Primary Septoplasty in the Repair of Unilateral Complete Cleft Lip and Palate

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Background: The purpose of this study was to assess and compare nasal symmetry in patients who underwent correction of a complete unilateral cleft lip using the Afroze incision without and with primary septoplasty using a standardized two-dimensional photographic analysis.

Methods: A prospective cohort study of 190 consecutive patients with complete unilateral cleft lip and alveolus with cleft palate treated with or without septoplasty using the Afroze incision technique was conducted at a high-volume center. Eighty-two patients operated on without primary septoplasty and 76 patients operated on with primary septoplasty were evaluated. Nasal symmetry was compared between patients using two-dimensional photographic analysis. Ratios between the cleft side and the non–cleft side for five parameters were used to assess symmetry: alar base–to–interpupillary line distance, columella-to–Cupid's bow distance, nostril gap area, nostril width, and nostril height. The Mann-Whitney *U* test was used to calculate differences between the two groups.

Results: Patients operated on with primary septoplasty showed more nasal symmetry compared with patients operated on without septoplasty. This difference was statistically significant for columella-to–Cupid's bow distance, nostril gap area, and nostril height ($p = 0.008$, $p < 0.001$, and $p < 0.001$, respectively) and for the distance between alar base and the alar base–to–interpupillary line distance ($p = 0.145$) the difference was present but not statistically significant. For nostril width, no difference was found ($p = 0.850$).

Conclusion: Patients treated with primary septoplasty showed better results in terms of nasal symmetry when analyzed using two-dimensional photographic analyses. (*Plast. Reconstr. Surg.* 127: 761, 2011.)

Despite a multiplicity of surgical approaches to its correction and as much variation in treatment philosophy, the cleft lip nasal deformity remains a formidable challenge to the reconstructive surgeon treating patients with these congenital deformities. Historically, correction of the cleft nose deformity had been delayed until nasal growth was complete.[1] Early surgical intervention was thought to interfere with normal growth, leading to poor long-term results.[1] Patients with cleft nose deformity had to tolerate the physical nasal deformity and the psychological trauma well into their adolescence.[1] Randall noted that these patients often were more concerned with their nasal deformity than with their lip deformity.[2]

Refinement of rhinoplasty techniques has facilitated the ability to address the deformity associated with cleft lip.[1] McComb[3] and Anderl[4] have published long-term studies that show very little impact on growth with primary correction of the nose deformity along with the correction of the cleft lip. Nevertheless, controversy remains regarding the best time to attempt primary surgical correction of unilateral cleft lip nasal deformity.[5–7] Although a growing number of centers perform the nasal repair in conjunction with cleft lip surgery, some choose a secondary rhinoplasty at a later stage, when the car-

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tilage is better formed.[5,6] It appears, however, that early repair results in less severe secondary deformity. As a consequence, many authorities now reposition the cartilaginous nasal framework before age 5 or 6 years.[5,6]

Ralph Latham, in 1969, proposed a hypothesis that the nasal septum was the key factor in height and anteroposterior dimensions of the face in addition to that of the nose.[8] Currently, the literature offers numerous opinions regarding the best surgical approach and timing of intervention for correction of the cleft lip nose deformity; however, consensus regarding the selection of the operative procedure, its timing, and its expected effects on subsequent growth has not been reached.[9,10] In this study, the outcome of nasal symmetry after complete unilateral cleft lip correction with primary septoplasty using the Afroze incision was compared with the outcome of nasal symmetry without primary septoplasty using the Afroze incision.[11,12]

PATIENTS AND METHODS

In this prospective cohort study, 190 consecutive patients with a nonsyndromic unilateral cleft of the lip and alveolus with cleft palate, presenting at a high-volume cleft center from 2003 to 2005, were included in the study. Patients younger than 1 year were eligible for this study. The Afroze incision[11,12] without primary septoplasty (group A) was used in 2003 and 2004, and the Afroze incision with primary septoplasty[11,12] (group B) was used between 2004 and 2005. Each group had 95 consecutive patients operated on by a single surgeon. The parents of the children enrolled in the study were asked to bring them back to the clinic 2 years postoperatively to have two-dimensional photographs taken. Approvals were sought and received from the ethical board of the hospital to apply the treatment methods for the two groups of patients.

Septoplasty

All patients underwent lip repair using the Afroze technique.[11,12] This technique is a combination of the Millard advancement rotation technique on the noncleft (medial) side and the Pfeifer incision on the cleft (lateral) side.

In the group of patients treated with primary septoplasty (group B), the anterior nasal spine was located by subperiosteal dissection and all of its attachments were separated. The septum was carefully isolated through the same incision by raising the perichondrium on both sides of the septum. The septum was detached from its attachment to the nasal spine and maxillary crest and straightened. The perichondrium around the detached septum was sutured together in such a way that the septum was now in its central position but not resting on the anterior part of the maxilla. The nasal sill was sutured by joining the hair-bearing nasal mucosa on both sides. The alar part of the nasalis muscle was then positioned below the nasal sill and attached to its counterpart on the normal side to form a sling, thereby supporting the nasal sill on the cleft side, septum, and ala. After completing the repositioning of the alar part of the nasalis muscle, the orbicularis oris muscle was sutured to its counterpart, and finally the skin was sutured.

Photographic Analysis

Two different photographic views were used for analysis: a submentovertical view and a frontal view.[11] All photographs were obtained by the same photographer using a standardized method. Photographs (1504 × 1000-pixel resolution) were taken with a Nikon D100 digital camera (Nikon Corp., Tokyo, Japan). For evaluation of surgical results, measurements were taken on standardized photographs using the analysis as described by Mommaerts and Nagy.[13,14] Indirect anthropometric measurements were performed on the digital photographs processed by Photoshop 9.0 (Adobe Systems, Inc., San Jose, Calif.) with the help of Scion Image software (National Institutes of Health, Bethesda, Md.).[14,15]

The measurements that were performed using the submentovertical view were the nostril gap area, nostril width, and nostril height (Fig. 1). These three measurements were performed to quantify the nostril symmetry.

The parameters in the submentovertical view photographs were measured using the line and angle tool for linear and angular measurements, respectively, using Scion Image software. The area measurement were carried out with the help of Magic Wand Tool as described by Mommaerts and Nagy.[14,15]

The measurements performed on the frontal view photographs were the distance from the alar base to the interpupillary line, and the distance from the highest point of Cupid's bow to the horizontal line crossing the columellar base parallel to the bipupillary line (Fig. 2).

For all five parameters, the values on the cleft side were divided by the values on the noncleft side. A ratio of 1 indicated perfect symmetry, and any deviation from 1 was a measure of asymmetry. However, because a ratio of 4:3 is essentially the

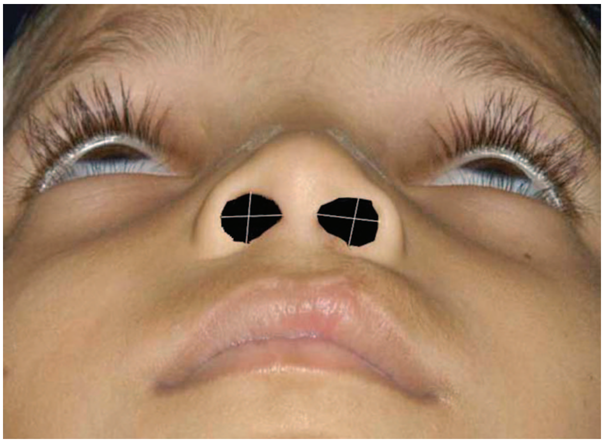

Fig. 1. Nostril gap area is measured in square millimeters using Scion Image software with Adobe Photoshop. Nostril width is measured in millimeters from the midpoint of the lateral surface of the nostril to the midpoint of the columellar surface of the nostril. Nostril height is measured from the alar base of the nostril to the midpoint of the superior surface of the nostril.

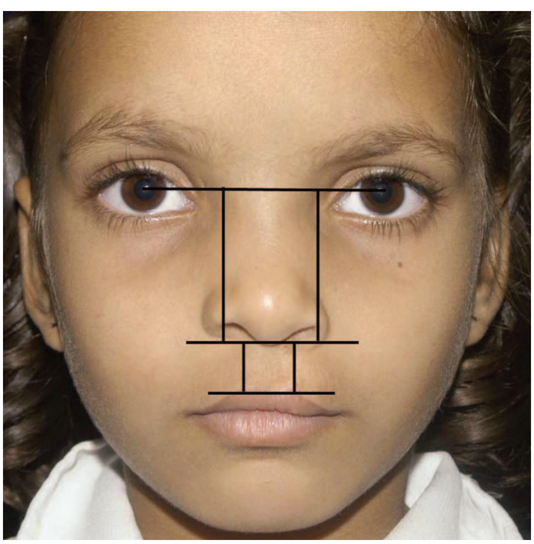

Fig. 2. The alar base–to–interpupillary line distance is measured perpendicularly from the alar base to the interpupillary line on the left and right sides. The columella-to–Cupid's bow distance is measured from the highest point on the Cupid's bow left and right to the horizontal line crossing columellar base parallel to the bipupillary line on the left and right sides.

same as a ratio of 3:4, the difference between the ratio and 1 is not a good expression of asymmetry. Therefore, the final asymmetry score ratio will be ratio – 1 for ratios greater than 1, and 1/ratio – 1 for ratios smaller than 1. Throughout this article, the asymmetry scored is expressed as a percentage. For the five ratios, standard descriptive statistics are used. The five asymmetry scores are presented descriptively using a five-point scale (asymmetry <0.5 percent, ≥0.5 percent but <5 percent, ≥5 percent but <10 percent, ≥10 percent but <15 percent, or ≥15 percent). Because the asymmetry scores have a skew and irregular distribution, nonparametric statistics were required for statistical testing. Therefore, statistical differences between the two groups were analyzed using the Mann-Whitney *U* test.

All measurements were performed by two observers (S.G.-R., R.R.R.), each scoring 50 percent of the experimental and 50 percent of the control group. To assess observer performance, 20 randomly selected cases were scored by both observers. Observer performance was analyzed using the reliability score (calculated as Pearson's correlation) and the duplicate measurement error. In addition, the paired *t* test was applied to test for statistically significant differences between both observers. All statistical analyses were performed using SPSS 16.0 (SPSS, Inc., Chicago, Ill.).

RESULTS

Patient Groups

All patients enrolled in both groups were recalled after 2 years. Of the 95 patients enrolled in group A, 82 returned for evaluation (13.69 percent were lost to follow-up), whereas in group B, 76 patients returned (20 percent were lost to follow-up). Group A consisted of 82 patients, of which 55 were left clefts (19 female patients and 36 male patients) and 27 were right clefts (12 female patients and 15 male patients). Group B consisted of 76 patients, of which 55 were left clefts (23 female patients and 32 male patients) and 21 were right clefts (nine female patients and 12 male patients). In this study, patients with cleft lip and alveolus with cleft palate were included.

Reliability

In Table 1, the results of the interobserver analysis are summarized. The reliability scores were all above 0.7, except for a relatively low score for nostril height on the noncleft side, with a reliability of 0.563. The duplicate measurement errors ranged between 0.107 and 0.294 mm. No statistically significant differences between the two observers for the 10 distances measured were found ($p \geq 0.099$).

Nasal Scores

In Table 2, the descriptive statistics for the five ratios are depicted. For both groups, nostril height shows the largest asymmetry of all variables.

Table 1. Interobserver Performance*

Parameter	DME	Reliability	Difference between Observers: Mean Difference	p	95% CI for Difference
AB-IPP					
Cleft side	0.16	0.986	0.010	0.852	–0.096–0.115
Noncleft side	0.18	0.982	–0.019	0.743	–0.138–0.100
CCB					
Cleft side	0.18	0.866	0.084	0.164	–0.038–0.206
Noncleft side	0.25	0.722	0.079	0.320	–0.083–0.242
Nostril gap area					
Cleft side	0.11	0.993	0.040	0.251	–0.031–0.111
Noncleft side	0.16	0.984	–0.080	0.129	–0.184–0.025
Nostril width					
Cleft side	0.29	0.757	–0.058	0.543	–0.252–0.137
Noncleft side	0.22	0.821	0.120	0.099	–0.025–0.264
Nostril height					
Cleft side	0.14	0.822	–0.001	0.983	–0.096–0.094
Noncleft side	0.24	0.563	–0.083	0.293	–0.244–0.078

DME, duplicate measurement errors; CI, confidence interval; AB-IPP, alar base–to–interpupillary line distance; CCB, columella-to–Cupid's bow distance.
*Duplicate measurement errors and differences are expressed in millimeters and square millimeters.

Table 2. Descriptive Statistics per Treatment Group*

	Cleft-to-Noncleft Ratio: Minimum	Maximum	Mean	SD
Without septoplasty (n = 82)				
AB-IPP	0.91	1.09	0.99	0.04
CCB	0.83	1.83	1.12	0.15
Nostril gap area	0.26	2.74	1.28	0.40
Nostril width	0.56	1.85	0.94	0.21
Nostril height	0.90	6.47	1.65	0.76
With septoplasty (n = 76)				
AB-IPP	0.87	1.11	1.00	0.04
CCB	0.88	1.79	1.07	0.14
Nostril gap area	0.70	1.95	1.06	0.22
Nostril width	0.56	1.55	0.90	0.19
Nostril height	0.72	3.44	1.31	0.40

AB-IPP, alar base–to–interpupillary line distance; CCB, columella-to–Cupid's bow distance.
*Asymmetry is expressed as a ratio (for each parameter, the cleft side value is divided by the noncleft side value).

Table 3 depicts the distribution of the cases over the various levels of asymmetry for the five parameters. This table shows that considerable differences can be seen when comparing the five parameters. For instance, for the alar base–to–interpupillary line distance in both groups, the large majority of cases have less than 5 percent asymmetry, whereas for nostril height, the majority of the cases have greater than 15 percent asymmetry.

Table 4 shows the results of the Mann-Whitney *U* tests to statistically test whether the two treatment groups were different regarding asymmetry for the five parameters. For three parameters, columella-to–Cupid's bow distance, nostril gap area, and nostril height, the group treated using a septoplasty showed statistically significantly lower asymmetry scores. For the alar base–to–interpupillary line distance, there was a tendency for better symmetry in the group with septoplasty, but the result was not statistically significant ($p = 0.145$). For the last parameter, nostril width, the p value was very high ($p = 0.850$), which gives no indication that either group shows better results.

DISCUSSION

Unilateral cleft lip nasal deformity is characterized by a prominent asymmetry resulting from distorted and displaced structures.[8] It consists of a depressed cleft side dome and splayed ala.[16–18] The cleft side alar base is also depressed and frequently vertically elevated; at the same time, the alar rim is everted, exposing the nasal lining.[16–18] The septum is pulled to the noncleft side along with the premaxilla by the muscle imbalance.[16–18] The nasal dorsum is deviated toward the noncleft side.[16–18] These nasal deformities are further compounded by the skeletal base malposition on the cleft side.[16,18,19] Primary correction of the nasal deformity performed at the time of lip repair has therefore gained popularity, and is aimed at early restoration of the symmetry by lifting the alar cartilage and lengthening the columella on the cleft side.[8,19,20] Functional and aesthetic results have proven to be very gratifying and long lasting.[1]

The theory of septal repositioning during the primary cheiloplasty procedure is based on the premise that most fibers of the alar part of the nasalis muscle and deep bundles of the orbicularis oris insert into the mucoperichondrium and anterior nasal septum in unilateral cleft lip patients. Cor-

Table 3. Cross Tables between Treatment Group and Levels of Asymmetry*

	Level of Asymmetry									
	None		<5%		5–10%		10–15%		>15%	
Parameter	No.	%	No.	%	No.	%	No.	%	No.	%
AB-IPP										
Without septoplasty	6	–7.30	56	–68.30	20	–24.0	0	0.00	0	0.00
With septoplasty	14	–18.40	51	–67.10	9	–11.80	1	–1.30	1	–1.30
CCB										
Without septoplasty	7	–8.50	15	–18.30	15	–18.30	12	–14.60	33	–40.20
With septoplasty	13	–17.10	20	–26.30	16	–21.10	12	–15.80	15	–19.70
Nostril gap area										
Without septoplasty	2	–2.40	8	–9.80	6	–7.30	11	–13.40	55	–67.10
With septoplasty	2	–2.60	26	–34.20	12	–15.80	11	–14.50	25	–32.90
Nostril width										
Without septoplasty	5	–6.10	10	–12.20	13	–15.90	15	–18.30	39	–47.60
With septoplasty	2	–2.60	11	–14.50	13	–17.10	10	–13.20	40	–52.60
Nostril height										
Without septoplasty	1	–1.20	1	–1.20	7	–8.50	2	–2.40	71	–86.60
With septoplasty	1	–1.30	11	–14.50	15	–19.70	5	–6.60	44	–57.90

AB-IPP, alar base–to–interpupillary line distance; CCB, columella-to–Cupid's bow distance.
*Number and percentage of patients for each level of asymmetry are given. Asymmetry is expressed as a ratio (for each parameter, the cleft side value is divided by the noncleft side value). The asymmetry scores are represented by a five-point scale (asymmetry <0.5 percent, ≥0.5 percent but <5 percent, ≥5 percent but <10 percent, ≥10 percent but <15 percent, or ≥15 percent).

Table 4. Results of Mann-Whitney *U* Test Comparing the Two Treatment Groups

Parameter	*p*	Group with Lowest Asymmetry
AB-IPP	0.145	With septoplasty
CCB	0.008*	With septoplasty
Nostril gap area	<0.001*	With septoplasty
Nostril width	0.850	Without septoplasty
Nostril height	<0.001*	With septoplasty

AB-IPP, alar base–to–interpupillary line distance; CCB, columella-to–Cupid's bow distance.
*Statistically significant difference.

rection of the deviated septum is important because it provides stability and exact positioning of the previously lifted alar crus of the cleft side and nasal tip. As a consequence, the nose can grow in a balanced way, with equal muscular force being exerted on both sides.[11,19,21] Studies have demonstrated that no negative sequelae are observed after manipulation of the septum in children.[21,22] Smahel et al. studied the effect of primary septum repositioning on facial growth using radiographic cephalometrics and concluded that patients with primary repositioning of the nasal septum had a more favorable nasal prominence and better vertical growth of the upper and whole face in the posterior third.[23] If no primary correction is performed, nasal breathing problems persist until late corrections are made.[8,13]

Objective evaluation of the nasal form and symmetry in cleft patients is difficult. Mommaerts and Nagy developed a computer analysis for nasal form and symmetry (intranasal symmetry and symmetrical position of the nose) to evaluate primary and secondary cleft rhinoplasty outcomes.[14] This nasal analysis has proven to be appropriate for comparing results of different surgical techniques in which indirect anthropometric measurements were performed on digital photographs with the Scion Image software.[13–15] In the present study, this method was used. One of the disadvantages of indirect measurements on photographs is the difficulty of standardizing the way photographs are taken, because it is hard to take photographs from a standardized distance with the head of the child in a standardized position.[14] To bypass these problems, only ratios between cleft and noncleft sides, not absolute distances, were used. The interobserver analysis showed good performance characteristics, and the reliability was comparable to the values described in the original article on this method,[12] except for the reliability of the nostril gap area on the noncleft side. This is most likely caused by a far smaller variability of the values measured on the noncleft side, which makes achieving high reliability more difficult. Because a statistically significant difference was found between the control group and the experimental group regarding the nostril gap area, observer performance was not hampered by this relatively low reliability.

In 2004, Kim et al. compared the results of primary correction of cleft lip using conventional methods and cases operated on with simultaneous rhinoplasty using photographs and anthropometric evaluation.[24] In cases of simultaneous repair, nasal tip projection and columellar length were increased by 24.8 and 28.8 percent, respectively. Nasal width was increased by 12.3 percent in the cases of simultaneous repair and 12.6 percent in the cases without primary rhinoplasty. The difference in postoperative anthropometric measurement between patients undergoing primary nasal correction and normal children was not significant.[24]

In this study, we have attempted to correct the malpositioned architecture of the nose through a morphologic functional repair of the nasal septum and repositioning of the alar nasalis muscle without correcting the other parts of the nose. The results of the present study support the opinion of advantages of primary septoplasty because the nostril of the cleft side showed better symmetry in the group treated with septoplasty. The ratios of the patients who underwent septoplasty were much closer to 1 in comparison with the ratios of those operated on without septoplasty for three of the five parameters, namely, columella-to–Cupid's bow distance, nostril gap area, and nostril height, thus indicating that a better (near normal) symmetry of nose and lip segment could be achieved for cases operated on with primary septoplasty. Although on average the ratios are relatively close to the perfect value of 1, especially in the group operated on with primary septoplasty, this average is the sum of cases with ratios less than 1 and greater than 1. The average ratio is not suitable for comparing the two groups, because ratios greater than 1 and less than 1 nullify each other, whereas both indicate a lack of symmetry. Therefore, to test the findings statistically, the Mann-Whitney *U* test was used.

In this study, ratios were used when comparing results of two surgical techniques to eliminate observation bias caused by differences in imaging and imaging techniques. Farkas et al. used direct anthropometric analysis.[25] Direct anthropometric analysis is accurate and well accepted by anthropologists but is very difficult to reproduce, especially when large numbers of patients are involved and by direct measurement no record is available for later reevaluation.[25,26] Indirect anthropometry eliminates such drawbacks. However, any photograph is a two-dimensional image of a three-dimensional structure. Thus, it was extremely important to take photographs in the proper position and to avoid any transverse rotation of the face, which could result in misleading projections of facial structures on the photographs. Therefore, for future studies, a three-dimensional analysis of nasal form would be a much better tool for assessing such symmetries with improved precision.

This study cannot answer the question of whether undisturbed growth of the nose will occur in the long run. The patients were between 3 and 4 years of age at the time of follow-up. Nasal development needs to be reevaluated in both groups after growth has ceased.

CONCLUSIONS

The results of the present study and an intensive survey of the literature led to a conclusion that a significant difference in terms of nasal symmetry and alar height symmetry could be found in patients treated with primary septoplasty in comparison with those treated without septoplasty. The symmetrical outcomes were much better in patients treated with septoplasty when assessed by the two-dimensional photographic analysis.

The final outcome of nasal deformity awaits a follow-up period of many more years to profoundly evaluate the influence on nasal growth and outcome. Thus, a study with a longer follow-up is required to comment on the superiority of one method over the other.

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PATIENT CONSENT

Parents or guardians provided written consent for the use of the patient's images.

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