Dorsal Augmentation Rhinoplasty with Irradiated Homograft Costal Cartilage

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ABSTRACT

Augmentation of the nasal framework requires a working knowledge of nasal and facial anatomy, as well as the principles of facial proportion and balance. Dorsal augmentation rhinoplasty is a valuable means of improving nasal appearance in patients with a low and/or concave nasal dorsum, obtuse nasofrontal angle, and low radix. It frequently is combined with other techniques, including columellar strut grafting, nasal tip grafting, and tip suturing, as dorsal deficiencies are often associated with poor tip projection and support and a shortened columella. Our experience with dorsal augmentation rhinoplasty, including the use of irradiated homograft costal cartilage for grafting in 56 surgeries, is described. A high level of patient satisfaction with a low percentage of complications has been seen.

KEYWORDS: Dorsal augmentation, rhinoplasty, irradiated homograft costal cartilage

Cosmetic and reconstructive rhinoplasty is one of the most challenging, but also one of the most rewarding, operations in plastic surgery. Rhinoplasty requires an understanding of the principles of facial proportion and balance. An aesthetically pleasing result can only be achieved if the subunits of the nose are in harmony with each other and the nose, as a whole, balances other features of the face, including the chin, lips, midface, orbits, and forehead.

Dorsal deficiencies in nasal anatomy are particularly disharmonious. In our experience with a large number of non-Caucasian patients, augmentation of the dorsum is an important part in achieving an excellent aesthetic result. A deficient nasal dorsum manifests as an obtuse nasofrontal angle and acute nasofacial angle. The dorsum cannot be treated in isolation, however. Frequently associated with dorsal deficiencies are a low radix, poor tip projection and definition, a shortened columella, and an obtuse nasolabial angle. During the

rhinoplasty procedure, these features also must be addressed adequately, often requiring the use of other techniques, including columellar strut grafts, tip grafts, lower lateral cartilage suture maneuvers, and spreader grafts.

Augmentation of the nasal skeleton usually requires a large amount of cartilage for grafting, especially in ethnic noses requiring multiple grafts. Many grafts are available, including autografts such as septal, conchal, and costal cartilages. Alloplastic materials, including silicone and polyethylene, avoid donor site morbidity and afford ease of access but have significantly higher rates of infection, displacement, and exposure due to the lack of biointegration. In cases where autograft septal cartilage is not present in sufficient volume for the necessary grafting, it is our preference to use irradiated homograft costal cartilage (IHCC), as published by Strauch and Wallach.¹ IHCC provides a readily available source of cartilage that is easily carved and sculpted.

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It is particularly useful in dorsal augmentation and has been successfully used in 56 rhinoplasty surgeries by the authors over the past 18 years.

OPERATIVE TECHNIQUES

It is the authors' preference for an open rhinoplasty approach in patients requiring a significant amount of grafting. A closed, or endonasal, approach was employed in nine cases, being used in patients requiring smaller degrees of recontouring; for example, cases limited to use of a small dorsal onlay graft or a tip graft. Precise dorsal pocket dissection is essential in the closed technique but does not replace suture fixation, as described later.

In the majority of cases, septal cartilage is inadequate and additional cartilage volume is required. IHCC is our preferred source of graft material in these cases and is available from a variety of tissue banks, including All Source (800-077-8655), the University of Texas (800-433-6667), and the University of Northern California (800-922-3100). IHCC has been used in 56 rhinoplasty surgeries in 52 patients (16 male and 36 female), ages 12 to 65 years, over the past 18 years. Follow-up ranged from 1 year to 14 years. It was used as dorsal onlay graft in 28 cases. It also has been used in 43 cases as a columellar strut, 28 cases as spreader grafts, 11 cases as lateral crural grafts, 9 tip grafts, and 6 maxillary grafts, either independently or, more frequently, in combination with the dorsal onlay grafts. In addition, a separate radix graft was employed in three cases for an exceptionally low radix and obtuse nasofrontal angle.

Except for some early cases in our series, dorsal grafts were secured to the septum using nonabsorbable sutures at two sites, most frequently the periosteum of the nasal bones and the dorsal septum. The open approach facilitates this fixation due to the improved exposure. Maxillary-columellar-tip grafts were secured to the medical crura with two or three nonabsorbable sutures. The 4- to 8-cm length of the IHCC grafts

provides excellent donor material and dimensions for dorsal augmentation. The grafts are hand-carved on a sterile side-table in the operating room to provide appropriate size and shape. Perichondrium is preserved on the graft when possible. Columellar-maxillary-tip grafts are carved to project slightly anterior to the lower lateral cartilage domes, which is especially important in cases requiring improved tip projection. A V-cut in the base of the columellar graft accommodates the anterior nasal spine for added stability. A wide V-cut can also be incorporated into the distal tip of the graft to improve the tip light reflex when appropriate. More recently, separate tip grafts have been secured to the inclined end of the maxillary columellar tip grafts. The inclination at the end of the supporting graft allows for greater stability and eliminates the dead space. Defatting of the tip skin is almost always unnecessary and avoided. A 5-day course of postoperative prophylactic antibiotics is prescribed.

RESULTS

Fifty-six rhinoplasty operations involving the use of irradiated homograft costal cartilage for grafting purposes have been performed over the past 18 years (Figs. 1 and 2). Follow-up ranged from 1 to 14 years. Immediate complications were defined as those occurring within 30 days postoperatively. The immediate complications were limited to two cases of graft exposures of IHCC: one of a spreader graft and the other a columellar strut. Both occurred early in the series before routine suture fixation became integrated into the technique.

Late complications were defined as those occurring more than 30 days postoperatively. Partial resorption of one graft was observed at 6 months postoperatively. A dorsal graft was found to have been displaced and required removal at 7 months; it had not been secured with sutures. Graft removal was required in a second case 7 years after the original surgery during which a columella strut had been placed

Figure 1 (A) Preoperative photograph of patient requiring dorsal augmentation. (B) Postoperative dorsal nasal augmentation with irradiated cartilage.

Figure 2 (A) Anteroposterior view of a patient with posttraumatic injury to the nose with loss of alar cartilages. (B) Lateral view of same patient. (C) Anteroposterior view, ten years after maxillary-columellar-tip graft, alar cartilage replacement, and small dorsal onlay graft, all with irradiated bone graft cartilage. (D) Lateral view of same patient 10 years after surgery.

in a 12-year-old girl with Binder's syndrome. The graft was removed because it did not grow proportionately with the child, which necessitated replacement with a larger one. Examination of the graft demonstrated no warping or resorption at 7 years.

DISCUSSION

Nasal contouring involves a complex interplay of anatomic substrates, including the relationships between nasal subunits and other features of the face, including

the chin, mouth, forehead, malar areas, and orbits. Operative planning for dorsal augmentation requires consideration of these features. In many cases, dorsal augmentation must be complemented by columellar grafts, tip grafts, tip suturing, radix grafts, and alar base excisions. This is particularly important in the so-called ethnic rhinoplasty, as described by Strauch et al² and Ofodile and Bokhari.^{3,4} Particular attention must be paid to patient expectations and desires. Frequently associated anatomic features that must be addressed include an obtuse nasofrontal angle, low radix,

short columellar, deficient tip projection and definition, and wide alar base. Dorsal augmentation may not only be for aesthetic concerns but also for functional considerations, such as in cases of dorsal nasal collapse, for example saddle nose deformities. In these cases, dorsal augmentation must be combined with spreader grafts and, in some instances, upper lateral cartilage grafts to open the internal nasal valve.

Septal cartilage is the preferred source in cases with modest tissue graft requirements, for example, limited dorsal augmentation and/or tip grafting. Septal cartilage has been used by many authors with excellent results, both as solid grafts and also as diced grafts. Advantages include its autologous nature, easy accessibility, and ability to be sculpted precisely; also, it is in the same operative field. Drawbacks include the limited quantity available, especially in secondary or tertiary rhinoplasties, and its thin nature, which may require stacking for significant dorsal augmentation.

IHCC has proved to be a reliable source for nasal cartilage grafting. Our experience over the past 18 years in 56 cases has demonstrated its safety and utility. Donor-site complications, such as pneumothorax, hemothorax, and scarring from costal grafts, are eliminated. Overall operative time is shortened as well by avoiding the need for autologous harvest. The avoidance of a donor scar is particularly attractive in this patient population, as a significant number of dorsal nasal augmentation procedures are performed in African-American and Hispanic patients, who have a higher predilection toward hypertrophic and keloid scars.

Use of irradiated cartilage was first described by Dingman and Grabb in 1961.⁵ They reported a resorption rate of 6.6% and graft mobility in 6.6% in 75 patients. Schuller et al reported a lower overall complication rate of 7.6%, with a partial resorption rate of 1.4%.⁶ Lefkowitz described the use of IHCC in dorsal augmentation in 24 patients in 1990.^{7,8} An infection rate of 7.4% and warping rate of 14.8% were documented. In 1993, Kridel and Konior published a series of IHCC for nasal augmentation in 117 patients.⁷ The infection rate was 3.3%, but no patient required graft removal. Overall resorption was 3.3%, with warping observed in 1.6% of cases. In vitro studies by Adams et al demonstrated significant warping.⁹

Clinical examination of our patients for up to 14 years demonstrates no significant warping, resorption, or need for graft removal, excepting the one case of early partial graft resorption at 6 months. In the two cases requiring graft removal, examination of the grafts revealed no noticeable warping or resorption. The lower complication rate demonstrated in our series may be attributable to the emphasis placed on secure suture fixation of graft material. Precise pocket dissection alone

is inadequate. Suture fixation of dorsal onlay grafts to the periosteum of the nasal bones and the dorsal septum should be performed with at least two sutures of non-absorbable sutures. The only grafts in our series that demonstrated migration or exposure were not secured. This observation prompted the use of suture fixation in all later cases in the series.

In addition, all specimens in our series were exposed to a higher radiation dose of 3 million rads than in some other series, particularly the study by Adams et al,⁹ which used grafts with a radiation exposure of 1.5 million to 2.5 million rads. Recent studies by Goode demonstrated warping when the irradiation dose was lowered to 2 million rads.¹⁰

Dorsal augmentation rhinoplasty is an important means of improving the appearance of the nose and its balance with other facial attributes. It is frequently combined with other grafting and suturing techniques to improve nasal dorsal contour, tip projection and definition, and nasal tip support. IHCC has proved its great clinical utility in these cases, in which the cartilage tissue requirements for grafting are significant. In our hands, aesthetically pleasing and consistent results have been achieved with a high margin of safety and low complication rate over the past 18 years.

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