

Diced Cartilage Grafts Wrapped in Rectus Abdominis Fascia for Nasal Dorsum Augmentation

Nazim Cerkes, M.D.
Karaca Basaran, M.D.

Istanbul, Turkey



Background: Dorsum augmentation is one of the most delicate components of rhinoplasty. Although various solid grafts have been used in the past for this purpose, diced cartilage grafts wrapped in fascia have become popular in recent decades. In this study, the authors analyze and discuss the results of using diced cartilage grafts wrapped in rectus abdominis muscle fascia for dorsal augmentation.

Methods: Nasal dorsum augmentation using the diced cartilage wrapped in rectus abdominis fascia technique was performed on 109 patients between 2008 and 2014. Six patients were primary cases, 69 patients were secondary, and 18 were tertiary. Sixteen patients had previously undergone more than three operations. In all patients, the rectus abdominis fascia was harvested with the described technique and wrapped around the diced cartilages obtained from the costal cartilage.

Results: The average follow-up period was 19.6 months (range, 6 to 47 months). Satisfactory results were obtained with acceptable complications and revision rates. Three patients underwent reoperation because of overcorrection. Insufficient augmentation was seen in five patients. In four patients, infection developed after postoperative day 5. One patient complained of a hypertrophic scar on the donor site. None of the patients showed any symptoms indicating an abdominal hernia.

Conclusions: Techniques using diced cartilage grafts wrapped in fascia have now become the gold standard for dorsal augmentations. When it is considered that secondary cases requiring dorsal augmentation are usually those also needing costal cartilage grafts, rectus abdominis fascia becomes a useful carrier for diced cartilages, which is in the same donor area. (*Plast. Reconstr. Surg.* 137: 43, 2016.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

Rhinoplasty is one of the most challenging operations in plastic surgery. For an ideal outcome, subunits including the radix, dorsum, tip, and alar base should be addressed individually. Among these areas, reconstruction of the dorsum is usually of primary importance to form an ideal nose. In secondary cases where structural elements are overresected, dorsal augmentation is usually necessary to achieve a satisfactory outcome. Although the graft choice at this stage is at the surgeon's discretion, autogenous grafts are preferred because of their various advantages compared with alloplastic materials.¹

In overresected secondary rhinoplasty patients in particular, a large amount of cartilage is usually required for grafting that can be obtained from the

costal cartilage. Solid dorsal onlay grafts prepared from the costal cartilage for dorsal augmentation are associated with high rates of revision because of various problems, including resorption, warping, and graft visibility, in the long term.¹ Consequently, diced cartilage graft wrapped in fascia has been the method preferred by various authors in recent years.^{2,3}

According to the literature, use of the diced cartilage graft wrapped in fascia technique first began during the 1940s.⁴ However, the technique was repopularized following the study conducted by Erol on 2365 patients where he used the diced cartilage graft wrapped in Surgicel modification (Ethicon, Inc., Somerville, N.J.).⁵ After this study, various advantages of the diced cartilage technique were highlighted and different variations of the technique were described. The most prominent

From private practice and the Department of Plastic, Reconstructive, and Aesthetic Surgery, Bagcilar Research and Training Hospital.

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DOI: 10.1097/PRS.0000000000001876

Disclosure: Neither of the authors has a financial interest in any of the products or devices mentioned in this article.

among them is the technique described by Daniel and Calvert, where the diced cartilage is wrapped in deep temporal fascia.⁶ In this method, if the reconstruction is performed using the costal cartilage, an additional donor site is required for harvest of the temporal fascia. However, to eliminate an additional donor site and to shorten the operating time, the fascia of the rectus abdominis muscle can be obtained through the same incision during the costal cartilage harvest and then used to prepare the diced cartilage grafts. Within the past 6 years, the fascia of the rectus abdominis muscle has been used to wrap the diced cartilage grafts in 109 patients in whom the dorsal augmentation was performed using costal cartilage. In this study, the advantages and disadvantages of the diced cartilage wrapped in rectus abdominis fascia technique along with the aesthetic outcomes are discussed.

PATIENTS AND METHODS

In the present study, 109 patients with a mean age of 27 years (range, 19 to 38 years) who were operated on between 2008 and 2014 were enrolled. All patients included in this study required dorsal augmentation. Sixty-three patients were women and 46 were men. Sixty-nine patients had undergone one prior operation, 18 had undergone two operations, 11 had undergone three operations, four had undergone four operations, and one patient had undergone seven previous operations. Six patients were operated on for the first time. Among these primary patients, three patients were operated on for dorsal augmentation, two for correction of cleft-lip nose deformities and one for reconstruction of Binder syndrome. The open rhinoplasty technique was used in all of the patients, and costal cartilage was the preferred cartilage graft. During the postoperative period, the patients were followed up to evaluate the results and possible complications at months 1, 3, 6, 12, and 24. The results were documented clinically and photographically.

Surgical Technique

Using the open rhinoplasty technique, the nasal dorsal skin flap is elevated through a mid-columellar inverted-V incision. In patients who require structural grafting, the necessary dissections are performed on the septal and alar cartilages (Fig. 1). Osteotomies are performed when required. After the nasal anatomy and the existing deformities are revealed, the graft harvesting procedure is initiated. The donor site is infiltrated

with a mean volume of 8 to 10 cc of 1:200,000 bupivacaine/adrenaline solution. In female patients, a 4.5- to 5-cm incision is made 5 cm laterally from the midline along the inframammary fold. In male patients, the incision is kept shorter, usually approximately 2.5 to 3 cm, and placed exactly on the rib cartilage to be harvested. The skin and the subcutaneous tissues are dissected with a monopolar cautery. Below the Scarpa fascia, the fascia of the rectus abdominis muscle is reached. The skin flap is undermined inferiorly above the superior portion of the rectus abdominis muscle and the external fascia of the rectus abdominis muscle is exposed. Harvesting of the rectus abdominis fascia graft is started with a transverse incision approximately 3 cm below the xiphoid process and 1 to 1.5 cm laterally from the linea alba using a no. 15 blade. Then, vertical incisions parallel to the linea alba and another transverse incision inferiorly are performed on the fascia. The attachments to the underlying muscle are dissected off using pointed scissors, and approximately 5 × 5 cm of rectus abdominis fascia is harvested. Subsequently, the rectus abdominis muscle fibers are split longitudinally and the cartilaginous portion of the sixth rib is exposed. An incision is made on the perichondrium parallel to the longitudinal axis of the rib cartilage with a no. 15 blade and then the perichondrium is elevated using a blunt-curved dissector and the rib cartilage is harvested. In patients requiring a larger amount of cartilage, the rib cartilage is obtained in full thickness, whereas in some cases only the required amount of cartilage is harvested from the lower portion of the rib cartilage. After harvesting the fascia and cartilage grafts, a Jackson-Pratt drain is placed and the donor site is repaired in layers. The skin closure is performed intradermally using 4-0 poliglecaprone. For structural grafts (e.g., septal L-strut, spreader grafts, columellar strut, lateral crural grafts), the central and straight parts of the rib cartilage are preferred. The remaining parts of the rib cartilage are diced into small pieces smaller than 0.3 × 0.3 mm using a no. 11 blade. It should be noted that, in older patients, the costal cartilages can be found to be calcified. For those cases, the outer portion of the cartilage can be used, and a larger, no. 20 blade can be used for dicing. The diced cartilage grafts are filled in a 1-cc tuberculin syringe.

Next, the fascial sleeve is prepared. The dimensions of the sleeve are planned according to the dorsal defect. The rectus abdominis fascia is pinned and folded on a silastic block and the fascial sleeve is constructed with 5-0 rapid Vicryl

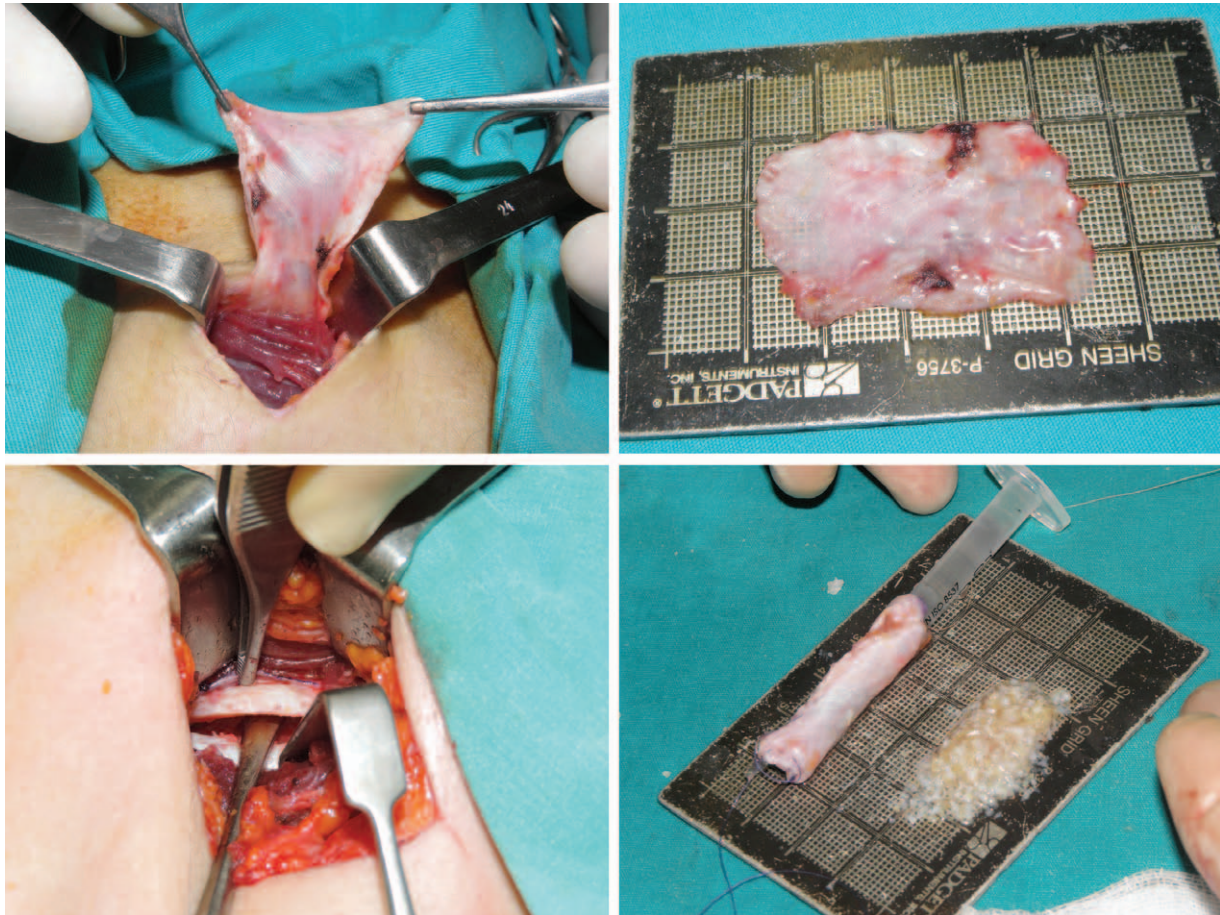


Fig. 1. (Above, left) The rectus abdominis fascia is dissected off from the underlying muscle. (Above, right) The harvested rectus abdominis fascia. (Below, left) The lower half of the sixth rib cartilage is separated and ready for harvest. (Below, right) The fascial sleeve is constructed and slipped into a 1-cc tuberculin syringe. Note that the rib cartilage is diced into very small bits.

running sutures. The cephalic end of the sleeve is closed with sutures. After preparation of the fascial sleeve, the syringe is slipped into the sleeve through the open end and the sleeve is filled with diced cartilage until the desired thickness is obtained. The caudal end of the sleeve remains open. The graft is molded on a flat surface using the index finger, and excessive diced cartilage is removed if required.

After performing structural reconstruction of the septum and nasal tip cartilages using the strut grafts prepared from the costal cartilage, the diced cartilage wrapped in rectus abdominis fascia graft is placed for dorsal augmentation. Then, 5-0 rapid Vicryl (Ethicon) sutures are placed on each side of the cranial tip of the diced cartilage wrapped in rectus abdominis fascia graft for pull-out suturing. The skin flap is lifted up with an Aufricht retractor and the two pull-out sutures are passed through the skin on both sides of the radix. Under direct visualization, the diced cartilage wrapped in rectus abdominis fascia graft is

slipped into the recipient bed using a forceps. To stabilize the graft on the midline, the caudal end of the graft is fixed either to the soft tissues below the lateral crura or to the upper lateral cartilages using one or two 5-0 rapid Vicryl sutures on each side. The mid-columellar incision is closed using 6-0 rapid Vicryl and the intranasal incisions are closed with 5-0 rapid Vicryl. Intranasal Doyle splints are used in patients who have a septoplasty or septal reconstruction. A thermoplastic Denver splint is placed on the dorsum.

RESULTS

All of the patients were followed up for an average period of 19.6 months (range, 6 to 47 months). The overall evaluation was performed by inspection, palpation, and photographic documentation. All of the patients were asked about their satisfaction 1 year after their operation. The patients were simply asked whether they were satisfied with the result or not. Ninety-three of the

109 patients (85 percent) answered this question as “yes.” No major graft resorption was observed in the patients, excluding the ones with postoperative infection (Figs. 2 through 5).

In four patients, postoperative infection was seen. All of these patients were treated with antibiotic therapy together with drainage. In one of these patients, methicillin resistant *Staphylococcus aureus* was detected in microbiological culture. Total graft resorption occurred in three cases, and in one case the graft was lost partially.

Dorsal overcorrection was observed in three patients. In two of these patients, dorsal reduction using the closed technique was performed at postoperative months 12 and 16, respectively. A simple intercartilaginous incision was performed and the dorsal graft was visualized. A stepwise reduction was performed with a no. 11 blade to diminish the previous solidified graft placed on the dorsum. No other revision was performed in addition. In one patient, the graft was removed completely and replaced after reshaping (Fig. 6). In that patient, it was seen that the diced cartilage graft was solidified and viable. Inadequate augmentation was observed in four patients. In one of these patients, a revision dorsal augmentation was performed through the closed technique using a diced cartilage wrapped in fascia graft prepared from deep temporal fascia and conchal cartilage. In one patient requiring a minor augmentation, revision was performed using an onlay graft prepared from mastoid fascia and mastoid soft tissues. The remaining two patients did not accept a revision. One patient had a tip revision using rib cartilage, but no further intervention was performed to the diced cartilage wrapped in rectus abdominis fascia graft.

In terms of the donor-site complications, a seroma was observed at the donor site in one patient. Following repetitive aspirations, total healing occurred. In one male patient, hypertrophic scarring was seen. However, the patient did not want any treatment for his scar.

During the follow-up visits at months 3, 6, and 12, patients were asked to increase the intraabdominal pressure to examine for the presence of an abdominal hernia. None of the patients showed any symptoms indicating an abdominal hernia or rectus diastasis. Removal of the fascia did not cause a bulging of the rectus abdominis muscle in any patients.

DISCUSSION

Dorsum augmentation is one of the most delicate parts of reconstructive rhinoplasty. Several

methods have been used to achieve adequate dorsal augmentation. Although the diced cartilage techniques have come to the forefront in recent years, there have been various alternative methods in use for decades.⁷⁻¹¹ Among these, autologous cartilage grafts have several advantages in terms of survival, shaping, and donor-site morbidity.⁷ However, warping and visibility of the graft contours can be a problem in the long term, particularly for the rib grafts. Revision rates for large solid dorsal onlay grafts carved from the rib cartilage are fairly high, even for the most experienced surgeons.

The complications observed with the use of solid onlay cartilage grafts have led to the concept of “diced cartilage,” which is an easier and practical alternative for dorsal augmentation. Diced cartilage grafts were first used by Peer in 1943 to camouflage the previously placed cartilage grafts.¹² Cottle used the same technique for nasal contouring and augmentation in pediatric patients.¹³ In 1983, Wilflingseder used diced cartilages to obtain a semirigid cartilage in cranio-plasty.¹⁴ In the early 2000s, Erol published the long-term results of 2365 rhinoplasty patients for whom the diced cartilage was used and wrapped in Surgicel.⁵ Daniel and Calvert claimed that they followed the technique described by Erol, but discontinued the study because of severe graft loss in the early period.⁶ Similarly, Brenner et al. have histologically compared isolated cartilage grafts with diced cartilage grafts wrapped in Surgicel and deep temporal fascia in nude Rowlett rats. They observed that the cartilages wrapped in Surgicel contained the minimum cartilage cells, whereas those wrapped in fascia showed greater viability. Based on these findings, they claimed that Surgicel somehow caused inflammation and foreign body reaction, leading to secondary cartilage loss.¹⁵⁻¹⁷

Although we accept the technique described by Erol as an important milestone, the fact that cartilage viability is demonstratively affected has emphasized the importance of autogenous fascia. Diced cartilage and fascia grafts have been a widely accepted procedure in the past decade because of ease of preparation and several other advantages. Diced cartilage wrapped in fascia grafts can be prepared faster and do not have the risk of warping. Over a period of months, the diced cartilage solidifies, and the survival rate is comparable to that of solid grafts. The diced cartilage grafts can be prepared from the septum, ear, or rib cartilage. A perfect piece of cartilage is not needed for preparation of diced cartilage; any remaining cartilage pieces after septum and tip reconstruction can be used. The shape and

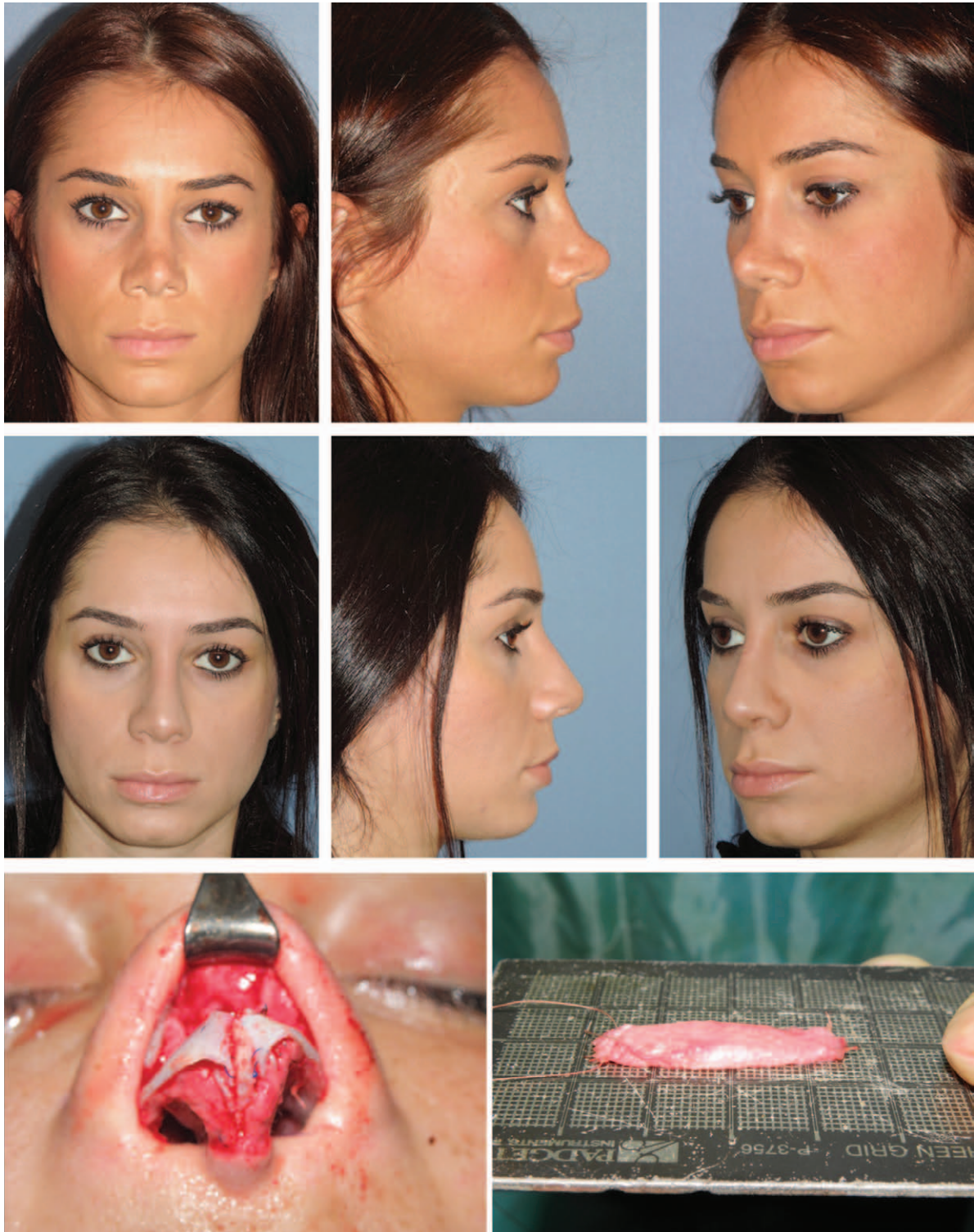


Fig. 2. (Above, left) A 23-year-old female patient who underwent rhinoplasty 3 years previously. She would like to have a more natural nose, with less tip projection and an augmented dorsum. (Above, center) Lateral view of the patient. (Above, right) Oblique view of the patient. (Below, left) The deformed lateral crural segments are resected. The nasal tip is reconstructed with a columellar strut and bent lateral crural grafts. (Center, left) Two-year postoperative anterior view. Tip projection is decreased and refined, nasal dorsum is augmented, and a more natural nose is achieved. (Center, center) Postoperative lateral view. (Center, right) Postoperative oblique view. (Below, right) A 2-mm-thick diced cartilage wrapped in rectus abdominis fascia graft is prepared and placed as a dorsal onlay graft for the dorsal augmentation.



Fig. 3. (Left) This 37-year old patient underwent primary rhinoplasty 4 years previously. The operation resulted in an overreduced dorsum. Two and a half years after the primary operation, a revision operation was performed by another surgeon and a solid dorsal onlay graft from the rib cartilage was placed to augment the nasal dorsum. A few months after this operation, the dorsal graft warped. At the examination, we observed that the septal cartilage was not stable and was overresected dorsally and caudally. (Right) Lateral view of the patient.



Fig. 4. (Above, left) The dorsal onlay graft that was placed in the previous operation is removed. (Above, right) An inferior portion of sixth rib cartilage is harvested. Septal L-strut reconstruction is performed initially. (Below) An 8-mm-thick diced cartilage wrapped



Fig. 5. (Left) Two years after the operation, the postoperative photograph shows a significant improvement in the aesthetic appearance. Functional improvement is also significant. (Right) Lateral view of the patient postoperatively.

thickness of the graft are easily customized, and the graft can fit to an irregular recipient bed. Another important advantage of diced cartilage wrapped in fascia graft is the absolute unification with the recipient bed, which may not occur in solid onlay grafts from rib cartilage. Molding of the graft is possible intraoperatively and in the early postoperative period to obtain a desired shape.

After the description by Daniel, we used the diced cartilage wrapped in deep temporal fascia technique in a number of patients in whom we performed dorsal augmentation. When the positive influence of an autogenous carrier (such as the deep temporal fascia) on cartilage viability was subsequently demonstrated, we thought that the rectus abdominis muscle fascia, which is similar to deep temporal fascia, could be used for this purpose. In patients in whom rib cartilage was used, we harvested the rectus abdominis fascia through the same incision for diced cartilage fascia grafting. The experience with over 100 cases showed us that comparable results without resorption of diced cartilage are obtained with the use of rectus abdominis fascia as a carrier.

We believe that the technique we described possesses certain advantages. Various advantages

Fig. 4. (Continued). in fascia graft is prepared using rectus abdominis fascia and rib cartilage. The graft is tapered on both ends. It is placed on the dorsum with pull-out sutures from the glabellar region.

of the diced cartilage wrapped in deep temporal fascia technique that have been previously mentioned are also valid for the diced cartilage wrapped in rectus abdominis fascia method. The most important advantage of the diced cartilage wrapped in rectus abdominis fascia method is avoiding additional donor-site morbidity in patients requiring the use of rib cartilage for structural reconstruction and dorsal augmentation. Harvesting of the rectus abdominis fascia is easier compared with the deep temporal fascia, and larger fascia grafts can be obtained from the upper portion of the rectus abdominis muscle. Excessive parts of the fascia graft can be used to camouflage irregularities if a nasal tip reconstruction is performed using rib cartilage.¹⁸ Because of its thickness, rectus abdominis fascia is very useful for camouflaging the sharp edges of the tip grafts.

Because the rectus abdominis muscle is covered with fascia on both anterior and posterior surfaces above the arcuate line, there is no significant risk for abdominal wall weakness or abdominal hernia. We have not seen this type of problem in any of our patients. Because the linea alba remains intact during fascia harvest, there is also no risk of rectus diastasis.

Although the thickness of the rectus abdominis fascia is different in every individual, the rectus abdominis fascia is approximately twice as thick as the deep temporal fascia. We think that it is more advantageous in secondary cases with thinned

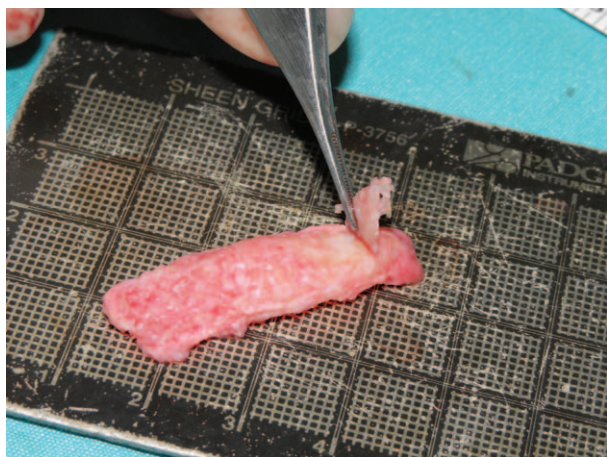


Fig. 6. A patient who had a revision of diced cartilage wrapped in rectus abdominis fascia graft. The graft is taken out. Intraoperative photograph shows that 8 months after the initial operation, the diced cartilage graft is solidified and viable. The graft is reshaped using a blade.

skin because of multiple operations. We did not observe any negative effects resulting from the greater thickness of the rectus abdominis fascia on viability of the cartilage grafts.

According to our subjective observations based on the approximately 170 dorsal augmentations we performed using the diced cartilage wrapped in fascia technique, there is no difference between the rectus abdominis fascia and deep temporal fascia methods in terms of graft survival. However, it is an interesting finding that the edema during the first 6 to 8 postoperative weeks is more prominent with the rectus abdominis fascia method. Although the comments listed above are subjective findings based on our experience, the study performed by As'adi et al. is worth mentioning with regard to obtaining objective data. In their study, the authors classified randomly 36 patients requiring dorsal augmentation with the diced cartilage wrapped in fascial sleeve technique. The control group included ones in which deep temporal fascia was used, whereas the intervention group included patients in which rectus abdominis fascia was used as a sleeve. They observed shorter operative and hospitalization times and higher satisfaction rates in the rectus abdominis fascia group. As we suggested in our study, they strongly recommended use of rectus abdominis fascia as a sleeve for diced cartilage in dorsal nasal augmentations.¹⁹

In our opinion, if the reconstruction is performed using rib cartilage, the rectus abdominis fascia should be the graft of choice for preparation of a diced cartilage wrapped in fascia dorsal

graft. This method eliminates an additional donor site and shortens the operating time. In patients in whom a septal cartilage or an auricular cartilage is used for reconstruction, deep temporal fascia can be preferred because of the proximity of the donor site. However, in male patients with a short haircut, rectus abdominis fascia can be preferred to deep temporal fascia even if a rib cartilage is not used. In female patients, an inframammary fold incision can be preferred to the temporal incision to eliminate the risk of alopecia at the incision line. If rib cartilage will not be used, the donor site for the fascia harvest should be discussed with the patient before surgery, and the decision is made according to the patient's preference. In three of our patients, we preferred the rectus abdominis fascia solely for these reasons, although we did not use rib cartilage.

CONCLUSIONS

Techniques involving diced cartilage wrapped in fascia grafts are very popular for nasal dorsal augmentation.² The majority of patients undergoing dorsal augmentation are secondary cases who require rib cartilage grafts. Therefore, diced cartilage wrapped in rectus abdominis fascia seems to be a more advantageous alternative compared with diced cartilage wrapped in deep temporal fascia because it does not necessitate an additional donor site.

Karaca Basaran, M.D.
BEAH

Mimar Sinan Caddesi 6
Sokak, Istanbul, Turkey
basarankaraca@gmail.com

PATIENT CONSENT

Patients provided written consent for the use of their images.

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