Invited Review / Davetli Derleme

The use and possible complications of graft materials in rhinoplasty

Rinoplastide greft materyallerinin kullanımı ve muhtemel komplikasyonları

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Rhinoplasty is indicated for improving nasal breathing, the appearance of the nose, mental well-being and self-confidence. In rhinoplasty, the most important factors are the surgeon's experience and sense of balance and beauty. Facial beauty is related to balance and the symmetry of different parts of the face, including the nose. Balance can be achieved by augmentation or reduction of the various parts of the nose. In rhinoplasty surgery, grafting has become the most widely used technique as well as suture techniques. Currently, grafting is frequently used to support the nasal structure, augment the nose, and correct the nasal contour both in primary and revision rhinoplasty surgery. Therefore, it is expected that surgeon must be comfortable with grafting techniques. Of note, not only the use of suitable surgical techniques, but also the surgeon's experience, patient selection, and regular follow-up influence the success of the procedure.

Key Words: Graft; review; rhinoplasty.

Rinoplasti, burundan yapılan solunumu, burnun görüntüsünü, zihinsel iyilik halini ve özgüveni iyileştirmek için yapılır. Rinoplastide en önemli etmenler cerrahın deneyimi ve denge ve güzellik hissidir. Yüz güzelliği, burun başta olmak üzere, yüzdeki unsurların denge ve simetrisine bağlıdır. Denge ise, burnun çeşitli kısımlarının büyütülmesi veya küçültülmesi ile elde edilebilir. Rinoplasti ameliyatlarında greftleme, dikiş tekniklerinin yanı sıra, en sık kullanılan tekniktir. Günümüzde hem primer hem de revizyon rinoplasti ameliyatlarında burun yapısını desteklemek, burnu büyütmek ve burun konturunu düzletmek için greftleme sıkça kullanılır. Bu nedenle cerrahın greftleme tekniklerine hakim olması beklenir. Bunun yanı sıra uygun cerrahi tekniklerin kullanımı, cerrahın deneyimi, hasta seçimi ve düzenli takip işlemin başarısını etkiler.

Anahtar Sözcükler: Greft; yorum; rinoplasti.

In the last 20 years, the field of aesthetic and reconstructive nasal surgery has seen remarkable growth and development, evolving from primarily closed rhinoplasty and reduction surgery to open rhinoplasty with appropriate reconstruction of both the aesthetic and reconstructive defect. During the surgical improvement in rhinoplasty next to suture techniques, grafting has become

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the most-used technique in rhinoplasty surgery. Grafting is currently used to support the nasal structure, to augment the nose, and to correct the nasal contour both in primary and revision rhinoplasty cases. Therefore, grafting techniques should be learnt in detail. This article aims to review the usage and complications of augmentation, contour and camouflage grafts in rhinoplasty.

GRAFTS IN RHINOPLASTY

A graft can be any tissue or organ that is used for implantation or transplantation. Depending upon the source of harvest, grafts are classified as autografts, allografts (homografts), xenografts, and alloplastic grafts.

Autografts are tissue obtained from the patients themselves, i.e., the same organism. Allografts (homografts) are tissues obtained from the same species, especially human cadavers. Xenografts are not used in rhinoplasty because of the risk of graft versus host reactions when using tissues obtained from different species. Alloplasts are synthetic products.

An ideal grafting material should have compatible physical properties.[1] For example, in the cartilaginous part of the nose, any bony or stiff graft material may cause unnatural stiffness and easily fracture. Other properties of an ideal graft are: no inflammatory response, easily removed, not likely to migrate, easy to modify or mold, easy to obtain, resistant to infection, cost-effective, non-resorbable, not likely to transmit disease, non-carcinogenic, and easy to camouflage.

Unfortunately, there is no ideal graft material available today. All existing graft materials have both advantages and disadvantages as explained in this article.

Graft materials are primarily used to support the nasal structure, to provide contour or camouflage for defects, to augment the nose and to restore the nose to an aesthetic and functional ideal. Grafting can be performed via both open and endonasal approaches, so it depends on the surgeons' experience and preference.

AUTOGRAFTS

Autografts, tissues obtained from the same organism, are the best graft materials for rhinoplasty. Because they are biocompatible, a graft versus host reaction is not seen, they have less risk of infection and extrusion, and there is no potential to transmit diseases such as prion.

However, autografts have disadvantages as well. Donor site morbidity such as pneumothorax is possible after harvesting costal cartilage, and is the most important handicap in the use of autografts. Furthermore, because autografts are harvested simultaneously during an operation, the length of the procedure is increased. Although biocompatibility is an advantage in grafting, the resorption risk of the autograft can turn the advantage of biocompatibility into a disadvantage.

The most commonly used autografts in rhinoplasty are cartilage, especially septum, bone and fascia.

a) Cartilaginous grafts

Autogenous cartilage is generally the first choice in graft material for rhinoplasty.[2] Because it can survive without a vascular supply, the resorption rate of cartilage is much lower than that of a bone graft.[3] Moreover, when the perichondrium is left intact, less resorption is seen. Cartilage is also soft and pliable, and therefore provides a more natural feel to the nose than a bone graft.

The most important disadvantage of cartilaginous grafts is their tendency for warping. To prevent warping, the stresses should be balanced by trimming in "balanced cross-section" as described by Gibson and Davis.[4] In addition to this, placing a Kirschner wire (K-wire) centrally and longitudinally through the graft, as demonstrated by Gunter et al.[2] can reduce warping.

The best and most convenient source of cartilage graft is the septum, because it is harvested from the same operative field and does not induce an immune response.[5] To protect the midvault, a caudal and dorsal 10-15 mm width "L-shaped" strut should be preserved. For the additional length of a graft, a part of the perpendicular plate of ethmoid can be included to the cartilaginous graft.[6]

In the literature, there are few complications with septal cartilage grafts. Koybasi reported graft extrusion in a 25-year-old patient two years after septorhinoplasty.[7]

When septal cartilage is not available, especially in revision rhinoplasty cases, auricular and costal cartilages are the next best choices.

An auricular cartilage graft is harvested from the symba or concha. To preserve the structure of the auricle, the incision should be performed between the antihelical crest and concha. Subperichondrial elevation provides an easier dissection plane. Thus, the concha and symba are manifested and the auricular cartilage graft can be harvested. As a graft, because its thickness varies from person to person, it can be stiff or pliable. Murrell[8] used an auricular cartilage graft in 101 rhinoplasty cases. In seven cases, bilateral auricular cartilage grafts had been harvested. There were two cases of donor site ulceration, one of which resulted in a pinpoint fistula in the ear. In the other case, graft migration was seen.

When a large amount of graft tissue is needed, especially in revision rhinoplasty cases, a costal cartilage graft is harvested via submammary incision from the fifth or sixth rib. To diminish postoperative pain, intercostal nerves and vessels should not be injured. It is advised that the perichondrium of a costal graft should be dissected in order to reduce warping.[9] Although one of the more serious complications in costal cartilage grafting is known as pneumothorax, to our knowledge, the incidence of this complication has not been reported in the medical literature. Moshaver and Gantous[10] used costal cartilage grafts in 37 rhinoplasty cases, and reported that only one patient had a donor site skin infection while two patients had columellar skin infections. Baek et al.[11] used costal cartilage grafts in 28 rhinoplasty cases, and there were parietal pleura violations in four patients, but no clinically significant pneumothorax had been documented. Moon et al.[12] analyzed 108 rhinoplasty cases via costal cartilage graft. Of the 13 patients with donor site complications, nine patients had a seroma in the chest wound, one patient had pneumothorax which resolved after two days, and two patients had developed a keloid scar on the chest wound.

b) Bone grafts

When the deformity is severe and cannot be corrected with cartilage grafts, as in the case of saddle nose deformity, a bone graft can be used. Compared to cartilage graft materials, bone is difficult to shape and fix to the recipient site. Because membranous bones such as calvarial bone grafts have less resorption than endochondral bone grafts such as rib and iliac crest, they have become popular in grafting.[13] Cil et al.[14] used iliac crest bone grafts in nine cases with crooked noses. On 18-month follow-up evaluation there was no resorption, extrusion or infection and no donor site complications.

Because of its strength, low resorption rate, low donor site morbidity and proximity to the operation site, a calvarial bone graft is also preferable in rhinoplasty. Romo et al.[15] used calvarial bone grafts in the nasal reconstruction of 17 patients. There were no major complications, including hematoma, cerebrospinal fluid leak, or infection.

Özturan et al.[16] described a new autologous bone graft, inferior turbinate bone. Because it is in the same operative field, the harvesting of inferior turbinate bone is easier than other bone grafts. At a 13-month follow-up evaluation, using three-dimensional computed tomography, it is demonstrated that the reconstructed area was mostly free of postoperative resorption. However, as Ozturan et al.[16] commented, for this graft technique, multiple applications and longer follow-up periods are needed.

c) Fascia grafts

To camouflage bone and cartilage irregularities, autologous soft tissue grafts are used, such as temporalis fascia and fascia lata grafts.

A temporalis fascia graft is harvested easily. Its thickness is approximately 2-3 mm and some authors[17] prefer using two thin layers of temporalis fascia in rhinoplasty procedures. Temporalis fascia is also used as a wrap material for diced cartilage.[18,19] Besharatizadeh et al.[20] used temporalis fascia grafts for augmentation in 15 rhinoplasty cases. A minor hematoma at the donor site was observed in just one patient. At the recipient site, there was no infection, persistent erythema of nasal skin extrusion, displacement, or irregularity of the graft contour.

Fascia lata grafts were used in the treatment of upper eyelid ptosis before usage in rhinoplasty.[21] Recently, for dorsal augmentation in rhinoplasty, Jang et al.[22] described the use of autoplastic processed fascia lata as an allograft. The use of fascia lata graft as an autogenous graft for nasal dorsal contouring and camouflage was first reported by Karaaltın et al.[23] Because fascia lata is thicker than temporalis fascia as a camouflage graft, better results have been observed in the long term. Fascia lata was used in 63 cases, and

in only one of them had seroma been observed at the donor site. In addition to this, Karaaltın et al.[24] used autologous fascia lata grafts for contour restoration and camouflage in tertiary rhinoplasty of 23 patients.

Dermal fat is also used as an autologous graft in rhinoplasty, but due to its easy resorption, it is not preferable.[25]

ALLOGRAFTS

Allografts (homografts) are tissues obtained from the same species, specifically human cadavers. The advantages of allografts are that there is no donor site morbidity risk, no limit to the supply, and no increase in surgical time. They are also accepted as biocompatible like autografts. However, because allografts are harvested from different organisms, infection rates increase, especially the transmission of prions. Other disadvantages are the higher cost, increased resorption rate, and extrusion.

Bone allografts are used commonly in orthopedics, oral surgery and spinal surgery. In rhinoplasty, the most commonly used allografts are irradiated costal bone and cartilage, because of the serious complication risks of harvesting costal cartilage autograft material. Costal cartilage is obtained from donors younger than 25 years, thus the risk of rib calcification is eliminated. Donors have been screened for systemic diseases, local infections, metastatic cancer, intravenous drug use, venereal diseases, hepatitis and human immunodeficiency virus. A study of 357 patients by Kridel et al.,[26] used irradiated homologous costal cartilage grafts. At the mean 13.45-year-follow-up evaluation, the total complication rate was 3.25%, including ten warped grafts, nine infections at recipient site, five infective resorptions, five non-infective resorptions, and three occasions of graft mobility.

In rhinoplasty the most commonly used homograft is alloderm. Alloderm is a freeze-dried acellular allogenic cadaver dermis. It can be used directly or with other autologous grafts as a camouflage graft. Gryskiewicz[27] had used alloderm for dorsal augmentation. In a one-year follow-up, there were no absorption and contour changes with patients.

ALLOPLASTS

Alloplasts are manufactured products. Alloplastic grafts are preferred because of their unlimited availability and lack of donor site morbidity, although the risk of stimulating an aggressive foreign body reaction that can lead to extrusion limits their usage.

Silicone is an alloplast graft which has no pores, so no tissue ingrowth reaction is seen with its usage. Because silicone is a stiff implant, it remains slightly mobile and it has a high extrusion risk. Wang et al.[28] used silicone sheets in 27 patients, one of them was not been satisfied from the result of procedure. In one patient extrusion occurred and in another infection was observed.

Gore-Tex® is an expanded polytetra-fluoroethylene polymer. Because of its porous texture, soft tissue infiltration and cellular attachment are seen. Over a 17-year period, Conrad et al.[29] studied 521 patients that underwent Gore-Tex® implantation rhinoplasty. In 33 cases, surgically or biologically related complications were observed and 11 underwent replacement with autogenous cartilage because of extrusion and infection.[29] İnanlı et al.[30] used Gore-Tex® for dorsal augmentation in 74 patients. During the mean 28-month follow-up period, no complications were recorded.

Medpore® is a porous high density polyethylene sheet. Compared to Gore-Tex® as an alloplast, it is a more rigid graft material. Han et al.[31] used Medpore® for the Westernization of the Asian nose in 58 patients who had a limited amount of septal cartilage. In only two cases had graft material been exposed.

Synthetic absorbables, such as Surgicel methylcellulose, are also used in rhinoplasty as an alloplastic graft material. Turkish delight is a Surgicel-wrapped diced cartilage described by Erol[32] In fact, it is a combination of autologous and alloplastic graft materials. Harvested autologous cartilage graft from the septum, concha, or rib is diced into pieces of 0.5-1 mm. One cubic centimeter of the patient's blood and an antibiotic (rifamycin) are added to cartilage mass and mixed. Then, this fine-textured cartilage mass is wrapped in Surgicel to obtain a cylindrical form. It is molded with the fingers into a suitable form. Erol[32] used the technique to treat 2,365 patients and followed them for 10 years. In only 16 patients (0.7%) had overcorrection and/or fibrosis been observed. The rate of resorption was 0.5%. In rhinoplasty, Turkish delight has been used practically since

after Erol[32] introduced it. Daniel and Calvert[33] used also diced cartilage as a camouflage graft successfully without complication. However, Arslan et al.[34] researched 32 patients that underwent rhinoplasty surgery with the help of Turkish delight grafts. Nineteen patients with a history of trauma had not maintained their long-term volume in a standard fashion. Consequently, Arslan et al.[34] prefer not to use diced cartilage from a traumatized origin for any purpose.

In conclusion, comparing autologous, homologous, and alloplastic grafts, the most-used graft materials are autogenous grafts because they are easily harvested, biocompatible, and cost effective. The lowest infection rate and revision rate are seen in autogenous cartilage grafts. The highest resorption rate is seen in homologous grafts.[35] In contrast to other graft materials, alloplastic grafts have no warping risk. Because of their non-porous texture, silicone grafts are the most commonly-extruded grafts.[1] According to the advantages and disadvantages of graft materials, a convenient graft material should be decided before surgery, and performed properly. However, in rhinoplasty, not only the use of suitable surgical techniques, but also the surgeon's experience, patient selection, and periodic follow-up evaluations influence the procedure's success.

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