Objective: To evaluate a surgical technique used to straighten and support the crooked middle third of the nose.

Design: Retrospective review of 41 patients with a markedly crooked nose who underwent correction using extended spreader grafts made from high-density porous polyethylene. Follow-up ranged from 6 months to 2 years.

Results: Every patient had substantial improvement in the straightening of the middle third of the crooked nose and the airway in one procedure. There were no cases of extrusion or infection.

Conclusions: The extended spreader graft technique introduces structural reinforcement to permit straightening of the middle third of the nose. It is safe, effective, and reliable. The graft material provides increased strength against further trauma or the long-term forces of scar contracture. This technique has compelling benefits compared with all other techniques used to straighten the severely crooked middle third of the nose.

Arch Facial Plast Surg. 2005;7:74-80

Straightening the Crooked Middle Third of the Nose
Using Porous Polyethylene Extended Spreader Grafts

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A third option to straighten the crooked middle third of the nose involves the use of structural grafting. Several authors\textsuperscript{1,12,13} mention how spreader grafts may help straighten the crooked nose. Byrd et al\textsuperscript{13} describe the use of cartilage grafts to reinforce and straighten the middle third of the crooked nose. The technique extends the use of traditional spreader grafts, which have usually been used to provide airway support or to widen the middle third of the nose. Terkonda and Sykes\textsuperscript{1} mention using cartilaginous or bony struts along the dorsum for the same purpose. They used a drill to fashion suture holes in the ethmoid bones to increase suture stability of these grafts. This article extends this concept further to manage the difficult crooked middle third of the nose. Many patients with a crooked nose have undergone previous surgery and have a crooked septum, with little straight cartilage. High-density porous polyethylene (HDPP) has been used successfully in rhinoplasty for many years. It has been used for dorsal implants and as various struts.\textsuperscript{11} The use of this material to create spreader grafts has not been previously described, to our knowledge. High-density porous polyethylene provides adequate size and strength to create reliable extended spreader grafts to maintain a straight middle third of the nose.

**METHODS**

The nose is sterilized with povidone-iodine internally, as well as externally in cases in which an allograft is likely to be used. External rhinoplasty permits full exposure of the middle third of the nose to aid insertion of the grafts and more complete assessment of the dorsal septal pathologic condition. The dorsal septal cartilage is completely degloved by raising bilateral septal mucoperichondrial flaps and freeing the attachments of the upper lateral cartilage. Hump reduction and any osteotomies are completed if necessary. Standard techniques in the body of the septum, such as resection, shaving, and “swinging door,” are completed to create an adequate airway. A cartilaginous septal “L” strut is preserved, leaving at least 1 cm at the dorsum and caudal portion. At this stage, the septum is carefully inspected to determine the exact cause of the middle-third deformity. The crooked dorsal septal cartilage is crosshatched vigorously to break any deformities, such as fractures or concavities. Just before it is about to be reconstructed, it can be weakened aggressively, leaving a framework to guide placement of the HDPP implants. The keystone attachment between the cartilage and the perpendicular plate of the ethmoid at the rhinion is always preserved to eliminate the risk of a step deformity at this site. The HDPP extended spreader grafts are prepared. The grafts generally measure $3.5 \text{ cm} \times 5 \text{ mm}$ and are 0.85 mm thick (Figure 1). The grafts traverse the full length of the middle third of the nose and pass under the nasal bones to the ante-
rior septal angle (Figure 2). The dorsal edge of the implant runs immediately under the dorsal cartilage and does not protrude above it. The graft is never more than 5 mm in height to reduce entry into the nasal cavity. To reduce risk of infection, the graft is soaked in gentamicin sulfate before insertion and is not touched by glove or laid on fabric. A graft is placed on each side of the septum and stabilized to the septum with multiple 3-0 polydioxanone sutures (Figure 3).

The caudal ends of the grafts provide strong support for placement of sutures to the lower lateral cartilage or for a columellar

![Figure 4. A 24-year-old woman after previous rhinoseptoplasty (A and B) and after the surgery described herein (C and D).](image-url)
strut. The columnellar strut can be placed between the medial crura and sutured between the caudal ends of the 2 spreader grafts.

The upper lateral cartilage may be reattached to the middle third of the nose, and the nose is closed in routine fashion. Septal splints are often used and a routine taping plaster placed. The patient receives cephalothin sodium for 1 week.

RESULTS

I undertook 787 rhinoplasty cases between March 4, 2002, and March 1, 2004. The study group consisted of the 41 patients who had HDPP extended spreader grafts placed during this time. There were 26 men and 15 women, with a mean age of 34 years. Twenty cases were revision surgery, with the original surgery having been done elsewhere in every case. None of these patients have required revision surgery thus far.

Follow-up ranged from 6 months to 2 years. Results were documented by facial photography using frontal, lateral, and base views with the same camera, using a fixed focal length with a 100-mm lens (Figures 4, 5, 6, and 7). There were no cases of infection, extrusion, exposure, or palpability of the HDPP grafts.

A naive judge who was blinded to the preoperative and postoperative status of the patients viewed the clinical photographs. The crooked middle third of the nose became significantly straighter in every case.

COMMENT

Extended spreader grafts are a reliable and safe way to correct the crooked middle third of the nose. These grafts are indicated in all cases of significant deformity in which standard septoplasty techniques do not provide adequate straightening. They provide strength on each side of the dorsal septum when manipulating even the most difficult deformities. The grafts provide airway support by maintaining nasal structure when undertaking complete septal straightening in the airway and by provid-

Figure 5. A 24-year-old woman without previous surgery or trauma (A, B, and C) and after the surgery described herein (D, E, and F).
ing width to the nasal valve angle. The caudal end of the grafts serves as a strong anchor for sutures to directly support the nasal tip and the columella. The extended grafts provide increased strength to the bridge and can be used regardless of the state of the septal cartilage reserves.

Unlike most rhinoplasty populations, this subgroup of patients with a significantly crooked nose had a strong male predominance, which may be consistent with exposure to trauma. This social factor emphasizes the need to create a strong reconstruction when correcting the crooked nose. The standard techniques of cross-hatching and septal cartilage resection weaken the nose in a subgroup in whom increased strength is required. Apart from strengthening against accidental injury, extended spreader grafts are likely to resist the forces of scar contracture over the years.

Extended spreader grafts create a 3-layered dorsal septum, creating significant dorsal support. The middle third of the nose becomes stronger than the virgin nose, which has a single vertical cartilaginous support structure. Unlike anchored dorsal bone grafts, which provide an unnatural rock-like middle third, the nose can still be moved from side to side like a normal nose. Attachment at the keystone area between the perpendicular plate of the ethmoid and the septal cartilage is always preserved to maintain a smooth rhinion.

The amount of dorsal support with extended spreader grafts permits the surgeon to aggressively and adequately straighten the middle third of the crooked nose and the airway without fear that the nose will be weakened. In contrast, cross-hatching techniques force the surgeon to accept a compromise. Aggressive cross-hatching causes weakening and instability, and there is no supportive reinforcement. The weakened nose is vulnerable to the powerful force of scar tissue contraction over time and to injury. On the other hand, inadequate cross-hatching fails to correct the deformity. The extended spreader graft introduces a strong, straight, supportive element to the nose. This support provides guidance to keep the nose straight during healing.

Patients with a crooked middle third of the nose commonly have significant septal deviation blocking the airway. The extra support provided by the extended spreader grafts provides comfort when straightening the internal septum. The surgeon can use aggressive techniques on the airway without fear that the dorsum will collapse.

Figure 6. A 40-year-old woman with previous nasal trauma and rhinoseptoplasty (A, B, and C) and after the surgery described herein (D, E, and F).
The extended spreader grafts provide some widening of the middle third of the nose. This provides support of the nasal valve, creates cosmetic balance, and is likely to reduce the incidence of the “inverted V deformity” that may accompany middle-third surgery. Although 0.85-mm-thick materials were used in this series, thicker grafts could be used to help fill out the narrow middle third of the nose further if required.

The caudal end of the extended spreader grafts neatly interfaces with the tip cartilage and columella. This permits improved control of the tip. Suturing the grafts provides excellent and direct control of the tip cartilage. If an HDPP columellar strut is used, it should run between the medial crura to provide cartilage cover to reduce the risk of extrusion.

Use of HDPP provides increased flexibility in graft design and availability. The surgeon can easily and quickly modify the graft into the necessary shape without compromise. The use of septal cartilage grafts is preferred, where possible, but the surgeon often must use suboptimal grafts because of lack of available septal cartilage. The ear cartilage is inherently crooked and is not suitable for this type of surgery. Rib grafts can be used, but they increase the extent of surgery, risk, and operative time.

An alternate approach to manage the crooked middle third of the nose is extracorporeal septoplasty. This technique involves removing the entire septum, straightening, and then replacing with sutures. I have found that complete septal removal is destabilizing and prefer to avoid

Figure 7. A 38-year-old man with previous nasal trauma (A, B, and C) and after the surgery described herein (D, E, and F).
disrupting the keystone area of the rhinion wherever possible.

I selected the worst cases for this type of reconstruction. Half of the cases in this series were revision cases from other surgeons. This reflects the difficulty surgeons faced in straightening the crooked nose. None of the patients have required or seem likely to require further surgery so far. The high success rate is likely to extend the indications to use this approach for lesser degrees of deviation.

The main risk of this approach relates to the use of foreign materials in the nose. I have yet to see infection, extrusion, palpability, or any other complication when using HDPP grafts in this application in this series or in any of 23 subsequent cases. However, there are some key technical points to manage this risk.

The lower edge of the HDPP spreader graft should remain high in the septum, never coming lower than 4 to 5 mm from the dorsum. High-density porous polyethylene was not used within the body of the septum itself. The septal mucoperichondrial flaps are then repositioned and sutured over the grafts to protect them. If a septal flap is torn or incomplete, then the polyethylene grafts would not be used on that side where it might be exposed. A unilateral polyethylene graft can be positioned, or septal cartilage can be used on one or either side. The graft must have adequate cover, especially at the caudal end. The graft may need to be trimmed after placement to ensure that it is not exposed at the apex of the nostril.

Septal cartilage could be a suitable material for extended spreader grafts, should an adequate piece be available. However, the surgeon is often forced to make a compromise in the size and shape of the graft! because of the limited amount of suitable material available in the crooked nose.

Other points to reduce the risk of infection include sterilizing the nose inside and outside with povidone-iodine, handling the spreader grafts with surgical instruments only, and using antibiotics. Multiple 5-0 polydioxanone sutures hold the grafts against the septum long enough for healing. Should infection develop subsequently, there are no permanent sutures in the way to impair removal.

This technique ensures that the bridge remains smooth to the touch under the thin skin of the dorsum. The dorsal edge of the polyethylene grafts should not run higher than the dorsal septum itself. Otherwise, the thin polyethylene edge may become palpable. Resuturing the upper lateral cartilage over the new 3-layered septum provides further camouflage if necessary.

This procedure is safe, effective, and reliable. The use of porous polyethylene grafts ensures that an ideal graft size and shape can be used regardless of the amount or quality of septal cartilage available. It leaves the external nose straight, smooth, and strong to reduce the effects of future scar contracture or trauma.

Accepted for Publication: November 16, 2004.
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Previous Presentation: This study was presented at the 54th National Scientific Meeting of the Australian Society of Otolaryngology–Head and Neck Surgery; March 25, 2004; Sydney.

REFERENCES