ELSEVIER
SAUNDERS

FACIAL PLASTIC
SURGERY CLINICS
OF NORTH AMERICA

Facial Plast Surg Clin N Am ■ (2006) ■–■

Septal Considerations in Revision Rhinoplasty

Armando Boccieri, MD*, Carlo Macro, MD

Assessment of the condition of the nasal septum is an indispensable preliminary stage in the surgical treatment of revision rhinoplasty. The septal structure performs a key function in supporting the nasal pyramid, and its straightness constitutes an essential prerequisite for the achievement of satisfactory esthetic results. Irvin Goldman in the 1960s coined the renowned dictum, "As the septum goes, so goes the nose." This statement still retains validity and relevance in light of the developments in nasal surgery over the last few years. Examination of the outcome of previous rhinoplasties often reveals overaggressive resection of this anatomic structure and collapse of the nasal dorsum or, on the contrary, insufficient correction of septal deviation. The result of such incorrect treatment is a varying degree of esthetic and functional impairment that can prove difficult to repair. The most recent reconstructive techniques adopted in surgical revision use grafts to replace the missing structures, and the nasal septum constitutes a primary source of material to this end. This function as donor site depends on the presence of the septum after the initial operation and can be performed also in the patient who has incomplete correction of the nasal septum.

This article analyzes the following three fundamental aspects of the nasal septum in revision rhinoplasty: (1) deficit of the septal structure to varying degrees, (2) persistent deviation of the nasal septum, and (3) supratip deformity caused by inappropriate resection of the dorsal septum. Attention is focused separately on the residual nasal septum as a source of material in revision operations for grafts to reconstruct impaired anatomic structures. The article also describes and discusses some recent reconstructive techniques used to address problems regarding the nasal septum during revision rhinoplasty.

Pathologic anatomy of the nasal septum

The complete resolution of functional and esthetic problems during revision surgery can only be ensured by a thorough understanding of certain elements of anatomy and physiopathology. The anatomic constituents of the nasal septum are the nasal spine of the frontal bone, the perpendicular plate of the ethmoid, a portion of the medial segments of the nasal bones, the vomer and crest of the sphenoid, the nasal crest of the maxilla, the premaxilla and nasal spine, the quadrangular cartilage, the upper lateral cartilage, the membranous septum, and the columella [1].

Department of Maxillo-Facial Surgery, S. Camillo Hospital, Circonvallazione Gianicolense, 87-00152, Rome, Italy
* Corresponding author. Viale U. Tupini 133, Rome 00144, Italy.
E-mail address: armando.boccieri@libero.it (A. Boccieri).

1064-7406/06/$ – see front matter doi:10.1016/j.fsc.2006.06.005
facialplastic.theclinics.com

The cartilaginous portion of the nasal septum situated in front of an imaginary line running from the osteocartilaginous joint of the rhinion to the anterior nasal spine actually provides nasal support. Reconstruction of an L-shaped supporting septal structure, regardless of the procedure used, must ensure complete restoration of this important anterior anatomic region. The predominantly osseous portion of the nasal septum situated behind the same imaginary line is far less involved in postsurgical esthetic problems. Nevertheless, marked deviations of the ethmoid that are not surgically treated can sometimes prevent the correct positioning of nasal bones with respect to the septum after osteotomies and can cause functional respiratory disorders. In such cases, revision will obviously involve the submucous resection of the deviated area with no need for structural repair.

The anterior portion of the cartilaginous septum performs its supporting function on the middle nasal vault in conjunction with the upper lateral cartilages and on the nasal tip through the attachments of the medial crural footplates to the caudal border of the quadrangular cartilage and the domes. Absence or severe deviation of the caudal septum can cause loss of projection and ptosis of the tip as well as columellar retraction [2].

The angle of the internal nasal valve formed by the nasal septum and the upper lateral cartilages, which should physiologically have values between 10 and 15 degrees, is impaired by the absence and by the severe deviation of the septum. In the first case, the structure collapses with extreme widening of the angle, giving the anatomopathologic appearance referred to as "ballooning." In the second case, there is a narrowing of the angle on the concave side of the deviation with stenosis of the internal nasal valve [3]. In both situations, the valvular impairments cause considerable difficulty in nasal respiration.

With respect to the relations between the cartilaginous septum and the upper lateral cartilages, the two structures are practically continuous, and recent anatomic studies have shown that the nasal septum has a wide Y-shape in its dorsal most portion [4]. In a physiologic condition, this widening of the dorsal septum functions with the two upper lateral cartilages as two spreader grafts [5] and ensures normal respiratory flow at the level of the internal nasal valve [6].

Various factors are involved in the etiopathogenesis of persistent deviations of the nasal septum. Apart from cases of inadequate surgical treatment, failure is often caused by the presence of deforming forces extrinsic and intrinsic to the cartilaginous septum that tend over time to cause the recurrence of deviation [7]. The intrinsic forces are those inherent in the structure of the cartilaginous septum that retain the "memory" of their deviation and tend to return to the incorrect original position even after reshaping. From an ultrastructural viewpoint, this phenomenon appears to be due to interlocked stresses inside the cartilage, which are governed, in turn, by the protein-polysaccharide complexes associated with the collagenic fibers [8,9]. The extrinsic deforming forces are exerted on the cartilaginous septum by the surrounding structures connected to it, such as the nasal bones, upper lateral cartilages, vomer, ethmoid, and maxillary crest. If still deviated and not perfectly separated from the nasal septum during the operation, these anatomic structures can cause the deviation of the cartilaginous septum to reappear over time. The deforming forces external to the cartilaginous septum also include the postoperative contraction of cicatricial fibrosis, which can lead to relapse and distortion.

Absence of the nasal septum

Unfortunately, the idea that an L-shaped structure at least 1.5 cm in width must always be preserved at the end of every septorhinoplasty operation is still not known to and accepted by all surgeons. The function of this pillar is to support the nasal pyramid and maintain a physiologic relationship between the nasal septum and the upper lateral cartilages at the level of the internal nasal valve. Even in cases in which the residual L-shaped structure is deviated, it must not be removed but rather reshaped or replaced with no alteration of functions. It is probably the difficulty encountered in correcting deviations in this site that prompts some surgeons to undertake its erroneous partial or total removal. In these circumstances, the mucoperichondrial covering can remain intact even though it no longer contains the cartilaginous structure normally present. This point is important for surgical purposes as a criterion to differentiate the type of treatment to be employed. When the mucoperichondrium is also lacking and there is perforation of the nasal septum, it is necessary to employ different surgical techniques serving also to reconstruct the covering.

In reconstruction of the cartilaginous septum, the authors stress the need for preliminary assessment of the impairment to the structure as a prerequisite in deciding which technique to use. When the deficit is confined to the caudal most portion of the nasal septum, it is possible to consider first the technique of caudal septal extension grafting [10], which consists of excising a straight inferoposterior portion of the cartilaginous septum (if present) and using it to replace the anterior pillar of the L-shaped

structure (Fig. 1). This graft is posteriorly sutured to the caudal border of the surviving nasal septum with two 4.0 polydioxanone (PDS) mattress sutures and secured anteriorly between the medial crura with two buried 5.0 Prolene sutures and a single temporary 4.0 Monocryl mattress suture. When a sufficiently large cartilaginous structure is not available posteriorly, any cartilaginous hump present can be excised and reshaped to reconstruct the absent caudal septum [11]. The hump must obviously be pared down and flattened to obtain a suitable structure for the type of graft required. When neither of these sources for reconstruction of the nasal septum is available and the structural deficit of the septum is subtotal, the auricular concha can be used for the graft [12]. It is essential when harvesting conchal material to preserve the helix root and the antihelix fold so as to leave no trace in the auricular pavilion. If the approach is performed from the posterior surface of the ear, it is advisable to insert four or five needles in the anterior surface of the ear so that the incisions can be made posteriorly without damaging these important anatomic folds (Fig. 2A,B). The concha can be reshaped and can provide a straight sturdy structure similar to that of the nasal septum to be replaced. To straighten the concha, it is first necessary to perform a series of incisions in the concave side followed by two figure-eight sutures of 5.0 nylon. To reinforce the structure, two spreader grafts taken from the outer and inferior border of the concha are then sutured with 5.0 nylon to the two sides of the concha with their concave sides to the inside (Fig. 3). The region of the concha where the two spreader grafts are attached will correspond to the dorsal pillar of the "neo-septum." When the concha is particularly curved, it is sometimes possible to use a third graft taken from the central region of the concha and secured to what will then be the caudal pillar of the neo-septum. The end result is a straight, sturdy, L-shaped supporting structure, which will be inserted between the two flaps of the mucoperichondrium where the septal structure is missing.

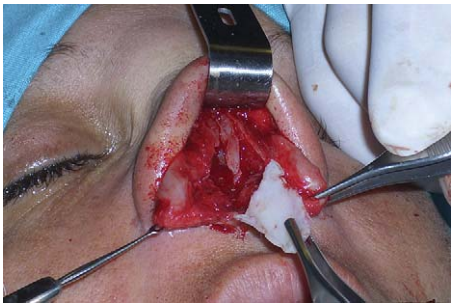

Fig. 1. Caudal extension graft technique. A segment of straight septal cartilage is harvested from the posteroinferior septum and then sutured to the existing caudal septum.

Regardless of the type of graft selected, it is essential to separate the two mucoperichondrial flaps precisely so as to create a pocket (Fig. 4A). It is also vital in such cases to use an open approach, and the authors systematically employ a transcrural and transdomal path of access. The detachment must be precise and avoid any laceration of the mucous membrane. Of crucial importance in this phase are abundant infiltration with vasoconstrictor, strong outward traction of the two flaps, and the use of a sharpened scalpel from front to back and from top to bottom. Insertion of the surgeon's index finger into the right nasal cavity and frequent interior checking of the nasal cavities can prove useful to proceed confidently during the detachment and to ensure immediate awareness of any laceration of the mucous membrane. After insertion between the two flaps of mucous membrane, the graft must be secured with permanent sutures to the posterior septal residues (if present), the upper lateral cartilages, and the medial crura by means of a tongue-in-groove technique (Fig. 4B) [13]. This technique makes it possible to obtain a correct nasolabial angle and adequate tip projection (Fig. 5).

Persistent septal deviation

In the results of septorhinoplasty, a basic distinction should be drawn between deviations of the nasal septum that affect the dorsal or caudal pillar of the structure and those affecting the internal basal and medioseptal region. An evident esthetic defect arises in the first two cases, whereas the third involves only a functional respiratory defect of varying severity. The presence of these problems stems essentially from two causes: (1) incomplete treatment on the part of the surgeon or (2) the use of inappropriate surgical techniques to neutralize the tendency of the cartilaginous deviation to return to its original incorrect position over time. Hump excision can sometimes accentuate deviation of the nasal dorsum because the nasal septum, previously concealed beneath the hump, is clearly exposed and can present a more marked deviation than the removed upper portion.

The correction of septal deviation constitutes the first stage during revision because other associated corrections could be affected by the persistence of the defect if performed first. For example, correction of the nasal tip or a graft on the dorsum could, if performed in an earlier phase, leave major asymmetries at the end of the operation.

In patients in whom internal deviations of the nasal septum do not involve the L-shaped structure,

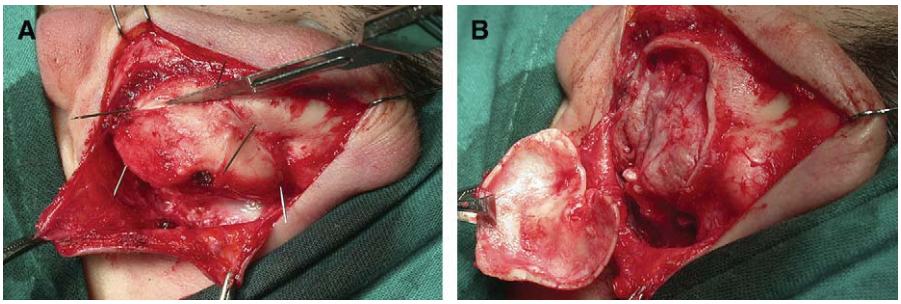

Fig. 2. (*A*) Cartilage incision along the outline marked by needles. (*B*) Resection of the cartilage graft leaving the helix root and the antihelix fold intact.

the preferred treatment involves vertical shaves and staggered incisions or the resection of particularly crooked portions [14–16]. Septal or maxillary spurs on the floor of the nasal cavities require submucous excision above all when they are in the vicinity of the internal nasal valve, in which position they are functionally significant. There is no good reason to insist on the removal of very posterior spurs, given their negligible functional effect on respiratory airflow. Posterior deviations of the perpendicular plate of the ethmoid can be repositioned easily on the median line by means of fracture with a Goldman displacer. The anterior nasal spine, if left crooked in the previous operation, can also be fractured and secured to the periosteum in the middle with slow absorption sutures.

In the patient who has deviation of the caudal septum with projection of the septal border into one of the nasal cavities, excellent results can be obtained through use of the "swinging door" technique [17]. This technique involves excision of a thin vertical strip of cartilage at the point of greatest angle of the nasal septum, inferior detachment from the maxillary crest, and rotation toward the center of the freed caudal septum like a door swinging on its hinges. The base of the caudal septum is then secured with slow absorption stitches to the columella and the anterior nasal spine to ensure that the correct position is maintained over time.

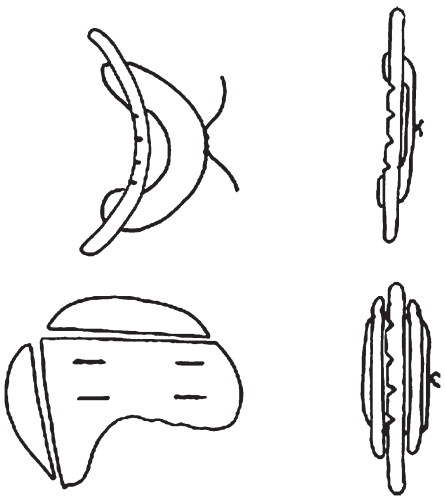

Fig. 3. (*Above left*) Incision of curved conchal cartilage. (*Above right*) Figure-eight suture. (*Below left*) Harvesting of spreader grafts. (*Below right*) Placement of spreader grafts. (*From* Boccieri A. Subtotal reconstruction of the nasal septum using a conchal reshaped graft. Ann Plast Surg 2004;119; with permission).

Although a closed approach with hemitransfixion incision can prove sufficient for all of the techniques outlined previously, an open approach is indicated if the persistence of the deviation affects the dorsal portion of the nasal septum. This approach is justified by the need for a more complete and three-dimensional view of the deviation and by the greater ease of suturing grafts in the more posterior regions, which are otherwise inaccessible [18].

The technique used in revision rhinoplasty to correct deviation of the dorsal septum must be chosen in relation to the severity of the defect and the type of graft available. For slight C-shaped deformities of the middle third, it is possible to opt for selective tangential shaving of the convex side of the dorsal border of the septum with the insertion of a unilateral planoconvex spreader graft between the concave side of the dorsal septum and the upper lateral cartilage [2]. The use of one or two spreader grafts is indicated for moderately severe residual deformities of the dorsal septum [19–21]. In patients in whom the cartilaginous septum is still present after the previous operation, a unilateral spreader graft harvested from the septum and sutured to the concave side of the deviation can prove sufficient (Fig. 6A,B). Before the graft is secured, several vertical incisions are generally made on the concave side to open the cartilaginous spring. When the residual cartilaginous septum is not sufficient to provide material, two spreader grafts can be harvested from the auricular concha and secured to either side of the septum with their concave sides on the inside.

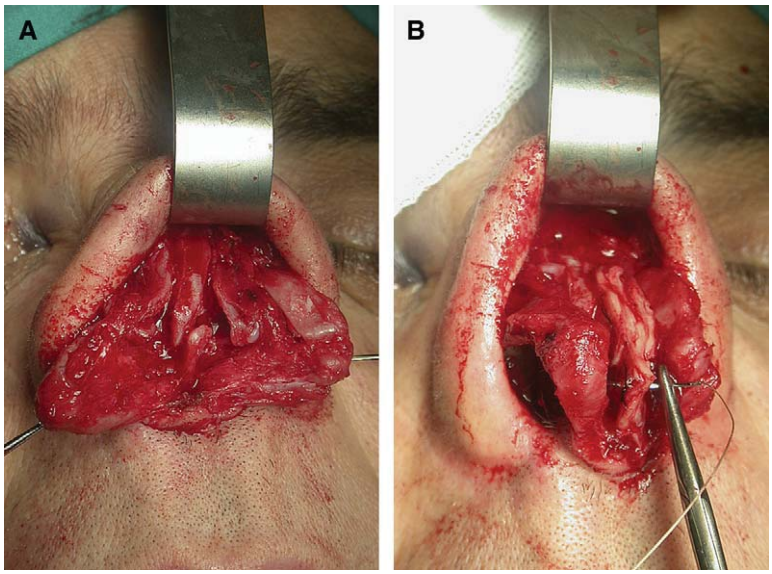

Fig. 4. (*A*) Separation of the two mucoperichondrial flaps. A suitable pocket has been obtained for the graft. (*B*) Suturing of the conchal graft in place of the missing septum.

The crossbar graft technique is indicated for severe persistent deviations of the dorsal septum [22]. This technique combines septoplasty by means of staggered incisions with the insertion of a spreader graft in the dorsal septum. The graft must be positioned on the concave side of the deviation or, in the patient who has linear deviation of the dorsal septum, on the side where there is a gap between the septum and the upper lateral cartilages. The incisions are made on the dorsal and caudal pillars of the L-shaped structure, normally, three on each side, two on the outside, and one on the inside in the areas of greatest deviation. At the end, the crossbar graft is embedded between the two incisions in the dorsal and caudal pillars and sutured front and back with two mattress stitches of 5.0 Vicryl (Fig. 7). In revision cases, the crossbar can also be harvested from the cartilaginous nasal septum, if this was not radically excised during the previous operation, provided that the L-shaped structure is left intact. If harvesting the crossbar from the cartilaginous septum would impair the integrity of the L-shaped structure, a strip of the perpendicular plate of the ethmoid can be used for the same end (Fig. 8).

In patients in whom the deviation of the dorsal septum is accompanied by an inverted V deformity of the nasal pyramid owing to excessive excision of the upper lateral cartilages, it is advisable to use two spreader grafts taken from the auricular concha, which are effective in the correction of both deformations. The two spreader grafts are secured to the dorsal septum with their natural concavity turned to the inside, and their thickness is adjusted to the concavity and convexity of the dorsal septum to make it straight (Fig. 9).

Supratip deformity owing to the dorsal septum

Supratip deformity is frequently involved in revision rhinoplasty. It takes the form of convexity in the region of Converse's weak triangle, which causes the lower third of the nose to assume the particular "polly beak" shape. This sequela can arise after rhinoplasties performed by inexperienced surgeons and unexpectedly after rhinoplasties performed by expert surgeons, in which case imponderables connected with the characteristics of the patient and aspects of scar-tissue formation are probably involved [23]. Insufficient removal of the dorsal cartilaginous septum and overresection of the nasal dorsum with the formation of scar tissue are securely identified as two etiopathogenetic causes connected with the nasal septum in the genesis of polly beak deformity [24]. In the second case, the deformity is caused by an excess of scar tissue produced to eliminate the void left in the supratip region by overzealous resection of the caudal nasal dorsum [25]. In addition to these causes, two other elements are often present that work to accentuate the deformity, namely, underprojection of the tip and insufficient resection of the cephalic portion of the lower lateral cartilages.

Simple palpation of the supratip can reveal the consistency of the region and supply diagnostic indications of the type of polly beak deformity presented by the patient before surgery. When the cause is an overprojected caudal dorsum, the deformity can easily be corrected by removal of the surplus cartilage (Fig. 10). If the supratip fullness is instead caused by swelling and scar tissue and is diagnosed within 3 months after the operation, the

Fig. 5. Case 1. Man aged 19 years subjected to two previous septoplasties. Loss of the supporting septal structure caused droopiness of the nasal tip, an acute nasolabial angle, and respiratory difficulty. Subtotal reconstruction of the nasal septum was performed using a reshaped conchal graft. (*A*) Finger pressure revealing the absence of the cartilaginous septum. (*B,D,F,H*) Preoperative views. (*C,E,G,I*) Postoperative views 1 year after surgery.

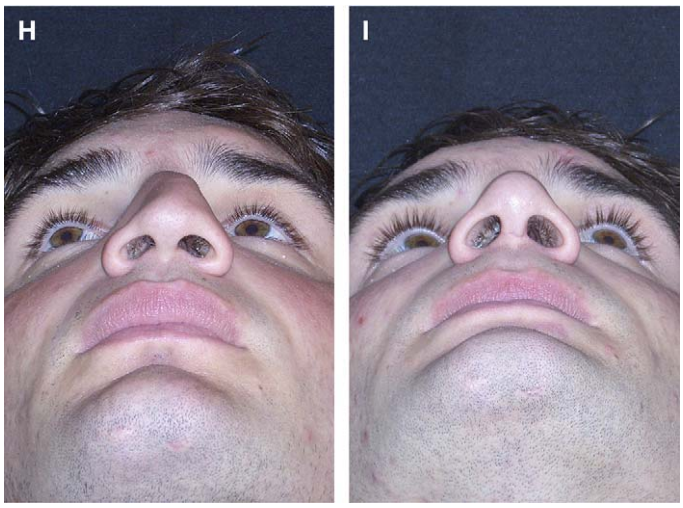

Fig. 5. (*continued*).

Fig 5, continued. Basal view prior to (H) and post (I) revision surgery.

area can be subjected to injection with triamcinolone and compression taping [24]. The triamcinolone injection must be performed carefully to the correct subdermal depth, avoiding injection into the dermis, and can be repeated up to three times at intervals of 3 to 4 weeks. If pharmacologic treatment fails to provide the desired results, revision surgery must be performed after an interval of at least 1 year. This period of time is necessary to ensure that the cicatricial contraction is completely finished and the condition to be corrected is definitive. The surgical treatment in such cases involves complete removal of scar tissue from the area of the supratip and exposure of the dorsal cartilaginous septum beneath. The height of the latter is often insufficient, and a graft of septal or auricular cartilage can be used to fill the void in the area of the supratip.

Regardless of whether the deformity of the dorsal septum is due to the excess or absence of material, it is important to ascertain whether there is any accompanying decrease in tip projection, in which case cartilaginous grafts of the shield [26] or Peck type [27] are indicated. In such cases, reshaping of the tip must precede reshaping of the dorsum because the latter depends on the projection of the tip. It is important to create a break point at the level of the supratip at the end of the revision. A slight unevenness between the domes and the plane of the dorsal septum ensures a more than satisfactory esthetic result. It is advisable to leave a gap between the two cartilaginous structures of approximately 6 to 7 mm, or even as much as 10 mm in the patient who has particularly thick skin [24,28]. Careful postoperative observation of the patient, prolonged taping of the supratip, and injection with triamcinolone if required are part of the correct treatment to avoid this deformity in surgical revision.

Use of septal cartilage for grafting

When present, the nasal septum constitutes the primary source of material for structural grafts in revision rhinoplasties. The quality of the cartilage is optimal for durability and definition beneath the layer of soft tissues and the skin.

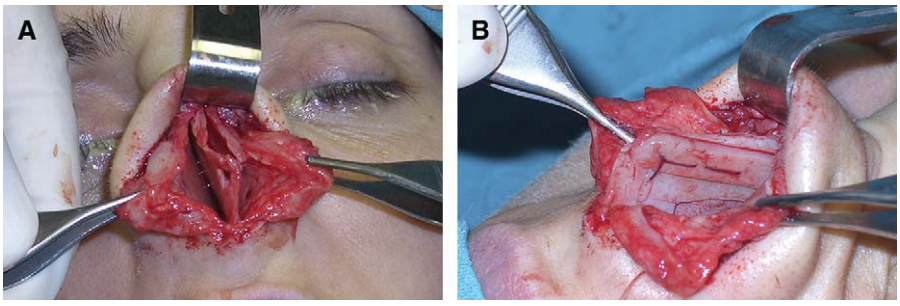

Fig. 6. (*A*) Persistent septal deviation with concave side on the left. (*B*) Placement of unilateral spreader graft on the concave side.

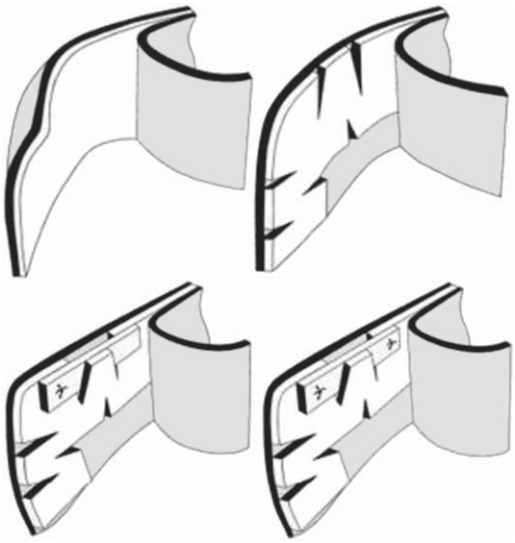

Fig. 7. (*Above left*) Preoperative curvature of the septum. (*Above right*) Pattern of staggered incisions. (*Below left*) Septal crossbar graft fitted between two septal vertical intracartilaginous incisions (closed approach). (*Below right*) Additional posterior suture (open approach). (From Boccieri A, Pascali M. Septal crossbar graft for the correction of the crooked nose. Plast Reconstr Surg 2003;111:631; with permission).

Harvesting can be performed by means of a hemitransfixion incision or through a transcrural open approach if planned for other corrections. After detaching the mucoperichondrium on one side, a vertical cartilaginous incision is performed posterior and parallel to the caudal border of the septum at a distance of approximately 1 to 1.5 cm. The incision stops approximately 1 to 1.5 cm from the dorsal edge of the septum. This incision serves to deglove the contralateral mucoperichondrium as well as the perpendicular plate of the ethmoid on both sides. The cartilaginous septum is then detached inferiorly from the maxillary crest, and an incision is made in it superiorly parallel to the dorsal edge so as to leave the graft connected only posteriorly to the perpendicular plate of the ethmoid. At this point, it is preferable, if necessary, to fracture the perpendicular plate of the ethmoid inferiorly with a Goldman displacer to extract the graft of cartilaginous septum together with a small portion of ethmoidal bone (Fig. 11). The cartilaginous septum is harvested together with this portion of ethmoid because of the difficulty of separating them inside the nasal cavities without risking a fracture of the cartilage anterior to their joint, reducing the length of the graft [29]. The excision should be performed with as little trauma as possible, because even small lacerations or fractures of the septum can impair the shape of the grafts to be obtained and their

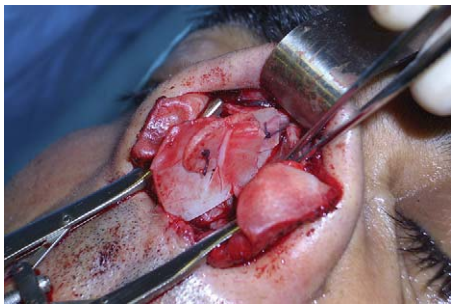

Fig. 8. Septal crossbar graft harvested from ethmoidal bone is sutured on the concave side of the septal deviation.

strength as structural supports. The newly harvested piece of cartilage is vaguely rectangular in shape and can be used to carve all of the grafts required for the revision. If only one or two grafts are required, the excision can be confined to a limited portion of the cartilaginous septum to avoid uselessly weakening the structural support of the nasal pyramid. In the patient who has undergone previous submucous resection of the septum, the excision will necessarily be limited to a small quantity of cartilage to avoid any damage to the residual supporting L-shaped structure. Numerous types of grafts can be obtained from the nasal septum for surgical revision, including grafts serving to reconstruct all three thirds of the nasal pyramid.

Correction of a saddle nose deformity is frequently needed in connection with the upper and middle thirds of the nose. In these patients, the graft must be cut in an oval shape and carefully tapered to the sides with the edges beveled so as to avoid any perception of "steps" beneath the skin. A useful procedure for curving the graft is to perform an incision part of the way through the thickness along the midline together with another two lateral and parallel incisions, if necessary. By exerting pressure with the fingers along the lines of incision, it is possible to cause a greenstick fracture and to obtain an inverted V-frame graft or U-frame graft adapting well to the nasal dorsum [29].

A narrow middle third of the nose with collapse of the middle nasal vault and an inverted V deformity can be the result of particularly aggressive and excessively reductive rhinoplasty. Revision rhinoplasty requires the use of spreader grafts in such cases [5]. These rectangular grafts are inserted and secured between the dorsal septum and the upper lateral cartilages and are useful in functional and esthetic terms, first, by restoring a physiologic angle of 10 to 15 degrees at the level of the internal nasal valve and, second, by bringing the middle third of the nose into the right balance with the upper and lower thirds. Spreader grafts can be

Fig. 9. Case 2. Patient aged 28 years subjected to three previous septorhinoplasties. The patient presented with persistent deviation of the dorsal septum with an inverted V deformity, nasal obstruction, a malpositioned septal graft on the nasal dorsum, and an overprojected tip. Revision rhinoplasty was performed using two conchal spreader grafts, removal of the previous graft, and dome truncation. (*A*) Collapse of the middle nasal vault is evident during forced inspiration. (*B,D,F,H*) Preoperative views. (*C,E,G,I*) Postoperative views 1 year after surgery.

Fig. 9. (*continued*).

Fig 9. (continued). Base view prior to (H) and post (I) revision surgery.

harvested from the middle portion of the cartilaginous septum and from the posteroinferior region and are generally cut and pared down to about 1 to 4 mm in thickness, 3 to 6 mm in height, and 8 to 25 mm in length [30].

The problem most often encountered in the lower third of the nose after septorhinoplasty is an underprojected ptotic nasal tip. Such anomalies can present immediately after the operation or years later owing to the force of gravity and the cicatricial contraction of the cutaneous covering. A columellar strut, shield graft, or onlay tip graft are the procedures indicated for correction. These grafts can be obtained from any part of the septum but preferably are harvested from the cartilaginous portion adjacent to the ethmoidal bone where the septum is thicker and tougher and better suited to the required function of structural support. The columellar strut is rectangular in shape and is inserted and sutured in place between the two medial crura from the nasal spine to the domes [31]. This graft proves particularly useful to improve the projection and support of the nasal tip and to straighten and reinforce the columella. A further increase in the projection and definition of the nasal tip can be obtained by means of a shield graft. This versatile graft is roughly trapezoidal in shape and is sutured with 6.0 nylon to the front of the medial crura in their upper portion to protrude approximately 1 to 2 mm over the domes. The shield graft also gives symmetry to the tip, masks irregularities of the domes, and determines the supratip break. Another graft serving to increase projection is the tip onlay graft described by Peck, which can also be positioned in layers on the domes by means of the umbrella technique.

Alar batten grafts are also obtained from the nasal septum and are frequently used in revision rhinoplasties [32]. These rectangular curvilinear grafts measure about 10 to 15 mm in length and 4 to 8 mm in width. They are used in cases of excessive resection of the lateral or upper lateral cartilages with weakening and retraction of the lateral nasal wall, situations that often cause respiratory problems with collapse of the nasal valve during inspiration. Alar batten grafts are lodged in a precisely formed pocket extending from the lateral third of the lateral crura to the piriform aperture. The convex side of the graft is placed on the outside so as to lateralize the collapsed portion of the lateral nasal wall. Another type of graft used in revision rhinoplasty and obtained primarily from the septum is the lateral crural strut graft [33], consisting of a strip of cartilage about 3 to 4 mm in width and 15 to 25 mm in length. This graft is secured to the deep surface of the lateral crura with two or three sutures of 5.0 Vicryl. This procedure can be used in secondary rhinoplasty to correct alar rim retraction and alar rim collapse owing to excessive resection of the lateral crura. The cartilage of the septum is the only one that can be used in crushed form as a filling graft in the closing phases of revision to finish off and optimize the contours of the nasal pyramid.

Discussion

A septal anomaly is frequently found subsequent to septorhinoplasty and can stem from a pathology already present before the operation or an iatrogenic pathology. The abnormalities of the nasal septum presented by patients often differ greatly, and it is difficult to find any features common to them all. In their pathogenesis, there is always the common fact of failure in the initial operation to find the right proportion between how much should be removed and how much should be left of this

Fig. 10. Case 3. Woman aged 31 years subjected to one previous septorhinoplasty presenting with a supratip deformity caused by an overprojecting caudal dorsum as well as persistent septal deviation and an alar collapse on the right side. Correction was obtained through resection of residual excessive caudal dorsum and placement of a septal spreader graft and alar graft on the right side. (*A,C,E,G*) Preoperative views. (*B,D,F,H*) Postoperative views 1 year after surgery.

Fig. 11. Septal graft of cartilage with ethmoidal bone harvested during revision rhinoplasty.

important anatomic structure. Added to this in all cases is the difficulty of re-establishing a balance between the nasal septum and the surrounding structures, whose position is influenced by the septum, which, in turn, is influenced by certain close anatomic connections.

When the nasal septum is missing, examination of the latest literature shows that most authors agree on the need to reconstruct an L-shaped structure similar to the original one. Onlay grafts, which disguise the esthetic deformity but are functionally inefficient, are thought to be useless. Despite agreement on this common reconstructive aim, opinions are divided on the type of graft to use, with experts variously advocating rib, alloplastic materials, and the auricular concha [34–37]. Obtaining grafts from the rib leaves an unavoidable visible scar, and there is a risk of morbidity of the donor site. Moreover, the graft is not easy to reshape and tends to warp over time. Alloplastic grafts do not possess the particular elasticity of the tissues they are to replace and are subject to infection and extrusion. If performed by means of a retroauricular approach, leaving the root of the helix and the fold of the antihelix intact, the harvesting of grafts from the auricular concha leaves no visible signs. As autologous cartilage, it also provides the best guarantees of resistance to infection and a low degree of resorption as well as being easy to shape. Nevertheless, the auricular cartilage presents histologic characteristics differing from those of the structure to be replaced, being elastic and not hyaline, unlike the nasal septum. From a macroscopic viewpoint, the concha is curved rather then straight like the septum and not sturdy enough to serve as a supporting structure. The technique described for reshaping the conchal graft by means of incisions, figure-eight sutures, and the use of spreader grafts harvested from the concha and attached to the concha itself succeeds in rectifying these negative aspects of the auricular cartilage [12]. Although retaining elasticity, the neo-septum obtained from the auricular concha is ultimately very similar to the nasal septum to be reconstructed in terms of toughness and straightness. Moreover, the presence of spreader grafts on the dorsal side of the graft can prove useful in reconstructing the middle nasal vault in patients in whom the upper lateral cartilages were subjected to abundant excision during the previous operation. In patients in whom the upper lateral cartilages are normally present, the spreader grafts should instead be secured in a lower position with respect to the dorsal edge of the neo-septum so as to have no esthetic effect.

The use of spreader grafts has constituted a great step forward in the correction of persistent deviations of the nasal septum after septorhinoplastic surgery; however, in these cases, the therapeutic strategy requires a gradual and sequential approach in which the use of these grafts may not be needed. Careful analysis of the cause of the septal deviation, its location, and its extent is an indispensable prerequisite for selection of the most suitable procedure to solve the problem. In the patient who has deflection of the nasal septum in the inner portion of the nasal cavities with no involvement of the peripheral structure and the presence of respiratory problems alone, it will be necessary to remove the deviated part (above all if it is osseous) or to perform a septoplasty. This situation is not common in dealing with the results of septorhinoplasty, because it would mean that the functional pathology had been completely ignored during the previous operation. The persistence of deviation owing to the use of techniques incapable of countering the postoperative deforming forces responsible for relapse is instead more frequently encountered. As noted previously, an anatomic memory of the deviation tends to make the cartilaginous septum return to the original incorrect position. In this connection, many techniques using morselizations, incisions, and sections fail to ensure satisfactory end results even though the septal pillar is left intact to perform its function of structural support. Although effective, the treatment adopted is sometimes performed incompletely. During performance of the "swinging door" technique, for example, the surgeon may make a vertical incision but fail to excise a strip or to secure adequately the detached segment anteriorly to the nasal spine. Conversely, overaggressive resection of the nasal septum often causes collapse of the nasal dorsum with the presence of notches and hollows to varying degrees. To prevent such problems, the septoplasty techniques regarded to be safest are those making use of staggered incisions, which interrupt the cartilaginous spring without destroying the continuity within the structure.

In all cases of persistence of septal deviation, it is indispensable during revision to neutralize all of

the deforming forces that support the cartilaginous memory [7]. The cartilaginous septum can be detached from the extrinsic deforming forces of the surrounding structures by means of osteotomies, extramucous separation from the upper lateral cartilages, and the severing of attachments with the vomer, maxillary crest, and ethmoid. The septum is then freed from the effect of the intrinsic deforming forces within the cartilage by means of incisions to open the cartilaginous spring and straighten the septum. In most cases of deviation of the dorsal portion of the septum, it is advisable to combine these procedures with the use of spreader grafts, which ensures a stable result over time, counters the cartilaginous memory, and reinforces the septal structure. The placement of a spreader graft on the concave side of the septal deviation generally provides an excellent solution in all cases of medium severity. The crossbar graft technique is most appropriate in more serious cases of crooked noses, whereas the thickness of a single spreader graft could prove insufficient to correct the deformity [22]. In surgical revision, this type of graft can be obtained from the septal cartilage, if still present, or the ethmoidal bone.

The final effect is to straighten the dorsal septum, reinforce the L-shaped structure, and counter to the greatest possible degree the deforming forces extrinsic and intrinsic to the septum that tend to cause relapse over time. The crossbar graft also exerts lateral pressure on the upper lateral cartilage on the concave side, restoring a correct angle of the internal nasal valve and harmonizing the esthetic lines from eyebrow to tip on both sides.

An alternative to the use of one spreader graft obtained from the septum is two spreader grafts obtained from the auricular concha. Although not as tough as septal cartilage, grafts of auricular cartilage can serve to guide and reinforce the structure when placed on both sides of the dorsal septum. These bilateral spreader grafts are indicated in revisions involving not only the correction of septal deviation but also reconstruction of the middle nasal vault owing to the presence of an inverted V deformity.

Supratip deformity is another of the most frequent causes prompting revision rhinoplasty. This unesthetic convexity, located immediately above the nasal tip, was long attributed exclusively to the presence of an excess of dorsal septum in that area. Sheen stated in 1979 that many supratip deformities were, in fact, not due to this cause but to overresection of the caudal dorsum [25]. In such cases, overzealous resection creates a void that stimulates the formation of scar tissue to fill it up. An excess of this tissue creates the polly beak deformity. Given that very different forms of treatment are possible, correct diagnostic analysis is essential in addressing this problem. Toward this end, study of the case history can provide useful information about previous instances of scar tissue formation, and palpation of the supratip region can ascertain the consistency of the convexity present. In the patient who has an underresected caudal dorsum, the correct treatment cannot be other than appropriate and carefully calibrated excision of the septum in the region of the supratip. Conversely, in the patient who has an overresected caudal dorsum and excessive scar tissue, the surgical treatment must seek not only to remove the fibrous excess but also to avoid recreating the void that actually caused the deformity in the first place. If satisfactory results are to be obtained, crucial steps are the placement of cartilaginous grafts in the area of the supratip, a compressive nasal splint, and careful prolonged postoperative taping. It has also been suggested that a Vicryl suture can be used in this area between the subcutis and the cartilage of the dorsal septum to eliminate the void [24].

The creation of an esthetically valid supratip break is often difficult to achieve owing to the different factors involved in its definition. The calculation of a difference in height of 6 to 10 mm between the dorsal septum and the domes is a rough guide that must be adapted in relation to other parameters such as the thickness of the skin and projection of the tip [24,28]. The same holds true for the angle formed between the perpendicular through the domes and the cephalic border of the lower lateral cartilages, which should ideally range between 45 and 30 degrees according to whether the skin is thin or thick [28]. All of these numerical calculations assume that the intraoperative projection of the nasal tip will remain the same in the later postoperative result; however, the mechanisms of tip support are often affected by the surgical maneuvers performed during revision, such as access incisions severing the membranous septum or the attachments between septum and domes. It is nearly always necessary in these cases to use a columellar strut to ensure that tip projection is controlled and stable over time. In treatment of the polly beak deformity, a further and highly variable factor can sometimes thwart even the efforts of the most expert surgeon, namely, postoperative cicatrization. Some patients tend to present with hypertrophic cicatrization even in the absence of any triggering element. This tendency, which can sometimes be revealed by other hypertrophic or keloid scars, must be detected through careful postoperative observation and treated with injections of triamcinolone in the supratip area.

Other variables involved in the definition of the supratip break include the sex and taste of the

patient, the taste of the surgeon, and current fashion. A depression in the area of the supratip may correspond to an esthetic ideal of female but not male beauty, and some patients may prefer an almost completely straight profile, which also appears to be in line with contemporary fashion.

The cartilaginous septum is the central element involved in planning a revision operation not only as the location of impairments to be corrected but also as a possible source of material for reconstructive grafts. When present, the cartilage of the nasal septum has long been recognized as preferable to other types of cartilage and to alloplastic grafts [38]. It is easy to harvest and carve, structurally suitable for supporting functions, thick and useful for filling depressions, easy to flatten, and displays little tendency to warp. Because it is elastic and not hyaline, unlike the septum, the cartilage of the auricular concha is less sturdy and less capable for providing support. Its curved shape makes it generally suitable for reconstruction of the nasal wing. Rib cartilage is of the hyaline type, like the septum, but harvesting leaves a visible scar, and the donor site presents a certain degree of morbidity. It is also more difficult to shape, fragile, and subject to warping over time [39]. Grafts obtained from the cartilaginous septum are effective in the reconstruction of all sections of the nasal pyramid and can be adapted to meet all of the specific requirements presented by each individual case. Unlike most alloplastic grafts, these grafts combine toughness with sufficient elasticity to allow the "mobile part" of the nose to preserve its physiologic flexibility. Like the other cartilaginous grafts, they are largely impervious to infection and resorption, the latter being in most cases minimal and short-lived with a tendency to decrease considerably after the initial postoperative period [40].

A common objective exists no matter which reconstructive technique is employed, namely, the restoration of a straight, sturdy, and elastic L-shaped septal structure. Correction of the nasal septum constitutes the first indispensable phase of reconstruction during revision when there are also other nasal structures to be reconstructed. The symmetry and support of the nasal pyramid in all of its components will depend on the precision with which this important internal pillar is restored. Nasal respiratory function will also hinge upon this structure being restored as closely as possible to its physiologic state.

Summary

The correction of impairments of the nasal septum is a crucial surgical stage in revision rhinoplasty. The pathologic elements observed most frequently in clinical practice include structural deficits of the caudal septum, the persistence of septal deviation, and deformity of the supratip area. This article is intended as a guide to the gradual analytical correction of the different anomalies of the nasal septum, with the septum being the primary source of material for the most common types of reconstructive grafts.

References

[1] Tardy ME. Rhinoplasty: the art and the science. In: Surgical Anatomy, Vol. I. Napoli: EdiSES Srl; 1999. p. 87–99.
[2] Toriumi DM, Ries WR. Innovative surgical management of the crooked nose. Facial Plast Clin N Am 1993;1:63–78.
[3] Wustrow TPU, Kastenbauer E. Surgery of the internal nasal valve. Facial Plast Surg 1995;11:213–27.
[4] Teller DC. Anatomy of a rhinoplasty: emphasis on the middle third of the nose. Facial Plast Surg 1997;13:241–52.
[5] Sheen JH. Spreader graft: a method of reconstructing the roof of the middle nasal vault following rhinoplasty. Plast Reconstr Surg 1984; 73:230–7.
[6] Boccieri A, Macro C. The use of spreader grafts in primary rhinoplasty. Ann Plast Surg 2005;55(2): 127–31.
[7] Byrd HS. The crooked nose: an algorithm for repair. In: Proceedings of the 17th Annual Dallas Rhinoplasty Symposium. 2000. p. 239–42.
[8] Tardy ME. Rhinoplasty: the art and the science. In: Nasal reconstruction with autologous cartilaginous grafts. Napoli: EdiSES Srl; 1999. p. 661.
[9] Fry HJ. Nasal skeletal trauma and the interlocked stresses of the nasal septal cartilage. Br J Plast Surg 1967;20:146–58.
[10] Toriumi DM. Subtotal reconstruction of the nasal septum: a preliminary report. Laryngoscope 1994;104:906–13.
[11] Mocella S. Septal perforations' closure and reconstructive septorhinoplasty with hump and bioimplant material. Presented at the Annual Conference of the EAFPS. Florence, Italy, September 2005.
[12] Boccieri A. Subtotal reconstruction of the nasal septum using a conchal reshaped graft. Ann Plast Surg 2004;53(2):118–25.
[13] Kridel RWH, Scott BA, Foda HMT. The tongue in groove technique in septorhinoplasty: a ten year experience. Arch Facial Plast Surg 1999;1:246–56.
[14] Brain D. The septum in functional rhinoplasty. Facial Plast Surg 1986;3:235–41.
[15] Gomulinski L. Morphological aspect of septal deformations. Their correction during complex rhinoplasties. Ann Chir Plast 1982;27:343–9.
[16] Lawson W, Reind AJ. Correcting functional problems. Facial Plast Surg Clin North Am 1994;2: 501–20.

[17] Seltzer A. The nasal septum: plastic repair of the deviated septum, associated with a deflected tip. Arch Otolaryngol 1944;40:433–9.
[18] Mangat DS, Smith BJ. Septoplasty via the open approach. Facial Plast Surg 1988;5:161–6.
[19] Guyuron B, Uzzo CD, Scull H. A practical classification of septonasal deviation and an effective guide to septal surgery. Plast Reconstr Surg 1999;104:2202–9.
[20] Rohrich RJ, Hollier LH. Use of spreader grafts in the external approach to rhinoplasty. Clin Plast Surg 1996;23:255–62.
[21] Pontius AT, Leach JL. New techniques for management of the crooked nose. Arch Facial Plast Surg 2004;6(4):263–6.
[22] Boccieri A, Pascali M. Septal crossbar graft for the correction of the crooked nose. Plast Reconstr Surg 2003;111:629–38.
[23] Meyer R. Secondary and functional rhinoplasty: the difficult nose. In: Residual deformity of the cartilaginous framework. Orlando (FL): Grune & Stratton; 1998. p. 130–8.
[24] Guyuron B, DeLuca L, Lash R. Supratip deformity: a closer look. Plast Reconstr Surg 2000; 105:1140–51.
[25] Sheen JH. A new look at supratip deformity. Ann Plast Surg 1979;3:498–504.
[26] Sheen JH. Achieving more nasal tip projection by the use of a small autogenous vomer or septal cartilage graft. Plast Reconstr Surg 1975;56: 35–40.
[27] Peck GC. The onlay graft for nasal tip projection. Plast Reconstr Surg 1983;71:27–37.
[28] Byrd HS. The supratip break. In: Proceedings of the 17th Annual Dallas Rhinoplasty Symposium. 2000. p. 261.
[29] Gunter JP, Rohrich RJ. Augmentation rhinoplasty: dorsal onlay grafting using shaped autogenous septal cartilage. Plast Reconstr Surg 1990; 86:39–45.
[30] Toriumi DM. Management of the middle nasal vault in rhinoplasty. Operative Tech Plast Reconstr Surg 1995;2:16–30.
[31] Foman S, Goldman IB, Neivert H, et al. Management of deformities of the lower cartilaginous vault. Arch Otolaryngol 1951;54:467–72.
[32] Toriumi DM, Josen J, Weinberger M, et al. Use of alar batten graft for correction of nasal collapse. Arch Otolaryngol Head Neck Surg 1997;123: 802–8.
[33] Gunter JP, Friedman RM. Lateral crural strut graft: technique and applications in rhinoplasty. Plast Reconstr Surg 1997;99:943–52.
[34] Kridel RWH, Konior RJ. Irradiated cartilage grafts in the nose: a preliminary report. Arch Otolaryngol Head Neck Surg 1993;119:24–31.
[35] Gunter JP, Clark CP, Friedman RM. Internal stabilization of autogenous rib cartilage grafts in rhinoplasty: a barrier to cartilage warping. Plast Reconstr Surg 1997;100:161–8.
[36] Romo T, Sonne J, Choe KC. Revision rhinoplasty. Facial Plast Surg 2003;19:299–307.
[37] Neu BR. Combined conchal cartilage-ethmoid bone grafts in nasal surgery. Plast Reconstr Surg 2000;106:171–5.
[38] Quatela VC, Jacono AA. Structural grafting in rhinoplasty. Facial Plast Surg 2002;18:223–32.
[39] Arden RL, Crumley RL. Cartilage grafts in open rhinoplasty. Facial Plast Surg 1993;9: 285–94.
[40] Maas CS, Monhian N, Shah SB. Implants in rhinoplasty. Facial Plast Surg 1997;13:279–90.