



## REVIEW ARTICLE

## Secondary Rhinoplasty Using Autologous Rib Cartilage: A Review

Guillermo Navarro Santos, Sylvia Elizabeth Villarreal Navarro, Arturo Alanís Ibarra, Sergio Andrés de Lara Ovalle, Adriana Miroslava Pérez Peña and Esaú Floriano Sánchez\*

Department of Otolaryngology-Head and Neck Surgery, EMGS Medicine School and Central Military Hospital, México

\*Corresponding author: Esaú Floriano Sánchez, Department of Otolaryngology-Head and Neck Surgery, EMGS (Escuela Militar de Graduados de Sanidad) Medicine School; Batalla de Celaya 202, Lomas de Sotelo, Militar, Miguel Hidalgo, 11200 México, Tel: +52-55-5520-1545



### Abstract

Rhinoplasty is one of the most complex procedures in the cosmetic surgery field. Satisfactory long-term results rely on using grafts with enough strength for adequate support and low resorption rates. Grafts in septorhinoplasty can be obtained from autologous, homologous and alloplastic materials. Autologous rib cartilage is the graft material of choice for secondary rhinoplasty when enough septal cartilage is not available. In this review different types of grafts, techniques to avoid warping, complications and surgery techniques with emphasis on autologous rib cartilage are assessed.

### Keywords

Secondary rhinoplasty, Revision rhinoplasty, Rib, Costal cartilage, Review

### Abbreviations

K-wire: Kirschner Wire

an extensive analysis of the nasal deformities and anatomy is needed. An appropriate preoperative evaluation, including defining the nasal deformity, a thorough history and physical examination, and a meticulous aesthetic, facial and nasal analysis should be made. During the preoperative evaluation, the patient's psychological status should be assessed, according to Cochran, et al. 5% of patients that seek cosmetic surgery have body dysmorphic disorder [1].

During the evaluation, the surgeon must communicate clearly to the patient any potential limitation according to the revision surgery. Patients expectations should be parallel to realistic results. Revision rhinoplasty can be extremely challenging; the surgeon must accurately diagnose a problem in the nasal structure or function often dismissed by the previous surgeon. Addressing the distorted nasal anatomy, scar tissue and weakened nasal architecture is complex. Restoration of the nasal function and an esthetically appealing result are needed to have a satisfied patient [3].

### Evaluation of the Nose

The upper third dorsal irregularities are the third most frequent problem among patients looking for aesthetic surgery and the second most frequent surgeon finding [4].

The surgeon should ask about nasal obstructions and positions that worsen it. It is crucial to determine the exact location of the nasal valve collapse and define if the collapse is static or dynamic. A tip applicator can be used to support the lateral sidewall of the nose in

### Introduction

The incidence of primary rhinoplasties that require secondary revision goes among 5-12%. The most frequent causes of rhinoplasty deformities are due to displacement or distortion of anatomic structures and under or over-resection of the nasal framework.

Rhinoplasty is one of the most complex procedures in the cosmetic surgery field. Reconstruction of the nasal osseocartilaginous framework is the foundation of a successful secondary rhinoplasty [1,2]. Secondary surgery is usually addressed after 12 months from the previous rhinoplasty. In order to have a successful secondary rhinoplasty, an accurate clinical diagnosis and

several positions, as the patient is being questioned, in order to define the portion where the cartilaginous support is weakest. The Cottle maneuver is helpful to determine the most significant site of nasal obstruction. It is performed when the examiner elevates superiorly and laterally the cheek of the patient, opening the internal nasal valve. Lastly, elevation of the nasal tip should be done and if it relieves the patient nasal obstruction symptoms, and the nasal tip is ptotic, tip elevation should be planned for surgery [5].

## Grafts

Over the past years, the paradigm has changed from overaggressive and reductive rhinoplasty to greater use of augmentation [6]. Satisfactory long term results rely on using grafts with enough strength for adequate support and low resorption rates [2]. Grafts in septorhinoplasty can be obtained from autologous, homologous and alloplastic materials. Autogenous grafts are harvested from the same individual and can be of cartilage, bone and subcutaneous tissue [3]. Autologous cartilage has many advantages versus other kinds of grafts. It survives as a living tissue, has a minimal resorption, does not stimulate an immune response and has a predictable long-term clinical outcome [3,7]. They also have a higher compatibility, lower risk of infection and extrusion compared with homografts and alloplastic materials [6].

Despite alloplastic implants are better tolerated by Asians, that usually have thicker skin and soft tissue envelope, alloplastic materials are likely to have long term complications, such as deviation, infection, extrusion, contracted nose, palpability and an unnatural look [1,8].

Septal cartilage is the graft of choice in secondary rhinoplasty [1,3,6], due to its versatility and the fact that it can be harvested easily in the same field with minimal cosmetic or functional morbidity. According to Romo, et al., the total available septal cartilage ranges from 25 to 40 mm in length. Generally, in primary rhinoplasty, septal cartilage is harvested for grafting material. Hence, available septal cartilage in revision rhinoplasty is frequently limited [3].

Auricular cartilage is another source of cartilage graft. Concha cavum can provide cartilage for tip grafts or dorsal onlay grafts. The shape of the concha cymba makes a good grafting to reconstruct the lower lateral cartilage complex. Nevertheless, it is difficult to obtain and maintain the desired shape and contour due to flaccidity and numerous convolutions.

Autologous rib cartilage is the graft material of choice for secondary rhinoplasty when enough septal cartilage is not available. It is the most abundant source of cartilage for graft fabrication. Also, it provides the structural support and dorsal augmentation that it is usually needed when the deformities found are severe [1]. The

need for adequate volume and strength in this case, precludes the use of septal and auricular cartilage [8].

However, complications have been described for using rib cartilage for dorsal augmentation, as its tendency to warp and its donor-site morbidities, such as postoperative scarring and pneumothorax [9].

## Complications

Even though long-term complications associated with autologous rib cartilage are low, warping and hypertrophic chest scarring have relatively high rates [9]. Costal cartilage is often overlooked because of unpredictable warping that can jeopardize the aesthetic result [6]. Warping is considered the most frequent complication of rib cartilage graft use in rhinoplasty, with a rate of 10%.

Numerous methods have been proposed to prevent warping. The most frequently applied techniques were delaying grafting or immersing the graft in solution before shaping and insertion. Gunter has described the use of K-wires to stabilize the rib cartilage grafts, but complications like infection, pain, numbness of the anterior palatal mucosa and extrusion of the K-wire can happen [10,11]. The use of K-wires can prevent warping, especially in larger dorsal and columellar grafts [7].

Irradiation of homograft cartilage has been described to decrease rates of warping, but due to its potential resorption, surgeons are reluctant to use it. Gibson and Davis described the importance of minimizing warping by the technique of concentric carving, balanced cross-section of costal cartilage. Adams, et al. described a higher degree of warping in the peripheral samples than in the central sampled. David W. Kim, et al. described that less warping occurs when dorsal grafts are carved using a concentric technique instead of an eccentric technique of cutting [12]. Most warping happens within 15 to 60 min of harvesting; therefore, it is important to wait for early warping to occur and reshape the graft before placing it. Also, warping can be prevented by using balanced carving, rigid cartilage-bone fixation or using diced cartilage graft [7].

Despite the infection rates are low, it occurs in a context of revision surgery, long surgery time and use of perichondrium. It can be treated with drainage and intravenous antibiotics with complications found rare. Displacement of the cartilage has been described to be related to the surgeon's skill rather than the cartilage itself.

Association between hypertrophic chest scarring in African and Asian ethnicity have been described. Pneumothorax is a rare complication, but careful dissection preserving the posterior perichondrium is crucial to prevent this complication, while harvesting a rib cartilage [9].

## Costal Cartilage Harvesting

Some authors recommend asking for a rib X-ray series to look for possible calcifications. Even though this case its frequently present in older patients, it can be present in young patients, more commonly females. Calcification makes harvesting more difficult and if totally calcified, it cannot be used as a grafting material [13].

Rib cartilage harvesting can be performed from the right side to prevent confusion with cardiac chest pain. Or it can be harvested on the patients left side to facilitate a two-team approach. Ribs are counted from the sternomanubrial joint caudally. The choice of which rib to harvest depends on the amount of cartilage required and it should provide the straightest and longest segment. For dorsal onlay grafts, the cartilage of the fifth, sixth and seventh, if needed, is harvested. The incision is made directly over the chosen rib in male patients. In females, the incision is placed 5 mm above the inframammary fold and measures 5 cm in length. The incision should not extend beyond the medial extent of the inframammary fold, for aesthetic purposes [11].

After the markings have been made, the area is injected with 1% lidocaine with 1:100,000 epinephrine. The skin is incised with a #15 blade scalpel, and subcutaneous tissues are separated by electrocautery. In patients that had undergone into a mammary augmentation surgery, surgeon should have special caution by avoiding entering the capsule to not contaminate the implant pocket with skin flora. This can be prevented by making gentle cephalic traction on the implant, displacing it away from the area of dissection. When the muscular fascia its reached, it is important to palpate the underlying rib, in order to prevent a pneumothorax. Dissection of the subcutaneous tissue and external oblique muscles is continued. Muscle fibers are separated with Kelly forceps, instead of being cut, in order to minimize postoperative pain. When the fascia is reached and a rib is selected, two parallel incisions are made along the superior and inferior borders of the rib cartilage and until the chondrocostal junction. Several small "T" shaped incisions are made medial and lateral extent to facilitate the reflection of the perichondrium.

Harvesting can be performed by an initial incision with a blade and the cartilage cut its completed with a Freer elevator [13]. After superior and inferior perichondrium elevation, rib cartilage can be harvested circumferentially, being cautious of the pleura on the medial surface and the neuro-vascular bundle inferiorly. Preserving the inner lamella of the rib is recommended, in order to reduce postoperative pain, splinting and pneumothorax. The zone is irrigated with physiological saline solution and performing a Valsalva maneuver. If air is noted, a Nelaton catheter should be inserted at the tear site in the parietal pleura and into the thoracic cavity [14]. The anesthesiologist should apply positive airway

pressure and the Nelaton catheter is removed while applying negative pressure. If there is any doubt related to the effectiveness of the procedure, a postoperative chest radiography should be made [2]. The separated muscles are approximated, and the wound is closed using 4-0 vicryl. Skin is sutured with 6-0 nylon which is removed on the seventh postoperative day.

Our research it is self-funded. The authors declare that they have not received funding from any organization.

The authors declare that they have no conflict of interest.

The authors declare that they contributed equally and have jointly supervised the work.

## References

1. Cochran CS, Gunter JP (2010) Secondary rhinoplasty and the use of autogenous rib cartilage grafts. *Clin Plast Surg* 37: 371-382.
2. Gunter J, Cochran C, Marin V (2008) Dorsal Augmentation with Autogenous Rib Cartilage. *Semin Plast Surg* 22: 74-89.
3. Romo T, Kwak ES (2006) Nasal Grafts and Implants in Revision Rhinoplasty. *Facial Plast Surg Clin North Am* 14: 373-387.
4. Kreutzer C, Hoehne J, Gubisch W, Rezaeian F, Haack S (2017) Free diced cartilage: A new application of diced cartilage grafts in primary and secondary rhinoplasty. *Plast Reconstr Surg* 140: 461-470.
5. Liang J, Kim JE, Sykes J (2013) Management of the middle third in revision rhinoplasty. *Adv Aesthetic Rhinoplasty: Art, Sci New Clin Tech* 1: 1083-1093.
6. Sajjadian A, Rubinstein R, Naghshineh N (2010) Current status of grafts and implants in rhinoplasty: Part i. autologous grafts. *Plast Reconstr Surg* 125: 40-49.
7. Moretti A, Sciuto S (2013) Rib grafts in septorhinoplasty. *Acta Otorhinolaryngol Ital* 33: 190-195.
8. Won T-B, Jin H-R (2019) Revision rhinoplasty using autologous rib cartilage in Asians. *Plast Aesthetic Res* 2019: 6.
9. Wee JH, Park MH, Oh S, Jin HR (2015) Complications associated with autologous rib cartilage use in rhinoplasty: A meta-analysis. *JAMA Facial Plast Surg* 17: 49-55.
10. Loghmani S, Loghmani A, Maraki F (2019) Oblique split rib graft surgery in primary and secondary septorhinoplasty. *World J Plast Surg* 8: 237-244.
11. Marin VP, Landecker A, Gunter JP (2008) Harvesting Rib Cartilage Grafts for for secondary rhinoplasty. *Plast Reconstr Surg* 121: 1442-1448.
12. Kim DW, Shah AR, Toriumi DM (2006) Concentric and Eccentric carved costal cartilage. *Arch Facial Plast Surg* 8: 42-46.
13. Kim JY, Han JJ, Sunwoo WS, Koo JW, Oh SH, et al. (2018) Sudden sensorineural hearing loss in children and adolescents: Clinical characteristics and age-related prognosis. *Auris Nasus Larynx* 45: 447-455.
14. Ortega FG, Pio RG, Muñoz SD, Pinto CJL, Cardemil MF (2017) Injerto costal para reconstrucción nasal: Experiencia de 6 años en el Hospital San Juan de Dios. *Rev Otorrinolaringol y Cirugía Cabeza y Cuello* 77: 44-50.