

# Rib grafts in septorhinoplasty

## *Innesti di costa nella settorinoplastica*

A. MORETTI<sup>1</sup>, S. SCIUTO<sup>2</sup>

<sup>1</sup> Department of Medical, Oral and Biotechnological Sciences, ENT Section, "G. d'Annunzio" University of Chieti-Pescara, Italy; <sup>2</sup> Casa di Cura Nostra Signora della Mercedes, Rome, Italy

### SUMMARY

Autogenous cartilage has generally been considered the gold standard grafting material in reconstructive septorhinoplasty for volume filling and structural support. In the restructuring of the nasal skeleton, autogenous cartilage can be harvested from the nasal septum, the auricle or the rib, but costal cartilage is considered the best graft material in patients requiring major reconstruction. Rib cartilage is an outstanding material in reconstructive septorhinoplasty, especially in revision surgery and when large amounts of tissue are required. This autologous material has a low rate of complications such as resorption, infection and extrusion compared to homografts and alloplastic implants. In the present study, the authors analyze and discuss the use of autogenous rib cartilage in 54 patients who underwent primary and revision septorhinoplasty. Its use is also suggested in cases in which there is a need to have a fair amount of cartilaginous tissue to be grafted for nasal framework reconstruction and respiratory function improvement.

KEY WORDS: Reconstructive septorhinoplasty • Grafts • Rib cartilage

### RIASSUNTO

*La cartilagine autologa viene generalmente considerata come il materiale di prima scelta per gli innesti nella cosiddetta settorinoplastica ricostruttiva sia per quanto riguarda il sostegno strutturale del naso che per gli effetti di riempimento che da essa si possono ottenere. Nella ristrutturazione dell'architettura di sostegno nasale il tessuto cartilagineo può essere ricavato dal setto, dal padiglione auricolare o dalla costa. Quest'ultima sede rappresenta il sito donatore principale nelle ricostruzioni maggiori ed in particolare nella chirurgia di revisione da eseguire in pazienti con deplezione cartilaginea. La cartilagine costale autologa se confrontata con omoinnesti ed impianti alloplastici presenta una bassa percentuale di complicanze, soprattutto infezioni ed estrusione anche se non è scevra da possibile riassorbimento e distorsione. Nel presente studio gli Autori analizzano e discutono l'impiego della cartilagine costale autologa in 54 pazienti sottoposti a settorinoplastica primaria o di revisione e ne suggeriscono l'impiego in tutti quei casi in cui vi è la necessità di avere a disposizione una congrua quantità di tessuto da innestare per ristabilire la struttura di sostegno e migliorare la funzionalità nasale.*

PAROLE CHIAVE: *Settorinoplastica ricostruttiva • Innesti • Cartilagine costale*

Acta Otorhinolaryngol Ital 2013;33:190-195

## Introduction

Grafts in septorhinoplasty can be obtained from different autologous and homologous tissues or from alloplastic materials. Autologous cartilage presents many advantages compared to other kinds of grafts: it survives as a living tissue, seldom undergoes resorption, does not stimulate an immune response, is ideal for all types of grafting and presents only biological costs, but its use requires longer operation time. Septum, auricular concha and rib are the best cartilaginous donor sites for autologous nasal grafting. Rib cartilage is the graft material of choice for dorsal augmentation and reconstructive support when sufficient septal cartilage is not available <sup>1</sup>. Autologous rib cartilage is often overlooked in reconstructive septorhinoplasty because of potential donor-site morbidity and the warping effect <sup>2-8</sup>; however, its use is indispensa-

ble when large amounts of tissue and multiple grafts are required, especially in patients already surgically treated, with cartilage depletion. Usually two teams work simultaneously, but since most warping occurs within 15-60 min of harvesting (early warping), the same surgeon can harvest the rib before modeling the graft and preparing the recipient site, preferably using an open approach, to verify cartilaginous structure modifications. The central portion of the 5<sup>th</sup> to 8<sup>th</sup> rib is preferred by some surgeons <sup>9</sup>; however, the 11<sup>th</sup> and 12<sup>th</sup> free-floating ribs are naturally straighter, require less carving and undergo less warping <sup>10</sup>. To reduce the warping effect, Gunter suggested to reinforce larger grafts (dorsal onlay graft and columellar strut) with a centrally placed Kirschner-wire to provide a more stable and predictable result <sup>6</sup>. The graft is preferably harvested from the right side to prevent the possibility of confounding any cardiac chest pain, although

in some cases, to facilitate a two-team approach, rib cartilage harvesting is performed on the patient's left side. Rib cartilage can be harvested circumferentially, after superior and inferior perichondrium elevation, taking special precaution not to injure the inferior line neurovascular bundle or closely adherent pleura on the medial surface. Rib harvesting can be also limited to the outer lamella preserving the internal costal arch. By preserving the inner lamella of the rib, postoperative morbidities, including pain, splinting and pneumothorax, are reduced<sup>10</sup>. In revision rhinoplasty, the dorsum is frequently over-resected and the septal L-structure is weakened. In these cases, dorsal spreader grafts should be placed along either side of the septum to provide a stable recipient site for the dorsal onlay graft<sup>11</sup>. The spreader grafts should be stabilized with horizontal mattress sutures at the same level as the septum and extend from the keystone area to the septal angle in preparation for receiving the dorsal onlay graft. Spreader grafts are used to widen a narrow dorsum when necessary to obtain better symmetry of the middle third of the nose, but also to improve the acute angle of the internal nasal valve when related respiratory insufficiency is present. To restore effective L-strut support, it is very important to prepare a precise pocket between the medial crura for placement of the columellar strut. To obtain a stable and strong medial framework in most severe depleted cartilaginous cases, it is necessary to hinge the columellar strut with the dorsal graft<sup>11</sup>. The present study describes the authors' experience in the use of autologous rib grafts in primary and revision cases of septorhinoplasty.

## Methods

We retrospectively analyzed data from 54 patients who underwent septorhinoplasty using autologous rib cartilage grafts in the last 10 years. The study population consisted of 33 male and 21 female patients (mean age: 34 years; age range: 16–64 years). All septorhinoplasties were performed under general anaesthesia in patients with depletion or deformities of the osteocartilaginous nasal framework using an open approach. Twelve patients were primary cases: 8 with post-traumatic deformities and 4 presented congenital abnormalities. Three patients showed stigmata of cocaine abuse, 1 presented sequelae due to haematoma of the septum, and 38 were revision cases, 7 of which previously treated with alloplastic implants. The patients had several degrees of saddle nose deformity and complained of nasal obstruction: in 42 cases, most of the septum was absent, and 6 patients had previous aggressive septoplasty with septal perforation in 2 cases. Eleven patients had internal nasal valve insufficiency. All patients showed tip deformity and alteration of the relationship between dorsal lines and columella-tip complex. In correction of the iatrogenic nasal deformities such as stigmata of alloplastic implant,

saddle nose, septal perforations, valvular collapse and nasal airflow obstruction, the procedure included placement of septal grafts, alar, tip and dorsal onlay grafts, spreader grafts, columellar struts and shield grafts.

In male patients, an incision was made over the seventh costal cartilage and in the women under the breast crease to hide the scar. After skin incision, the external oblique muscle was reached and the fascia over this muscle was opened. The overlying muscles were spread, parallel of the direction of their fibres and appropriately retracted, to reduce postoperative pain, until exposing the underlying costal cartilage. The perichondrium was incised parallel to the outer surface and circumferentially elevated to perform full-thickness harvesting of the rib cartilage. In some cases, when the harvesting was limited to the outer lamella, the perichondrium was elevated only to the external surface. Once elevation was complete, the desired section of the rib was performed.

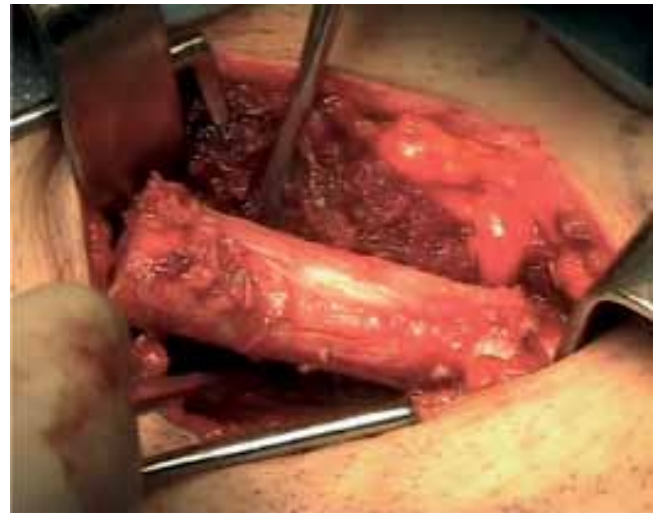


Fig. 1. Full-thickness harvesting of the rib.



Fig. 2. Harvesting of the rib limited to the outer lamella.

Rib cartilage can be removed full-thickness (Fig. 1), taking special precaution to the neurovascular bundle or the closely adherent pleura medially. The harvesting can be also conducted only to the outer portion to maintain the continuity of the internal costal arch (Fig. 2). By preserving the inner lamella of the rib, postoperative morbidities, including pain, splinting and pneumothorax, are reduced. After the graft was removed, the donor site was closed in layers without drains. The harvested costal cartilage was shaped as a vertical strip except in patients with severe saddle nose deformity when a large amount of cartilage is required to recreate the new L-structure with a columellar strut hinged with a large dorsal graft (Fig. 3). The central portion was usually used in dorsal reshaping (dorsal and spreader graft) and for septal reconstruction, while the peripheral portion was shaped in alar and tip replacement grafts after approximately 30 min to allow most of the warping to occur. All the grafts were inserted using an open approach that offers the best exposure of nasal structures by providing graft positioning and stabilization in the desired locations without distortion. The costal cartilage grafts were used as dorsal, septal and columellar strut in all cases (Fig. 4), while spreader grafts were utilized in

17 patients to provide further stability to the septal graft or to improve nasal valve function. In each case, the dorsum was made as flat and smooth as possible before the dorsal onlay graft was placed (Fig. 5). Alar and tip onlay grafts (Fig. 6) had various combinations with the previous grafts in 48 patients to address structural defects. Only in three cases, with underprojected tip, was a shield graft used.

### Results

The follow-up ranged from 6 to 36 months, with an average of 18 months. None of the patients had any intra-operative complications. Oral analgesic was always adequate for pain control and chest pain subsided within 1 to 6 weeks postoperatively. Cosmetic appearance and nasal obstruction were improved in all cases. Regarding complications, none of the 54 patients had grafts extrusion. Four patients had infection in recipient sites (3 on the columella and 1 on the dorsum) with significant grafts resorption in 2 cases with a history of cocaine abuse. Warping defect was noticed in 3 patients after the oedema subsided. In 2 of these, distortion occurred in the dorsal onlay graft and revision surgery was required. In the third



**Fig. 3.** Preoperative and 2-years postoperative photographs of a patient who had two previous aggressive septorhinoplasty. All the grafts used were harvested from rib cartilage.





**Fig. 4.** Intraoperative view of the case shown in Figure 3. The dorsal onlay graft positioned over spreader grafts was used to make the dorsum as flat and smooth as possible and to improve internal nasal valve dysfunction. Caudal portion of the dorsal rib graft is placed under the cephalic margin of the alar cartilages to make the internal nasal valve angle more rounded. Umbrella tip graft is sutured over the domes to achieve more tip projection.

patient, minor warping occurred in the caudal septum and columella, and revision was not required. Only two patients developed donor site complications: 1 patient with early wound infection was successfully treated with oral antibiotics, and no further intervention was required; the other initially developed a seroma and a keloid scar of the chest incision, which was treated with steroid injections.

## Discussion

The goal of septorhinoplasty is reconstruction of the nasal skeleton to provide adequate structural support allowing for optimum functioning of the nasal airway while achieving an aesthetically pleasing result with the rest of the face. Overall, autogenous grafts, particularly cartilaginous types, have been the gold standard largely because of their large acceptance rate, durability, virtual lack of an immunogenic response, low infection, and extrusion rates<sup>7 12-15</sup>. 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 tissues with severe structural defects in which adequate septal tissue is not present<sup>7 12</sup>. The main disadvantage of the autogenous costal cartilage graft is its tendency to warp from tension forces on its surface<sup>16</sup>. The key to minimizing this effect is to make sure to carve the cartilage equally on each side, and thus maintain a balanced cross section of the graft<sup>6 8 17</sup>. Because most warp-

ing occurs within 15 to 60 min of harvesting, it is very important to wait for early warping to occur and reshape the graft before placement<sup>16 17</sup>. Possible warping defects can be prevented by using balanced carving, using rigid cartilage-bone fixation or laminated graft for dorsal augmentation, or by using a diced cartilage graft<sup>18-22</sup>. Long-term warping, especially in larger dorsal and columellar grafts, can be also overcome using K-wires as advocated by Gunter et al.<sup>6</sup>.

One of the most important advantages of autogenous rib cartilage is the low rate of infection and extrusion compared to other non-autogenous materials or alloplastic implants<sup>1 14</sup>. Various types of allografts have been used in reconstructive septorhinoplasty, particularly for dorsal augmentation, including silastic, high-density porous polyethylene (Medpor), and expanded polytetrafluoroethylene (Gore-Tex)<sup>7</sup>. Alloplastic implants have the advantages of being easy to use, readily available and an unlimited supply. Unfortunately, because of their permanent nature, many of these allografts are associated with long-term complications such as infection, migration, extrusion and palpability<sup>23-25</sup>. In contrast to conventional beliefs, some Asian surgeons report that autologous rib cartilage is associated with a relatively high complication rate and a relatively low aesthetic satisfaction outcome<sup>21</sup>. They also report that complications, especially infections in revision rhinoplasty cases, are related to the possibility of poor blood supply in the recipient area particularly when large masses of graft are used. In fact, multiple grafts may affect skin tension, and scar tissues from previous surgery can reduce the vascular supply to the graft site and increase the probability of infection<sup>21 26</sup>. The relatively high complication rate is also frequently observed in patients with bad lifestyle and related to a history of cocaine abuse and/or alcohol consumption or in smoker patients with metabolic diseases.

## Conclusions

In selected primary septorhinoplasty and in patients where there is previous compromise septal and conchal donor sites, the only alternative is to use distant autogenous tissue, homografts, or alloplastic materials. Autografts do not induce an immune response, and also have the lowest infection and extrusion rates of any currently available materials. Autogenous rib cartilage grafts are the gold standard for nasal reconstruction in patients with cartilage depletion and when large amounts of tissue are needed. We have found, according to other similar experiences, that autogenous costal cartilage grafting offers strength for nasal support to replace or augment missing tissue with similar tissue and recreates the nasal anatomy as close to normal as possible.

We conclude that autogenous rib cartilage grafts are an outstanding material in septorhinoplasty when structural, functional and aesthetic problems are present and when



**Fig. 5.** Above: saddle nose as the result of septoplasty with complications leading to almost total resorption of the septum and collapse of the cartilaginous vault. Below: the end result obtained by balancing the profile through reconstruction of the cartilaginous dorsum and excision of the osseous dorsum



**Fig. 6.** Intraoperative photograph of the case shown in Figure 5. Reconstruction of an L-shaped structure to support the dorsum completed with grafts to ensure the projection and definition of the tip.

an effective volume filling and reconstruction of the nasal structures are needed. Its use should however be adopted keeping in mind the possibility of complications.

### References

- 1 Porter JP. *Grafts in rhinoplasty, alloplastic vs autogenous.* Arch Otolaryngol Head Neck Surg 2000;126:558-61.
- 2 Brent B. *The versatile cartilage autograft: current trends in clinical transplantation.* Clin Plast Surg 1979;6:163-80.
- 3 Kim DW, Shah AR, Toriumi DM. *Concentric and eccentric carved costal cartilage.* Arch Facial Plast Surg 2006;8:42-6.
- 4 Agaoglu G, Erol OO. *In situ split costal cartilage graft harvesting through a small incision using a gouge.* Plast Reconstr Surg 2000;106:932-5.
- 5 Maas CS, Monhian N, Shah SB. *Implants in rhinoplasty.* Facial Plast Surg 1997;13:279-90.
- 6 Gunter JP, Clark CP, Friedman RM. *Internal stabilization of cartilaginous rib cartilage grafts in rhinoplasty: a barrier to cartilage warping.* Plast Reconstr Surg 1997;100:161-9.
- 7 Moshaver A, Gantous A. *The use of autogenous costal cartilage graft in septorhinoplasty.* Otolaryngol Head Neck Surg 2007;137:862-7.

- <sup>8</sup> Gibson T, Davis WB. *The distortion of autogenous cartilage grafts: its cause and prevention*. Br J Plast Surg 1958;10:257-73.
- <sup>9</sup> Lee M, Inman J, Ducic Y. *Central segment harvest of costal cartilage in rhinoplasty*. Laryngoscope 2011;121:2155-8.
- <sup>10</sup> Ansari K, Asaria J, Hilger P, et al. *Grafts and implants in rhinoplasty. Techniques and long-term results*. Operative Techniques in Otolaryngol 2008;19:42-58.
- <sup>11</sup> Yilmaz M, Vayvada H, Menderes A, et al. *Dorsal nasal augmentation with rib cartilage graft: long-term results and patient satisfaction*. J Craniofac Surg 2007;18:1457-62.
- <sup>12</sup> Araco A, Gravante G, Araco F, et al. *Autologous cartilage grafts rhinoplasties*. Aesthetic Plast Surg 2006;30:169-74.
- <sup>13</sup> Vuyk HD, Adamson PA. *Biomaterials in rhinoplasty*. Clin Otolaryngol 1998;23:209-17.
- <sup>14</sup> Adamson PA. *Grafts in rhinoplasty: autogenous grafts are superior to alloplastic*. Arch Otolaryngol Head Neck Surg 2000;126:561-2.
- <sup>15</sup> Toriumi DM. *Autogenous grafts are worth the extra time*. Arch Otolaryngol Head Neck Surg 2000;126:562-4.
- <sup>16</sup> Adams WP, Rohrich RJ, Gunter JP, et al. *The rate of warping in irradiated and nonirradiated homograft rib cartilage: a controlled comparison and clinical implications*. Plast Reconstr Surg 1999;103:265-70.
- <sup>17</sup> Cakmak O, Ergin T. *The versatile autogenous costal cartilage graft in septorhinoplasty*. Arch Facial Plast Surg 2002;4:172-6.
- <sup>18</sup> Swanepoel PF, Fysh R. *Laminated dorsal beam graft to eliminate postoperative twisting complications*. Arch Facial Plast Surg 2007;9:285-9.
- <sup>19</sup> Sherris DA, Kern EB. *The versatile autogenous rib graft in septorhinoplasty*. Am J Rhinol 1998;12:221-7.
- <sup>20</sup> Daniel RK. *Diced cartilage grafts in rhinoplasty surgery: current techniques and applications*. Plast Reconstr Surg 2008;122:1883-91.
- <sup>21</sup> Moon BJ, Lee HJ, Jang YJ. *Outcomes following rhinoplasty using autologous costal cartilage*. Arch Facial Plast Surg 2012;14:175-80.
- <sup>22</sup> Jang YJ, Min JY, Lau BC. *A multilayer cartilaginous tip-grafting technique for improved nasal tip refinement in Asian rhinoplasty*. Otolaryngol Head Neck Surg 2011;145:217-22.
- <sup>23</sup> Davis PKB, Jones SM. *The complications of silastic implants: experience with 137 consecutive cases*. Br J Plast Surg 1971;24:405-11.
- <sup>24</sup> Godin MS, Waldman R, Johnson CM. *The use of expanded polytetrafluoroethylene (Gore-Tex) in rhinoplasty*. Arch Otolaryngol Head Neck Surg 1995;121:1131-6.
- <sup>25</sup> Raghavan U, Jones NS, Romo R. *Immediate autogenous cartilage grafts in rhinoplasty after alloplastic implant rejection*. Arch Facial Plast Surg 2004;6:192-6.
- <sup>26</sup> Holt GR, Garner ET, McLarey D. *Postoperative sequelae and complications of rhinoplasty*. Otolaryngol Clin North Am 1987;20:853-76.

Received: December 15, 2012 - Accepted: January 7, 2013