Background: Re-establishing nasal tip projection is one of the main objectives in secondary rhinoplasty. The columellar strut is used as a basic element for support and the septal cartilage graft as the first choice for reconstruction. Nevertheless, the septal cartilage is often missing in this category of patient because of previous surgery, obliging the surgeon to seek a safe, effective, and versatile alternative.

Objective: We describe a simple procedure to increase the strength of an autologous ear graft cartilage to be used as a columellar strut in patients having secondary rhinoplasty.

Methods: We removed a 3.5 × 1.5-cm auricular concha graft through a postauricular approach, leaving the perichondrium on the posterior surface and trimming it on the helical crus. Later, we made a cylinder-shaped structure to be used as a columellar strut graft in patients in whom the septum was absent. We used the open rhinoplasty technique, applying the basic principles of secondary rhinoplasty, in all of the patients.

Results: Between February 2002 and June 2006, we used this technique in 13 patients ranging in age from 19 to 52 years who required revision rhinoplasty. The clinical follow-up period ranged from 4 to 48 months. Five of the patients experienced minor complications; nevertheless, all were satisfied with the postoperative results.

Conclusion: The auricular cartilage struts constructed using this method were strong enough to enhance tip support and projection, with satisfactory results assessed by both the patients and our team. (Aesthetic Surg J 2006;26:662–668.)

Revision rhinoplasty is a challenge for the surgeon, with respect to both repair techniques and choice of implant material to be used for augmentation grafting. The nasal tip is the area of the greatest post-rhinoplasty dissatisfaction. Because most rhinoplasty techniques destabilize major and minor tip-supporting mechanisms, they create a condition of inherent weakness that sometimes results in an underprojected ptotic nasal tip often associated with nasal valve collapse. Consequently, re-establishing nasal tip projection is one of the main objectives in secondary rhinoplasty.

There are a number of grafting materials available, each of which has its own advantages and drawbacks. In revision rhinoplasty, it is advisable to replace missing or scarred structures with similar tissue; if the cartilage is deficient, this structure should be replaced with like tissue as well. It is recommended that autogenous tissue be used whenever available for this procedure for the following reasons: lack of immunogenicity; minimal inflammatory response; low rates of resorption, infection, and extrusion; easy manipulation, carving and shaping; flexibility; long-lasting results with respect to shape and size; and finally, unlike bone or alloplastic material, autogenous cartilage may be positioned in areas where there is little soft tissue coverage.

Nasal procedures that involve structural autologous cartilage grafting include columellar strut, tip graft, alar replacement, sidewall replacement, spreader grafts, and caudal and dorsal septal grafts. All of these ensure adequate nasal tip support for the patient and are ideal for correction of the underprojected ptotic tip. Since nasal projection is principally supported by the columella, the main reason for using the columellar strut as an integral structural graft is to increase tip support, strength, stability, and symmetry lost as a result of previous rhinoplasty.

Autogenous septal cartilage (hyaline cartilage) is generally recognized as the ideal material for columellar struts. Often, patients requiring secondary rhinoplasty have undergone septoplasty that involved sacrifice of almost all of the septal cartilage. The surgeon is then faced with the dilemma of which material to use for
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edge, the structure bends and curves (Figure 1, A and B). This is demonstrated through the theory of columns and by the theory of plaques and membranes. It occurs because the strength necessary to bend the material is much less than that which is necessary to compress (flatten) the element in respect to the vertical axis. However a curved surface has a greater weight capacity (flatten) the element in respect to the vertical axis. We applied this theory to form a structural graft using ear cartilage to be used as a columellar strut in patients requiring revision rhinoplasty.

Surgical Technique

It is important to consider the method by which cartilage grafts are harvested, carved, and placed to carry out a successful procedure. All cartilage grafts must be collected asatraumatically as possible because small lacerations in the cartilage can alter their tensile strength and ability to support the nose. Except for the lobule, the auricle is supported by a thin elastic fibrocartilage that is 0.5 to 1 mm thick, and varies among individuals, determining its stiffness and flexibility.

We examined the patient’s ears to see if one was more prominent than the other and, thus, a more preferred side for sleeping. All procedures were performed with the patient under general anesthesia using a postauricular approach. Local anesthetic (1% lidocaine with 1:100,000 epinephrine) was injected on the anterior surface of the ear into the subperiosteal plane and on the posterior surface into the subcutaneous plane to enable hydrodissection and to separate the skin that covers the concha cavum and cymba from the underlying cartilage.

Having prepared the postauricular area, a vertical incision measuring approximately 3.5 cm was made in the skin overlying the prominence of the concha. The skin-soft tissue envelope was removed and the cymba concha and cavum concha were exposed, leaving the perichondrium intact, and therefore contributing to the 3-dimensional strength of the cartilage. The anterior skin and soft tissue were elevated in the subperiosteal plane, and the cartilage was resected, taking care to preserve an adequate amount of cartilage along the anthelical fold (Figure 2). (An approximately 5-mm vertical wall of the cavum concha was left intact to avoid flattening of the ear). After hemostasis was achieved, the incision was closed with Monocryl 4-0 (Ethicon, Johnson & Johnson, Somerville, NJ) using an intradermal running suture, making 1 or 2 stitches in the posterior dermis to close the dead space. A bolster dressing of cotton dental roll or other suitable material was placed into the concha to decrease the risk of hematoma.

structural grafting. When septal cartilage is not available, other autogenous cartilage grafts (conchal or costal) are considered to be the most desirable materials because they provide structural support. Auricular cartilage (elastic cartilage) can be used in rhinoplasty because it is almost always available and because it can be harvested easily with little risk of an ear deformity. However, its use is limited because it lacks sufficient strength, due to its elasticity. This is the reason that it has sometimes been associated with warping or deformation with ongoing scar contracture in the nose.

Rib cartilage (hyaline cartilage), another choice that has been demonstrated to provide a large amount of structural cartilage for sculpting a columellar strut, provides both strength and resistance to resorption. Some drawbacks of using this material are increased pain and transient atelectasis, hematoma, chest scar, damage of the intracostal nerves and vessels, a possibility of pneumothorax, a tendency to warp, and lengthy operative time.

The elastic ear cartilage is soft and, thus, not an ideal substitute for the structured hyaline cartilage of the septum for the columellar strut. Several possibilities have been proposed to try to strengthen the conchal cartilage so that it could be used as a columellar strut, including the following: doubling the thickness by folding it over or combining 2 pieces of cartilage; joining the cartilage with a thin strip of perpendicular plate of ethmoid, making a cartilage-bone combination graft; using a 2-layered conchal cartilage graft and placing the concave sides together to create a single pea-pod shaped graft; applying a mattress suture nylon to the convex side of the conchal cartilage graft to straighten an abnormally curved columellar strut graft; and using a conchal cartilage as a butterfly-shaped graft. However, even when layered, the strut taken from the ear is not as strong for nasal tip support as a septal cartilage graft of the same size.

We have applied the principles of materials resistance engineering to overcome the inherent weakness of auricular cartilage. In materials resistance engineering, the strength or stiffness of a material to support weight is known as the elastic modulus, and can be thought of as the load that is required to displace or distort a homogenous, geometrical sample. The intrinsic capacity of a structural element depends on both its geometry and the mechanical resistance and elastic modus of its material.

Let us consider the ear cartilage as a laminal structure of thin thickness. When the lamina is positioned parallel to the vertical axis and weight is placed on its superior...
Figure 1. A, B, The weight put on the superior edge of a lamina bends and curves the structure. C, D, The curved surface has much more strength to support the weight.

On average, an ear cartilage graft of $3.5 \times 1.5$ cm was obtained from the auricular concha to create a columellar strut. It was sometimes necessary to trim the helical crus, located between the cymba and cavum, to obtain even thickness throughout the graft (Figure 3). The cartilage graft was rolled to form a cylinder-shaped structure and then sutured with 5-0 nylon to be used as a strut graft and placed caudally to the septal cartilage (Figure 4). It was our theory that rolling the conchal cartilage strengthened the cartilage, and at the same time, allowed the strut graft to retain some flexibility and provide more support to the tip.

Open rhinoplasty was performed in all patients using standard techniques. Stairstep columellar and bilateral marginal incisions were made. The strut was placed in a
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Pocket between the medial crura from the nasal spine to the tip, and it was fixed with a 6-0 nylon suture (Figure 5). Any tip asymmetry was corrected with interdomal and/or transdomal sutures, minimizing the need for tip grafts. The domes were then pulled superiorly and medially into the strut, increasing nasal tip projection. The length of the strut did not project into the skin-soft tissue, thus avoiding any external deformity.

Results

Between February 2002 and June 2006, we performed our technique on 13 patients, 6 men and 7 women, who required revision rhinoplasty. Their ages ranged between 19 and 52 years. Twelve of the cases were secondary cosmetic rhinoplasties and 1 was tertiary. The methods used to assess the viability of the columellar strut were clinical and computed tomographic follow-up during a period ranging between 4 and 48 months (Figure 6).

The placement of the columellar strut as described corrected columellar retraction, improved the nasolabial angle, and increased tip projection. Five of the patients experienced minor complications, including 2 cases of hematoma at the donor site, 1 case of infection in the soft tissue of the nasal tip, and 2 cases of slight lateral deviation of the columella. No patients complained of ear deformity, but 2 patients presented with insignificant rippling at the donor site. It is important to note that no cases of graft resorption or extrusion were observed in any of the cases during clini-
cal follow-up. All patients had inconspicuous scars as a result of the ear and nose incisions. We noted that there was minimal widening at the columellar base in almost all cases; nevertheless, all patients were satisfied with the postoperative results (Figures 7 and 8).

**Discussion**

Columellar struts were popularized by Peck. Placement of a columellar strut provides an approximately 40% increase in nasal tip support in the vector along the columella, rendering it capable of withstanding the compressive forces of the inherent weight of the skin-soft tissue and the inevitability of scar contracture.

Septal cartilage is usually the first choice as donor material in nasal surgery. In situations where septum is lacking because of a calcified septum, prior trauma, surgery, disease, or other reasons, the patient’s own septum may not supply a sufficient amount of donor cartilage. Auricular cartilage grafts have become a versatile alternative for treating such cases and have been used in nasal surgery for more than 100 years with a low incidence of complications. Contraindications for auricular cartilage grafting include systemic diseases that might impair wound healing or the quality/quantity of

**Figure 6.** Postoperative coronal computed tomography 6 months after placement of a columellar strut for tip support in secondary rhinoplasty. The tubular cartilage graft is visible as a round density under the caudal septum (white arrow).

**Figure 7.** A, C, E, G, Preoperative views of a 29-year old man with an underprojected nasal tip after 2 previous surgeries. B, D, F, H, Postoperative views 3 years after tertiary rhinoplasty using an open rhinoplasty technique, cephalic resection of alar cartilages, and transdomal suture through the strut of ear cartilage.
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Some studies have suggested an improved resistance to resorption of conchal cartilage grafts with perichondrium. Histopathology analysis strongly suggests that the presence of perichondrium enhances both survival and healing of free cartilage grafts. Moreover, when the perichondrium is left intact on the posterior surface of the graft during harvesting, dissection is easier and the risk of cartilage damage is lower.

It is important to recognize that although cartilage has chondrocytes and intercellular substances as its main tissues, these elements differ considerably and their functions within the body are quite different. Some, like the costal and septal cartilage, serve basically to give support, whereas others such as the auricular cartilage serve mainly to provide contour. The elastic auricular concha cartilage has many chondrocytes and little intercellular substance, and is basically made up of irregularly distributed elastic fibers. The septal, costal, and alar hyaline cartilages have a considerable amount of intercellular substance, primarily formed by regularly distributed collagen fibers whose main function is to give tensile strength for tissue, whereas elastic fibers easily yield to tension but recover their original shape once the tension is released.

Conclusion

Auricular cartilage grafts are a safe, effective, and versatile option for use as a donor material in secondary rhinoplasty. In our practice, we have obtained satisfactory results with minimal complications by using these grafts.

References


![Figure 8. A, C, E, G. Preoperative views of a 19-year-old man with an underprojected nasal tip 2 years after primary rhinoplasty. B, D, F, H. Postoperative views 13 months after open rhinoplasty and placement of ear cartilage columellar strut with mattress suture to straighten the dorsal septum and transdomal suture through the strut.](image-url)

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Reprint requests: Jenny Carvajal, MD, Calle 6 sur #43-A-214, Medellin, Colombia.
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