$.

Table 2
Descriptive statistics of strut graft.

Parameter	Group	Mean ratio Cleft/non cleft	Variance	SD	S.E. mean
Nostril width	Preop	1.22	0.07	0.27	0.05
	Postop	1.13	0.08	0.28	0.05
Nostril height	Preop	0.78	0.06	0.24	0.04
	Postop	0.88	0.03	0.18	0.03
Nostril gap area	Preop	1.05	0.18	0.43	0.08
	Postop	1	0.03	0.18	0.03

Level of asymmetry $N = 30$.

Table 3
Statistically significant parameters for both grafts.

Group	Parameter	p-value
Dorsum graft	Nostril width	0
	Nostril height	**0.0035**
	Nostril gap area	0.14
Strut graft	Nostril width	0.23
	Nostril height	0.07
	Nostril gap area	0.5

Statistically significant parameters $p < 0.05$ (in bold).

A review of literature is a testament to the difficult nature of secondary rhinoplasty associated with cleft lip (Foda and Khaled, 2000). A varied opinion exists regarding addressing the nose during primary cheiloplasty. All the techniques address some aspect of the deformity; however complete correction of some noses remains an elusive goal (Foda and Khaled, 2000). Each patient presents a unique challenge that may be addressed best with some techniques and not with others (Gubisch, 1990; Foda and Khaled, 2000). Pathologic anatomy is related to the extent of the deformity – nasal tip is deflected toward the cleft side, the dome of the cleft side is retroplaced, the angle between the medial and lateral crura is excessively obtuse, the ala buckles inward on the cleft side, the alarfacial groove on the cleft side is absent, maxillary deficiency is real or apparent, the circumference of the naris is greater on the cleft side, the naris on the cleft side is retroplaced, the columella is shorter in the anteroposterior dimension on the cleft side, the medial crus is displaced on the cleft side, the columella is positioned obliquely with its base toward the noncleft side, the nasal floor is absent, hypertrophy is present in the inferior turbinate on the cleft side, the vestibular web is within the cleft side of the interior nostril, and so on (Thomas, 2009). One of the most common defects in patients with cleft lip is a depressed nasal tip, due to the lack of natural support caused by the severely deviated septum. The presence of a short columella worsens the tip position and makes the correction very difficult (Carlino, 2008).

Surgical therapy during the first 18 months of life leads to an acceptable functional result in most patients with unilateral cleft, lip and palate. However, morphologic results tend to be less satisfactory (Stauber et al., 2008). An indication thereof is the high number of patients desiring corrective surgery due to persistent nasal asymmetry (Stauber et al., 2008). There are various kinds of deformities in the cleft lip nose, such as flattening or inferior displacement of the alar dome, septal cartilage deviation, nostril floor depression, and short columella (Nakakita et al., 1999). It goes without saying that the main goal of revision is to obtain symmetry along with other deformity correction and tip elevation (Nakakita et al., 1999). Secondary cleft nasal reconstruction should not be

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performed without first evaluating and correcting any significant problems with the skeletal base under the nose (Cutting, 2000). Therefore all the patients were corrected for their underlying skeletal base deformities prior to rhinoplasty.

Gunter and Rohrich pointed out that open rhinoplasty is good for diagnosing the reason for the deformity, as it opens up the bone structure completely, which is key to nasal plastic surgery (Nashimura, 1980; Gunter and Rohrich, 1987). The open rhinoplasty technique has been widely criticized because of the columellar scar (Foda, 2004). In our observation this is due to edema between the medial crura due to loss of cartilaginous attachments in cleft nose defects. When open rhinoplasty is performed with careful flap elevation and meticulous closure, the incisional scar is hardly visible, even to the patient. Furthermore, the patient is more concerned about the form of the nose than the columellar scar itself (Gunter and Rohrich, 1987; Mavili and Tuncali, 1999).

We identified two main areas of nasal defects in unilateral cleft lip. One was the depressed dorsum of the nose and the other was a drooping tip. We have therefore, addressed these two defects in these patients. The dorsal graft is an excellent way to raise the depressed dorsum found in some unilateral cleft defects. This graft also aids in supporting the tip of the nose which can be lifted by attaching the alar cartilages to it. In patients who did not have a depression of the dorsum of the nose, using only a strut graft to strengthen the medial crura of the lower lateral cartilages was considered adequate for lifting the nasal tip. All patients, however, were treated with a V to Y advancement in the vestibule of the cleft nostril to increase its height. Grafting onto the columella is aimed to strengthen the tip support and correct the buckled and malpositioned alar cartilages (Arnnop et al., 2011). The graft will increase the columella show, a nasolabial angle, the nasal projection, and the structural integrity of the tip support and nasal base (Arnnop et al., 2011). Both nasal tip refinement and preservation of tip rotation are best corrected using interdomal and transdomal sutures (Arnnop et al., 2011).

Most surgeons have preferred autogenous cartilage and bone grafts (Tzvetkov, 2002; Muzaffer et al., 2004). The disadvantage of such grafts was distortion or unevenness, unpredictability, the extreme length of time and labor involved and the problem of donor characteristics (Nakakita et al., 1999; Tzvetkov, 2002). Autogenous bone grafts are more difficult to shape and carry a significantly higher resorption rate (Foda, 2005). Alloplastic grafts like silastic and silicone do not adhere to the surrounding tissues and are associated with a high incidence of migration and extrusion through the skin, infection and foreign body reaction (Gunter and Rohrich, 1987; Tzvetkov, 2002; Foda, 2005). High density porous polyethylene (Medpore®) is a polymer with regularly spaced pores measuring 100–300 lm in diameter allowing significant tissue in growth instead of surrounding fibrous tissue capsule formation, which results in rapid and strong implant fixation (Gui et al., 2008). This tissue in growth also makes it more resistant to bacterial infection (Gui et al., 2008). Long-term follow-up evaluation demonstrated no problems related to bio incompatibility and a minimal complication rate (3% infection and 8% displeasing contours) making it an excellent option for facial skeletal augmentation for the appropriate patient. The material is easily carved and flexible (Gui et al., 2008; Yang et al., 2009).

In the present study, costo-chondral cartilage was used for dorsum augmentation in the first nine patients and as strut graft for the first 18 patients. High density poly ethylene was used in the next 21 patients with dorsal grafting and 11 patients with strut grafting. A prolonged operating time leads to the use of high density poly ethylene grafting replacing costo-chondral grafting.

Outcome assessment requires parameters and tools to assess. With respect to surgery upon the nose, possible aspects for outcome assessment include morphology, appearance, function, and satisfaction which can be assessed by anthropometric measurement, photographic scaling, nasometry, and psychological instruments (Tzvetkov, 2002). Different evaluation methods have been described, such as direct (Farkas et al., 1993; Horswell and Pospisil, 1995) and indirect anthropometric analysis (Kohout et al., 1998; Liou et al., 2004), panel evaluation (Cussons et al., 1993; Saxby and Palmer, 1986), and linear, area and 3D computerized measurements (Yamada et al., 1999; Wong et al., 2002; Hood et al., 2003). The current study is limited to the assessment of nostril symmetry using 2D photographs.

Preoperatively both the groups in this study demonstrated similar nostril asymmetries and similarly distorted nostril shapes in terms of width and height. The nostril height asymmetry was more pronounced in both the groups. The cleft nostril is wider than the noncleft side, but of a lesser height. Thus the cleft specific nostril distortion is reflected in both the groups irrespective of other parameters such as depresssed nasal bridge, short columella etc. In the dorsal graft group, surgery could achieve significant nostril height symmetry at the expense of nostril width symmetry. The other parameters improved, though not significantly. This resulted in a narrow cleft side nostril. Suturing the alar cartilages over the dorsal graft could have contributed to the drastic change in the nostril shape after radix grafting keeping the nostril gap area uniform. The strut graft improved the nostril symmetry in terms of the three parameters but not to a statistically significant level.

Trenite performed 52 secondary rhinoplasties in five bilateral and 47 complete unilateral clefts with age ranging between 15 and 44 years using different grafts suited to the individual case. Evaluation of the results comparing the pre and postoperative photographic base views of the nose showed subjective and objective functional esthetic improvement in 95%, although no complete symmetry in basal view was achieved (Trenite et al., 1997). Kim et al. also used photographs and anthropometric evaluation to evaluate the results after primary rhinoplasty. Nasal tip projection and columellar length were increased 24.8% and 28.8%, respectively; nasal width was increased 12.3% (Kim et al., 2004). The quantitative assessment of facial asymmetry performed on two dimensional reproductions of hard tissue (radiographs) or soft tissue (photographs) project a complex 3D structure onto a two dimensional plane, thus causing loss of one of the facial dimensions, usually facial depth (Stauber et al., 2008). To evaluate the efficacy of the many different treatment methods with a standardized, quantitative method, and to identify whether any one surgical technique is better than another in improving the appearance of patients with cleft lip and palate, it is recommended that facial features be assessed three-dimensionally and analyzed statistically (Stauber et al., 2008). No reports, however, exist in the literature concerning the combined use of objective and quantitative measures of morphology and esthetic assessments to predict and evaluate facial and nasal esthetics (Russell et al., 2001).

5. Conclusion

A decrease in the cleft side nostril width less than that of the noncleft side was noted after using a dorsal graft inspite of a near perfect symmetrical outcome in terms of nostril height and nostril gap area. Thus a satisfactory symmetrical outcome could be achieved in both the treatment groups with the exception of nostril width symmetry in group treated with dorsum graft.

There was an improvement in the nostril symmetry in patients undergoing strut grafting. This improvement, however, was not statistically significant.

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Acknowledgments

Competing interests: None declared.
Funding: None.
Ethical approval: Not required.

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