

ORIGINAL RESEARCH—FACIAL PLASTIC AND RECONSTRUCTIVE SURGERY

The use of autogenous costal cartilage graft in septorhinoplasty

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INTRODUCTION: Reconstructive septorhinoplasty in complex nasal deformities often requires harvesting a large amount of tissue for grafting. Autogenous septal cartilage has generally been considered the gold standard grafting material. The aim of this paper was to report our experience with the use of costal cartilage grafts in cases with significant structural deformities and insufficient septal cartilage.

DESIGN: Retrospective chart review.

PATIENTS: Between 1998 and 2006, 37 patients underwent septorhinoplasty using costal cartilage as the primary source for grafting. Twenty-two men and 14 women with a median age of 42 were enrolled in the study. Patient demographics, indications for surgery, and immediate and late complications were reviewed. The follow-up range was 3 to 72 months.

CONCLUSIONS: Autogenous costal cartilage graft is a viable option in reconstructive septorhinoplasty. We advocate the use of this graft in septorhinoplasty cases requiring a large volume of tissue and insufficient septal cartilage.

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The goal of septorhinoplasty is the reconstruction of the nasal skeleton in order to provide adequate structural support allowing for optimum functioning of the nasal airway while achieving an aesthetically pleasing harmony with the rest of the face. Following the traditional rhinoplasty principles that emphasize restructuring and augmentation of the nasal dorsum and tip can achieve these objectives. The most common restructuring techniques used in primary and secondary augmentation rhinoplasty have typically been the placement of columellar struts, tip grafts, and dorsal grafting.¹ Although these principles have been well accepted, the choice of materials used to obtain adequate support and augmentation is still controversial.^{1–4} In general, augmentation rhinoplasty can be performed through the placement of autogenous grafts, alloplastic implants, and homografts.^{1–4}

Overall, autogenous grafts, particularly the cartilaginous types, have been the gold standard largely because of their high acceptance rate, durability, virtual lack of an immunogenic response, low infection, and extrusion rates.^{2–5} Autogenous cartilage can be harvested from the nasal septum or the auricle. Options for autogenous bone grafts include

calvarial bone, iliac crest, and mastoid cortex.^{2,3} These grafts have been criticized for resulting in unnatural stiffness of the lower two-thirds of the nose, the potential for necrosis of the overlying skin, fractures of the grafts, and a significant rate of resorption.^{2,3} Hence, compared with autogenous cartilage grafts, autogenous bone grafts have become a second choice. Alloplastic materials such as silicone, Gore-Tex (WL Gore & Associates, AZ, USA), and Proplast (NovaMed, Chicago, IL) have been used because of their simplicity of placement, availability, and lack of resorption and donor morbidity. However, these grafts have been shown to result in a higher rate of infection and extrusion.^{2,3,5} Finally, some surgeons have used homografts such as irradiated cartilage and acellular dermis (Alloderm, LifeCell Corporation, TX, USA) with variable success.^{2–5} These materials are not commonly used because of the fear of disease transmission as well as a considerable rate of resorption and infection.

Facial plastic and reconstructive surgeons often need to address more severe nasal structural defects that can be secondary to congenital deformities, trauma, infection, or previous operations. These cases are particularly challenging and often require extensive reconstruction with large amounts of tissue. The use of costal cartilage is a viable option that is particularly appealing in these cases in which a large amount of tissue is required. This option is also very attractive in primary and secondary rhinoplasty cases with severe structural defects in which adequate septal tissue is not present. In this report, we attempt to describe our favourable experience with autogenous costal cartilage in septorhinoplasty.

METHODS AND SURGICAL TECHNIQUES

A retrospective chart review of patients undergoing septorhinoplasty with costal cartilage grafts between 1998 and 2006 was performed. Approval of the institution's ethics review board was obtained. Thirty-seven patients who fulfilled the criteria for enrollment in the study were identified. Patient demographics, surgical indication, immediate and

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Figure 1 (A) Pre- and (B) postoperative photographs of a patient with saddle nose deformity following nasal trauma. Columellar and dorsal grafts were used in this procedure.

late complications with donor and recipient sites, and outcomes were recorded. All operations were performed by the senior author (AG).

The surgical technique that we use has evolved and changed over the years allowing us to better replicate our results and predict our outcome more accurately. The following describes the technique that is currently being used.

A 3- to 5-cm incision in the inframammary region overlying the 6th rib is made. The external oblique muscles are identified and then incised over the selected costal arch. As the rib cartilage is identified, the perichondrium is incised and a circumferential subperichondrial elevation of the costal cartilage is made. The desired amount of cartilage is then removed with care. The cartilage can be removed as a full segmental piece from the osteochondilaginous junction to its junction with the sternum or only partially by harvesting part of the superior aspect of the rib cartilage preserving the continuity of the costal arch. Special care is taken to avoid penetration of the perichondrium during the elevation on the undersurface. The surgical site is then inspected for possible tears, and hemostasis is achieved. The donor site is closed in layers, and the skin is closed subcuticularly. The harvested cartilage is then “decorticated” by shaving off its external 1 mm of tissue and cut roughly into the desired shapes. It is placed in saline solution and left alone for approximately half an hour. When we are ready to insert our grafts, they are then shaped via cutting, shaving, rasping, and morselizing as needed.

In 12 of the patients, Kirschner wires were placed along the long axis of the cartilage to prevent warping. In the remaining patients, the outer portion of the cartilage was removed, and only the central portion was used as described earlier. The grafts are secured using either Tisseel (Baxter Health Care, Deerfield, IL), sutures, or nothing at all in some of the dorsal on lay grafts. In five patients, the dorsal grafts were rigidly fixed to the remaining nasal skeleton with a transcutaneous Kirschner wire. The placement of the cartilage graft is performed via an external rhinoplasty approach. We believe this approach allows for a more accurate diagnosis of the defect as well as proper placement and securing of the grafts. The most common grafting techniques were nasal dorsal augmentation via cantilever and dorsal on lay grafts and columellar strut grafts.

All patients were placed on oral antibiotics and were seen regularly in the clinic postoperatively. All patients were discharged home on the day of the surgery.

RESULTS

Between 1998 and 2006, 37 patients underwent septorhinoplasty using costal cartilage grafts. Patients included 22 men and 14 women with a median age of 42 (range, 18-82). Among the patients identified, 5 underwent primary septorhinoplasty and 32 secondary septorhinoplasty. The indica-



Figure 2 Preoperative (A and C) and postoperative (B and D) photographs of patients with extruded silicone implant. Revision septorhinoplasty using costal cartilage graft was performed.

tions for primary surgery were large septal perforation and traumatic deformities. The indications for secondary surgery included alloplastic implant extrusion, saddle nose deformity, iatrogenic nasal deformities, septal perforation, valvular collapse, and nasal airflow obstruction.

The costal cartilage grafts were used as dorsal and columellar grafts in 17 of the patients, spreader grafts in 7 of the patients, and a combination of batten/dorsal/columellar grafts in 2 of the patients. The remaining patients had various combinations of dorsal, columellar, spreader, or batten grafts in order to address the structural defects. The follow-up ranged from 3 to 72 months. None of the patients had any intraoperative complications. Oral analgesic was often adequate for pain control and chest pain subsided within 1 to 6 weeks postoperatively.

In our patient series, one patient developed donor site skin infection, and two developed columellar skin infection. These three patients were treated with oral antibiotics, and no further intervention was required. In 3 of the 12 patients with Kirschner wire placed through the long axis of the graft, extrusion of the wires was noted and the wires were simply pulled out in the clinic. This was quite troubling for

the patients but did not result in any long-term sequelae. Minimal warping was noted in three patients, of which two required minor revision surgery. All patients were satisfied with the postoperative aesthetic outcome and functional improvement was achieved in all patients except for one. This patient underwent 2 further revision operations, and, despite what appears to be a satisfactory structural support and patent airways, he was never satisfied with his breathing. We have not noted any extrusion or resorption of the grafts (Figs 1-3).

DISCUSSION

Autogenous septal cartilage is generally considered to be the gold standard grafting material for nasal surgery.¹⁻⁵ Autogenous grafts do not stimulate an immune response and as a result, have low rates of rejection, infection, or extrusion.²⁻⁴ The resorption rate of this tissue has also been shown to be fairly low.²⁻⁴ Because imbibition is the main modality for nourishment, it remains vital even if vascular-



Figure 3 The use of costal cartilage graft in cosmetic septorhinoplasty. Preoperative (A and C) and postoperative (B and D) photographs of patients with columellar and dorsal grafts using costal cartilage grafts.

ization is minimal because it is often the case in the presence of scar tissue. Traditionally, septal and conchal cartilages have been primarily used in reconstructive rhinoplasty. Each of these grafts has its inherent properties making them ideal for various scenarios.^{2,6} However, certain conditions mandate the use of a large volume of tissue for reconstruction. In cases of secondary septorhinoplasty, in which insufficient amount of septal tissue is present, we advocate the use of costal cartilage. We believe this graft is superior to conchal cartilage because of its abundance as well as its intrinsic strength that makes it ideal for structural reconstruction. Costal cartilage is strong, abundant, pliable, and durable. One of our patients had had a costal cartilage reconstruction performed in her youth and came to us with a nasal deformity secondary to trauma. She had fractured the graft in 3 pieces after 51 years. On surgical exploration, we found that the cartilage had retained its shape and presumable size without any evidence of resorption.

Costal cartilage graft is often overlooked in reconstructive septorhinoplasty because of potential donor-site morbidity and the warping effect.⁷⁻¹⁰ The key to minimize this is to wait for early warping to occur before reshaping the graft. Most warping occurs within 15 to 60 minutes of harvesting.⁷⁻¹⁰ Numerous investigators have advocated the use of the central portion of the graft because this portion undergoes less warping compared with the peripheral portions.⁸ We have found this to be essential in improving the predictability of our results. A recent study by Kim et al⁹ showed concentric carved costal cartilage undergoes a lot less warping than eccentric graft. Gunter et al¹⁰ favored using the costal graft with a small Kirschner wire placed in the center. In our series, we found a 25% pin extrusion rate, which was quite distressing for the patients. Although no long-term sequelae were noted, we opted to discontinue its use.

Pneumothorax is the most serious potential complication of costal cartilage harvesting. This can be avoided by carefully elevating the perichondrium on the undersurface of the rib. To our knowledge, the incidence of this complication has not been reported in the medical literature; however, it is generally found to be insignificantly low. Among the autogenous bone grafts used for reconstructive septorhinoplasty, calvarial bone has been shown to have a lower rate of resorption as long as it is rigidly fixed.^{11,12} Iliac crest bone is endochondral and may resorb quite readily.^{11,12} The general criticisms of bone grafts are the difficulty in shaping them and the unnatural firmness of the lower third of the nose.¹¹ To avoid potentially unsatisfactory results, maximizing contact with the recipient bed has been advocated.³

Irradiated homologous costal cartilage has also been advocated as a potential alternative.¹³ This tissue is readily available, easy to shape, and has a relatively low rate of infection and extrusion.¹³ The rates of resorption have been variable. The information regarding warping is also unclear. The fear with homografts is the potential risk of viral and prion transmission.

Alloplastic implants offer the advantage of unlimited availability and ease of use. However, these materials are generally not biologically incorporated into the tissue and, thus, carry a potentially higher rate of infection and extrusion.

CONCLUSION

We have found that autogenous costal cartilage grafting is a viable option in reconstructive septorhinoplasty. The inherent properties of this type of cartilage make it an ideal graft for the reconstruction of the nasal framework. It offers strength for support; almost unlimited availability when a lot of tissue is required; and the ability to mold it, bend it, carve it, and morselize it, making it a very malleable and versatile graft. It offers us the ability to replace or augment missing tissue with similar tissue and recreate the nasal anatomy as close to normal as possible. We advocate the use of this graft in septorhinoplasty cases requiring a large volume of tissue and insufficient septal cartilage. With proper care and careful surgical technique, one should expect reliable and replicable results with a low complication rate.

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AUTHOR CONTRIBUTIONS

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FINANCIAL DISCLOSURE

None.

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