Original Article - Evaluative Study

Outcomes of Open Rhinoplasty for Unilateral Cleft Patients using Photogrammetric Analysis - An Evaluative Study

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Abstract

Introduction: Secondary cleft rhinoplasty is a challenge due to the complex anatomy of the nose, with structural deformity and difficulty in surgical management. This study aimed to evaluate the effect of an anatomical-based approach on enhancing tip and alar symmetry in secondary unilateral cleft rhinoplasty using photogrammetric evaluation. **Methods:** The study was conducted on 57 adult patients seeking rhinoplasty after primary repair of congenital unilateral cleft lip deformity. All patients were operated upon using an external open rhinoplasty approach using an anatomical-based surgical technique. The cases were periodically followed up at three, six, 12 and 18 months for both aesthetic and functional outcomes with photogrammetric analysis of facial profile using the software Mirror Suite programme to compare before and after the surgical procedure. **Results:** The photogrammetric analysis showed a significant improvement of facial angles ($P = 0.05$). The nasofrontal angle changed from a median of 146° to 132.5°, nasolabial angle of 73° to 95°, nasofacial angle of 21.5° to 32° and nasomental angle of 105° to 130°. The rotation angle of the nasal tip showed a significant cephalic rotation with a mean increase of the tip elongation of 1.8 cm achieved per lateralised millimetre. **Discussion:** Secondary rhinoplasty in unilateral cleft deformities needs accurate evaluation of the anatomical and pathological abnormalities. Open approach is preferred with using costal cartilage graft allowing adequate columellar lengthening, maxillary enhancement and alar repositioning which leads to optimise the definition, projection and cephalic rotation with better stabilisation and symmetry of the nasal tip.

Keywords: Nose deformities, secondary rhinoplasty, symmetry, unilateral cleft

Introduction

Nasal surgery is the end result of an overall treatment programme for secondary cleft lip.[1,2] Secondary cleft rhinoplasty is a challenge due to the complex anatomy of the nose, with structural deformity and the difficulty in surgical management.[3,4] The surgical repair of the unilateral cleft lip nasal deformity should produce as much symmetry as possible to the non-cleft side.[5] A successful repair needs an accurate evaluation of the anatomical and functional abnormalities.[6] The secondary deformity of unilateral cleft nose includes a posterolaterally and inferiorly displaced alar base and dome, maxillary hypoplasia, deficient and depressed lower lateral cartilage, malpositioned alar cartilage with its medial crus depressed and deviated with the short columella to the normal side, and the caudal part of the septal cartilage is deviated to the non-cleft side leading to nostril asymmetry and airway problems.[7-9] These deformities emphasising an asymmetric and malpositioned nasal tip which appears wide, flattened, deviated and poorly projected.

This study aimed to evaluate the outcomes of open rhinoplasty for unilateral cleft patients using photogrammetric analysis.

Patients and Methods

An evaluative study was conducted on 57 adult patients including 34 females and 23 males in the period from January 2017 to February 2020 seeking for rhinoplasty after the

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primary repair of congenital unilateral cleft lip deformity. This study was conducted after receiving Institutional Review Board Approval of Menoufia Faculty of Medicine (Ethical Clearance Number: Plastic 39-1), and following the principles of the Declaration of Helsinki. All patients were evaluated after obtaining informed consent before the study for the pictures, surgical procedures and research participation. The authors declare that they have no conflict of interest with no funding.

The inclusion criteria were patients who had the primary repair of their unilateral cleft lip deformity done within the first six months of life and had no subsequent attempts for rhinoplasty before inclusion in this study. Female age above 14 years old and male above 16 years for assurance of complete maturation for the nasal septum and facial skeleton.

The exclusion criteria were patients who were required to complete the treatment protocol of secondary deformities including fistula repair, or facial advancement, as rhinoplasty should be the end procedure. Female age below 14 years old and male below 16 years were also excluded from the study.

Pre-operative evaluation

Complete general and local examinations were done comparing cleft and non-cleft side morphology including (1) State of dorsum deviation from the midline, (2) Tip position and definition, (3) Position of the columella, (4) Maturation of upper and lower lateral cartilages, (5) Alar base position and (6) Intranasal examination for the position of the nasal septum, nasal valve, turbinates and nasal floor.

Radiographic evaluation included computerised tomography (CT) of the face to evaluate the state of the septum, turbinate, maxillary and nasal bone deformities. Standard photographs were taken pre-and post-operatively including frontal, basal, lateral and oblique.

All patients were operated upon using the open rhinoplasty method using anatomical-based surgical technique to allow complete exposure of the complex pathology and deficient tissues.

Surgical procedures

The patient was operated under general orotracheal hypotensive anaesthesia in the supine position to decrease the incidence of bleeding and allow better visualisation of the nasal skeleton. Both the nasal skeleton and donor site were infiltrated with xylocaine 1% and 1:100,000 units of epinephrine waiting 10 min for the vasoconstrictive effect. The surgical team was divided into two groups for nasal exposure and harvesting of cartilage graft at the same time.

The grafts were prepared and customised according to the pathology of each patient [Figure 1].

Open rhinoplasty approach was done with V-shaped mid-columellar incision with complete exposure of the nasal septum, chondrovomerine junction, anterior nasal spine and upper and lower lateral cartilages [Figure 2a, and Videos 1 and 2].

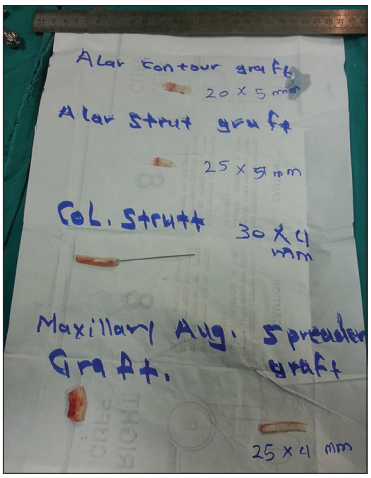

Figure 1: The harvested costal cartilage was prepared to make collumelar strut, alar strut, spreader and maxillary graft. The alar contour graft was prepared from elevated septal cartilage

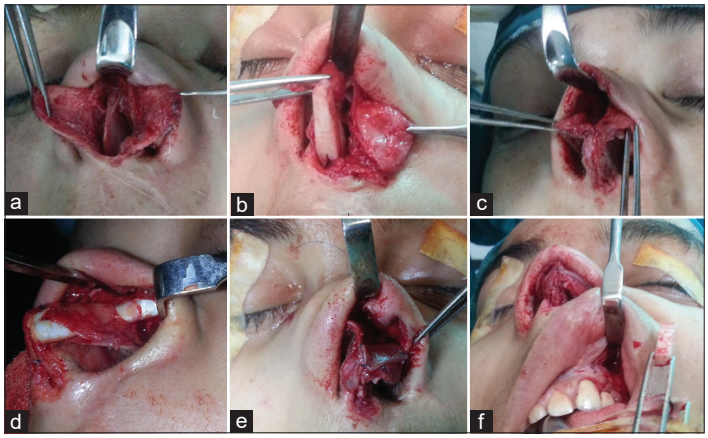

Figure 2: (a) Exposure of nasal skeleton. (b) The columellar strut was anchored by a wire fixation to the drilled burr hole within anterior nasal spine representing a fixed bony structure. (c) The columellar strut provides a more obtuse columella-lip angle with cephalic rotation and more elongation of the nasal tip. (d) The spreader graft was placed to enhance internal valve competence. (e) The alar contour graft was placed to span from the dome out beyond the alar crease like a sandwich. (f) The maxillary graft was placed to the created pocket through gingivolabial incision

A wide vomero-septal-ethmoid resection was performed leaving an 8-10 mm dorsal and caudal L-strut accompanied with repositioning of deviated septum to the aesthetic midline. A spreader graft was inserted on the concave side of the septum to straighten it and serve as a stent for the internal nasal valve.

The fashioned columellar strut was placed beyond the junction of the dorsal graft for a distance of 10-14 mm and in the zone of the anterior nasal spine representing a fixed bony structure where it was anchored with wire fixation using drilled burr hole affording adequate stabilisation [Figure 2b]. It produces a more obtuse columella-lip angle resulting in defined supratip break and youthful curve to the central lip [Figure 2c].

The spreader graft was placed to enhance internal valve competence [Figure 2d]. The alar strut graft was placed in the cleft-side nasal 3-4 mm in width and 28-30 mm in length providing strong support with fixing suture to the lateral crus which serves to stabilise external valve competence produced by the lateral release, followed by caudal rotation. An alar contour graft of residual septum was then placed to span from the dome out beyond the alar crease like a sandwich [Figure 2e].

The inter- and intradomal mattress sutures were performed to define the domes accompanied with slight overprojection of the cleft lateral crus and domal segment to compensate for the tight soft-tissue envelope on the cleft side and reduce the angle of divergence. A shield tip graft can be added to camouflage the sharp edges of the columellar strut and lateral crural grafts with the enhancement of nasal tip definition and contour.

Through a gingivolabial sulcus, a pyriform costal cartilage graft was inserted into the created pocket to augment the maxillary deficiency creating enhancement of the alar base support to the more anatomical anterior site and tip projection [Figure 2f, Video 2 and Multimedia File 2].

The bony vault was evaluated to identify the presence of broad nasal bones that need to be corrected through medial and lateral osteotomies. The skin is re-draped, and the incisions are closed using a deep 6-0 PDS suture, followed by interrupted 6-0 prolene sutures, and the marginal incisions were closed with interrupted 5-0 chromic sutures. Vaseline gauze was inserted in the nostril for support and splinting.

Post-operative care and follow-up

Discharge was at the second day of the surgical procedure on oral anti-oedematous drugs, and the vaseline gauze was removed at the fifth day.

The follow-up CT was done at six months after surgery to evaluate the outcomes and improvement [Figure 3]. Furthermore, the cases were periodically followed up at three, six and 12 months for both aesthetic and functional outcomes. Photogrammetric analysis of facial profile was done using software mirror through Adobe Photo editor programme to compare before and after the surgical procedure including nasofrontal angle (n = 115–130), nasofacial angle (n = 30–40), nasomental angle (n = 120–132) and nasolabial (n = 90–100).

Figure 3: Computerised tomography of the nose represents an axial cut; (left) pre-operative view shows the septal deviation towards the normal side, and turbinate hypertrophy on the cleft side, (right) post-operative view shows correction of the deformities

Statistical analysis

The data were processed in Excel software (version 2010; Microsoft Corporation), and analysed using the Statistical Product and Service Solutions (IBM SPSS, University of Chicago, USA) statistics version with *P*-value considered significant at 0.005 and highly significant at 0.001.

Results

A total of 57 patients with unilateral cleft lip–nose deformities underwent open rhinoplasty surgery. There were 34 females and 23 males; their ages varied from 14 to 33 with an average of 18 years.

The photogrammetric analysis showed a significant improvement of facial angles (P = 0.05). The nasofrontal angle changed from a median of 146° to 132.5° (n = 115–130), nasolabial angle 73° to 95° (n = 90–100), nasofacial angle 21.5° to 32° (n = 30–40) and nasomental angle 105° to 130° (n = 120–132). The rotation angle of the nasal tip showed a significant cephalic rotation with a mean increase of the tip elongation of 1.8 cm achieved per lateralised millimetre [Figures 4 and 5].

The modified rhinoplasty outcome evaluated questionnaire was applied for evaluation of patient satisfaction including four questions about the following: Satisfaction with appearance, ability to breathe, how much friends like your nose and limitation of social or professional activities.[10] The improvements after the surgical procedure had a great effect on patient satisfaction showing a mean satisfaction increase from 6.9 pre-treatment to 14.4 after treatment, indicating a highly significant improvement with good patient satisfaction [P = 0.001, Table 1].

Furthermore, all patients showed improvement of nasal congestion and breathing difficulty symptoms. The mean follow-up period of 19 months (range: 16–23 months) showed maintained good functional and cosmetic results. A second stage adjustment of nostril symmetry was required in three cases (5.26%).

Discussion

The nose is localised in the centre of the face and has a significant influence on aesthetic and psychosocial

adjustment.[11] Secondary rhinoplasty for unilateral cleft nose deformities demands an understanding of the underlying complex pathologic anatomy,[1] proper intraoperative exposure,[12] and strong grafting to allow sufficient support.[13]

The goals of rhinoplasty surgery are to enhance support and define projection, cephalic rotation, proper contour and symmetry. The factors contributing to the deformities in unilateral cleft patients include (a) columellar and alar deformity, (b) deviated and deficient septum, (c) dorsal deviation, (d) alar base malposition and (e) maxillary deficiency. These abnormalities mainly affect the lower two-thirds framework of the nose that stigmatise the cleft nose deformity. In our proposed technique, we performed open rhinoplasty with a comprehensive anatomical-based approach, starting with a complete septoplasty, followed by repositioning and augmentation of the distorted nasal skeleton with multiple costal cartilage grafts resulting in achieving more tip and alar symmetry with a stable framework.

Rohrich *et al*.[14] stated that the principal basis of the surgical repair for secondary rhinoplasty of unilateral cleft nasal deformity is to divide the procedure into seven areas: pyriform hypoplasia, septal reconstruction, dorsal reshaping, tip reshaping, tip projection, alar reshaping and alar repositioning. Surgical management for each is provided. The structured approach shows satisfying and stable outcomes,[15,16] in which cartilage grafts produce a stable basis for the suture techniques allowing proper nasal tip projection without performing the suture technique alone.[17]

On the other hand, Yasonov *et al*.[18] in the study of 60 patients with a follow-up period of one year, preferred the closed rhinoplasty for reposition of alar cartilage with minimal trauma to the nasal skeleton, less periorbital ecchymosis and short recovery period. Furthermore, Berghaus[19] stated that a closed approach allows for a comparatively straightforward cephalic resection. Thomas and Mishra[20] in a study of 69 patients, concluded that the closed rhinoplasty technique does not allow intercrural soft-tissue dissection, hence a better projection of the nasal tip is possible in the open tip rhinoplasty.

Table 1: The modified rhinoplasty outcome questionnaire; the four questions asked are listed in the first column, patients had to score each question with 0–4 points, where 0 was the least and 4 was the highest value; the total score was 16 points

	Mean±SD	
	Pre-operative	Post-operative
How much do you like the appearance of your nose?	0.7±0.7	3.8±0.8
How much can you breathe through your nose?	2.3±0.8	3.5±0.5
How much do you think your friends and those close to you like your nose?	1.8±0.7	3.4±0.4
Do you think the appearance of your nose limits your social or professional activities?	2.1±1.0	3.7±0.3
Total score	6.9±0.8	14.4±1.0

SD=Standard deviation

Many studies[21-23] concluded insignificant differences in Nasal Obstruction Symptom Evaluation (NOSE) score improvement, aesthetic outcomes and psychosocial distress levels with regard to rhinoplasty technique (open vs. closed). Kosins[24] in a study of 162 patients stated that open and closed approaches based on the tip and dorsal deformities have different indications: closed is preferred with thin skin, little dorsal modification, minimal tip deformities and over projected noses, whereas open is preferred where extensive dorsal modification is required, severe septal deviations, complex tip deformities and tip augmentation.

The use of alloplastic materials was recommended by some authors, such as Medpor strut graft[25] for columellar support, and silicone implants[26] for dorsum augmentation, costal grafts from a young cadaver[27] showing a significant improvement of tip projection, and alar symmetry compared to the severe deformities in the pre-operative state, but with the variable incidence of exposure, infection, revision rates or other adverse outcomes.[28] However, many authors support the use of autologous rib cartilage grafts with many advantages including natural source, natural curve, abundant volume, easy fabrication and sufficient strength with long-term improvement regarding nasal profile.[29-31]

We used the costal cartilage graft with sufficient strength and volume that can overcome the deficient structures and provide adequate axial and transverse stability against tension on the cleft side. The costal cartilage grafts provide a fashioned columellar strut acting as a pillar for the other additional grafts including spreader, dorsal and alar strut.

Zhang *et al*.[32] in a total of 118 patients with a secondary nasal deformity who had reconstructive rhinoplasty with an average follow-up period of 12 months demonstrated post-operative improvement in nasal morphologies, columella deviation angle and nasal tip height which are crucial parameters of nasal aesthetics. Han *et al*.[33] showed in the retrospective review that was conducted on 20 cases of unilateral cleft lip patients undergoing secondary rhinoplasty with combined costal cartilage graft and suture techniques resulting in increased nostril height and decreased width, obtaining satisfactory symmetry. Furthermore, Sertel *et al*.[34] used the L-shaped septal extension spreader graft combined with alar batten graft for soft-tissue repositioning for secondary rhinoplasties in unilateral cleft lip nose deformities minimising tip rigidity with significant improvement of the dome's height and its symmetry, as well as the alar side angle.

The photogrammetric analysis[35] of the facial profile was applied in this study using a software Adobe Photo editor programme and comparing the measurements before and after surgery with a mean follow-up period of 18 months showing

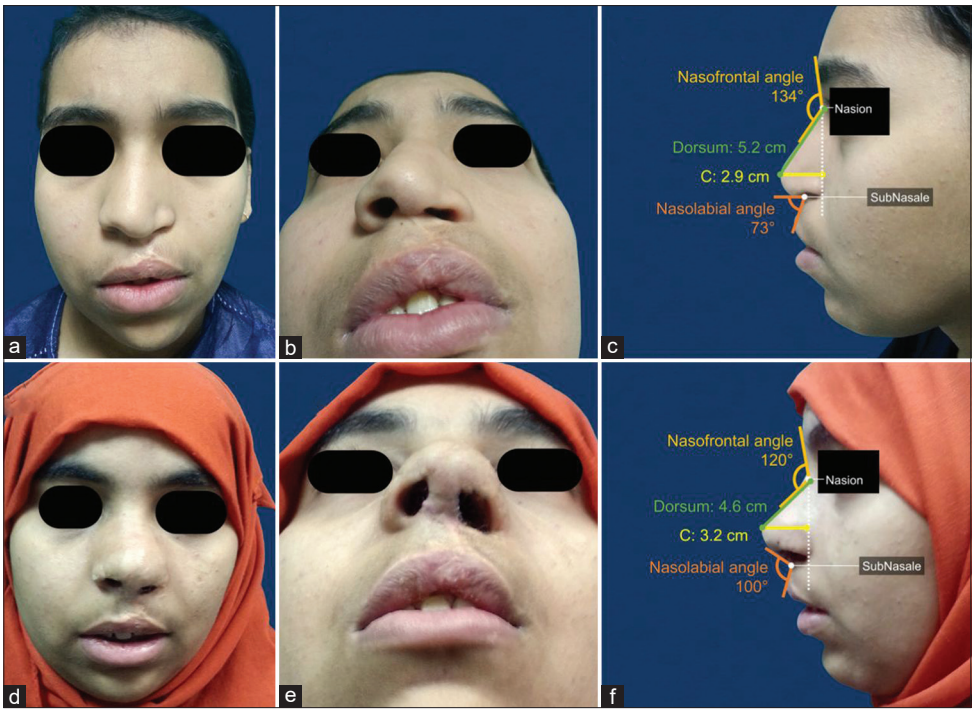

Figure 4: This 17-year-old female patient; preoperative; (above) left unilateral cleft nasal deformity characterised by alar collapse, hypoplastic cleft side ala, poor tip projection, and a broad nasal tip, (below) the patient is shown 6 months post-operatively, with a more defined supratip break, increase of the tip elongation and alar contour symmetry. (a and d): frontal view, (b and e) basal view, (c and f): lateral view

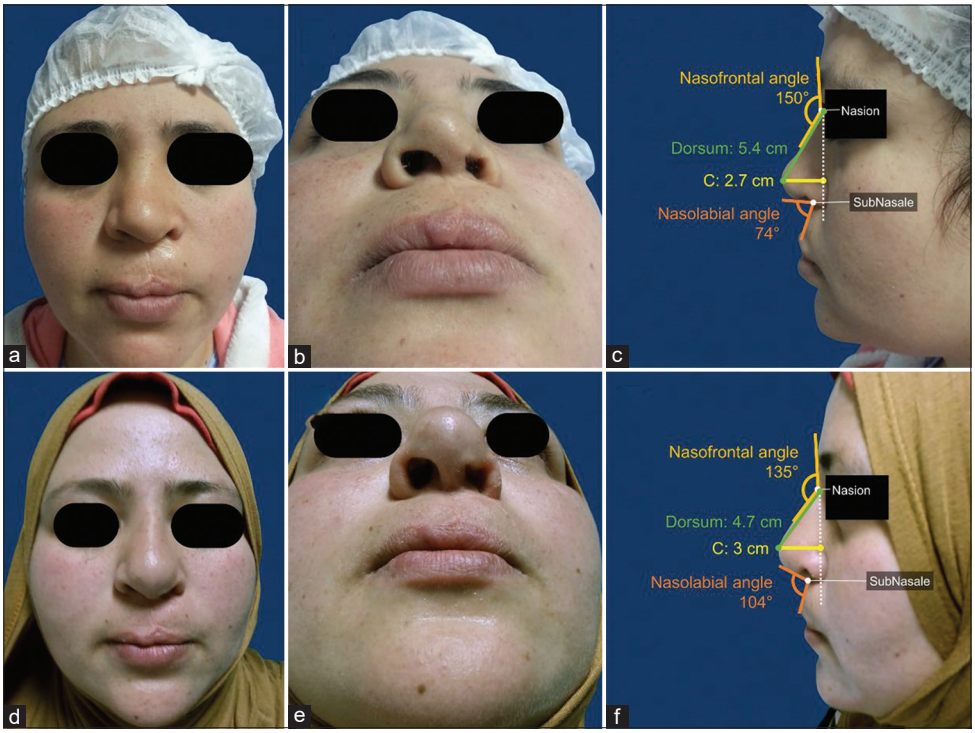

Figure 5: This 22-year-old female patient; preoperative; (above) left unilateral cleft nasal deformity with poor tip projection and collapsed left ala, (below) the patient is shown 18 months post-operatively, with improvement of the nasofacial angles, nasal tip, columella –lip angle, and alar contour. (a and d): frontal view, (b and e) basal view, (c and f): lateral view

significant improvements of all parameters including nasofacial angles, dorsal height, columellar elongation resulting in tip projection, definition and cephalic rotation. All patients were satisfied concerning outcomes with positive effects on social and psychological behaviour, also improvement of nasal congestion symptoms and breathing difficulties.

Conclusion

Successful secondary rhinoplasty in unilateral cleft deformities ultimately depends on an accurate analysis of the anatomic and pathological variables. Open approach is preferred, using costal cartilage graft allowing adequate columellar lengthening, maxillary enhancement and alar repositioning, optimising the definition, projection, and cephalic rotation with better stabilisation and symmetry of the nasal tip.

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.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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