

# The Auricular Cartilage in 197 Secondary and Tertiary Rhinoplasties

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**Background:** The purpose of this study was to describe and evaluate the efficacy of the use of auricular cartilage to treat aesthetic and functional deformities of patients who underwent secondary rhinoplasty or tertiary.

**Methods:** From July 2005 to July 2014, 197 patients (144 women and 53 men) underwent rhinoplasty with the use of cartilage grafts. A total of 137 patients (70%) underwent secondary rhinoplasty, 60 patients (30%) underwent tertiary rhinoplasty. Patients in whom the Cottle maneuver was positive (108 patients, 55%) underwent a rhinomanometry test and responded to a simple questionnaire that reported on their nasal patency. Patients were evaluated at 6, 12, 24 months after surgery.

**Results:** The results of this study revealed an effective correction of aesthetic deformities of patients and a significant improvement in airway patency in 108 patients with respiratory obstruction. No major complication was observed.

**Conclusions:** The use of auricular cartilage graft is efficacy to solve aesthetic and functional remnants after an incorrect procedure, or primary or secondary.

**Key Words:** Secondary rhinoplasty, tertiary rhinoplasty, auricular cartilage grafts

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Primary rhinoplasty is usually a successful venture for the patient and surgeon, but a revision rate of 8% to 15% is noted in the literature.<sup>1–3</sup> Aggressive resection of the cartilaginous or bony structure during rhinoplasty can result in such deformities as alar retraction, tip ptosis, and overrotation of the tip. Besides unacceptable results, nasal obstruction from internal and external nasal valve collapse is also common.<sup>4</sup> Revision rhinoplasty is a challenge in reconstruction to the rhinoplasty surgeon, both in the techniques of repair and the choice of implant material for augmentation grafting.<sup>5</sup> For this reason, there are a number of grafting materials available, including a wide variety of synthetic or alloplastic materials, autogenous materials (bone, cartilage) and homograft materials (rib cartilage, dermis). With regard to the alloplastic materials, including silicone implants, meshed

implants, porous implants, porous high density polyethylene, expanded-polytetrafluoroethylene (Gore-Tex; WL Gore, Flagstaff, AZ) there have been significant problems with the biocompatibility of these materials.<sup>6</sup> Toriumi<sup>7</sup> reviewed most of the disadvantages of using alloplastic implants, including infection, chronic inflammation, telangiectasia thinning of the skin, discoloration, excessive scar tissue formation, and/or deformity, chronic pain (which may be a result of chronic inflammation or capsule or scar contracture around the alloplast). High extrusion rate is also common. With regard to the autogenous materials, bone is used infrequently because it often yields unsatisfactory results in the aesthetic appearance of the nose, and has problems with graft resorption.<sup>8</sup> Cartilage remains the preferred grafting material for nasal implantation, as it is easy to shape and resistant both to infection, and to resorption.<sup>9,10</sup> As regards the donor region, septal, auricular or costal cartilage can be used in order of preference. Septal cartilage, however, is often unavailable or insufficient to fill all the structural gaps in the case of reconstructive rhinoplasty. On the contrary, the use of costal cartilage has 2 distinct disadvantages: a susceptibility to warp and significant donor site morbidity, including postoperative donor site pain, incisional scarring, chest wall deformity, temporary atelectasis, and the small risk for pneumothorax.<sup>11</sup>

The auricular cartilage is an alternative to the septum for reconstruction of all the cartilaginous structures of the nasal pyramid.<sup>4,5</sup> Auricular cartilage is easy to harvest, does not leave visible scar at the donor region, and is available in large quantity.

The aim of this article is to describe our personal experience and show representative results with the use of auricular cartilage grafting in 197 patients.

## MATERIALS AND METHODS

From July 2005 to July 2014, 197 patients (144 women and 53 men), with age ranging from 18 to 75 years (mean age = 36.6 years), underwent rhinoplasty with the use of auricular cartilage grafts at the Department of Plastic and Reconstructive Surgery, University of Tor Vergata, Rome. A total of 137 patients (70%) were candidates for secondary rhinoplasty (Figs. 1-9), 60 patients (30%) were candidates for tertiary rhinoplasty. From our study, we excluded all patients treated with cartilage grafts harvested from nasal septum or rib.

Preoperatively all patients received an initial interview, a photographic documentation, a computed tomography of the nose and paranasal sinuses, and physical examination. The physical examination included an assessment of the external appearance of the nose; intranasal examination; and Cottle maneuver in which the patient lateralizes the cheek and lateral wall of the nose, which results in improved nasal breathing. Patients in whom the Cottle maneuver was positive (108 patients, 55%) underwent a rhinomanometry (RMM) test. Active anterior RMM is the most commonly used technique to measure nasal patency.<sup>12</sup> The same patients also responded to a simple questionnaire that reported on their nasal patency on a scale from 0 (complete obstruction) to 10 (optimal airflow).<sup>13</sup>

We classified all patients according to type of graft used: in 85 patients (43%) we used the shield graft, in 53 patients (23%) alar batten graft, in 22 patients (11%) columellar strut, in 16 patients

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**FIGURE 1.** A, Preoperative frontal view of 52-year-old patient with an outcome of secondary rhinoplasty with dorsum lateral right deviation, right alar retraction and septal deviation. B, Twelve-month postoperative view. The postoperative views show the improvement of dorsum lateral right deviation.



**FIGURE 4.** A, Preoperative frontal view of 36-year-old patient who underwent previous reductive rhinoplasty and suffered from severe the iatrogenic nasal valve collapse of the right rim. B, Twenty-four months postoperative frontal view.



**FIGURE 2.** A, Preoperative lateral right view. B, Twelve-month postoperative lateral right views.



**FIGURE 5.** A, Preoperative lateral left view. B, Twenty-four month postoperative lateral right views.



**FIGURE 3.** A, Preoperative picture of rethi incision. B, Shield of Sheen placement. C, Auricular cartilage graft harvesting via an anterior approach. D, The columellar strut placement. It is held between lateral crus to reshape the tip.



**FIGURE 6.** A, The preoperative basal view reveals collapse of the internal nasal valve monilaterally. B, Twenty-four month postoperative basal views. The postoperative basal view show lateral positioning of the internal nasal valve and aesthetic improvement.



**FIGURE 7.** A, Graft placement. The alar batten graft is held externally on the skin. The graft is positioned at the precise point into the epicenter of the collapse. B, Columellar strut placement.



**FIGURE 8.** A, Preoperative frontal view of 39-year-old patient with an outcome of secondary rhinoplasty. Patient has osteo-cartilaginous deficit of nasal dorsum. B, Eighteen-month postoperative frontal view.



**FIGURE 9.** A, Preoperative lateral right view. B, Eighteen-month postoperative lateral right views.

**TABLE 1.** The Type of Grafts Used

Type of Grafts	Patients	Percentage
Shield graft	85	43%
Alar batten graft	53	23%
Columellar strut	22	11%
Spreader graft	16	8%
Onlay tip graft	9	4%
Septal extension graft	7	3%
Cap graft	5	2%

In 85 patients (43%) we used the shield graft, in 53 patients (23%) alar batten graft, in 22 patients (11%) columellar strut, in 16 patients (8%) spreader graft, in 9 patients (4%) onlay tip graft, in 7 patients (3%) septal extension graft and in 5 patients (2%) we used cap graft.

(8%) spreader graft, in 9 patients (4%) onlay tip graft, in 7 patients (3%) septal extension graft and in 5 patients (2%) we used cap graft (Table 1).

Postoperatively, all patients redone photographic evaluation, and aesthetic results were evaluated using a visual analog scale for the patient’s self-estimation (excellent, good, poor) and the plastic surgeon’s estimation (excellent, good, and poor) (Fig. 10).

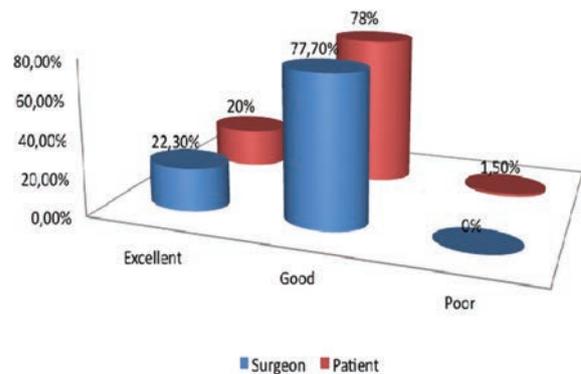
Postoperatively, patients who reported respiratory obstruction (108 patients, 55%) repeated the RMM test and responded again to the questionnaire on their nasal patency (Fig. 11).

Auricular cartilage was the donor site choice in all patients with anterior incision in 79 patients (40%), with posterior incision in 118 patients (60%).

At follow-up, patients were evaluated at 6, 12, and 24 months.

### RESULTS

All patients who underwent secondary or tertiary rhinoplasty using auricular cartilage grafts were evaluated with a postoperative follow-up of 24 months. Patients who reported respiratory obstruction (108 patients, 55%) noted improvement in their nasal patency, as demonstrated by the questionnaire on the subjective perception of nasal patency (3 patients not reported a subjective improvement in nasal airway breathing, despite RMM test showed a functional improvement). The mean improvement in nasal breathing score of 3, 65 on a scale of 10 (Fig. 11). The comparison of preoperative and postoperative rhinomanometric data also showed an increase in nasal functionality for all patients.



**FIGURE 10.** Evaluation of the esthetic results. Excellent in 44 patients (22%) and good in 153 (78%). For each score given by the surgeon, the patient’s assessment was the same or better.

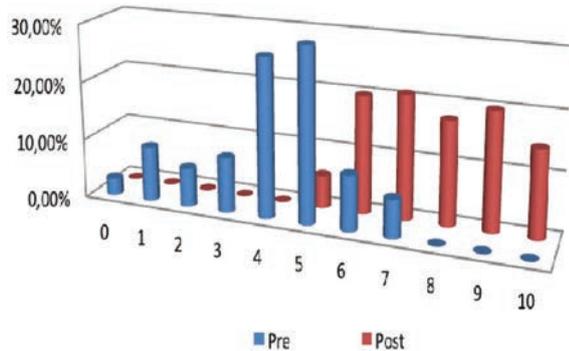


FIGURE 11. The mean improvement in nasal breathing.

The aesthetic results were evaluated by the surgeon as excellent in 44 patients (22%) and good in 153 (78%). For each score given by the surgeon, the patient's assessment was the same or better (Fig. 10).

We also evaluated intraoperative and postoperative complications. There were no infections (0%). Edematous tip in 30 patients (15%) resolved in 6 months, tenderness at the donor site in 20 patients (10%) resolved in 6 months, and there was graft resorption in 1 patient (0, 5%). Displacement of the graft developed in 6 patients (3%) (probably caused by the incorrect grafts fixation to the nasal structures). Hypertrophic scar at the donor site in 5 patients (2%) and necrosis of a full-thickness skin flap overlying the cartilage graft occurred in one patient (0, 5%) (Fig. 12).

### Nasal Obstruction and Surgical Technique

#### SPREADER GRAFT

##### Positioning

Spreader grafts are usually paired, longitudinal grafts placed between the dorsal septum and the upper lateral cartilages in a submuco-perichondrial pocket.<sup>14</sup>

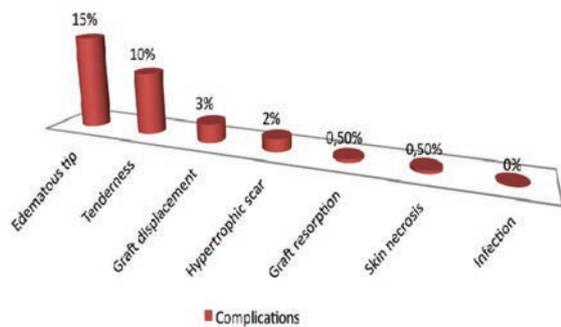


FIGURE 12. Evaluation of intraoperative and postoperative complications. There were no infections (0%). Edematous tip in 30 patients (15%) resolved in 6 months, tenderness at the donor site in 20 patients (10%) resolved in 6 months and there was graft resorption in 1 patient (0, 5%). Displacement of the graft developed in 6 patients (3%). Hypertrophic scar at the donor site in 5 patients (2%) and necrosis of a full-thickness skin flap overlying the cartilage graft occurred in one patient (0, 5%).

### Indications

Spreader grafts are used to restore or maintain the internal nasal valve, straighten a deviated dorsal septum, improve the dorsal aesthetic lines, and reconstruct an open roof deformity. In particular, bilateral spreader grafts were used in cases of narrow nose syndrome (short nasal bones, long and weak upper lateral cartilages, thin skin) and in cases of disproportionate nose with narrow middle vault and bulbous tip. Unilateral spreader grafts were placed on the concave side in cases of crooked nose.<sup>15</sup>

### Donor Region

Septal cartilage is the preferred source of the grafts, whose length and shape may vary depending on the indication.

### COLUMELLAR STRUT

##### Positioning

Columellar struts may be fixed to the nasal spine or premaxilla to give more stable support to the nasal tip.

##### Indications

A fixed columellar strut is the most effective way of increasing tip projection with a strut and can also aid in lengthening the nose.<sup>14</sup> The columellar strut aids in shaping the columellar-lobular angle. In particular, the columellar strut was used in secondary rhinoplasty in cases of sagging columella.

### Donor Region

Septal cartilage is preferred, but costal cartilage is used when a stronger strut and more enhanced projection are desired. Auricular cartilage may be used, but a double layer should be used if strength is needed.<sup>14</sup>

### ONLAY TIP GRAFT

##### Positioning

An onlay tip graft is a single or multilayered graft placed horizontally over the alar domes.<sup>14</sup>

##### Indications

The onlay tip graft is used to minimally increase tip projection but mainly to camouflage tip irregularities. The edges of the graft must be beveled or crushed to avoid postoperative visibility.

### Donor Region

Auricular cartilage is the preferred source of the grafts.

### SHIELD OF SHEEN GRAFT

##### Positioning

This shield-shaped graft is placed adjacent to the caudal edges of the anterior middle crura, extending into the tip.

##### Indications

The shield graft is used to increase tip projection, define the tip, and improve contour of the infratip-lobule.<sup>14</sup> Additional tip projection can be achieved by moving the graft more anteriorly above the tip. When the open approach is used, it is sutured to the caudal

margins of the cartilages. The graft edges should be beveled or lightly morselized to make them softer and less visible.<sup>14</sup>

### Donor Region

Auricular cartilage is preferred.

## ALAR BATTERN GRAFT

### Positioning

Positioning the graft can vary from case-to-case depending on whether internal or external nasal valve collapse is being treated. When internal nasal valve collapse was being treated, the graft was placed in a pocket at the site of the supra-alar collapse and near the caudal margin of the upper lateral cartilage or where the lateral crura may have been previously overresected. The convex side of the graft is oriented laterally to correct the supra-alar pinching. The pocket is subcutaneous, but if the pocket is too superficial and the skin is too thin, particular care must be taken to avoid edges because the graft may be palpable or visible. When external nasal valve collapse was being treated, the graft was typically placed into a pocket caudal to cephalically position lateral crura. To amplify the effect, the graft must be placed into a precise subcutaneous pocket at the point of maximal lateral wall collapse.<sup>15</sup>

### Indications

The authors have found the alar batten graft useful in the correction of malpositioned lateral crura and nasal valve collapse. The authors placed all the grafts via the open rhinoplasty approach. The major advantage to alar batten cartilage grafting is a similar contour to the alar rim, and establishes patency of the nasal valve.

### Donor Region

Auricular cartilage is preferred.

## SEPTAL EXTENSION GRAFT

### Positioning

The grafts are divided into three types. Type I grafts function as paired dorsal spreader grafts that extend beyond the anterior septal angle into the interdomal space. Type II grafts are paired batten grafts that extend diagonally across the caudal-dorsal junction of the septal L-strut into the tip-lobule complex. A type III graft functions as a direct extension graft affixed to the anterior septal angle.<sup>14</sup>

### Indications

Septal extension grafts are used to control the projection, support, shape, and rotation of the tip and are dependent on the presence of a stable caudal septum. They also help to create a supratip break.<sup>14</sup>

### Donor Region

Septal cartilage is the preferred source of the grafts. When septal cartilage is not present, for example in secondary rhinoplasty, it is possible to use auricular cartilage.

## CAP GRAFT

### Positioning

A cap graft is a small graft placed in the space between the tip-defining points and the middle crura.

### Indications

The graft is used to refine, soften, and fill in clefts of the nasal tip in patients with thin skin, to minimally enhance tip projection and occasionally refine the infratip lobule area.

### Donor Region

The preferred source of cartilage is from remnants obtained from the cephalic trim of the lower lateral cartilages, but septal, auricular, or rib cartilage may also be used.<sup>14</sup>

## DISCUSSION

In the last few decades, numerous grafting techniques have been developed to sculpt the nasal framework in primary rhinoplasty, and especially in the secondary.<sup>14</sup> These techniques are designed to provide key functional support to the nasal structures and to provide good aesthetic results.

Although the surgeon in reconstructive rhinoplasty has a number of options regarding the choice of materials (autogenous materials, homograft materials, and alloplastic materials), cartilage remains the most used tissue for nasal reconstruction.

Historically, a huge variety of alloplastic materials have been used. In current practice, those used include polymers, such as silicone, polyethylene, and polytetrafluoroethylene, but there have been significant problems with the biocompatibility of these materials.<sup>16</sup> High infection and extrusion rate is also common. Many patients experience a pressure sensation from the foreign body, whereas others find a notion of a foreign substance in the face increasingly disturbing.<sup>17</sup>

Cartilage satisfies many of the requirements of the ideal nasal implant. Their advantages are numerous: no disease transmission or biocompatibility issues, low rates of infection, resorption, rejection, and extrusion.<sup>11</sup>

The advantages of the cartilage are shown in one of the largest personal series in the world literature conducted of Tardy. Tardy<sup>17</sup> reported 17 years of experience with more than 2000 autogenous cartilage graft. He reported no graft rejection or evidence of graft loss caused by infection. Complications that did occur were attributed to surgical errors in graft contouring, fashioning, or inaccurate and imprecise host pocket preparation. Similarly, Collawn et al reported 10 years using cartilage grafts for nasal augmentation. Complication requiring reoperation occurred in 17% of patients in the first 4 years of the study and decreased to 2% of patients during the final 4 years of the study. Complications were attributed to technical errors. No graft reabsorption occurred.<sup>18</sup>

The cartilage may be harvested from the septum, external auricle, or from the rib. Rib autografts are frequently the cause of graft warping and postoperative complications as such are used less frequently in the nasal reconstruction. Gibson and Davis<sup>19</sup> have described a technique in which cartilage is cut according to a balanced, cross-shaped section, eliminating this deformity at least in part. Even when this technique, however, is carefully performed, a small portion of the graft can still tend to become deformed. Therefore, the only way to avoid any deformation is to not mold the graft at all. This is possible only with the use of cartilage grafts that have been taken from the 11th rib.<sup>20</sup> The molding, however, should always be kept to a minimum, and the portion of cartilage that comes closest in shape and size for the intended purpose should be selected for the transplant.

The general technique is based on the preparation of a subcutaneous pocket, supra- or subperiosteal, and supraperichondral, which can accept the fragment (or the fragments), and which are appropriately joined and overlapping, or prepared a mortiza with assembling sutures, and temporarily protected with Spangostan

(Codman and Shurtleff, a Johnson & Johnson Company, Norderstedt, Germany). It proceeds to increase the projection of the pyramid, the saddleback, and the nasal tip through the rib graft, positioning the columellar strut to increase the projection of the nasal tip manufactured through sculpture of the graft. The implant of a dorsal graft has produced increased tension of the external nasal valve, improving its caliber and consequently its capacity of dilating. Autografts of rib cartilage are therefore particularly indicated in patients where the nasal bones have been destroyed. The cartilage of 11th and 12th ribs, which is short and free, is medially turned, first downwards and then upwards. Contrary to what happens with the others, the 11th rib is not connected with the costal arch and is therefore free. For this reason, the 11th and 12th ribs are called "floating ribs." The 11th rib cartilage graft is an excellent option for the reconstruction of the dorsum and the nasal columella, and especially whenever there is severe saddling or loss of the sagittal projection of the nose.<sup>21</sup>

If the septal cartilage is unavailable or insufficient to reconstruct the nasal structures, according to Brent,<sup>22</sup> the auricular cartilage graft, is an ideal transplant tissue and perhaps the most versatile of all cartilage grafts.

Auricular cartilage has been used by most of the authoritative authors.

Hages<sup>23</sup> in 1965 reported that the bilateral conchal butterfly graft can be recommended for the correction of insufficient alae. In 1969 Stark<sup>24</sup> supported autogenous conchal cartilage as a proven transplant for concave deformities of the nose. In 1984, Muenker proposed an autogenous bilateral conchal graft in sandwich technique as an alternative solution to reconstruct a severe saddle-nose deformity. Tardy<sup>17</sup> in 1985 reported that the auricular cartilage autografts serve well for reconstructive needs in other areas of the head and neck. Toriumi<sup>25</sup> in 1997 used auricular cartilage as alar batten grafts for correction of nasal valve collapse. Published reports by Becker et al,<sup>5</sup> Bocchieri et al,<sup>13</sup> and Mowlavi et al<sup>26</sup> emphasized the advantages of auricular cartilage.

Auricular cartilage is easy to harvest and, as long as the anhelical fold is not transgressed, no change in the appearance of the ears occurs by the removal of the entire cymba and cavum concha.<sup>17</sup> Furthermore, auricular cartilage is elastic and has a high degree of memory.

An important consideration in harvesting is to use those portions of concha most similar to the nasal anatomic components to be reconstructed.<sup>13</sup> For example, 2 alar batten graft are obtained from the entire concha and used for bilateral nasal valve collapse as they are similar to the alar cartilage.<sup>27</sup> Still, according to Peck,<sup>28</sup> from the straightest portion of the conchal cartilage can be achieved an umbrella graft to reconstruct nasal tip. The extension of the helical root may be used to harvest a thicker graft, such as a spreader,<sup>29</sup> subdomal,<sup>30</sup> or columellar strut graft.

Another important consideration is to remember that the key to a successful rhinoplasty is the accurate diagnosis of both aesthetic and functional defects to be corrected.

Finally, we believe it is imperative the open approach. In fact, according to Gunter,<sup>31</sup> the open approach gives the surgeon the ability to inspect the osseocartilaginous framework in its natural state (without tension or distortion); it makes it easier some technical maneuvers; and it gives the surgeon more options in altering the osseocartilaginous framework.

## CONCLUSIONS

The auricular cartilage is efficacy to correct aesthetic and functional deformities left over after primary rhinoplasties. The major advantages to auricular cartilage is that it is an autologous tissue, it is easy to harvest and to shape, does not leave visible scars at the donor site and it has a low rate of reabsorption and displacement. We believe

that the key to a successful rhinoplasty is the accurate diagnosis of both aesthetic and functional defects to be corrected and that the open approach is imperative.

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