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Nasal patency after open rhinoplasty with spreader grafts

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Received 19 August 2011; accepted 26 November 2011

KEYWORDS

Nose;
Airflow;
Acoustic rhinometry;
Glatzel mirror test

Summary *Background:* Spreader grafts have been used in cosmetic rhinoplasty, but little information is available about the objective results of treatment. This study sought to determine subjective and objective functional results of open cosmetic rhinoplasty with spreader grafts.

Methods: Twenty patients (14 women, six men; mean age, 31 ± 6 years) had open cosmetic rhinoplasty. Surgery included dissection of the upper lateral cartilages, from the septum, and placement of spreader grafts, symmetrically, along the dorsal edge of the septal cartilage. Preoperative and postoperative evaluation included breathing quality score, acoustic rhinometry and a modified Glatzel mirror test.

Results: Evaluation after surgery (range, 5–18 months) showed significant improvement of breathing quality (before surgery, 8; after surgery, 9.4; $P \leq 0.001$) and a mean minimal cross-sectional area of the left side (before surgery, 0.6 cm^2 ; after surgery, 0.9 cm^2 ; $P \leq 0.01$). There was no significant change of the mean minimal cross-sectional area of the right side (acoustic rhinometry) or nasal patency (modified Glatzel mirror test) between preoperative and postoperative evaluation. Complications included postoperative synechiae in two patients and septal granuloma in one patient.

Conclusions: Open structure rhinoplasty using spreader grafts is effective in reconstructing the internal nasal valve and preserving or improving nasal patency.

Level of evidence: : IV (case series with preoperative and postoperative testing).

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The removal of a dorsal hump is commonly done during a rhinoplasty.^{1,2} However, functional and aesthetic compromises may occur because of excessive removal of cartilage and bone or disruption of the region between the upper lateral cartilages and the septum. Complications noted in long-term follow-up include saddle nose, inverted V dorsal contour deformity and internal or external nasal valve collapse.^{3–5} With open structure rhinoplasty, an open approach allows improved exposure, better control of technique and preservation of anatomic integrity, and this may improve predictability of long-term functional and aesthetic results.^{3,6}

The internal nasal valves, formed by the articulation of the caudal and dorsal edges of the upper lateral cartilages with the caudal septum (septal angle), may contribute to 50% of total airway resistance, and may be an important cause of nasal obstruction.^{7,8} During a rhinoplasty, techniques for managing the nasal valves include the spreader graft (in which autogenous strips of cartilage are placed between the septum and the upper lateral cartilages to provide a spreader effect).⁹ These spreader grafts may preserve or reconstruct the dorsal aesthetic lines and maintain or improve functional outcome by improving nasal patency and airflow.^{6,10} Modifications of the original method have been reported including miniature spreader grafts from the lateral crura of the lower lateral cartilages¹¹; double-layered spreader grafts¹²; spreader grafts made from nasal bones removed from the hump¹³; and use of absorbable and non-absorbable materials as nasal valve spacers.¹⁴

Acoustic rhinometry has been used to measure the cross-sectional area at the level of the internal nasal valve after reductive rhinoplasty.^{15,16} Different surgical methods provide subjective improvement after open structure rhinoplasty for reconstruction of the middle third of the nose.^{17–19} However, there is controversy about the best method for reconstructing the dorsum and the internal nasal valves.²⁰ Furthermore, there is no objective information available from acoustic rhinometry to compare nasal patency at the internal nasal valve before and after surgery with spreader grafts for reconstructing the middle third of the nose.

We hypothesised that open rhinoplasty with spreader grafts to reconstruct the middle third of the nose may give satisfactory clinical outcomes with minimal morbidity. This study sought to compare the functional outcomes before and after open structure cosmetic rhinoplasty using spreader grafts. Therefore, we analysed the outcome of surgery with a subjective questionnaire and objective measurements of nasal patency with acoustic rhinometry and the modified Glatzel mirror test.

Patients and methods

Subjects

This clinical prospective study was reviewed and approved by the Research Ethics Committee of the University of São Paulo and carried out from September 2009 to December 2010. The sample consisted of 20 consecutive patients (14 women, six men; aged 20–40 years; mean age, 31 ± 6

years), who were scheduled for cosmetic rhinoplasty and who were healthy and had a nasal aesthetic complaint (with or without functional complaint and with or without a dorsal hump). Asians and blacks were excluded from the study and other patients were excluded for history of nasal trauma, prior nasal surgery, major septal deviations or medical disorders.

Evaluation

All patients had preoperative and postoperative evaluation (90–120 days after surgery). Subjective evaluation was done with a questionnaire in which each patient rated breathing quality from 1 (poor) to 10 (excellent).

Measurements of the nasal cross-sectional area were performed by the same investigator using an acoustic rhinometer (Rhino Scan, SRE 2000, Rhinometrics, Lyngø, Denmark). With the patient seated, measurements were made before and after application of a nasal decongestant spray (oxymetazoline, 0.05%); however, to avoid potential errors associated with different degrees of congestion before and after surgery, only measurements after using the decongestant were analysed. An external nasal adapter was used, and care was taken to avoid distortion of the nostrils. The first two measurements of minimal cross-sectional area on the acoustic rhinometry graphs were recorded by obtaining three curves (averaged) during cessation of breathing (patient holding their breath).

Nasal patency was evaluated with the modified Glatzel mirror test, performed by a single investigator (VDP) with a metal plate (scored in millimetres) placed under and along the patient's nostrils. Measurements were made with the patient seated and the head vertical. The area of condensation obtained on the metal plate after normal expiration (with mouth closed) was marked with a ballpoint pen and then transferred to a millimetre reference sheet. The markings were a measure of the area of nasal aeration; these markings were quantified in sq. cm (UTHSCSA Image Tool for Windows, version 3.0, San Antonio, TX, USA),²¹ and the left and right sides were recorded separately.

Surgical technique

All patients had surgery by one surgeon (VDP) with general anaesthesia and infiltration with lidocaine (0.5%) and epinephrine (1:80 000). An open approach rhinoplasty, with stepwise dissection and proper identification of the cartilages, was performed. The upper lateral cartilages were carefully dissected from the septum of the submucoperichondrial layer, and the connections were detached (Figure 1(a)). Septal cartilage was harvested, leaving a 10-mm L-shaped strut for nasal support. Then, each nasal component that contributed to the unpleasant appearance of the patient was addressed. In each patient, two rectangular strips of cartilage were removed from the septum for use as spreader grafts (Figure 1(b)). Spreader grafts were measured (length, thickness and height) with a ruler and placed symmetrically and bilaterally (length of graft along length of nose) along the dorsal edge of the remaining septal cartilage (Figure 1(c) and (d)), spanning the entire distance of the dorsal border of the upper lateral

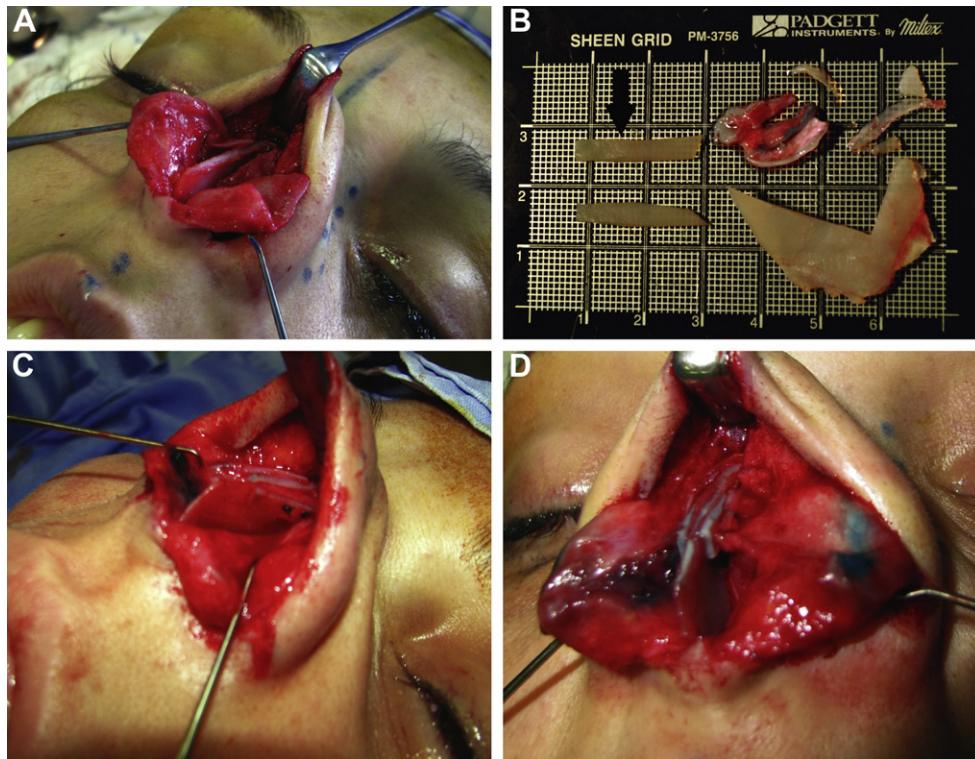


Figure 1 Operative technique of rhinoplasty with spreader grafts. A. Nasal cartilages after detachment of connections. B. Spreader grafts made from strips of septal cartilage (black arrow). C. Spreader grafts placed along the dorsal edge of the remaining septal cartilage and secured with 2 U-shaped sutures (5-0 monofilament nylon). D. Upper lateral cartilages reattached to the septum with 3U-shaped non-absorbable sutures (5-0 monofilament nylon).

cartilages (cephalic to the nasal bones). Lateral osteotomies were performed in 16 patients (80%); no nasal turbinate surgery or transverse or medial osteotomies were performed. After vestibular and skin closure, a thermo-plastic cast was applied to stabilise the nasal pyramid for 7 days.

Data analysis

Non-parametric tests were used for statistical analysis. The Kolmogorov–Smirnov test was used to evaluate whether the data could be adequately modelled by a normal distribution. After the normal distribution assumption was not verified, the Wilcoxon signed rank test was used. Statistically significant differences were defined by $P \leq 0.05$.

Results

The size of the spreader grafts was similar for most patients, with a narrow range of variation noted for graft width and thickness (Table 1). Follow-up evaluation (range, 5–18 months) showed complications in three patients (15%); two patients developed synechiae (adhesions) distant from the nasal valves that were treated with sectioning with local anaesthesia and one patient developed a septal granuloma that was treated with local drainage. No patients developed excessive width of the middle third of the nose.

There was a significant improvement of mean subjective breathing quality before and after surgery (Figure 2). Mean minimal cross-sectional area, determined by acoustic rhinometry, was similar between left and right sides before

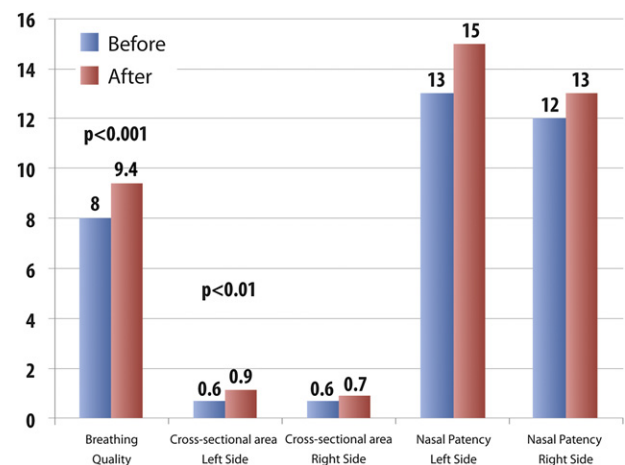
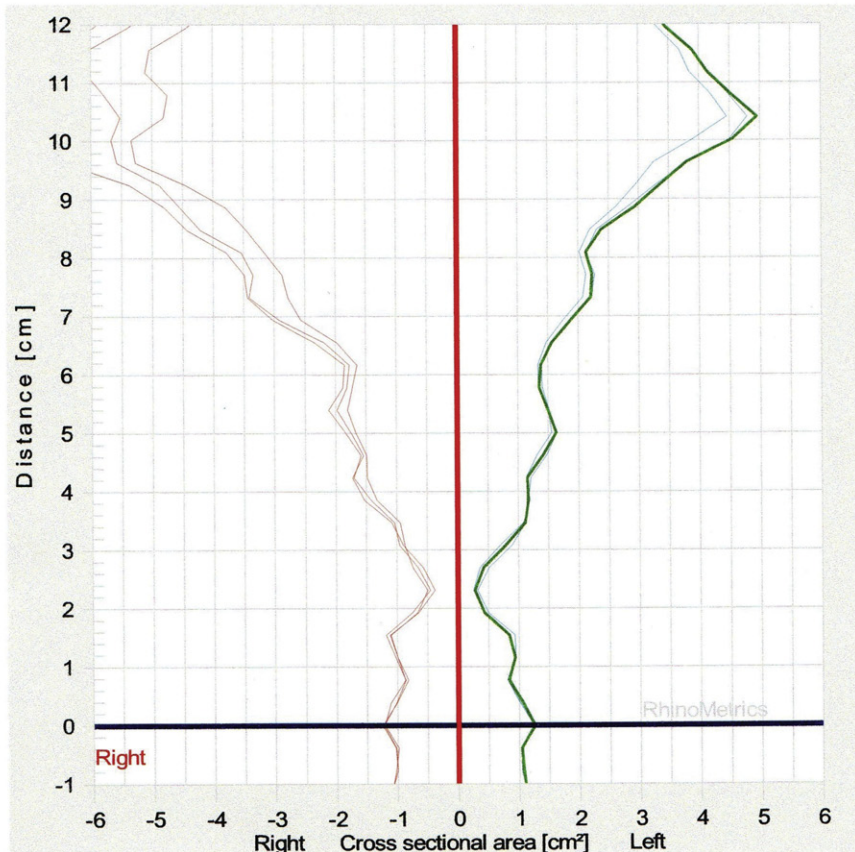


Figure 2 Subjective breathing quality and objective measurements of nasal cross-sectional area and nasal patency in 20 patients who had open rhinoplasty with spreader grafts. Follow-up duration: range, 5–18 months after surgery. Comparison of data before and after surgery. Breathing quality questionnaire: patient rating from 1 (poor) to 10 (excellent); minimal cross sectional area: determined with acoustic rhinometry; nasal patency: determined with modified Glatzel mirror test.

surgery; after surgery, mean minimal cross-sectional area of the left side was significantly greater than the preoperative ipsilateral and postoperative contralateral values (Figures 2 and 3). The minimal cross-sectional area typically was noted at the second valley in the graph, corresponding

to the internal nasal valve in most noses (Figure 3). There was no significant difference in mean nasal patency, determined by the modified Glatzel mirror test, between preoperative and postoperative values or between left and right sides (Figure 4).

A		- COM VASO - RhinoScan	
Patient journal		Examination journal	
Patient name:		Title:	COM VASO
Social security no.:		Created date:	10/12/2009 11:12:42
Personal journal no.:		Type:	RhinoScan
Born:	5/7/1971	Examiner:	SMQC
Sex:	F	Software ver.:	4.0.5.0, v 3.00.Xj/v 3.0b
Diagnosis:		Probe:	



Date and time	Side	Title	Distance ranges:			Dist MCA1 VOL1			Dist MCA2 VOL2 Nose Piece		
			Units:			[0.00;2.20] cm	[cm²]	[cm³]	[2.20;5.40] cm	[cm]	[cm²]
10/12/2009 11:11:58	L	L 09-12-10 11:11:58	2.20	0.37	1.88	2.31	0.32	3.49			
10/12/2009 11:12:10	L	L 09-12-10 11:12:10	2.20	0.30	1.79	2.31	0.25	3.20			
10/12/2009 11:12:23	L	L 09-12-10 11:12:23	2.20	0.32	1.84	2.31	0.28	3.34			
10/12/2009 11:10:38	R	R 09-12-10 11:10:38	2.20	0.54	2.14	2.31	0.46	4.10			
10/12/2009 11:11:07	R	R 09-12-10 11:11:07	2.20	0.46	2.04	2.31	0.38	4.01			
10/12/2009 11:11:25	R	R 09-12-10 11:11:25	2.20	0.55	2.10	2.31	0.50	3.79			

Figure 3 Acoustic rhinometry graph in a 35-year-old patient (female) who had open rhinoplasty with spreader grafts. The minimal cross section area was noted at the second valley, corresponding to the internal nasal valve. A. Preoperative graph. B. Postoperative graph.

B

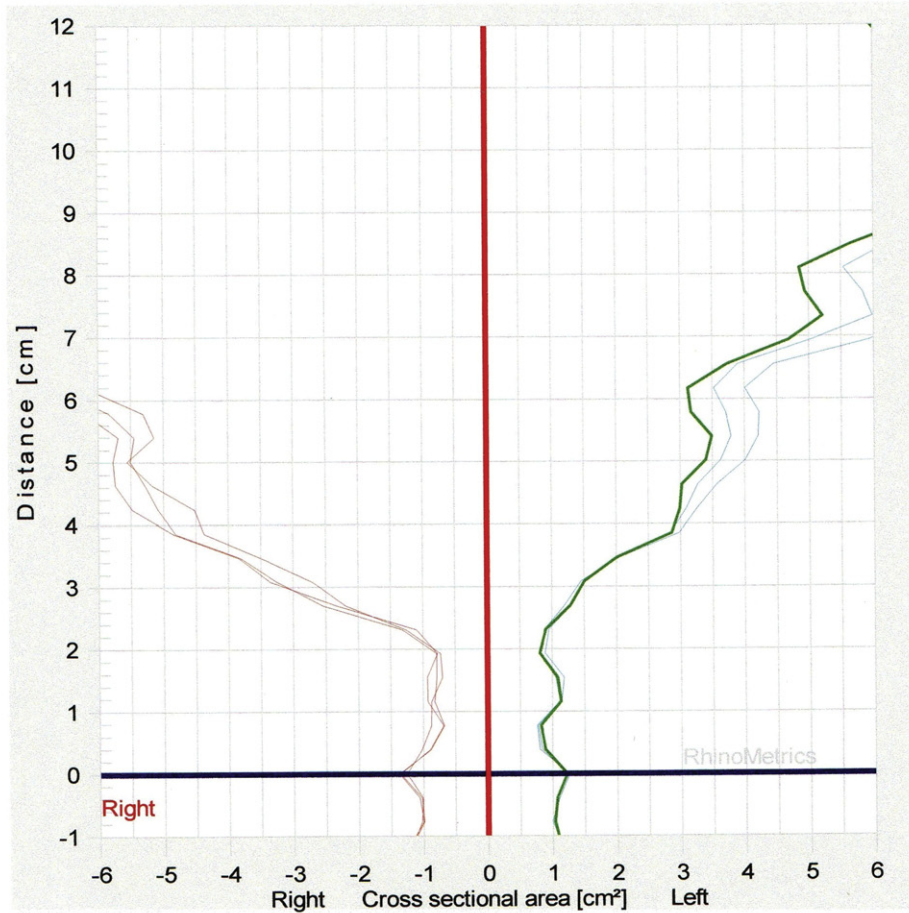
- C.VASO POS OPERATO - RhinoScan

Patient journal

Patient name:
 Social security no.:
 Personal journal no.:
 Born: 25/7/1971
 Sex: F
 Diagnosis:

Examination journal

Title: C.VASO POS OPERATO
 Created date: 6/8/2010 11:30:35
 Type: RhinoScan
 Examiner: SMQC
 Software ver.: 4.0.5.0, v 3.00.Xj/v 3.0b
 Probe:



Date and time	Side	Title	Dist MCA1 VOL1			Dist MCA2 VOL2 Nose Piece			
			Distance ranges:	[0,00;2,20] cm		[2,20;5,40] cm			
			Units:	[cm]	[cm²]	[cm³]	[cm]	[cm²]	[cm³]
6/8/2010 11:29:58	L	L 10-08-06 11:29:58		0,77	0,76	2,06	2,20	0,86	8,23
6/8/2010 11:30:11	L	L 10-08-06 11:30:11		0,77	0,77	2,17	2,20	0,93	7,82
6/8/2010 11:30:30	L	L 10-08-06 11:30:30		1,93	0,81	2,14	2,20	0,87	7,54
6/8/2010 11:28:15	R	R 10-08-06 11:28:15		1,54	0,70	1,97	2,20	1,11	12,18
6/8/2010 11:29:05	R	R 10-08-06 11:29:05		0,77	0,67	1,90	2,20	1,16	13,13
6/8/2010 11:29:42	R	R 10-08-06 11:29:42		0,77	0,69	1,98	2,20	1,00	13,53

Figure 3 (continued).

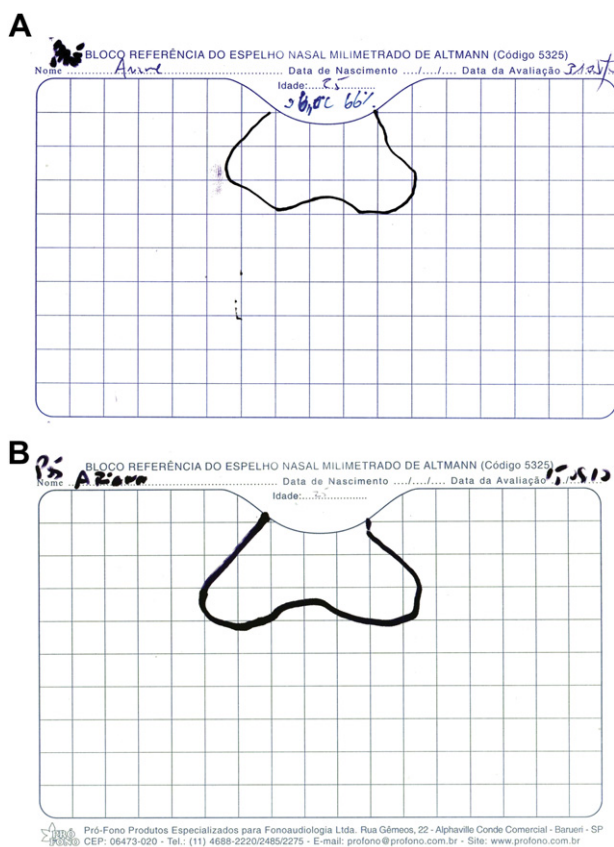


Figure 4 Modified glatzel mirror test in a 39-year-old patient (female) who had open rhinoplasty with spreader grafts. The millimeter reference sheet is marked with a ballpoint pen to document the area of condensation formed on the Glatzel mirror. A. Preoperative graph. B. Postoperative graph.

Discussion

The data showed improvement of subjective breathing quality and cross-sectional area (left side) after open rhinoplasty with spreader grafts (Figure 2), with few complications, in support of the hypothesis that this technique may provide a satisfactory clinical outcome. Minor differences in the size of the spreader grafts were noted (Table 1), likely because the grafts were customised to the various size and features of the individual noses. The use of only the septum as a donor site minimised potential difference in tissue memory and mechanical properties between septal cartilage and other cartilage from sources such as the ear or the rib.²² The improvement noted in breathing quality and acoustic rhinometry (Figure 2) suggests that spreader grafts may be effective in reconstructing the internal nasal valve.

Table 1 Dimensions of spreader grafts measured during surgery in 20 patients who had open rhinoplasty.

Dimension	Mean	Range	95% Confidence interval
Length (mm)	21	17–26	19–22
Width (mm)	3.3	2.5–4.5	3.0–3.5
Thickness (mm)	1.3	1–1.8	1.2–1.4

Although several methods may objectively evaluate the patency of nasal airflow^{23,24} enabling precise diagnosis and treatment, there is disagreement about the ideal.^{7,23,24} The modified Glatzel mirror method is frequently used in clinical practice and has the advantages of requiring minimal co-operation from the patient and being fast, easy and non-invasive. However, a literature review showed no published normative data for this test, and most previous studies using this test were with children, making it difficult to compare the present results with those previously published.²⁵ Others authors have suggested that as a method to evaluate nasal patency, the modified Glatzel method should be restricted to surgical or allergic patients.²⁶ However, the present study showed no significant change in nasal patency with the Glatzel method, in contrast with a significant increase in the cross-sectional area of the left side with acoustic rhinometry, suggesting that the Glatzel method is less sensitive than acoustic rhinometry in documenting small anatomic changes.

Acoustic rhinometry also has the advantages of requiring minimal patient co-operation and being fast. Furthermore, acoustic rhinometry does not require airflow through the nose (static technique), potentially facilitating measurement in any age group. The test uses a reflected sound signal to measure the cross-sectional area and volume of the nasal passage, but regions located after severe obstruction may not be estimated accurately (accuracy decreases with distance from the nostril).^{24,27} In a previous comparative study of data from magnetic resonance imaging and acoustic rhinometry, it was noted that acoustic rhinometry may have acceptable accuracy only when done with a decongestant.²⁸ Nevertheless, acoustic rhinometry has been validated with computed tomography and may be used in the evaluation of the anterior nose with good reproducibility and accuracy.²⁹ Furthermore, the results obtained with acoustic rhinometry in this study (Figure 2) were similar to previously published values in normal subjects (after decongestant, 0.76 cm²), subjects with obstructive complaints (after decongestant, 0.40 cm²)³⁰ and a sample of 1756 patients (average, 0.60 cm²).²⁷

Spreader grafts were designed to push the upper lateral cartilages in the lateral direction, thus increasing the cross-sectional area of the internal nasal valve.^{6–8} The increase in cross-sectional area on the left side, documented with acoustic rhinometry, was consistent with the subjective improvement of nasal patency (Figure 2).³¹ One assumption to explain the difference between the right and left sides could be related to septal deviations (without dorsal deviation), which most commonly occur to the left side, causing collapse and obstruction to the cross-sectional area on the right side, because spreader grafts' effectiveness is limited by the remaining dorsal deviation after septoplasty. That could explain the difference between only the right and left sides in the postoperative period; however, the cross-sectional area was similar between the right and left sides in the preoperative moment. Therefore, we could not support such a hypothesis. Although lateral osteotomies have been associated with minimal cross-sectional area,¹⁶ the cross-sectional area in the present study was increased on the left side even though a lateral osteotomy was performed (symmetrically) in most patients (80%).

The increased average minimum cross-sectional area noted after rhinoplasty in this study (Figure 2) conflicts with the results of prior studies that show a decrease in minimum cross-sectional area after reduction cosmetic rhinoplasty.^{15,16} This is probably due to the fact that a reductive rhinoplasty fails to maintain or improve nasal patency. A previous study of rhinoplasty with spreader grafts and dorsal onlay grafts showed subjective improvement in nasal airflow, but no objective measurements were included.³²

Limitations of the current study include the short follow-up period and small sample size, which may have limited the potential to demonstrate statistically significant improvement of cross-sectional area on the right side (acoustic rhinometry) or nasal patency (modified Glatzel mirror test). Disadvantages of the spreader graft technique with an open approach include the potential risk of excessive widening of the nasal dorsum and the time required to obtain cartilage grafts. Nevertheless, our findings suggest that open rhinoplasty with spreader grafts may provide benefits that outweigh the risks and disadvantages, and the open approach may enable the surgeon to evaluate directly the width needed for improvement of the nasal cavity.

Financial disclosure and products

There was no external funding for this study. The authors have no financial interest or commercial association with any subject matter or products mentioned in our article.

The authors declare that no competing financial interest exist with regard to the present article.

References

- Joseph J. Nasenplastik um sonstige gesechtsplastik, Webst einem Anhang uber Mammoplastik und einige weitere Operationen aus dem Gebiete der ausseren Korperplastik, *Ein Atlas und Lehrbruch*. Leipzig: Curt Kabitzch; 1931.
- Jang YJ, Kim JH. Classification of convex nasal dorsum deformities in Asian patients and treatment outcomes. *J Plast Reconstr Aesthet Surg* 2011;**64**:301–6.
- Gunter JP. The merits of the open approach in rhinoplasty. *Plast Reconstr Surg* 1997;**99**:863–7.
- Karaaltin MV, Orhan KS, Demirel T. Fascia lata graft for nasal dorsal contouring in rhinoplasty. *J Plast Reconstr Aesthet Surg* 2009;**62**:1255–60.
- Burm JS. Correction of the Asian deviated nose with no hump using unilateral bony mobilisation and dorsal septal suture fixation. *J Plast Reconstr Aesthet Surg* 2007;**60**:180–7.
- Rohrich RJ, Muzaffar AR, Janis JE. Component dorsal hump reduction: the importance of maintaining dorsal aesthetic lines in rhinoplasty. *Plast Reconstr Surg* 2004;**114**:1298–308 [discussion 309–312].
- Constantian MB, Clardy RB. The relative importance of septal and nasal valvular surgery in correcting airway obstruction in primary and secondary rhinoplasty. *Plast Reconstr Surg* 1996;**98**:38–54 [discussion 5–8].
- Howard BK, Rohrich RJ. Understanding the nasal airway: principles and practice. *Plast Reconstr Surg* 2002;**109**:1128–46. quiz 45–46.
- Sheen JH. Spreader graft: a method of reconstructing the roof of the middle nasal vault following rhinoplasty. *Plast Reconstr Surg* 1984;**73**:230–9.
- Arslan E, Majka C, Beden V. Combined use of triple cartilage grafts in secondary rhinoplasty. *J Plast Reconstr Aesthet Surg* 2007;**60**:171–9.
- Bocchieri A. Mini spreader grafts: a new technique associated with reshaping of the nasal tip. *Plast Reconstr Surg* 2005;**116**:1525–34.
- Seyhan A, Ozden S, Gungor M, Celik D. A double-layered, stepped spreader graft for the deviated nose. *Ann Plast Surg* 2009;**62**:604–8.
- Emsen IM. A different approach to the reconstruction of the stubborn crooked nose with a different spreader graft: nasal bone grafts harvested from the removed nasal hump. *Aesthetic Plast Surg* 2008;**32**:266–73.
- Reiffel AJ, Cross KJ, Spinelli HM. Nasal spreader grafts: a comparison of medpor to autologous tissue reconstruction. *Ann Plast Surg* 2011;**66**:24–8.
- Adamson P, Smith O, Cole P. The effect of cosmetic rhinoplasty on nasal patency. *Laryngoscope* 1990;**100**:357–9.
- Grymer LF. Reduction rhinoplasty and nasal patency: change in the cross-sectional area of the nose evaluated by acoustic rhinometry. *Laryngoscope* 1995;**105**:429–31.
- Bertrand B, Eloy P, Collet S, Lamarque C, Rombaux P. Effect of nasal valve surgery by open-septorhinoplasty and lateral cartilage grafts (spreader grafts) on snoring among a population of single snorers. Preliminary report. *Acta Otorhinolaryngol Belg* 2002;**56**:149–55.
- Stacey DH, Cook TA, Marcus BC. Correction of internal nasal valve stenosis: a single surgeon comparison of butterfly versus traditional spreader grafts. *Ann Plast Surg* 2009;**63**:280–4.
- Pochat V, Alonso N, Meneses J. Avaliação funcional e estética da rinoplastia com enxertos cartilaginosos. *Rev Bras Cir Plást* 2010;**25**:260–70.
- Guyuron B, Michelow BJ, Englehardt C. Upper lateral splay graft. *Plast Reconstr Surg* 1998;**102**:2169–77.
- Wilcox D, Dove B, McDavid D, Greer D. *UTHSCSA image toll for Windows*. 3.00 ed. Texas: The University of Texas Health Science Center; 2002.
- Bocchieri A, Marano A. The conchal cartilage graft in nasal reconstruction. *J Plast Reconstr Aesthet Surg* 2007;**60**:188–94.
- Hilberg O, Jackson AC, Swift DL, Pedersen OF. Acoustic rhinometry: evaluation of nasal cavity geometry by acoustic reflection. *J Appl Physiol* 1989;**66**:295–303.
- Valero AL. *Manual de rinometria acústica*. Barcelona: MRA; 2000.
- Degan VV, Puppini-Rontani RM. Nasal breathing after removing sucking habit and myofunctional therapy. *Rev CEFAC* 2007;**9**:55–60.
- Bassi IB, Franco LP, Motta AR. Eficácia do emprego do espelho de Glatzel na avaliação da permeabilidade nasal. *Revista da Sociedade Brasileira de Fonoaudiologia* 2009;**14**:367–71.
- Hilberg O, Pedersen OF. Acoustic rhinometry: recommendations for technical specifications and standard operating procedures. *Rhinol Suppl* 2000;**16**:3–17.
- Corey JP, Nalbone VP, Ng BA. Anatomic correlates of acoustic rhinometry as measured by rigid nasal endoscopy. *Otolaryngol Head Neck Surg* 1999;**121**:572–6.
- Terheyden H, Maune S, Mertens J, Hilberg O. Acoustic rhinometry: validation by three-dimensionally reconstructed computer tomographic scans. *J Appl Physiol* 2000;**89**:1013–21.
- Roithmann R, Cole P, Chapnik J, Shpirer I, Hoffstein V, Zamel N. Acoustic rhinometry in the evaluation of nasal obstruction. *Laryngoscope* 1995;**105**:275–81.
- Grymer LF, Hilberg O, Elbrond O, Pedersen OF. Acoustic rhinometry: evaluation of the nasal cavity with septal deviations, before and after septoplasty. *Laryngoscope* 1989;**99**:1180–7.
- Acarturk S, Arslan E, Demirkan F, Unal S. An algorithm for deciding alternative grafting materials used in secondary rhinoplasty. *J Plast Reconstr Aesthet Surg* 2006;**59**:409–16 [discussion 17–18].