

Correction of Cleft Lip Nose Deformity With Rib Cartilage

Farhad Hafezi, MD, FACS; Bijan Naghibzadeh, MD, FACS; Abbas Kazemi Ashtiani, MD, FACS; S. Jaber Mousavi, MD; Amir Hossein Nouhi, MD; and Ghazal Naghibzadeh

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Abstract

Background: Correction of cleft lip nasal deformities (CLND) is often unsatisfactory because of problems resulting from cartilage weakness and strong soft tissue forces. Therefore, strong cartilaginous support, such as rib cartilage, is mandatory.

Objectives: The authors describe placement of rib cartilage grafts to create a more symmetric and aesthetically acceptable repair of CLND with improved nasal air flow.

Methods: Two groups of patients, including those with unilateral and bilateral CLND, underwent operations with different sources of autologous cartilage. Group 1 received grafts from the septum and ear, whereas group 2 received grafts from the septum and ribs. Results were evaluated by 2 independent physicians who rated improvement between pre- and postoperative photographs.

Results: There were significant differences in postoperative improvement between patients who received septal/ear cartilage grafts and those who received septal/rib cartilage grafts in both unilateral and bilateral cases ($P = .028$ and $P = .043$, respectively).

Conclusions: The authors' results demonstrate that rib cartilage has a positive effect on the aesthetic outcome of CLND operations and provides a strong support structure for correcting this deformity with minimal postoperative complications.

Level of Evidence: 4

Keywords

cleft lip nose, rib cartilage, cartilage graft, rhinoplasty

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Although there are facilities that, in the past 10 years, have treated cleft lip nasal deformities (CLND) via preoperative orthodontic care as well as noninvasive molding accompanied by total lip and limited nasal modifications,¹ such facilities were not and still are not available in Iran. Therefore, patients who underwent attempted surgical correction in previous decades had very severe deformities, and neither patients nor surgeons were satisfied with the surgical outcome or the postoperative nasal appearance.

With the use of the Gunter rib cartilage harvesting technique, which involves a minimal incision (4 cm) and less morbidity,² rib cartilage grafting has become the main workhorse of CLND surgery. The reasons for using such a strong structure as rib cartilage for the correction of CLND are manifold. Severe weakness, deformity, and collapse of the lower lateral cartilage (LLC) as well as scarring and a short alar line

on the cleft side are forces that should be neutralized by a strong, reinforced scaffold to keep the nose in its new position. With severe downward force applied on the columella by

Dr Hafezi is a Professor of Plastic Surgery, Dr Ashtiani is an Associate Professor of Plastic Surgery, Dr Mousavi is a Community Medicine Specialist in the Burn Research Center, and Ms Naghibzadeh is a medical student at Tehran University of Medical Sciences in Tehran, Iran. Dr Naghibzadeh is a Professor of Ear, Nose, and Throat Surgery at Shahid Beheshti University of Medical Sciences, Tehran, Iran. Dr Nouhi is a Pathologist at the Kowsar Medical Laboratory in Tehran, Iran.

Corresponding Author:

Dr Farhad Hafezi, MD, FACS, 172 Zafar St, Suite 9, Tehran, 19197753661, Iran
E-mail: info@drhafezi.com

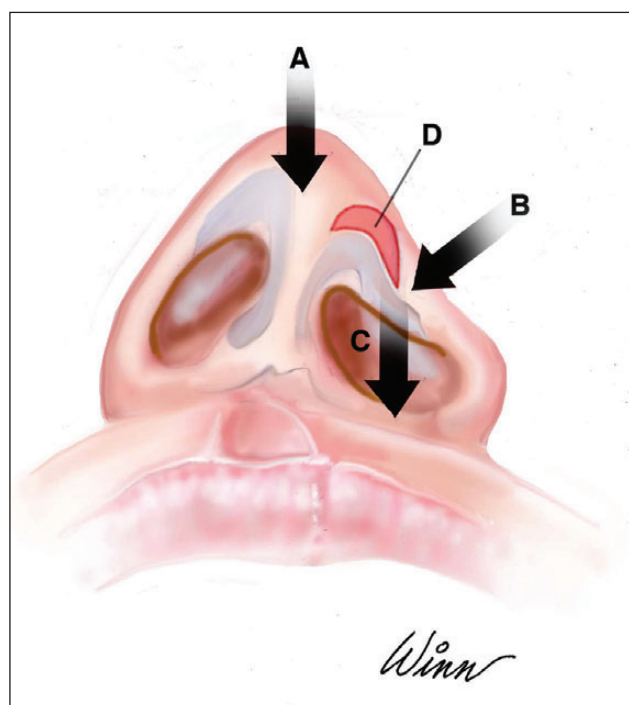


Figure 1. Schematic presentation of cleft lip nasal deformity. (A) Downward force of the short columella is due to an inferior-lying seal, underdeveloped medial crura, and contraction scars of previous operations on the cleft side. (B) Weak, inferiorly displaced lower lateral cartilage, which has weaker elastic recoil than the contralateral side, causes deformity of the alar rim. (C) A wide, depressed seal usually requires width reduction and augmentation. (D) Excess soft triangle requires either displacement superiorly or removal to produce more symmetric nostrils.

scars, along with soft tissue shortness and deficiencies on the cleft side (or both sides in bilateral cases), strong structural reinforcement is required for counterbalance (Figure 1). Furthermore, a depressed seal and an interrupted nostril circle may require a large amount of cartilage for augmentation.

Septal cartilage, which is the first choice in reconstructive rhinoplasty, will not provide sufficient material to correct these deformities. In addition, septal cartilage is insufficiently strong and buckles in most cases. Hence, it will not withstand the collapsing forces associated with CLND. Ear cartilage is another alternative but is collapsible, elastic, and convoluted. This material is not very helpful to correct severe columellar shortening or lateral crus weakness and buckling. In this report, we discuss rib cartilage as an autologous, solid substance that is sufficiently strong for the reconstruction of the extensive skeletal and soft tissue deficiencies characteristic of CLND. To our knowledge, no other autologous tissue is available with the quality and quantity of the rib cartilage for the correction of CLND.

METHODS

Forty-two patients with CLND who were at least 16 years of age and referred to St Fatima Hospital were included in

this study. All patients had severe LLC collapse and columellar shortening preoperatively. Primary operations for repair of cleft lip had been performed in all patients via various techniques during early childhood. Patients who had undergone molding prior to primary repair of cleft lip and those who had previous rhinoplasty were ineligible for this study. Two groups of patients were designated. Group 1 included 20 patients for whom we used septal and ear cartilage for all modifications and who were treated earlier in the study period (December 2004 to October 2009), and group 2 included 22 patients for whom we used septal and rib cartilage for all modifications and who were treated later in the study period (May 2009 to March 2011). The rest of the surgical techniques were identical in both groups. The amount of available septum is usually too small to correct all deformities in CLND cases. Also, due to the wide dissection involved in full mobilization of the bony-cartilaginous septum and deviated maxillary crest, we were unable to remove enough septal cartilage to fully correct any deformity; limiting septal dissection also prevented septal collapse and saddle nose deformity.

Operative Technique

Rib cartilage was harvested from all patients in group 2 prior to beginning the rhinoplasty procedure. Surgery was performed under general anesthesia and as an outpatient procedure. The sixth and/or seventh ribs were harvested via a 4-cm incision on the inframammary line 2 cm from the midline in women and at the subcostochondral area in men. After removing the cartilage, the chest wall was closed in layers. The rib was cut in 2-mm-thick strips and immersed in saline solution before starting the nasal operation. By dividing the upper lateral cartilage (ULC) from the septum, an open approach was used to expose the anatomy of the nasal cartilage. Complete straightening of the septum was achieved by bilateral de-gloving and removing the posterior segment, keeping at least a 1-cm-wide L-strut on the caudal segment and a 1.5-cm L-strut on the dorsal segments. The deformed maxillary crest was repositioned in the midline by osteotomy, and the excess portion of the crest that obstructed the airway on the noncleft side was excised in some unilateral cases. Osteotomy and midline replacement of the vomer and perpendicular plate of the ethmoid bone are usually mandatory in severe septal deviation cases; thus, lateral and medial osteotomies of the nasal bones were performed at this stage if a wide or asymmetric bony pyramid was present.

To create a splint for the septum, septal scoring was performed and bilateral strong spreader grafts were placed. In severely deviated noses, the ULC was nearly always asymmetric and had to be corrected using strong spreader grafts of unequal thickness. We used split rib cartilage to fix the thicker spreader on the concave side and thus provide sufficient strength to keep the septum straight. This anatomic correction is not achievable with convoluted, weak ear cartilage or resected septum, both of which are inadequate for the required reconstruction. The ULC was fixed over the grafted spreaders with 5-0 PDS sutures. The results of unilateral and bilateral cases were compared

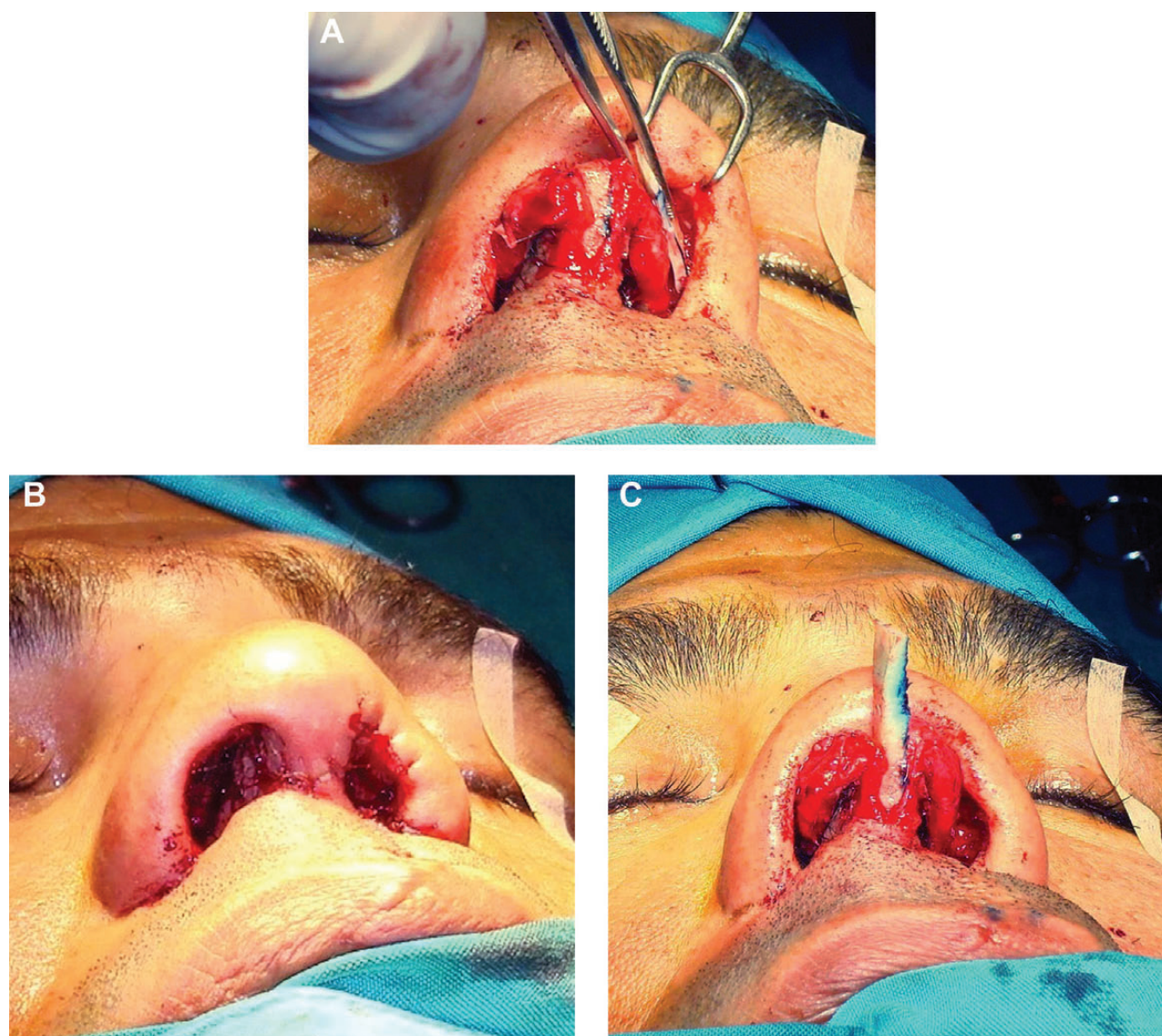


Figure 2. This 22-year-old man underwent correctional surgery for cleft lip nasal deformity (CLND). (A) Rib cartilage is inserted for an alar strut and seal augmentation. (B) Trimming the soft triangle is mandatory to achieve symmetry. (C) The key to reconstructing CLND is to overcome the downward forces over the short columella by inserting a strong columellar graft.

statistically using the Mann-Whitney test. The *P* value was .028 for unilateral and .043 for the bilateral group. The results show the positive effect of rib cartilage on the aesthetic outcome of CLND cases.

We then performed cephalic trimming of the LLC to equalize its width. Because the cleft side (or both sides in bilateral cases) was weak and crooked, we placed a strong strip of rib cartilage as an inlay graft by dissecting the LLC from the underlying skin. This graft extended from the piriform aperture to the dome to elevate the collapsing ala and to create the proper rotation and projection for a symmetric tip. Transdomal sutures were placed and a strong piece of long, straight rib cartilage was used as a columellar strut. This structure was the keystone of the operation

because it was designed to overcome the collapsing forces of the short columella and reconstruct the nasal tripod concept as described by Anderson.³

Interdomal suturing and/or a tip graft will help maintain the reconstructed LLC in a more symmetric position on both sides; thus, tip grafts were placed if the projection was inadequate.⁴ Excess seal skin was removed and the depressed alar base and seal were undermined, augmented, and overcorrected by a piece of cartilage. This maneuver helped to provide a 3-dimensional aesthetic result. The wound was closed, and the soft triangle was evaluated on the cleft side. If excess skin was present in this area, its full thickness was excised (Figure 2).⁵⁻⁸

Table 1. Independent Physician Evaluations of Unilateral Cleft Lip Nasal Deformity After Rib Cartilage Grafting

	Patient														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Group 1 ^a	B	B	B	G	B	G	B	G	B	B	B	G	W	G	G
Group 2 ^b	G	G	E	G	B	B	E	E	B	G	G	G	G	B	G

Abbreviations: W, worse; B, better; G, good; E, excellent.

^aSeptal and ear cartilage used for all modifications.

^bSeptal and rib cartilage used for all modifications.

Table 2. Independent Physician Evaluations of Bilateral Cleft Lip Nasal Deformity After Rib Cartilage Grafting

	Patient						
	1	2	3	4	5	6	7
Group 1 ^a	B	B	W	G	W		
Group 2 ^b	G	G	B	E	B	G	E

Abbreviations: W, worse; B, better; G, good; E, excellent.

^aSeptal and ear cartilage used for all modifications.

^bSeptal and rib cartilage used for all modifications.

Evaluation of Results

Preoperative and postoperative photos (at least 12 months of follow-up) were reviewed by 2 independent rhinoplasty surgeons who classified the results as worse (W), better (B), good (G), or excellent (E). Based on these evaluations, the results of both unilateral and bilateral CLND operations in groups 1 and 2 were compared statistically using the Mann-Whitney test.

RESULTS

Group 1 included 20 patients with an average age of 22.1 years (range, 17-29 years), 15 (10 women and 5 men) of whom presented with unilateral CLND and 5 (3 women and 2 men) of whom presented with bilateral CLND. All patients in this group underwent operations between December 2004 and October 2009. Group 2 included 22 patients with an average age of 23.1 years (range, 18-33 years), 15 (8 women and 7 men) of whom presented with unilateral CLND and 7 (5 women and 2 men) of whom presented with bilateral CLND. All patients in this group underwent operations between May 2009 and March 2011.

The mean follow-up period was 22 months (range, 13 months to 3 years). Independent surgeon evaluations revealed significant differences in quality of results between patients who received septal/ear cartilage grafts (group 1) and those who received septal/rib cartilage grafts (group 2) in both unilateral and bilateral cases ($P = .028$ and $P = .043$, respectively; Tables 1 and 2).

Postoperative complications included minimally asymmetric nostrils in 35 of 42 total patients (83%), warping in 1 patient (2%), pleural opening in 2 patients (4.7%),

minimal nasal airway problems in 5 patients (12%), hypertrophic scars in 2 patients (4.7%), and minimal tip drop in 3 patients (7.1%).

Clinical results are shown in Figures 3 to 5 (an additional result is shown in Figure 6, which is available online at www.aestheticsurgeryjournal.com).

DISCUSSION

Correction of cleft lip nasal deformities consists of both soft and skeletal tissue anomalies. A patient with unilateral CLND exhibits a deviated nasal tip, a unilaterally short columella, a long lateral crus, a short medial crus, a blunting dome, and a poorly defined tip. The alar bases are displaced posteriorly, laterally, and inferiorly, and there is a wide alar base and an absent or depressed nasal floor on the cleft side. The septum and anterior nasal spine (ANS) are deviated toward the noncleft side. There is webbing of the nasal vestibule and bowing or collapsed ULC. Compromised internal nasal valves and a wide asymmetric nasal dorsum are typically present. In a bilateral case of CLND, the orbicularis oris muscles are absent in the prolabium, and there is a short, displaced columella, an absent nasal floor, a wide nasal tip, and medial crus disfigurement. The dome is lower and the caudal septum is deviated. Soft tissue anomalies consist of short columellar skin, a deviated columella, short alar mucosa, excess soft triangle, and a depressed nasal seal.

A short columella is the key problem in unilateral and bilateral CLND. Scar contracture and tissue insufficiency make it particularly difficult to achieve satisfactory nasal symmetry with conventional methods.⁹ Several techniques have been reported to help surgeons address this dilemma. Tajima¹⁰ and Dibbell^{11,12} introduced correction of the soft triangle and also columellar lengthening by soft tissue replacements. The Abbe flap, Millard^{9,13} fork flap, and V-Y advancement flap are also very helpful in lengthening the short columella in severe bilateral cases of CLND. However, even with the application of all these modalities, the patient may not get the optimal symmetrical nose that he or she is seeking.

The purpose of our study was to identify a method of achieving more effective and permanent correction of severe CLND. Several authors have emphasized rib cartilage as the best autologous material available¹⁴ for use in



Figure 3. (A, C, E, G) This 24-year-old woman with unilateral cleft lip nasal deformity presented with midface, upper lip, and nasal asymmetry. Maxillary advancement was performed 1 year before presentation. (B, D, F, H) Nineteen months after receiving a rib cartilage graft and 12 months after an Abbe flap was used to correct upper lip shortening and scarring. There is a short, scarred right philtrum camouflaged by the patient with makeup and a tattoo.

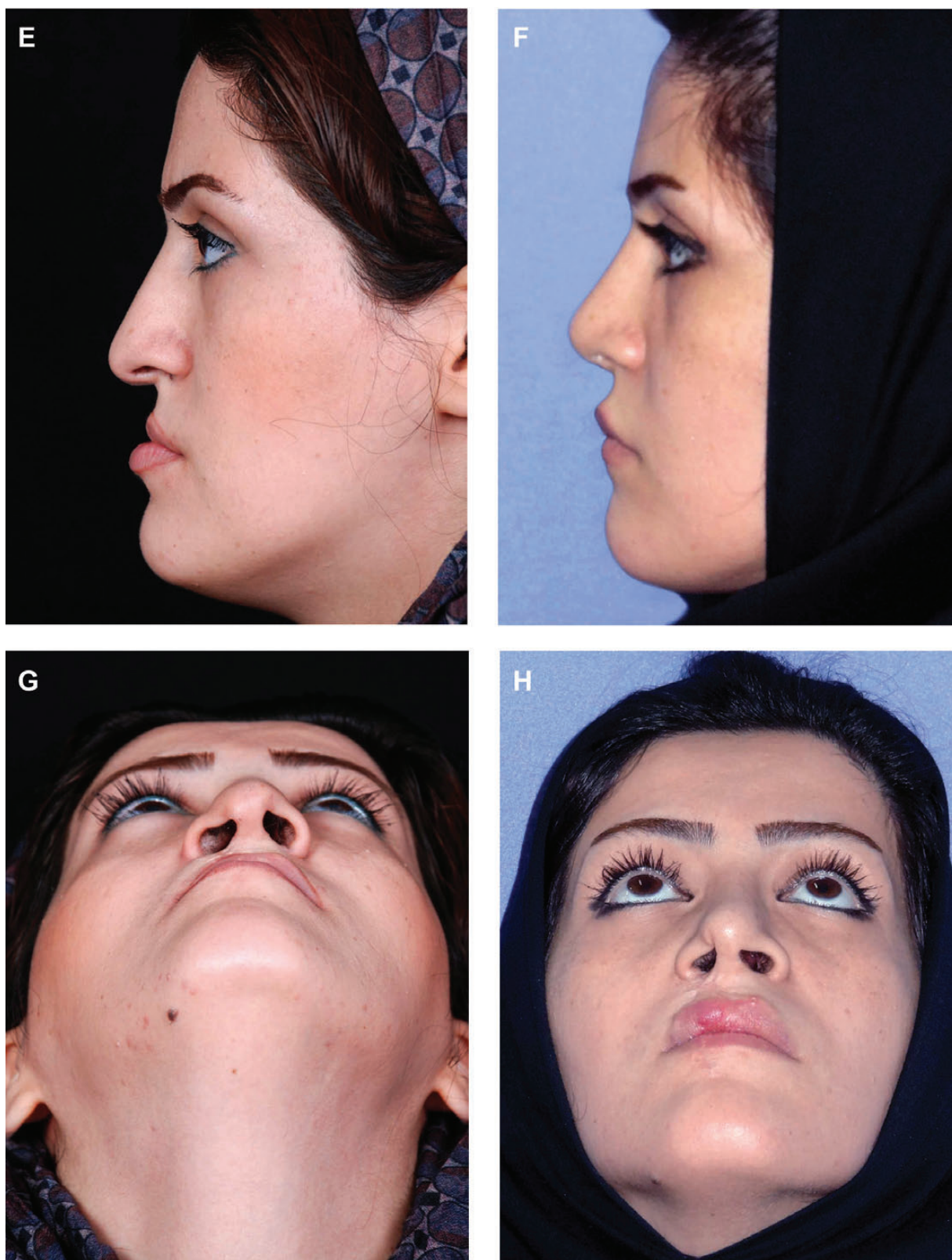


Figure 3. (continued) (A, C, E, G) This 24-year-old woman with unilateral cleft lip nasal deformity presented with midface, upper lip, and nasal asymmetry. Maxillary advancement was performed 1 year before presentation. (B, D, F, H) Nineteen months after receiving a rib cartilage graft and 12 months after an Abbe flap was used to correct upper lip shortening and scarring. There is a short, scarred right philtrum camouflaged by the patient with makeup and a tattoo.



Figure 4. (A, C, E, G) This 25-year-old man presented with severe cleft lip nasal deformity. (B, D, F, H) Two years after receiving a rib cartilage graft.



Figure 4. (continued) (A, C, E, G) This 25-year-old man presented with severe cleft lip nasal deformity. (B, D, F, H) Two years after receiving a rib cartilage graft.

severe secondary rhinoplasty.^{15,16} The earliest study to describe rib cartilage as graft material for nasal reconstruction was published in 1917 by Selfridge,¹⁷ and the author discussed the treatment of many saddle nose cases. The application of rib cartilage in nasal revision and reconstruction has been reported more recently by several authors.^{2,18-20} Notably, Steve Byrd and colleagues recently

reported on the characteristics and use of rib cartilage in nonprimary CLND cases.²⁰

Several obstacles have made surgeons reluctant to utilize rib cartilage despite its inherent structural advantages. These obstacles include fear of pneumothorax and chest tube insertion, a long and unattractive scar, and warping or postoperative bending and twisting of the graft. In

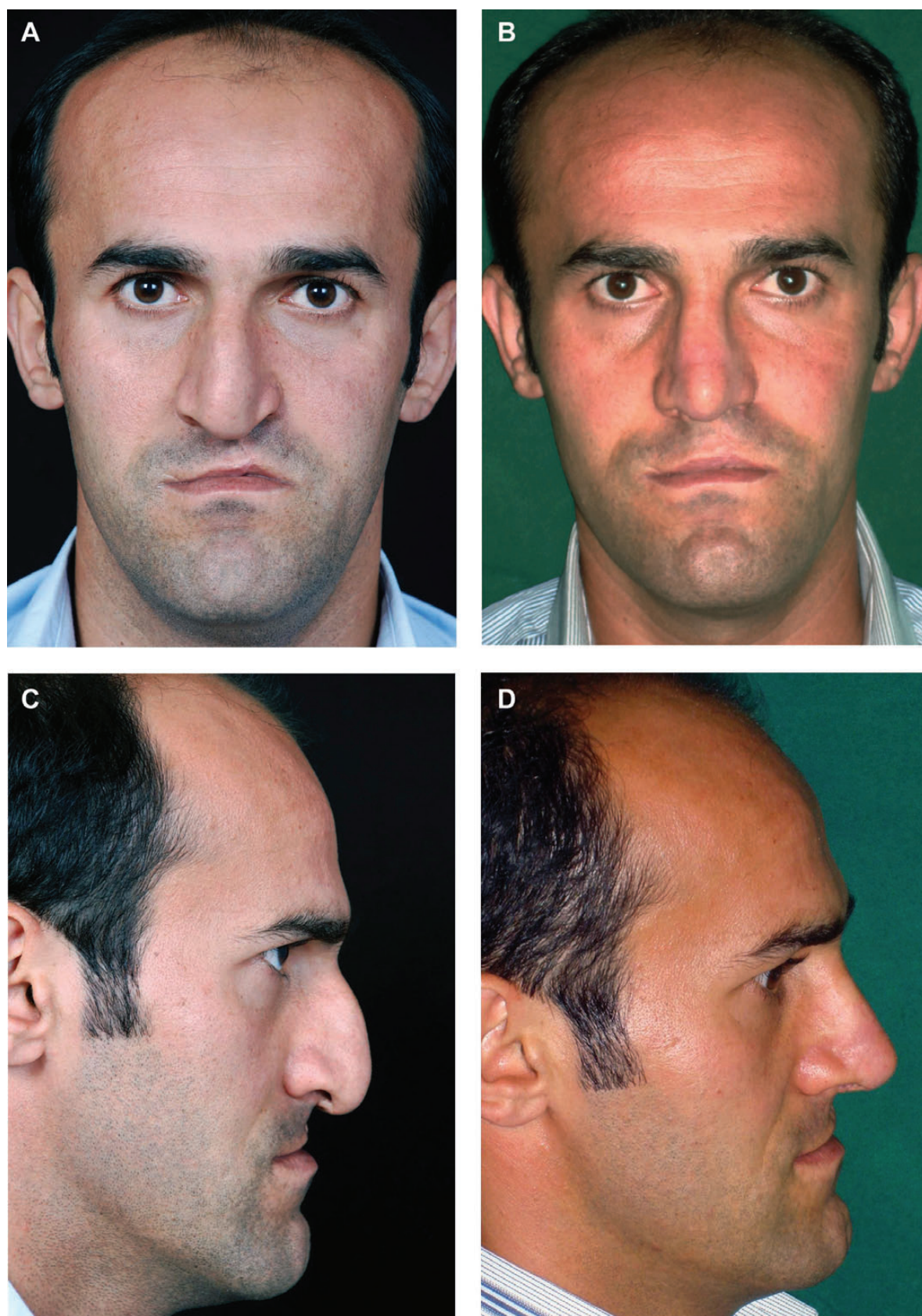


Figure 5. (A, C, E, G) This 29-year-old man presented with severe cleft lip nasal deformity. (B, D, F, H) Twenty-one months after receiving a rib cartilage graft. This patient had a maxillary advancement operation 14 months prior to correction of cleft lip nasal deformities.

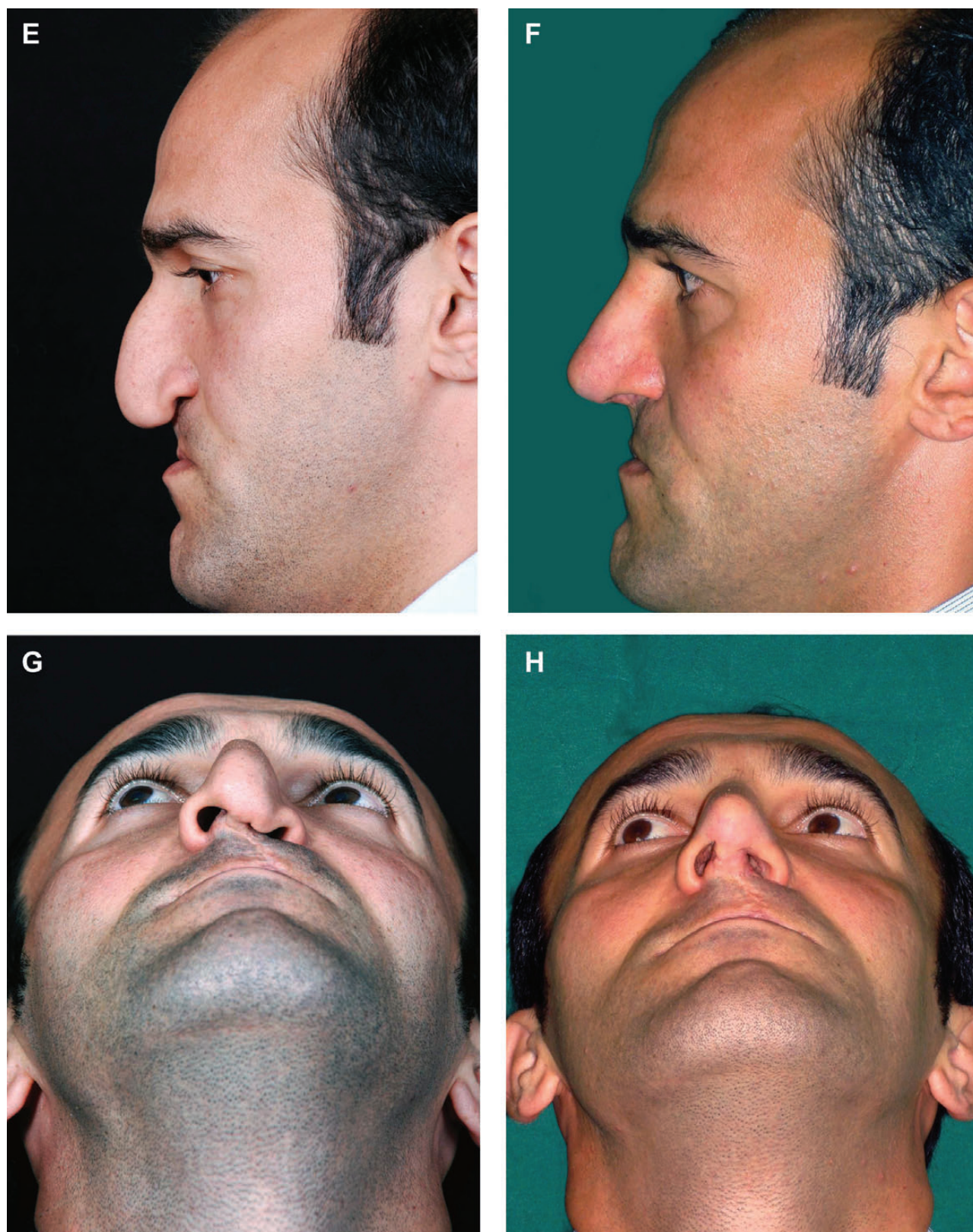


Figure 5. (continued) (A, C, E, G) This 29-year-old man presented with severe cleft lip nasal deformity. (B, D, F, H) Twenty-one months after receiving a rib cartilage graft. This patient had a maxillary advancement operation 14 months prior to correction of cleft lip nasal deformities.

addition, performing surgical procedures at 2 distant anatomic sites prolongs operative time. Consequently, patients are required to stay in the hospital for 1 or 2 days postoperatively instead of receiving an early discharge, which greatly increases hospital expenses.

The aforementioned obstacles have been of less concern in the modern approach to rib cartilage harvest for a variety of reasons. First, if the pleura is inadvertently opened, it is easily controlled by inserting a 14-French catheter in the wound, closing in multiple layers, and removing the catheter under positive pressure, which typically seals the pleural perforation. If the patient begins to have negative inspiratory pressure, a chest x-ray in the recovery room is helpful in detecting the uncommon risk of pneumothorax. Also, a 4-cm incision at the submammary crease in women and at the subcostochondral area in men provides sufficient exposure to harvest cartilage for reconstruction of the entire nasal skeleton. With this approach, 1 to 3 pieces of rib cartilage can be removed if necessary (ribs 5, 6, and 7) with minimal scarring subsequent to closure. While warping of the rib cartilage as described by Gibson and Davis²¹ is a distressing problem for surgeons, as the cartilage may bend to one side after it has already been carved to the desired shape, there are potential solutions. To prevent postoperative warping, Gunter et al²² reported the use of K-wires. Also, concentric carving of costal cartilage grafts may alleviate the problem.²³ However, if the rib cartilage is sliced and shaped into ideal form at the beginning of the operation and stored in saline solution for 20 minutes, 80% to 90% of the warping will occur on the table.²⁴ Surgeons can compensate for these deformities by suturing 2 bent cartilage segments face-to-face, making both segments stronger and straighter. Alternatively, bends that are already present in areas appropriate for curvature can be utilized. In terms of reducing operative time, with a small incision and the help of an assistant to remove the rib cartilage and close the wound while the surgeon is sculpting the graft, the duration of the operation does not increase by more than 30 minutes. The average operating time for rhinoplasty with this procedure is about 1.5 to 2 hours, and by harvesting the rib cartilage, it may extend to 2 to 2.5 hours. Last, patients can be discharged 5 to 6 hours postoperatively, and the hospital expenses are not much higher than those of a routine rhinoplasty operation.

The shortcoming of placing rib cartilage grafts for CLND operations is calcification of the cartilage, particularly in older patients. However, if the cartilage is minimally calcified and sculpting is still possible, warping is minimized or will not occur. The primary obstacle is severe calcification, which can be predicted by limited magnetic resonance imaging, as recommended by Gunter et al.²

CONCLUSIONS

New harvesting techniques have provided rhinoplasty surgeons with a source of abundant, strong,

autologous material that can be used for difficult nasal reconstructions and revisions, including CLND procedures. Our study suggests that the rib cartilage is the most accessible, high-quality material for this purpose. The harvest is easy, postoperative complications are minimal, and the aesthetic result is acceptable. Furthermore, the functional outcomes are improved due to the noncollapsible osteocartilaginous framework.

Disclosures

The authors declared no potential conflicts of interest with respect to the research, authorship, and publication of this article.

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