

Evolution of the Septal Crossbar Graft Technique

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ABSTRACT

The septal crossbar graft is a surgical technique used to correct crooked nose and solve the associated functional and aesthetic problems. Described for the first time in 2003, it combines staggered septal incisions with a spreader graft in the dorsal septum on the concave side of the deviation. The method has proved particularly useful in straightening the septum and ensuring postoperative results of lasting stability. Clinical experience over the last few years and the identification of some snags in the procedure have prompted modifications of the technique that should be regarded essentially as evolutionary stages. This article provides a detailed description of all the surgical phases of the technique in the light of these developments and discusses its strengths with respect to the specific problems of crooked nose. Attention is drawn in this connection to both the functional effect on the internal nasal valve and the aesthetic effect of reshaping the upper lateral cartilage.

KEYWORDS: Crooked nose, spreader grafts, crossbar graft, nasal valve

Crooked nose unquestionably constitutes the most severe and complex expression of deviation of the nasal septum. The involvement of the dorsalmost section of the nasal septum has effects of an aesthetic character that are often of great social impact. The eye is probably drawn to deformity of the nasal pyramid with respect to the median line more than to any other form of asymmetry because of the overwhelming predominance of the “face to face” approach in everyday interpersonal relations. At the same time, correction of this condition still presents serious difficulties due essentially to the involvement of the other structures adjoining the nasal septum and the frequent possibility of recurrence.

The septal crossbar graft technique¹ was devised in accordance with a new concept of tissue weave for the precise purpose of ensuring the greatest possible stability of immediate postoperative results over time. This article describes the technical modifications and suggestions arising out of clinical experience that have served to facilitate execution.

THE PATHOLOGICAL ANATOMY OF CROOKED NOSE

Classic cases of crooked nose can be C-shaped or S-shaped or involve linear deviation of the nasal pyramid.² The deformity can involve the nose as a whole or be confined with varying degrees of severity to the upper, middle, or lower third. In addition to the dorsal septum, deviation of the nasal septum often involves the median and basal septal regions and dislocations of the cartilaginous septum frequently coexist with respect to the perpendicular plate of the ethmoid, the vomer, the nasal spine, and the maxillary crest. These bony structures can also present different degrees of deviation with respect to the midline.

As regards deformity of the upper third, the bony pyramid can be symmetrical and deviated with respect to the median line, deviated and accompanied by a hump, or deviated with asymmetry of the nasal bones.³

In the middle third, the supporting framework of the nose is composed of the cartilaginous dorsal septum

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and the two upper lateral cartilages firmly attached to it. As the cutaneous and subcutaneous covering is generally thin in this region, even the slightest underlying asymmetry or irregularity can become clearly visible. Although asymmetry of the middle third in crooked nose is mostly caused by deviation of the dorsal septum, the upper lateral cartilages also play an important part, very often appearing depressed on the concave side and reducing the angle of the internal nasal valve between the upper lateral cartilages and the septum to below the physiological values of 10 to 15 degrees. The resulting stenosis of the internal nasal valve causes difficulty in nasal respiration that accentuates the problems due to the concomitant deviation of the septum.

Deformity in the lower third can be due to deviation of the caudal septum or nasal spine or to dislocation of the basal septum with respect to the nasal spine. The lower section of the nasal septum can protrude in one of the two nostrils. The caudal section of the septum normally provides support for the nasal tip by means of attachments with the domus and the medial crura. If the caudal septum is severely deviated, it fails to perform this important function and the nasal tip can be left with no support and an insufficient degree of projection.⁴ This very often coexists with asymmetry of the lower lateral cartilages with deviation and hypertrophy of one side with respect to the other. The medial crura can also present varying degrees of deviation.⁵ The cutaneous tissue can also be involved in the deformity and present defects of shape and thickness due to "expansion" caused by the asymmetric development of the cartilage. In fact, many of the anatomical malformations described are probably caused to the surrounding tissues over time by severe septal deviations that are left untreated.⁶

From the physiopathological viewpoint, it is important to emphasize the presence in crooked nose of both extrinsic and intrinsic tissue-deforming forces that act on the cartilaginous nasal septum.³ These forces are responsible for the deviation of the nasal septum and can lead to recurrence of the deformity if not released in the operation. In practical terms, they constitute a sort of "memory" and act over time like a spring to return the cartilage to its initial skewed position. The extrinsic dislocating forces are those produced on the septum by deviated nasal bones, the attachments of the upper lateral cartilages, and the connections with the vomer, the ethmoid, and the maxillary crest. The intrinsic dislocating forces can derive from distorted growth of the septal cartilage or injuries, after which the cartilaginous tissue always retains the inherent tendency to return to its initial position.⁷

PREOPERATIVE EVALUATION

Careful appraisal of the deformity constitutes the essential prerequisite in planning the surgical technique

and obtaining good results. In the first place, knowledge of the pathogenesis of crooked nose in relation to a malformative, traumatic, or iatrogenic cause is useful with a view to the choice of structural grafts. Anterior rhinoscopy constitutes an obligatory preliminary step to detect any deviation of other segments of the nasal septum as well as associated inflammatory pathologies. The case histories always include disorders of nasal respiration of varying degrees caused both by deviation of the septum and by stenosis of the internal nasal valve. Active anterior rhinomanometry (using the Costantian and Clardy method) can provide useful information in this respect.⁸

The simplest way to analyze asymmetries is to trace an imaginary vertical midline perpendicular to a horizontal line between the two medial angles.⁹ This simple procedure, which can be performed either during clinical examination or better still on preoperative photographs, gives immediate evidence of the type of deformity presented. It is necessary first and foremost to distinguish the nasal asymmetries from any other concomitant facial asymmetries. The next step is to place the crooked nose in one of the three main categories: C-shaped, S-shaped, or with linear deviation.

The division of the nasal pyramid into three sections, the upper, middle, and lower thirds, is useful to determine the sector in which the deformity predominates in relation to the anatomical structures concerned, which can be the nasal bones and the nasal processes of the upper maxillary in the upper third, the middle nasal vault (cartilaginous septum and upper lateral cartilages) in the middle third, and the caudal septum and lower lateral cartilages in the lower third.

A further procedure to be performed systematically is analysis of the two aesthetic lines stretching from the brow along the lateral border of the dorsal nasal subunit to the tip defining point.⁴ The effect of these lines can be accentuated by shining an oblique light on the face from above so as to create areas of shadow on the sides of the nose. Sometimes the nasal structures are aligned with the midline but the nose can appear crooked because of the presence of concavity or convexity along the edges of these two aesthetic lines. The irregularities detected in this respect must always be taken into consideration with a view to subsequent surgical correction.

Palpation can prove useful to determine the toughness of the cartilaginous structures, the strength of the cartilaginous spring, and the thickness of the skin. In addition to palpation, an applicator can be used to exert slight pressure on the septal mucosa through the nasal cavity to determine the possible absence of portions of the septum in cases of patients who have already undergone operations.

This preoperative appraisal must also serve to assess the severity of the deformity with a view to

selecting the most suitable type of surgical technique. In this connection, the septal crossbar graft technique has proved particularly effective in treating the most severe cases of crooked nose.

SURGICAL TECHNIQUE

It is preferable in every case to adopt an open approach to the nasal pyramid, combining an inverted V-shaped columellar incision with a bilateral marginal incision. Both the cartilaginous and the bony sections of the nasal dorsum are carefully detached down to the subperichondrial and subperiosteal level. The two medial crura are drawn out and an incision is then made in the intercrural tissue to reach the most proximal section of the caudal septum. The next step is the subperichondrial detachment of both sides of the nasal septum. In exposing the basal region of the septum, it also proves useful to expose the region of the nasal spine.

The dorsal portion of the nasal septum must be carefully separated extramucosally from the two upper lateral cartilages, using a Freer elevator placed beneath one of these as a guide. The deviation of the dorsal septum is clearly evident in all its component parts at the

end of this maneuver. On completion of the surgical stage of exposure, all the deviated bony and cartilaginous septal sections can be removed, taking care to preserve an L strut at least 15 mm in width. Particular attention must then be devoted to harvesting the straightest possible strip of ~3 to 6 mm in height, 1.5 to 2.5 in length, and 1 to 3 in thickness from the cartilaginous septum for subsequent implanting in the dorsal septum as a crossbar graft. In cases in which the cartilaginous septum has been removed in previous operations, a strip of the perpendicular plate of the ethmoid can be used for the same purpose.

If the caudal base of the L strut appears off center with respect to the midline, it must be detached from the maxillary crest and the nasal spine and reattached in a central position with a polydioxanone (PDS) 4.0 suture. In cases in which it is also completely skewed with respect to the midline, it must be fractured and secured in the correct position by suturing to the periosteum and the surrounding soft tissues.

Hump excision is performed at this point, if required, followed by medial and lateral micro-osteotomies, two of which are often performed on each side to eliminate any asymmetry of the bony structure.

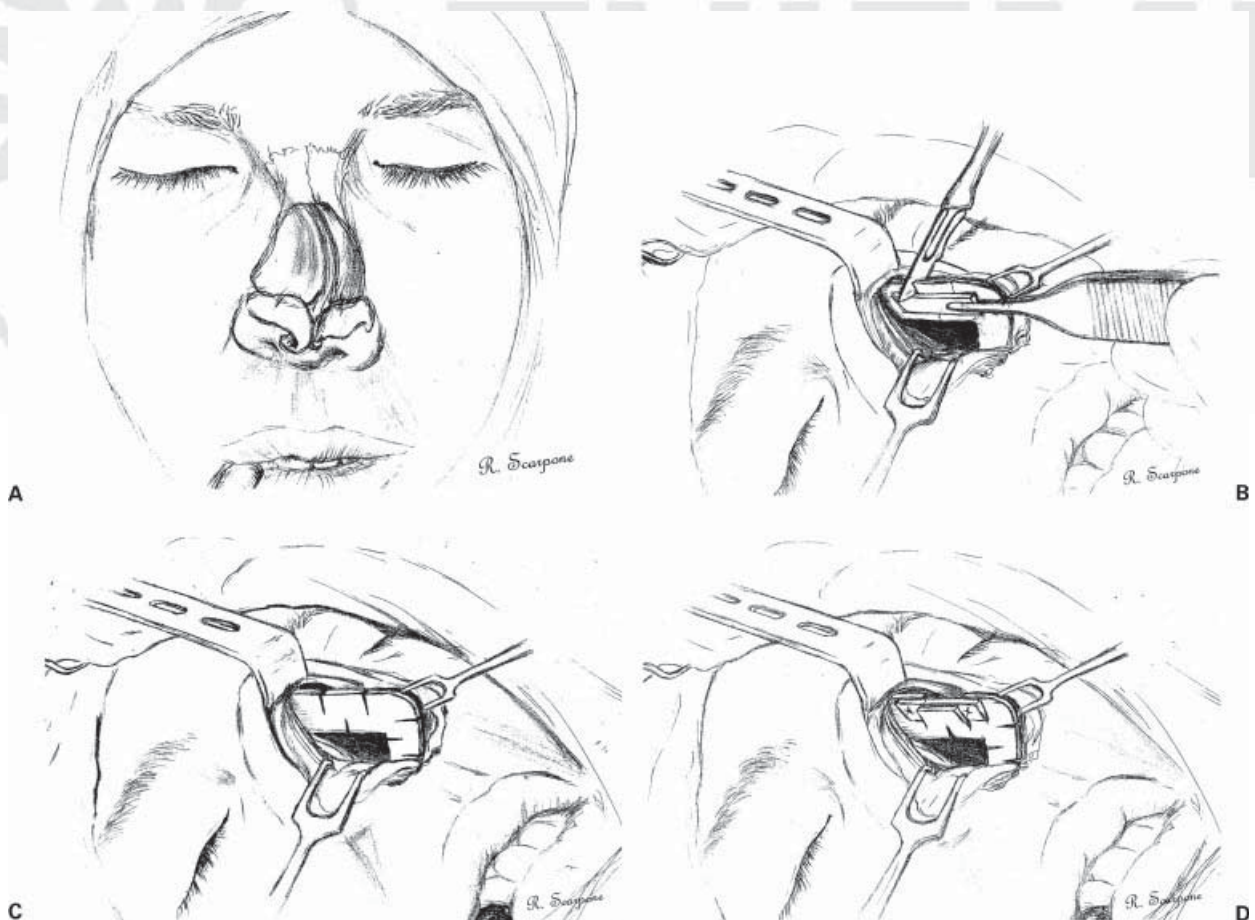
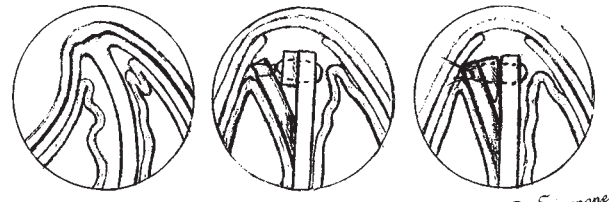


Figure 1 (A) Preoperative appearance of the deviation of the dorsal septum. (B) Measurement of the two dorsal incisions in relation to the length of the graft. (C) Staggered incisions. (D) Positioning and suturing of the septal crossbar graft.

Once freed from all the extrinsic deforming stresses exerted by the surrounding bony and cartilaginous structures, the septal L strut can be reshaped with no danger of alteration in the later stages of the operation. The first phase of the septal crossbar graft technique involves a series of incisions in both the dorsal and the caudal pillar of the L strut. These can be described schematically as three on each side, two on the outside and one on the inside at the points of greatest deviation. The next phase involves the positioning of the graft on the concave side of the dorsal septum or, in the case of linear deviation, on the side where a gap is present between the septum and upper lateral cartilages. As the crossbar graft is to be embedded between the two incisions in the dorsal pillar, it is useful to place the graft on the septum in that position before these are made (Fig. 1A, B). This makes it possible to determine the exact measurements of the two incisions in relation to the length of the graft and thus to leave a sufficient area of dorsal cartilage both in front and behind to which the crossbar graft is then secured with sutures (Fig. 1C, D).

A further improvement of the technique involves adjusting the thickness of the graft on one side with the creation of a roughly wedge-shaped element, which proves useful in adapting the lower part of the crossbar to the location in which it is embedded (Fig. 2).



R. Scarpone

Figure 2 Tapering the thickness of the graft to create a wedge-like shape.

Once lodged between the two vertical incisions in the dorsal septum, the crossbar graft is secured by means of two Vicryl 5.0 sutures. A third suture can also be performed in a central position if greater stability of the structural complex as a whole is required. In cases where an ethmoid crossbar graft is used, holes must be made in advance in the bone with a drill for the suturing thread. The realignment of the dorsal septum brought about by the crossbar is immediately apparent on completion of this phase (Fig. 3A, B).

A continuous mattress suture is performed with Vicryl R 5.0 from front to back and from back to front to reattach the mucoperichondrium to the septum on both sides.

Finally, the two upper lateral cartilages are sutured to the caudalmost section of the nasal septum. This suture must be performed while drawing the cartilages

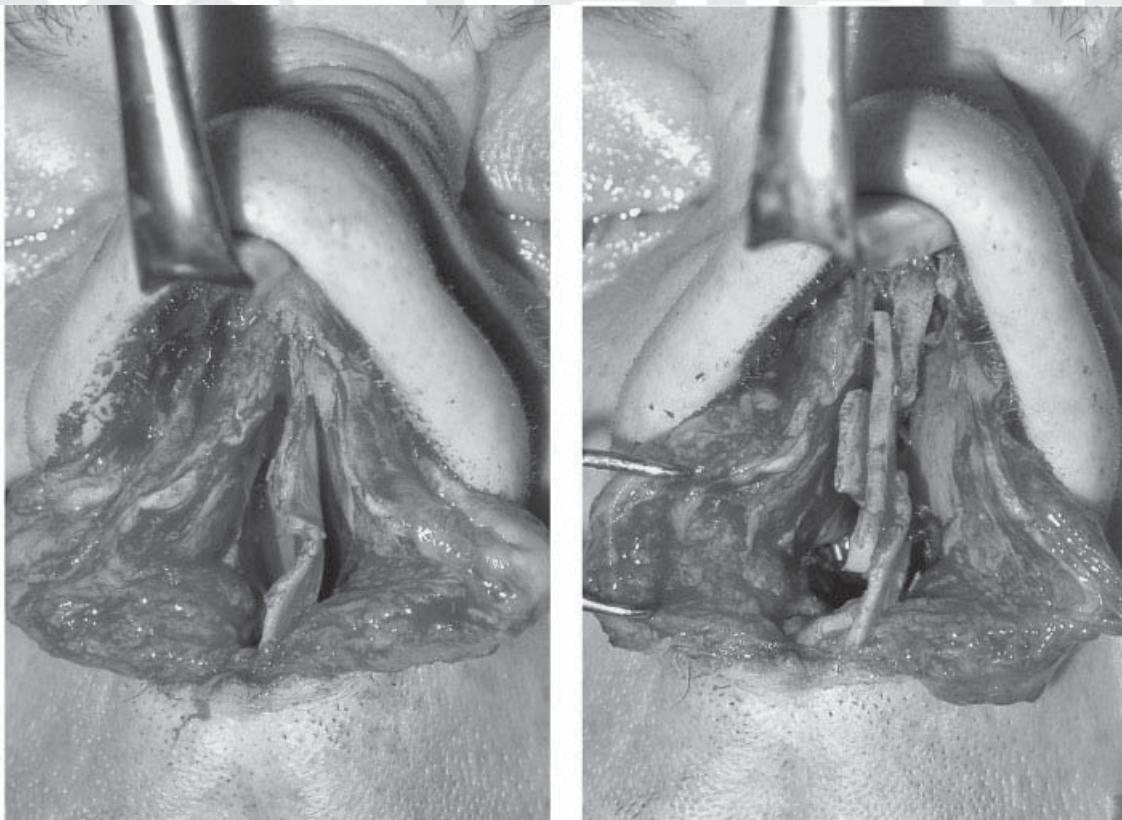


Figure 3 (A) Intraoperative view of severe crooked nose. (B) Intraoperative view of realignment of the dorsal septum due to the septal crossbar graft.



Figure 4 Intraoperative view of suturing of upper lateral cartilages.

forward and taking care to cover the crossbar to conceal the underlying outline (Fig. 4).

After this phase, the nasal tip can be reshaped if required, using the technique considered most suitable for the case in question and with no limitations. It should be stressed in this connection that asymmetry of the nasal pyramid often also involves the nasal tip and that the lateral crura can be of different sizes. Greater weight should therefore be given to the cartilage left than the cartilage removed in any cephalic resection of the lateral crura. It also proves necessary quite often in these cases to use a columellar strut to support the tip and ensure the straightness and symmetry of the medial crura.

Finally, the cutaneous incisions are sutured with 6.0 nylon. An endonasal splint or anterior nasal tamponade, or both, can be inserted. It is in any case necessary to apply an external splint, which should be removed on the seventh or eighth day after the operation.

Depending on the case, the septal crossbar graft technique can be combined with any other surgical technique of nasal reconstruction involving the further use of grafts. In particular, crushed cartilaginous onlay grafts can prove useful in the final phase of the operation to conceal slight irregularities of nasal contour and optimize the results.

Three typical cases of crooked nose are shown in Figures 5, 6, and 7. Correction was performed using a crossbar graft on the right side in all cases.

DISCUSSION

Although crooked nose clearly constitutes a problem today in social and etiopathogenetic terms, the problem of its treatment is perhaps not so clear and well known. In fact, apart from the patients with such severe asymmetry as to make any solution problematic, what is present in all cases is the risk of relapse. In practical terms, a result that seems more than satisfactory immediately after the operation can turn into a failure a few months later because of recurrence of the deviation to varying degrees. The elements primarily responsible for this are the cartilaginous structures of the nasal pyramid involved. By virtue of their elasticity, these anatomical structures retain a "memory" of the deviation and tend to return over time to their original condition.¹⁰ On the other hand, the bony structures of the nasal pyramid involved in the deviation remain permanently fixed in their new position after realignment. At most, a double lateral osteotomy may prove useful to give them greater freedom of movement and ensure the disappearance of all anatomical flaws.

All the difficulty in correcting crooked nose stems from the cartilaginous structure and especially the dorsal section of the nasal septum. As is known, although it is possible to remove most of the nasal septum, it is in any case necessary to leave an L-shaped structure to support the nasal pyramid as a whole. It is unfortunately indispensable in cases of crooked nose to modify this structure too, as the deformity would otherwise remain. Many of the techniques described in the literature involve morselizations, incisions, and resections to open the cartilaginous spring of the dorsal pillar of the septum and straighten the nose.¹¹⁻¹⁴ Unfortunately, these methods often fail to achieve the desired results, which can be due to the previously mentioned memory and to excessive weakening of the supporting pillar leading to collapse of the nasal dorsum. An alternative technique involves reshaping the nasal septum "extracorporeally" and grafting it back into the nasal pyramid.¹⁵⁻¹⁷ In practical terms, the nasal septum is removed completely, reshaped, and straightened outside the nose and then stitched back in place. It is thus possible to change the alignment of the nasal septum by securing a straight reshaped portion of it in a dorsal position. The technique provides a brilliant and radical solution to the problem but requires particular skill in aligning the graft perfectly with the surrounding structures; otherwise, a notch may be visible at the rhinion.¹⁸

The surgical treatment of crooked nose has been boosted considerably by the use of spreader grafts.¹⁹ Both support and alignment can be obtained by securing

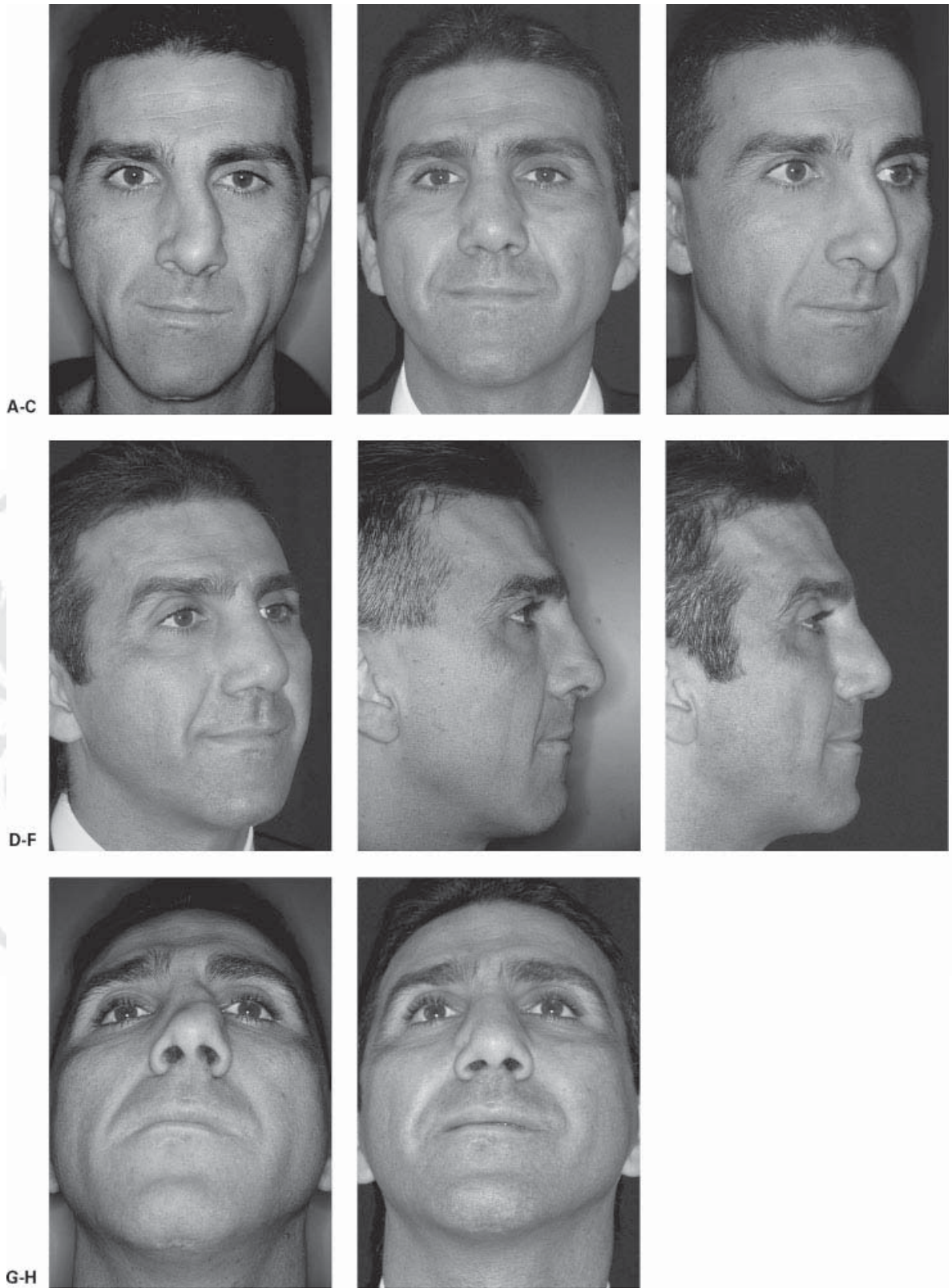


Figure 5 Case 1. Man aged 37 with crooked nose caused by sporting traumas. (A, C, E, G) Preoperative views. (B, D, F, H) Postoperative views 3 years after surgery.

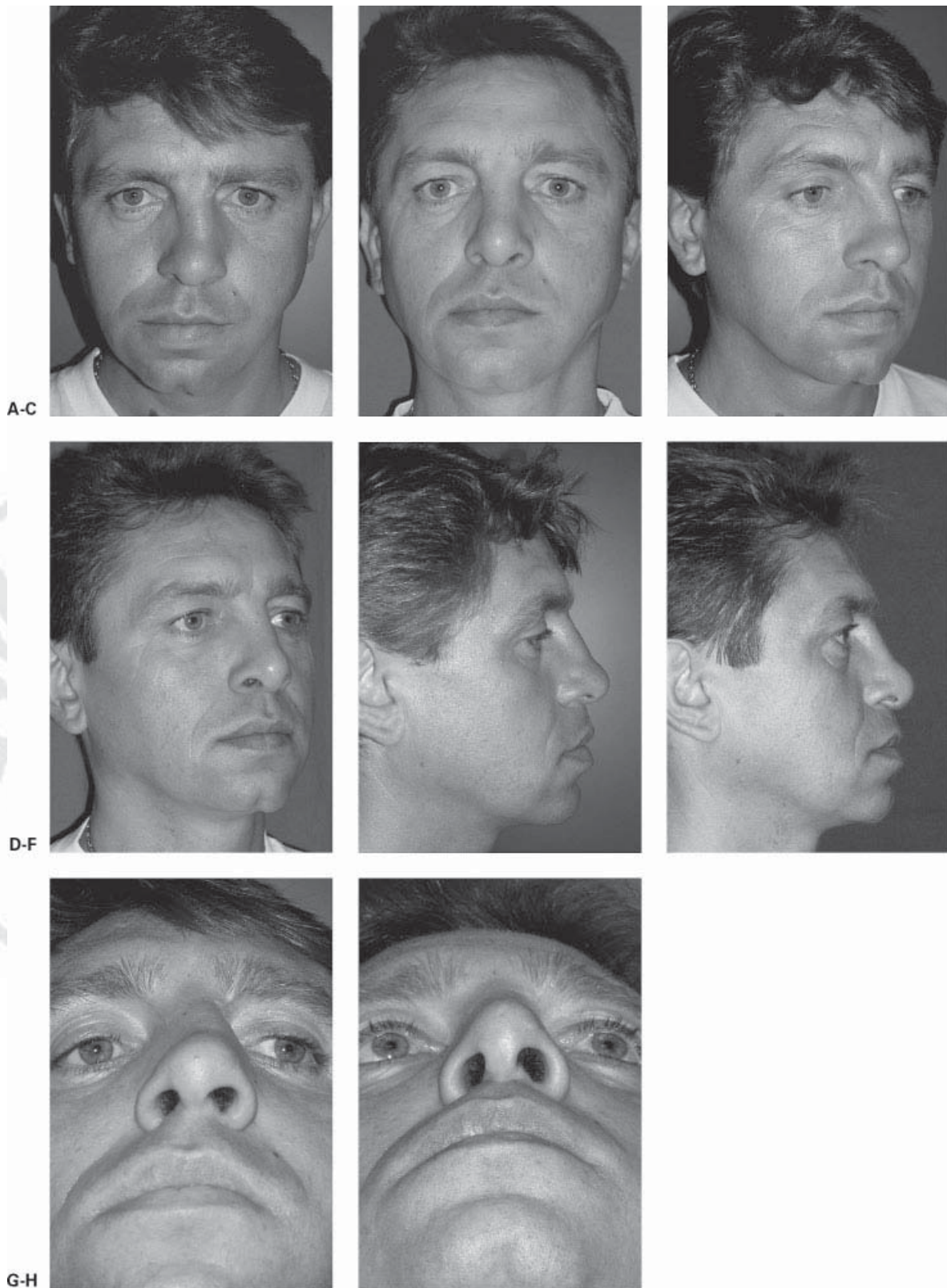


Figure 6 Case 2. Man aged 36 with crooked nose due to a severe maxillofacial trauma. (A, C, E, G) Preoperative views. (B, D, F, H) Postoperative views 3 years after surgery.

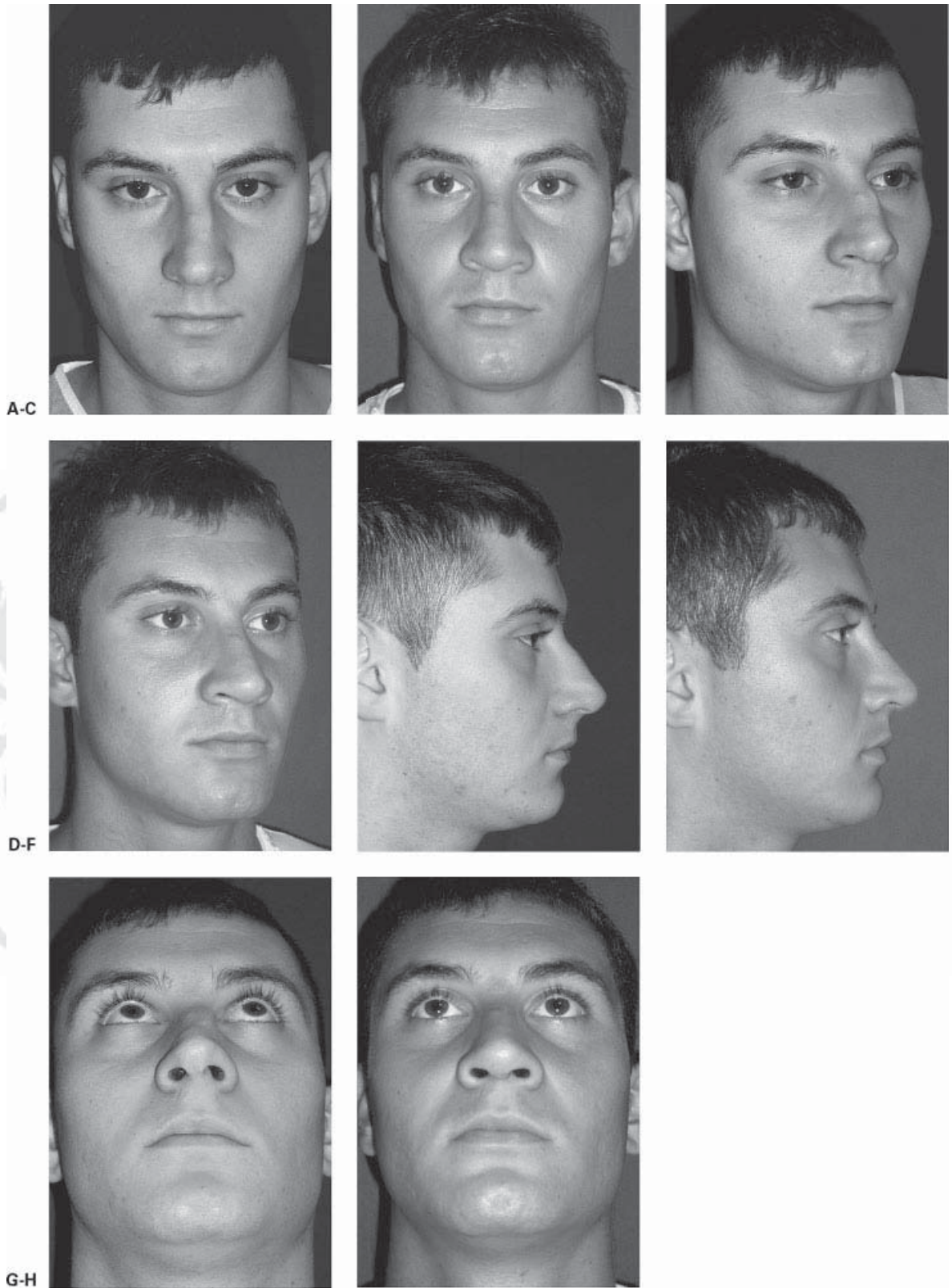


Figure 7 Case 3. Man aged 20 subjected to one previous septorhinoplasty for crooked nose. (A, C, E, G) Preoperative views. (B, D, F, H) Postoperative views 1 year after surgery.

a spreader graft to the concave side of the dorsal deviation of the septum.^{20–22} Removed from a straight medial section of the septum and sutured in the dorsal portion, the graft serves to straighten the septum at that point and counter the cartilaginous memory of the deviation. Importance also attaches to its strengthening of the dorsal pillar, which makes it possible to perform reshaping incisions with no fear of weakening of the structure.

The use of a septal crossbar graft to treat crooked nose forms part of this developing tradition. The rectangular cartilaginous graft is in fact embedded in the dorsal septum just as a bar was used to prevent a door being opened from the outside. The effectiveness of this mechanism of defense against attack from outside has been recognized since ancient times (Fig. 8A, B). In crooked nose, the immediate postoperative result must



Figure 8 (A) The system of barring doors has been known since ancient times, as shown in Domenico Veneziano's *Annunciation*, ca. 1445, Fitzwilliam Museum, Cambridge. (B) Enlarged detail of the door. (Reproduction by permission of the Syndics of Fitzwilliam Museum, Cambridge.)

be defended over time against the recovery of extrinsic and intrinsic dislocating forces as well as the contraction of scar formation.

The incisions in the dorsal pillar of the L strut are performed in a particular position making it possible to interweave the graft so as to create an authentic intra-septal spreader graft. To this end, it is preferable to harvest the graft before making the incisions. In this connection, it has been a useful improvement of the technique to position the graft temporarily alongside the dorsal septum before tracing the incisions, which makes it possible to establish the exact measurements of the latter in relation to the graft. All this ultimately serves to avoid the risk of harvesting a graft that is too short for the distance between the two incisions. The wedge-shaped tapering of the lower section of the crossbar also constitutes a valid technical development ensuring better alignment of the graft with the dorsal septum. Experience has shown that a perfectly rectangular thickness of the crossbar can cause excessive lateral mobilization of the stretch of dorsal cartilage between the two vertical incisions and thus result in overcorrection of the deviation. In any case, the raising and lateral movement of the upper lateral cartilage by the graft on the concave side makes it possible to restore a correct angle of the internal nasal valve (Fig. 9). In cases of crooked nose, the upper lateral

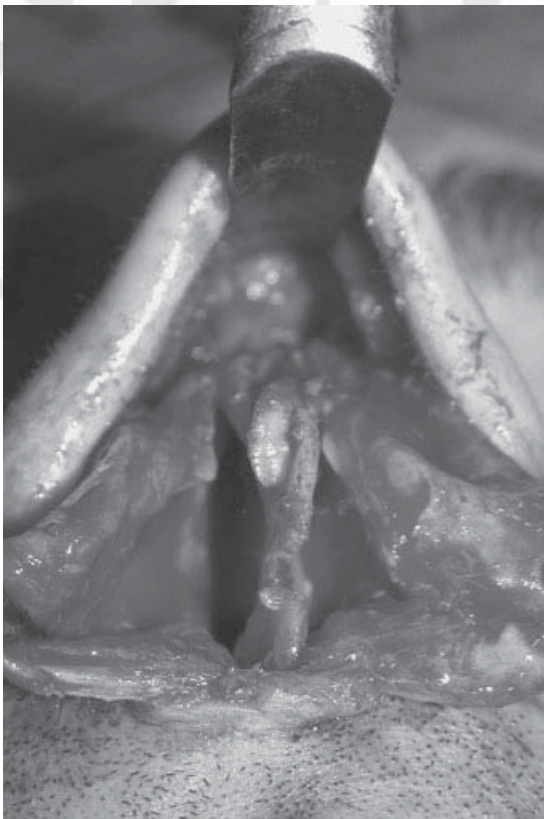


Figure 9 Intraoperative basal view of crossbar graft showing the restoration of the physiological angle of the internal nasal valve.

cartilage is in fact particularly depressed on the concave side and forms an angle with the septum that is generally less than 10 degrees. Application of the crossbar graft thus produces both a functional improvement in terms of respiration and a significant aesthetic effect.

It should be pointed out in this connection that cases of crooked nose brilliantly solved by means of other techniques often present as indelible stigmata of the deformity a lasting depression of the upper lateral cartilage on the concave side. This is caused by the difficulty of reshaping these cartilaginous structures, which are of reduced thickness and consistency. On the other hand, the onlay grafts used to disguise this blemish often prove ineffective over time both as a result of resorption problems and because they worsen the collapse of the upper lateral cartilage. The crossbar graft works instead with its upward pressure to restore the position and strength of the upper lateral cartilage, thus also enabling it to support small onlay grafts if necessary. The latter can in fact be used at the end of the operation to optimize the aesthetic results. The final objective is to make the aesthetic lines from eyebrow to tip on the concave and contralateral sides of the deformity symmetrical.

As regards the use of this technique in secondary septorhinoplasties, it should be borne in mind that in cases where submucous resection of the septum has already been performed, there may be no more cartilaginous tissue available for the graft. It is, however, sometimes possible also in revisions, because of the previous employment of conservative techniques, to harvest a strip of cartilage from the lower part of the dorsal septum without damaging the L strut. The auricular cartilage does not in any case appear to possess the properties needed to make a crossbar graft. It is in fact particularly curved and elastic and not tough enough to counter the cartilaginous memory of the deformity over time. Where a graft of cartilaginous septum is not available, it is therefore preferable to use a strip of the perpendicular plate of the ethmoid of the same shape and size in its place. The use of ethmoid bone has already been described by other authors both as a graft to strengthen particularly thin cartilaginous septa and as a graft to straighten particularly crooked septa.^{4,17,23} Although particularly thin, this type of bone is sufficiently tough to serve as a crossbar graft while also offering a certain degree of flexibility to the L-strut complex as a whole once secured to the dorsal septum.

Finally, clinical experience has shown that it is preferable to adopt an open approach to the nasal pyramid in performing a septal crossbar graft, as this makes it possible to obtain a direct three-dimensional view of the L strut and hence a simultaneous appraisal of all the crooked elements of the septum. This type of approach also makes it easier to secure the graft to the

septum by means of sutures in otherwise unreachable areas to the rear.

CONCLUSIONS

The septal crossbar graft technique introduces a new concept of embedding a graft in the nasal septum. The end effect obtained is structural reinforcement and maximum resistance to cartilaginous memory over time.

The method has proved very effective from the outset in treating the most severe cases of crooked nose, where the use of just one spreader graft on the concave side of the septum can prove insufficiently thick to correct the deformity. At the same time, the embedding of the crossbar graft in the nasal septum offers greater stability than simple attachment with sutures.

Some technical improvements have made it possible to attain an interweaving of the graft and its location to ensure that the straightened L structure of the septum remains impervious to the postoperative deforming forces. Recent use also in cases of septorhinoplasty revision has extended the range of applications of this technique.

The crossbar graft serves effectively to open up the internal nasal valve on the concave side of the deviation and ensure a functional improvement in nasal respiration. At the same time, the pressure exerted by the graft on the upper lateral cartilage also restores harmony and symmetry to the middle third of the nasal pyramid.

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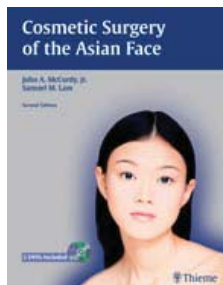
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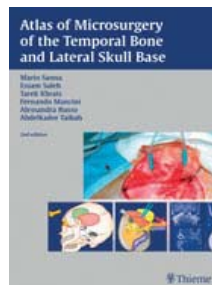
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