

# Barrel Roll Technique for the Correction of Long and Concave Lateral Crura

Armando Boccheri, MD; Tito M. Marianetti, MD

**Objective:** To describe the barrel roll technique that is capable of concurrently correcting 2 associated deformities—overprojection and ptosis of the nasal tip.

**Methods:** Thirty-two patients with concavity of the upper section of 1 or both lateral crura combined with a droopy tip were treated from January 1, 2005, through December 31, 2007. In all cases, the barrel roll technique was used, which involves rotating the lateral crus by 180° on its major axis so that the concavity is transformed into convexity, and carrying out lateral crural overlay to correct the overprojection concurrently.

**Results:** All the patients displayed functional and aesthetic improvement by correcting the droopy tip and con-

cavity of the lateral crura. Revision was necessary in 1 case of monolateral concavity. The comparison of preoperative and postoperative rhinomanometric data showed significant improvement of nasal airway resistance.

**Conclusions:** A combination of the overlay technique and rotation of a portion of the lateral crus on its axis is capable of concurrently correcting serious functional problems and aesthetic defects of the nasal tip. The open approach is essential for perfect positioning of the mobilized cartilaginous segments and ensuring stable results over time.

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**T**HE LATERAL CRUS CONSTITUTES the load-bearing structure of the nasal wing and determines both its shape and functional efficiency.

While continuing medially with the domal segment of the intermediate crus, it does not reach as far as the anterior nasal aperture laterally but is connected to it by dense fibrous connective tissue containing the sesamoid cartilages. The lateral crura can vary anatomically and often present differing degrees of concavity. Zelnick and Gingrass<sup>1</sup> and Oneal et al<sup>2</sup> have described several variants in the shape of the lateral crura and distinguished different types of concavity in terms of the involvement of their medial, central, or lateral portion. Costantian<sup>3</sup> and Courtiss and Goldwyn<sup>4</sup> have shown the physiological importance of the shape, robustness, and position of the lateral crus for the functioning of the external nasal valve. While concavity of the upper section has a negative functional effect, this fact is often ignored and aesthetic surgery on the nasal tip is confined to the correction of other parameters, such as projection and rotation. At most, there is some form of camouflage with no functional effect. Moreover, the presence of unduly long lateral crura often leads in aesthetic terms to a

droopy tip and constitutes a problem that is by no means easy to solve. The objective of this study is to describe a technique capable of concurrently correcting both types of anomaly.

## METHODS

Thirty-two patients, 12 men and 20 women, with concavity of the upper section of 1 or both lateral crura combined with a droopy tip were treated from January 1, 2005, through December 31, 2007. The patients ranged in age from 19 to 51 years (mean, 31 years). Considerable overprojection of the nasal tip was present in 20 patients. Primary rhinoplasty was involved in 16 patients, secondary in 13 patients, and tertiary in 3 patients. Anterior rhinomanometry was carried out preoperatively on all the patients using the Costantian-Clardy method.<sup>5</sup> The barrel roll technique was used in all cases. All operations were performed by the same surgeon (A.B.). The functional results were objectively ascertained 6 months after the operation by rhinomanometry performed by the same operator (T.M.M.) using the same method and instrument. Aesthetic appraisals were formulated independently both by the operating team and by other surgeons in the Department of Maxillo-Facial Surgery, San Camillo-Forlanini Hospital, Rome, Italy. The patients' family physicians also expressed aesthetic judgments by completing a form with a choice of 4 degrees of improve-

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#### Questionnaire for Patients' General Practitioner

- 1) Does the postoperative shape of the nose correspond on the whole to expectations?  
Yes      No      More or less
- 2) How would you describe the nasal profile obtained after the operation?  
Prominent      Concave      Right
- 3) Do you regard the shape and size of the nose as appropriate on frontal view?  
Yes      No      More or less
- 4) Would you describe the nose as natural in appearance after the operation?  
Yes      No      More or less
- 5) Would you describe the nose as in harmony with the rest of the face after the operation?  
Yes      No      More or less
- 6) Has the passing of time since the operation made any difference to the aesthetic result in your opinion?  
No      Yes, for the better      Yes, for the worse
- 7) Do you see any need for retouching?  
Yes      No      Perhaps
- 8) How would you judge the final aesthetic result?  
Unsatisfactory      Satisfactory      Good      Excellent

Figure 1. General practitioner questionnaire.

#### Questionnaire for Patients

- 1) Does the postoperative shape of the nose correspond on the whole to expectations?  
Yes      No      More or less
- 2) How would you describe the nasal profile obtained after the operation?  
Prominent      Concave      Right
- 3) Do you regard the shape and size of the nose as appropriate on frontal view?  
Yes      No      More or less
- 4) Would you describe the nose as natural in appearance after the operation?  
Yes      No      More or less
- 5) Would you describe the nose as in harmony with the rest of the face after the operation?  
Yes      No      More or less
- 6) Did you immediately feel at ease in interpersonal relations after the operation?  
Yes      No      More or less
- 7) Has the passing of time since the operation made any difference to the aesthetic result in your opinion?  
No      Yes, for the better      Yes, for the worse
- 8) Do you see any need for retouching?  
Yes      No      Perhaps
- 9) How has your breathing been since the operation?  
Better      The same      Worse
- 10) How would you judge the final aesthetic result?  
Unsatisfactory      Satisfactory      Good      Excellent

Figure 2. Patient questionnaire.

ment (unsatisfactory, satisfactory, good, and excellent) (**Figure 1**). The patients completed the same questionnaire registering the degree of improvement with respect to the preoperative situation for both function and aesthetics (**Figure 2**). Checks were carried out every week for the first month, every fortnight for the second month, every month for the next 6 months, and then every 3 months up to 18 months. The mean follow-up was 25 months (range, 19-43 months).

### SURGICAL TECHNIQUE

An open approach is used to expose the alar cartilages and the nasal ridge. An inverted-V columellar incision is made together with 2 marginal incisions at the level of the nasal vestibule. Cautious and careful exposure of the nasal tip reveals deformity of the lateral crura char-

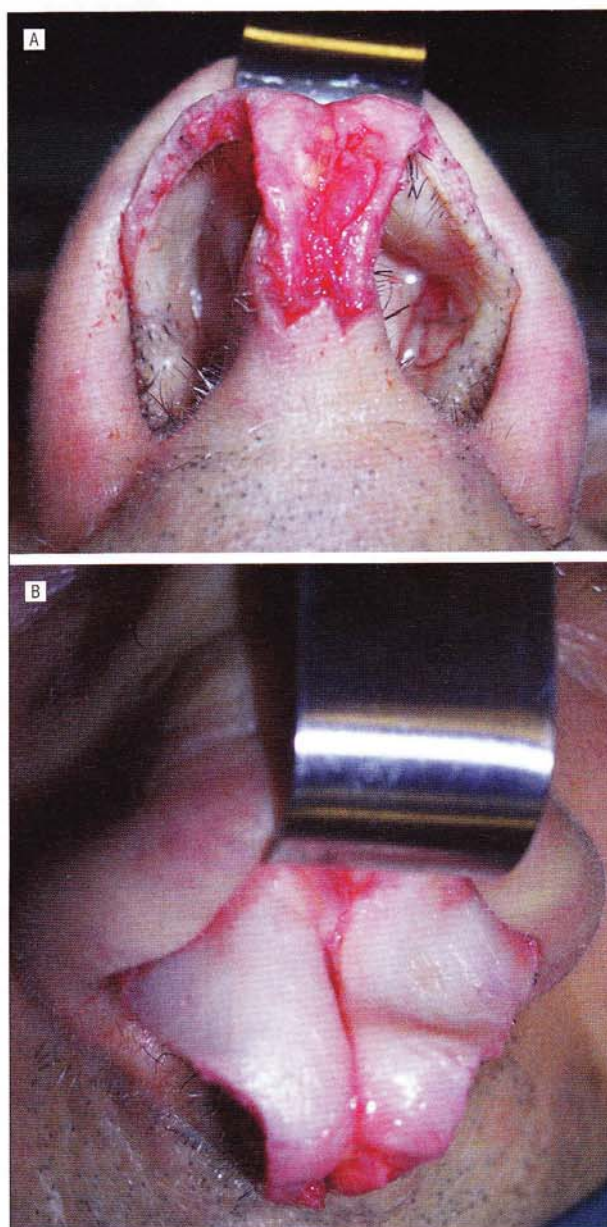
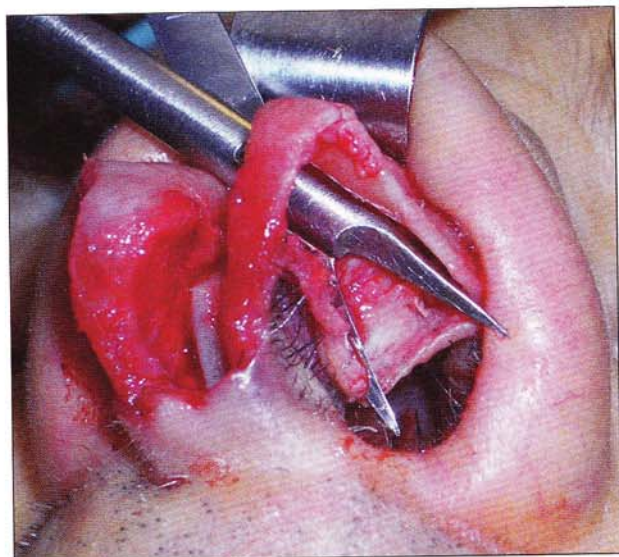


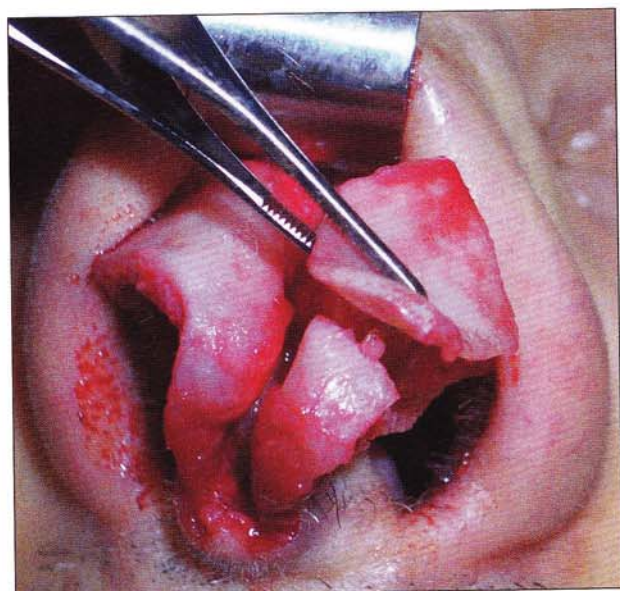
Figure 3. Basal (A) and frontal (B) views of the external nasal valve deformity and asymmetry are due to concavity of the upper section of the left lateral crus.

acterized by sagittal overdevelopment and concavity of the same (**Figure 3**). Median and lateral osteotomies and hump excision are performed where necessary, after careful detachment of the nasal dorsum, before going on to reshape the nasal tip. The first step of the barrel roll technique consists of detachment of the vestibular skin from the lateral crus over an area including all the crus as far as the dome (**Figure 4**). Abundant infiltration of the space between the lower surface of the lateral crus and vestibular skin below proves useful in this connection. Once the lateral crus has been freed completely, the anterior and posterior borders of the concavity are precisely identified and incisions are made at these points (**Figure 5**). Extracorporeal reshaping of the lateral crus is performed with the excision of its cephalic part where necessary (**Figure 6**). The lateral crus is rotated 180° on its major axis to transform the previous concavity into



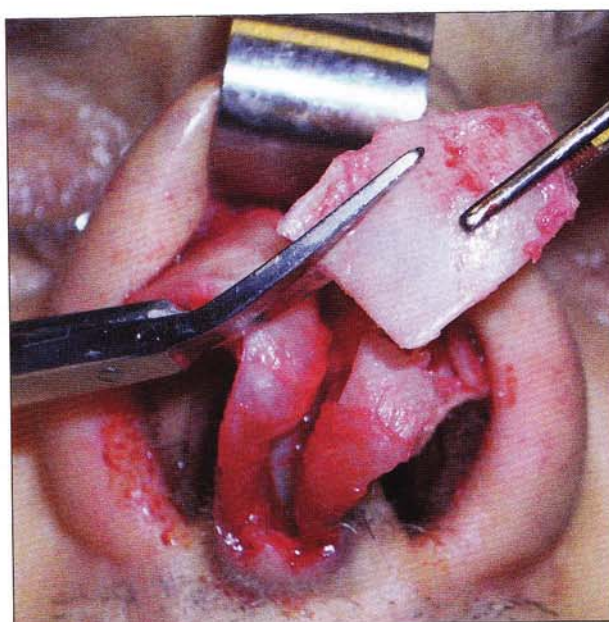


**Figure 4.** Complete detachment of the vestibular skin below the concave lateral crus.

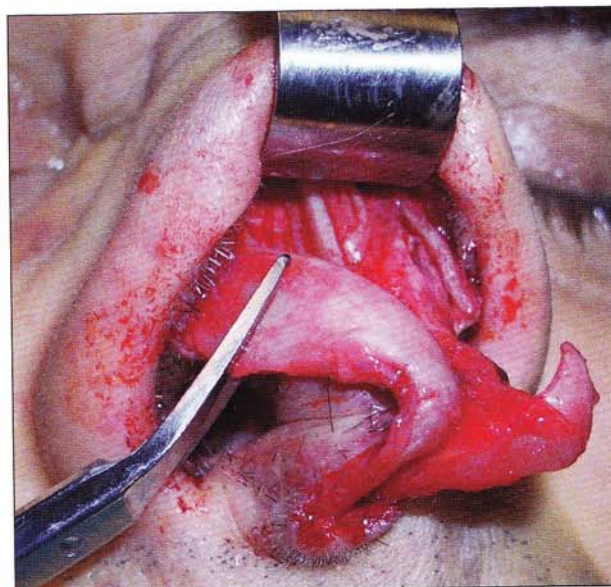


**Figure 5.** Sectioning and removal of the deformed portion of the left lateral crus.

convexity before being secured in its new position. Thus repositioned, the lateral crus is sutured with 6.0 nylon first in the anterior portion with a termino-terminal suture on the intermediate crus. Overlay of the posterior portion of the repositioned segment with the residual lateral crus is then carried out. The degree of overlay is determined by the desired degree of nasal tip rotation and deprojection. Once the degree of the overlay has been established, the lateral crus is secured posteriorly by suturing with 6.0 nylon. The barrel roll technique can be applied monolaterally or bilaterally depending on whether the concavity of the lateral crus is monolateral or bilateral. For monolateral correction, it is preferable for the overlay to be executed first from the nonconcave side (**Figure 7**), which can then be used as a guide to facilitate determination of the degree of overlay of the contralateral segment of crus rotated by 180° (**Figure 8**).



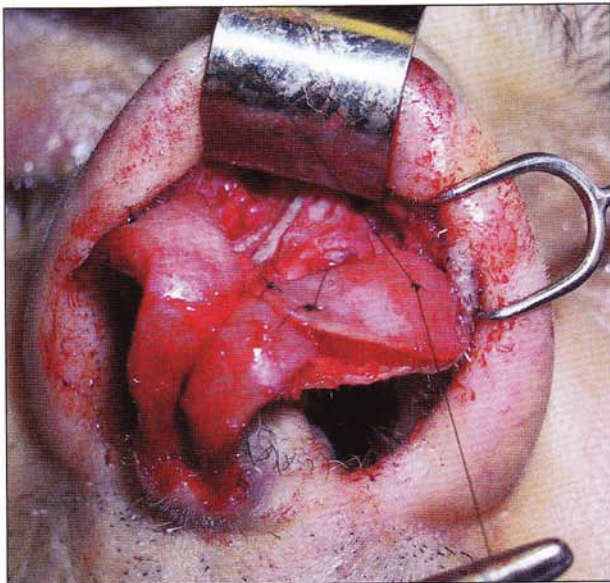
**Figure 6.** Extracorporeal reshaping of the lateral crus with trimming of the cephalic portion.



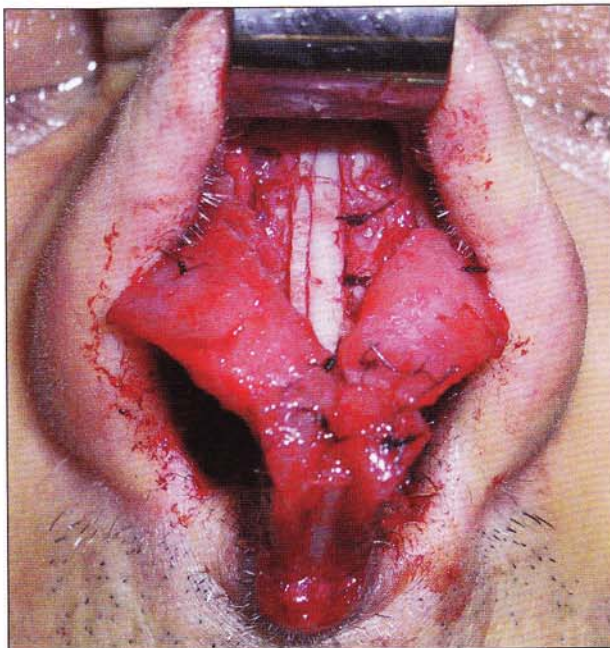
**Figure 7.** Sectioning of the right lateral crus for application of the overlay technique.

One or 2 mattress sutures with 5.0 polyglactin all the way through the thickness will help to ensure perfect adhesion of the vestibular skin below to the lateral crus. Once the integrity of the lateral crura has been restored, it is often useful to apply a transdomal suture at the end of the procedure to improve the definition of the nasal tip (**Figure 9**). Finally, the marginal incisions are sutured with 5.0 polyglactin 910, and the columellar incision is sutured with 6.0 nylon (**Figure 10**). The procedure ends with the insertion of an anterior nasal packing, which is removed after 24 to 48 hours, and the application of an external splint. The barrel roll technique can be used alone or together with other complex techniques. In any case, reshaping of the tip must be kept until the end of the rhi-





**Figure 8.** Repositioning and suturing of the left lateral crus after rotation of 180° on its major axis and overlay.



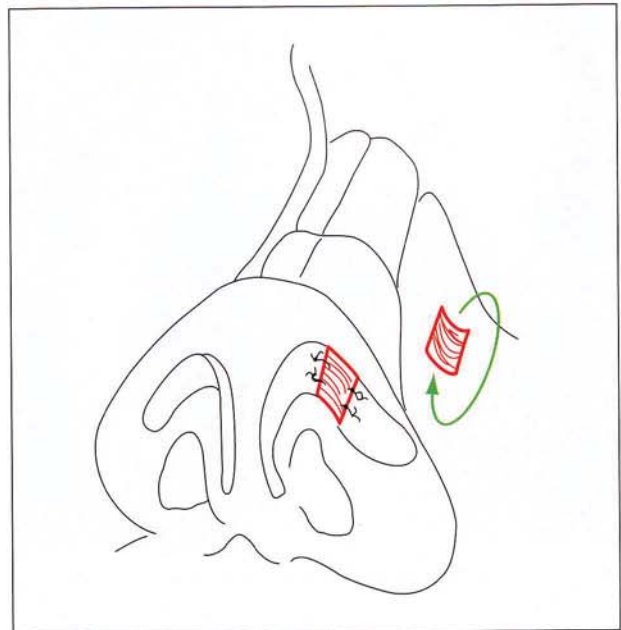
**Figure 9.** End result with pure overlay technique from the right side and barrel roll technique from the left side.

noplasty to avoid all risk of breaking the delicate interconnections established between the crural cartilaginous segments.

**Figure 11** and **Figure 12** show 2 different clinical cases characterized respectively by monolateral (Figure 11) and bilateral (Figure 12) concavity of the lateral crura with associated overprojection of the tip resolved concurrently using the barrel roll technique.

## RESULTS

All the patients showed both functional and aesthetic improvement. In particular, correction of the droopy tip and

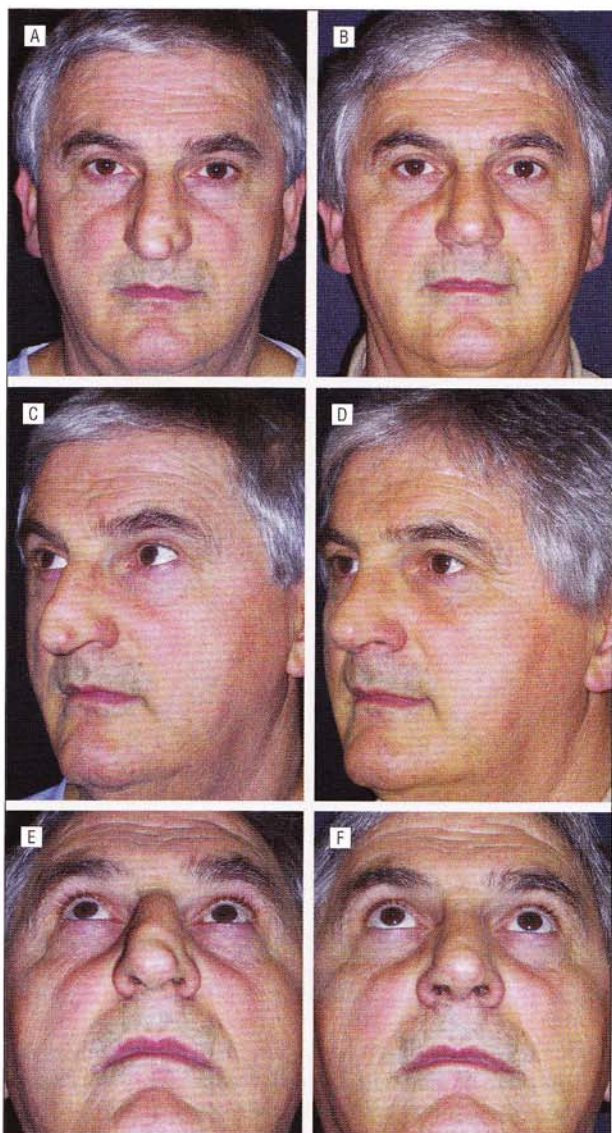


**Figure 10.** Schematic illustration of the barrel roll technique. Shown in red is the segment of lateral crus rotated by 180° on its major axis and overlapped.

the concavity of the lateral crura was achieved in all cases. Revision was necessary in 1 case of monolateral concavity because the patient presented a certain degree of postoperative asymmetry due to a difference in the length of the 2 lateral crura. This patient was one of the first to be operated on, and the unsatisfactory outcome was probably due to the fact that the barrel roll technique was performed first from the concave side followed by the overlay technique from the contralateral side. This approach makes it impossible to estimate precisely how much farther back the excised and grafted portion of the lateral crus should be positioned. During the revision operation, the lateral crus that was corrected using the barrel roll technique, which appeared exaggeratedly short, was sutured in a more caudal position to achieve perfect symmetry with the contralateral crus.

The aesthetic improvement registered for all the patients both by the operating team and by other surgeons in the same department was also confirmed by their family physicians, who assessed it as good in 9 cases and excellent in 23 cases. Analysis of the questionnaires completed by the patients showed a marked improvement as regards both functional symptoms and the perception of aesthetic appearance. Comparison of preoperative and postoperative rhinomanometric data showed a significant improvement of nasal airway resistance, where varying degrees of insufficiency of the external nasal valve had been identified preoperatively. The mean (SD) value of nasal airflow for all the patients was 312 (32) mL for 14 seconds at rest and 931 (102) for 14 seconds during forced inspiration. The values registered 6 months after the operation showed an increase of approximately 180% in airflow with respect to the preoperative values of 558 (63) for 14 seconds at rest and 1681 (157) during forced inspiration (**Table** and **Figure 13**). The major procedure executed during the rhinoplasty was the barrel roll technique combined with hump excision in all the cases.

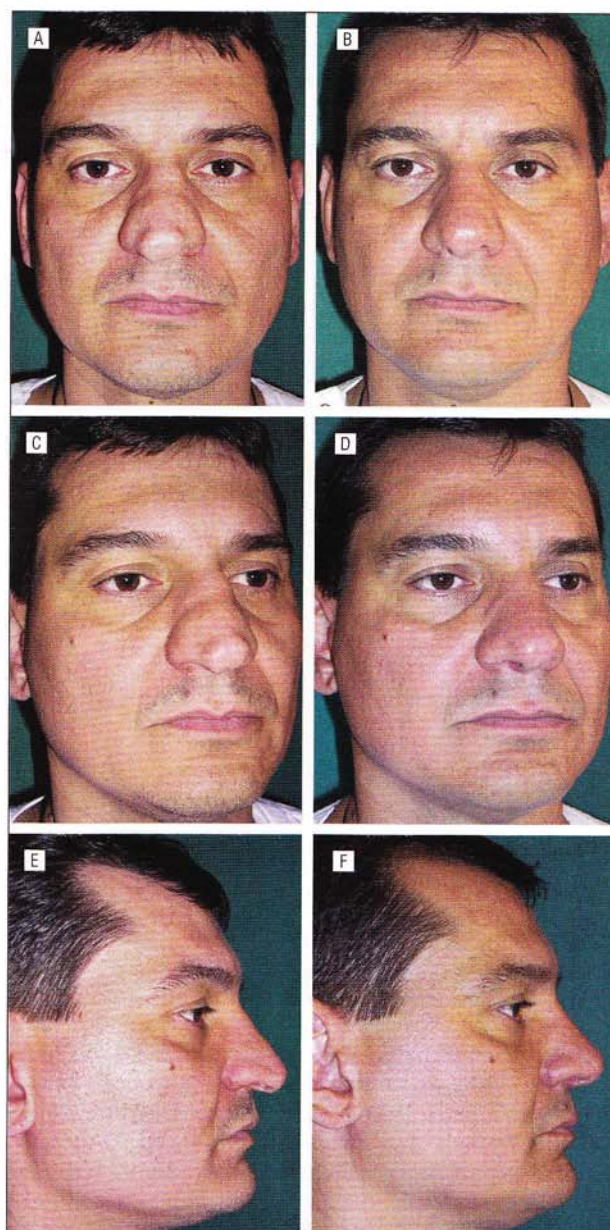




**Figure 11.** Patient with monolateral concavity of the lateral crus associated with overprojection of the tip. Frontal preoperative view (A) and 1-year postoperative results (B). Three-quarters preoperative view (C) and 1-year postoperative results (D). Basal preoperative view (E) and 1-year postoperative results (F).

#### COMMENT

Concavity of the lateral crura, which often leads to insufficiency of the external nasal valve, alar retraction, and a pinched nasal tip is a functional and aesthetic problem that proves hard to solve. Collapse occurs in the anterior two-thirds of the nasal wing, because it is supported in this region solely by the lateral crus. The literature includes many surgical techniques to correct this anatomical defect, described for the first time by Tardy et al,<sup>6</sup> who advocated a closed approach and a technique involving excision and regrafting of the lateral crus with a rotation of 180°. Various types of graft have been suggested to support and restore the shape of the lateral crus. The lateral crural strut graft and lateral crural spreader graft of Rohrich et al<sup>7</sup> and Gunter and Rohrich<sup>8</sup> and the batten grafts described by Toriumi et al<sup>9</sup> are well-known examples of possible solu-



**Figure 12.** Patient with bilateral concavity of the lateral crus associated with overprojection of the tip. Frontal preoperative view (A) and 4-year postoperative results (B). Three-quarters preoperative view (C) and 4-year postoperative results (D). Lateral preoperative view (E) and 4-year postoperative results (F). Note the correction of the tip ptosis allowed by the barrel roll technique.

tions to the problem. While these are valid surgical procedures, they may prove insufficient on their own in cases of particularly severe anatomical deformity with pronounced concavity of the lateral crus. They do not, in fact, involve any substantial modification of the anatomy of the alar cartilage. Even though the aesthetic problem is brilliantly solved, the residual concavity could continue to hamper the functioning of the external nasal valve. Another corrective method is the lateral crural turnover graft initially proposed by McCollough and Fedok,<sup>10</sup> which involves turning over the cephalic portion of the lateral crus inside the concavity of the crus itself. In this way, use is made of autologous cartilage that would otherwise be eliminated, the memory of the cartilaginous concavity is exploited against



Table. Preoperative and Postoperative Nasal Airflow

Patient No.	Preoperative Nasal Airflow, mL/14 s		Postoperative Nasal Airflow, mL/14 s	
	At Rest	During Forced Inspiration	At Rest	During Forced Inspiration
1	342	832	1000	1689
2	312	1020	602	1712
3	280	820	559	1568
4	324	859	558	1678
5	356	967	500	1701
6	282	983	480	1590
7	275	879	507	1704
8	325	949	632	1752
9	290	1011	563	1738
10	298	978	548	1690
11	302	931	523	1709
12	349	890	621	1681
13	352	930	604	1642
14	289	937	532	1689
15	273	982	546	1523
16	324	898	673	1708
17	326	938	538	1638
18	279	934	490	1710
19	300	1024	602	1809
20	311	922	590	1690
21	326	925	543	1706
22	321	957	565	1650
23	308	894	532	1542
24	314	931	498	1600
25	326	904	531	1702
26	357	982	543	1802
27	307	933	572	1642
28	289	919	560	1452
29	311	910	528	1713
30	312	879	558	1769
31	309	934	543	1803
32	315	942	557	1790

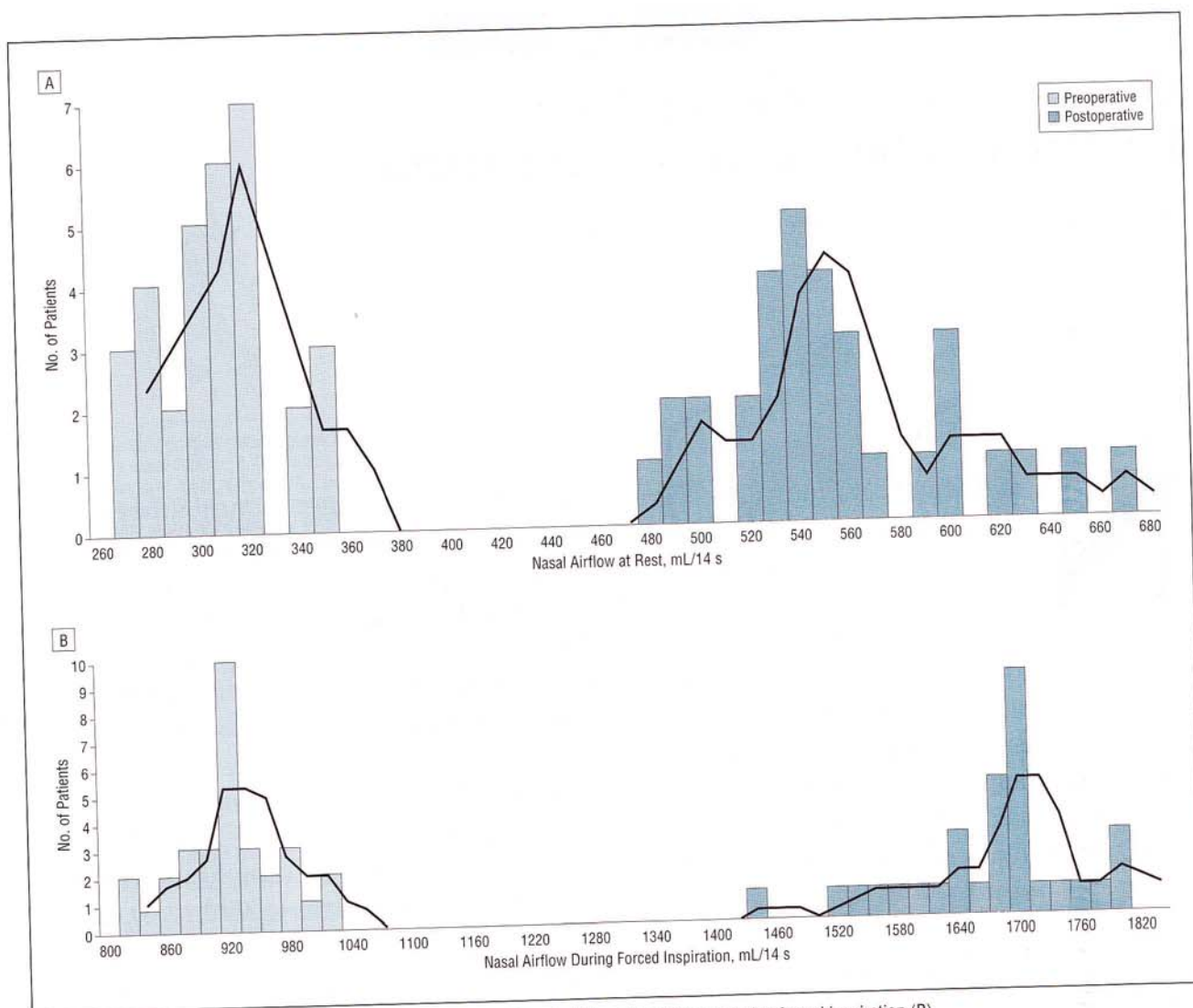
itself, and strengthening of the residual lateral crus is achieved. Described with a closed-delivery approach by McCollough and Fedok,<sup>10</sup> this technique was then taken up with an open approach by Janis et al,<sup>11</sup> who also introduced the modification of leaving the cephalic portion of the lateral crus attached to the anteromedial perichondrium by a stalk. Although useful and offering good results, this technique is, however, applicable exclusively in the case of wide lateral crura where cephalic resection of at least 3 to 4 mm is possible. Moreover, as the authors themselves stress, it often cannot be used in secondary or tertiary rhinoplasties where the cephalic portion of the alar cartilages is seldom preserved.

Another technique described to correct concavity of the lateral crura is based exclusively on sutures.<sup>12</sup> Neu<sup>13</sup> describes 15 patients with concavity of the lateral crura successfully treated using interlocking mattress sutures inserted in chain-link fashion. The positive aspects of this technique are preservation of the integrity of the cartilage and the reversibility of every surgical maneuver. As Gruber et al<sup>12</sup> and Neu<sup>13</sup> point out, however, the drawbacks are the presence of a learning curve, which involves extended operating time during the first applications of the technique, and the possibility that some forms of concavity cannot be resolved with sutures alone. Another problem frequently associated with concavity of the lateral crura is sagittal overdevelopment. The lateral crural overlay technique described by Kridel and Konior<sup>14</sup> is the technique of choice for the correction of a

droopy tip caused by excessive length of the lateral crura. The problem of the sagittal overdevelopment of the lateral crura is often associated with concavity and leads to the clinical appearance of a pinched and droopy nasal tip. The barrel roll technique makes it possible to concurrently correct the 2 associated types of deformity: lateral crura concavity and excessive length of the lateral crura in both primary and revision rhinoplasties. The only essential prerequisite for the application of this technique is the presence of robust lateral crura. Particular attention must be focused on the termino-terminal suture of the anteriormost portion of the rotated concave segment and to the posterior sutures determining the degree to which the cartilages overlap. Modulation of the overlay of the lateral crura makes it possible to modify the projection and the rotation of the nasal tip to obtain the best possible aesthetic result.

The originality of our study lies in its codification with the open approach of a technique that involves the use of 2 different procedures in a single operation. Moreover, careful preoperative analysis and precise intraoperative appraisal with the open approach make it possible to achieve exact correction both of the morphologic deformity of the lateral crura and of their excessive development in terms of length. In our experience, the functional and aesthetic results achieved by this technique have proved optimal and stable over time. It could be regarded as the preferred choice when the deformity of the





**Figure 13.** Preoperative and postoperative rhinomanometric data of nasal airflow at rest (A) and during forced inspiration (B).

concave lateral crura is associated with ptosis and over-projection of the tip.

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