The achievement of successful results in rhinoplasty may require the use of autografts, homografts, or alloplastic materials. Among the alloplastics, Dacron is an easily handled and manipulated synthetic material, readily applicable to nasal augmentation. The following represents the indications, surgical technique, outcome results, and analysis of our experience with Dacron mesh implants to the nasal tip, dorsum, and lateral walls in 136 patients.

The goal of an optimal aesthetic result in rhinoplasty may necessitate the use of grafts or implants. The different categories of materials used to achieve this consist of autografts, homografts, and alloplasts. The most common autografts used in rhinoplasty include septal cartilage and bone, conchal cartilage, and costal cartilage and bone. Although preferred by several researchers for their biocompatibility, bone and cartilage autografts may be associated with certain complications, particularly the predictability of the aesthetic result.

Several types of alloplastic materials have been, and continue to be, used for dorsal and tip augmentation in rhinoplasty. We believe implants have a valuable role in rhinoplasty, provided the right implant material is chosen and the correct technique is used for the proper indication. Some different types of alloplastic implants used in rhinoplasty are as follows: polytetrafluoroethylenes, the most common being Gore-Tex (W. L. Gore Associates, Inc, Flagstaff, Ariz); silicone rubber (such as Silastic); polyethylene, such as Medpore (Porex, Fairburn, Ga) and Plastipore (Richards Manufacturing Company, Memphis, Tenn) and polyesters and polyamides, such as Dacron (Ethicon Inc, Somerville, NJ), Mersilene (Ethicon Inc), Supramid (S. Jackson Inc, Alexandria, Va), and the Cooley Dacron knitted implant (Meadox; Boston Scientific, Quincy, Mass). Dacron material implants have been extensively used in cardiovascular surgery, with the results of many long-term follow-up studies reported in the medical literature.

Dacron fabric (Cooley) is a polyethylene terephthalate woven into a tight nonresorbable mesh. It is a multifilament fabric supplied as a white fabric sheet. Its design allows minimal tissue ingrowth that is enough to maintain the implant position. The multifilament arrangement makes the implant not slippery during surgery; therefore, it stays wherever it is placed and almost sticks to its bed or to the overlying skin. In addition, this implant may be handled, cut, and shaped easily while retaining a certain degree of body. It does not shred, as encountered with other Dacron-type materials, such as Mersilene mesh. In addition, its soft nature makes it difficult to detect by skin palpation or visual inspection, even years after being implanted.

One of us (N.F.) reported his experience with 98 cases of tip augmentation using Dacron mesh (Mersilene mesh) in 1991. Subsequent to this, our use of Dacron has moved from the looser mesh form (Mersilene) to the fabric form (Cooley) because of the latter’s further ease of intraoperative manipulation and minimal shredding. However, this advantage of the fabric form is minimal. As far as clinical results are concerned, both Dacron materials are identical.
PATIENTS AND METHODS

PATIENTS

A retrospective analysis was performed, reviewing the results in 136 patients who underwent rhinoplasty with augmentation using Dacron implants. The indications for dorsum augmentation were a deep nasofrontal angle, a saddle deformity of the dorsum, or a depressed supratip area. Dorsal saddle deformity was the most common indication of dorsal correction.

Indications for tip augmentation were previously detailed. The 2 most common indications were a recessed tip and a wide tip.

The implant may also be used in the lateral wall to augment a depression, typically in cases of side-to-side nasal pyramid deviation.

All patients included in this study were asked several months postoperatively to rate their degree of satisfaction with the cosmetic result. The results were graded as very happy (n=68), happy (n=59), satisfied (n=4), and dissatisfied (n=5). The surgeon, at that same time, rated his own assessment of the aesthetic result. The different grades were very good (n=64), good (n=40), satisfactory (n=24), and unsatisfactory (n=8).

TECHNIQUE

Tip Augmentation

The technique used for tip implantation was previously described in detail by one of us (N.F.). Several critical points and some minor modifications will be emphasized. The fabric material (Cooley) is first folded onto itself to form a pad that is 2 to 8 layers thick and approximately 1 cm in width (from left to right) and 8 mm in height (from superior to inferior). The thickness of each layer is approximately 0.5 mm. Therefore, a 2-layer implant is approximately 1 mm thick, and an 8-layer implant is approximately 4 mm thick. The implant is shaped like either a lozenge (10 mm in width × 7 mm in height) (Figure 1A) or a triangle (10 mm [base] × 5 mm × 5 mm, with the apex pointing downward). The triangular shape is used often in cases of thick nasal skin with poor definition. Depending on the degree of tip recession, 2 to 8 layers (1-4 mm) may be used. Typically, the most common thickness used is 4 to 6 layers. A central through-and-through catgut suture is used to hold the layers together.

After outlining the position of the implant on the nasal tip preoperatively (Figure 1A), a rim incision of 1.0 to 1.5 cm is made along the caudal border of the right alar cartilage (Figure 1B). Dissection of a subcutaneous pocket, slightly larger than the size of the implant, is then performed (Figure 1C). The implant, soaked in bacitracin solution, is held horizontally with a curved mosquito clamp, making sure that the end of the mosquito clamp is horizontally placed across the implant and that the tip of the instrument is on the left end of the implant (Figure 1D). The implant is then inserted while pulling the right alar rim up using a double-sharp hook and while pushing the alar cartilages down with blunt scissors. The tip of the curved mosquito clamp is positioned at point b under the skin (Figure 1E), and the implant is aligned horizontally over the line ab. The upper and lower parts of the implant are then stabilized gently, with the fingers placed above and below the curved mosquito clamp over the skin; then, the mosquito clamp is widely opened and slowly withdrawn. One 0-0 catgut suture is placed at the midpoint of the incision for approximation.

Dorsum Augmentation

The superior and inferior ends of the long axis of the implant are marked superiorly and inferiorly on the skin.

RESULTS

This series consisted of 92 women and 44 men, for a male-female ratio of 1:2.1. The mean ± SD age of the patients was 26.5 ± 7.5 years for men and 28.9 ± 9.4 years for women. All rhinoplasties were performed by the same surgeon (N.F.). In 88 (65%) of the 136 procedures, only the tip was augmented, while in 45 (33%) of the patients, the tip and the dorsum or lateral walls were augmented. In 3 instances (2%), Dacron was used on the dorsum only.

All patients were prescribed intraoperative antibiotics: intravenous cefazolin, 1 g, when an allergy to penicillin was ruled out or intravenous erythromycin in the case of penicillin allergy. All patients were treated with oral antibiotics (such as erythromycin) for 1 week postoperatively for further prophylactic coverage.

The follow-up ranged from 7 months to 12 years (average, 37 months). The same operating surgeon (N.F.) performed the follow-up and assessment. Figures 4, 5, 6, 7, 8, 9, and 10 show examples of preoperative and postoperative results of Dacron implantations in various patients (lateral wall implants in Figure 4; dorsum and supratip implants in Figure 5; implants in a patient who underwent revision rhinoplasty in Figure 6; dorsal implant thickest at the nasofrontal angle superiorly in Figure 7; dorsal implant of equal thickness in Figure 8; tip implant only, representing the most common implant indication, in Figure 9; and long-term results in Figure 10).

The most significant complication was infection, which occurred in 9 (6.6%) of the patients. In all cases, the patient was immediately given oral antibiotics on diagnosis of the infection, and the implant was removed under local anesthesia as soon as possible. Removal of the implant was always performed without difficulty because there was little tissue infiltration or fibrous attachment in all of the patients with infection. In the case of a tip implant, a curved mosquito clamp is used to retrieve the implant through a small rim incision. In the case of a dorsal or lateral wall implant infection, the same technique is used through an intercartilaginous incision, but more dissection is required. It is important to accurately count the number of layers removed to ensure complete removal of the implant.

Ten implants were removed in these 9 patients. Eight were tip implants, and 2 were dorsal implants. In a single
of the nose along the midline (Figure 2). In the event the dorsal depression is deeper on one area (typically the middle of the dorsum at the level of the rhinion), a third mark is placed on the skin at that site to identify the area of maximum implant thickness. In general, the length of the implant varies from 2.5 to 3.5 cm, the width from 8 to 10 mm, and the thickness from 2 to 6 layers (1-3 mm). In some instances, the thickness may be greater than 6 layers. The implant may be uniform in thickness or may have an area of greater thickness, as previously indicated. The implant is then shaped in the following manner: the upper and lower ends of the implant are made triangular to ensure a gradual tapering of the implant ends. This avoids an abrupt step deformity after the swelling subsides postoperatively. Also, the implant sides, namely, the left and right borders, are tapered (angled) for the same purpose. If one area of the implant (eg, the central third) is thicker than the rest, a second implant is calculated, measured, and tapered like the first main implant. The shorter implant is then placed under the longer one, and an additional through-and-through catgut suture is used to attach both implants together.

If the dorsal dissection has not been completed, a 1.5-cm incision is made on the medial end of the right intercartilaginous incision at the area of the septal angle (Figure 2). A subcutaneous or supraperichondrial supraperiosteal pocket is dissected along the dorsum. The layers of the prepared dorsal implant are usually sutured about the center or at both ends with 4-0 chromic transfixion sutures to hold the layers together (Figure 2). The implant is then placed between the 2 sides of an angled nasal bayonet forceps, ensuring that the superior end of the implant is exactly at the closed tip of the angled forceps. An Aufricht dorsal retractor is used to elevate the dorsal nasal skin, while a curved mosquito clamp is used to retrieve and pull down on the lower edge of the intercartilaginous incision for better entry (Figure 3). The angled forceps embracing the implant is then introduced slowly within the dorsal skin pocket, sliding against the Aufricht elevator (rather than against the dorsum), until it reaches the upper mark on the nasal skin. The Aufricht retractor is then moved slowly backward and removed. The fingers of the left hand are placed gently on either side of the implant. The angled forceps is opened widely and then slowly retraced backwards, using a gentle rocking motion to avoid implant retraction or displacement during this maneuver. The incision is then inspected to ensure that the lower end of the implant is positioned at least 4 mm away from the closure site. A single 4-0 chromic suture is then used to close the incision.

Lateral Wall Augmentation

An incision is made through one or both intercartilaginous folds, depending on whether the depression is unilateral or bilateral. The implant marking, preparation, and insertion are similar to that described for the dorsum. However, the implant is typically much thinner, varying between 1 and 2 layers (0.5-1.0 mm). For lateral wall augmentation, 50% undercorrection is the rule, as the slightest overcorrection will be extremely noticeable a few months postoperatively. The shape is again triangular and tapered if more than one layer is used.

In rare cases, when the lateral wall depression extends inferiorly beyond the lower border of the upper lateral cartilage, the access incision may be made intracartilaginous through the alar cartilage. This is because the incision to the pocket has to be at least 4 mm inferior to the implant.

instance, tip and dorsal implants were removed. In all patients, the infection resolved within days of implant removal. Of the 9 patients, 6 underwent another procedure during which a second Dacron implant was inserted. The remaining 3 patients declined a second surgery. (It has been our experience that after implant removal, the area previously receiving the implant seems to retain a mild degree of augmentation. We have no explanation as to why this happens, but it could theoretically be due to granulation tissue formation as a reaction to the implant or the infection.)

A diagnosis of implant infection was based on purulent discharge at the site of the pocket incision, in addition to one or more of the following signs: swelling, tenderness, redness, or extrusion. The presence of discharge is definite proof of implant infection. In the absence of discharge, the patient is given antibiotics and checked almost daily to rule out the small possibility of a limited skin infection (eg, furuncle) not involving the implant.

Two patients underwent revision because of an unsatisfactory aesthetic result, where a tip implant had migrated slightly to the right and a dorsal implant was too thick. This was remedied under local anesthesia by trimming a portion of the implant, a somewhat tedious procedure. The noninfected implant is usually well attached to the skin and underlying structures. Dissecting the implant off the overlying skin is easier than freeing it from the underlying cartilage or bone. The surgeon may choose 1 of 3 approaches: (1) trim the excess (the hardest to do, because the implant is well integrated and the Cooley fabric is difficult to cut when invaded with granulation tissue); (2) remove the entire implant and replace it with a brand new one (the easiest approach); or (3) remove the implant, reshape it, and reinsert it (the only problem is fixing it in place, because it tends to be slippery).

Dacron fabric allografts are among the myriad of options available in rhinoplastic surgery. Although potential postoperative infection is a disadvantage, Dacron fabric implants are particularly desirable to use in many cases of augmentation rhinoplasty. In terms of the aesthetic result, they have several advantages, the most important of which is having an impressive natural appearance and feel that are hard to detect by either visual examination or manual palpation. They display no tendencies for curling or resorption over time and are unlikely to un-

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dergo displacement. In our series, no cases of resorption or implant distortion were observed. In addition, there is no donor site morbidity. Dacron fabric can be molded to assume any shape or thickness required, providing a controllable and smooth contour. The amount of available material is unlimited. Decreased surgical time contributes to lower morbidity and lower cost. Finally, Dacron has been used extensively as a cardiovascular implant and has an excellent long-term record.12-17

Other implantable materials commonly used have similar advantages, but certain drawbacks make them less desirable. Silastic, for example, a silicone rubber, has a firm consistency, therefore tending to feel like a foreign body under the skin. Also, it lacks pores, impeding tissue ingrowth and possibly contributing to implant displacement. Its surface is slippery, which may lead to malpositioning and which makes it hard to handle intraoperatively. Gore-Tex, which has been used in nasal augmentation,6-8 also tends to be slippery, causing possible displacement in the initial postoperative period, before tissue ingrowth has taken place. In addition, Gore-Tex has a whitish color, which may become visible externally, particularly in thin-skinned individu-
Figure 4. A and B, Preoperative views of a 29-year-old man with a narrow bony bridge and concave upper lateral walls more on the left side than on the right, a recessed upper dorsum, thick redundant skin at the supratip and tip areas, and a drooping nasal tip. C and D, Postoperative result 2 years 4 months following a rhinoplasty with lateral wall implants (just 1 layer on the right and 2 on the left) and dorsal and tip implants.

Figure 5. A and B, Preoperative views of a 29-year-old woman with a low dorsum and thick skin at the tip and supratip. C and D, Postoperative results 11 months following rhinoplasty with a dorsal implant thickest at the supratip area because of a resistant skin concavity at that area. A tip implant was also used.
Figure 6. A and B, Preoperative photographs of a 20-year-old man with a history of 3 previous septorhinoplasties. He presented with a turned-up asymmetrical tip, a recessed dorsum, and lateral wall depressions, more obvious on the left. C and D, Postoperative results 7 years 2 months following a revision rhinoplasty with dorsal, tip, and left lateral wall Dacron (Ethicon Inc, Somerville, NJ) implants.

Figure 7. A and B, Preoperative photograph of a 33-year-old man with a recessed ill-defined nasal tip, a low upper dorsum, and very thick nasal skin. C and D, Postoperative results 2 years 10 months following a rhinoplasty with a dorsal implant (thicker at the root of the nose) and a nasal tip implant.
Figure 8. A and B, Preoperative photographs of a 27-year-old man with a projecting tip and a low dorsum. C and D, Postoperative results 12 months following a rhinoplasty with a dorsal implant of uniform thickness and a tip implant.

Figure 9. A and B, Preoperative views of a 22-year-old woman who is a typical example of a nose surgery candidate with a dorsal hump and a somewhat wide nasal tip. C and D, Postoperative photographs 15 months after a regular rhinoplasty combined with the placement of a tip implant to achieve a well-defined yet natural-looking nasal tip. This case is a typical example of the use of the Dacron (Ethicon Inc, Somerville, NJ) nasal tip implant, which is more often used in the nasal tip than in the dorsum or lateral walls.
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REFERENCES