OPEN

PRS GLOBAL OPEN

ORIGINAL ARTICLE
Pediatric/Craniofacial

Beware of Optical Illusion of the Alar Base in Unilateral Cleft Lip Nasal Deformity

Yoshiaki Sakamoto, MD*
Junpei Miyamoyo, MD†
Kazuo Kishi, MD*

Background: It is generally accepted that the alar base on the cleft side in the cleft lip nose is displaced outward and downward; therefore, it is rotated inward and upward in almost all procedures for cleft lip closure. However, nostril narrowing and collapse of the lower lateral cartilage on the cleft side are sometimes experienced. In this retrospective study, we investigated whether the preoperative alar base on the cleft side is displaced outward and downward.
Methods: This was a retrospective evaluation using preoperative frontal images obtained from patients with unilateral cleft lip (n = 245). The midcolumellar and subalare points were placed, and each ratio was analyzed and compared to those of age-matched controls (n = 40).
Results: The subalare on the noncleft side and subnasale were displaced upward and outward. In contrast, the subalare on the cleft side was displaced downward and inward. The displacement of the subalare was greater on the noncleft than on the cleft side. There were no significant differences between male and female patients and between the left and right sides. Among the complete cleft lip and palate, incomplete cleft lip and palate, complete cleft lip and alveolus, incomplete cleft lip and alveolus, and microform cleft lip groups, the complete cleft lip and palate group showed the greatest displacement.
Conclusion: The cleft alar base appeared to shift outward and downward because of an optical illusion, but in fact, both alar bases shifted; the alar base on the cleft side was displaced inward and downward, and the alar base on the noncleft side was displaced outward and upward. *(Plast Reconstr Surg Glob Open 2021;9:e3523; doi: 10.1097/GOX.0000000000003523; Published online 15 April 2021.)*

INTRODUCTION

Various methods for cleft lip repair have been reported, and the principle of every method is a design using anatomic landmarks.[1–7] Depending on the operative procedure and the severity of the cleft lip deformity, immediately after cleft lip closure, the nostril margin and lower lateral cartilage on the deformed cleft side collapse or present with wavy deformation (Fig. 1). Such deformation improves over time but could remain in the long term.

Therefore, lower lateral cartilage dissection is often considered the sine qua non of primary cleft rhinoplasty. Although previous reports based on observations have claimed that nasal correction does not adversely affect growth,[8,9] a recent cephalometric analysis suggested otherwise.[10] Regardless, cleft lip closure that minimizes nasal deformity is desirable.

Considering such nasal deformities, lower lateral cartilage on the cleft side, which has a nearly flat curve, appears to be caused by correcting the alar base in a superior medial direction. Correcting the alar base on the cleft side is decided based on the nostrils' width by comparing each side. However, taking the anatomical subunit approximation method as an example, the landmark to decide the nostrils' width has been described as somewhat arbitrary.[7]

From these findings, we hypothesized that the preoperative alar base position on the cleft side could not be evaluated correctly. In this study, we preoperatively analyzed the position of the alar base to determine its true position to obtain a symmetric nose by anthropometry of unilateral cleft lip patients and age-matched controls.

*From the *Department of Plastic and Reconstructive Surgery, Keio University School of Medicine, Tokyo, Japan; and †Miyamoto Plastic and Reconstructive Surgery Hospital, Hiroshima, Japan.*

Received for publication December 8, 2020; accepted February 14, 2021.

DOI: 10.1097/GOX.0000000000003523

Disclosure: *The authors have no financial interest to declare in relation to the content of this article.*

Fig. 1. Immediately after cleft lip closure. Note the nostril margin and lower lateral cartilage on the cleft side that have deformed and collapsed.

PATIENTS AND METHODS

Patients

We retrospectively enrolled patients who underwent cleft lip repair from 2005 to 2014. We excluded patients with bilateral cleft lip, syndromic diagnosis, and/or inadequate photographs. Our study included 245 patients [146 (59.6%) men and 99 (40.4%) women].

The operative age of primary cleft lip repair was 2–3 months, and the bodyweight of the patients greater than 5.0 kg. Preoperatively, no patients were treated with presurgical orthopedics or nasoalveolar molding. This study was approved by the Institutional Research Ethics Board (approval number, 20190287).

Assessment of Measurement

The measurement was performed using a frontal image preoperatively obtained under general anesthesia. An endocanthal line was drawn by connecting the right and left inner canthi. The image was then rotated in Photoshop (Abode Photoshop 7.0; Adobe, San Jose, Calif.) until the horizontal reference line was in a true horizontal position. The landmark points are schematically shown in Figure 2.

The facial midline was considered the line drawn from the mid-distance of the endocanthal points, perpendicular to the endocanthal line, as previously reported.[11] The midcolumellar point (sn) and subalare points (sbal) were placed at the center of the columellar base and at the lower limit of each alar base, respectively.[11] The height between each sbal and the endocanthal line was measured, and the height between the sn and endocanthal line was divided and considered as the vertical ratio. The width between the sbal on each side and the facial midline divided by the half distance of the endocanthal points was considered as the transverse ratio. The distance between the sbal on the noncleft side and the sn divided by the width between the sbal on the noncleft side and the facial midline was considered the sn–transverse ratio. The height between the sn and endocanthal line divided by the half distance of the endocanthal points was considered the sn–vertical ratio.

Age-matched Controls

We enrolled, as controls, 2- to 3-month-old patients (24 men and 16 women) who visited our hospital with cranial deformity as the chief complaint and showed no evidence of craniosynostosis.

Statistical Analysis

Continuous variables are expressed as the mean and SD. The groups were compared using analysis of variance (ANOVA) and Student's t-tests. Bonferroni post-hoc tests were performed for multiple comparisons. All tests were two-tailed, and statistical significance was defined as a P value <0.05. Statistical analyses were performed with SPSS version 23.0 (IBM Japan, Ltd., Tokyo, Japan).

RESULTS

The characteristics of the cleft and control groups are comparatively presented in Table 1. In the control group, the nostril ratio was approximately 1.00, and the vertical and transverse ratios were the same on both sides. These results suggested that the alar base was symmetric.

The vertical ratio on the cleft side was 1.05 ± 0.05 in the cleft group and 1.02 ± 0.02 in the control group, and the difference was statistically significant ($P < 0.05$). In contrast, the vertical ratio on the noncleft side was 0.91 ± 0.15 in the cleft group, and the difference with the control group was significant ($P < 0.05$). The results suggested that the noncleft alar base was displaced upward relative to the cleft alar base.

Likewise, the transverse ratios on the cleft and noncleft sides in the cleft group were 0.49 ± 0.06 and 0.64 ± 0.08, respectively. Compared with the transverse ratio in the control group, which was 0.53 ± 0.03, the difference was significant ($P < 0.05$). These results suggested that the subalare in each side was dislocated asymmetrically; the noncleft alar base was displaced outward, and the cleft alar base was displaced inward.

The sn–transverse ratios in the cleft and control groups were 0.29 ± 0.10 and null, respectively, with the difference being significant ($P < 0.05$). The sn–vertical ratios in the cleft and control groups were 1.81 ± 0.21 and 1.84 ± 0.08, respectively, with the difference being significant ($P < 0.05$). These data suggested that the subnasale in the patients with a cleft lip was dislocated upward and outward compared to the expected position.

Based on the dislocation of the sn in the patients with cleft lip, the vertical and transverse ratios mentioned above were corrected. As a result, the corrected vertical ratios on the cleft and noncleft sides were 1.04 and 0.90, respectively. The corrected transverse ratios on the cleft and noncleft sides were 0.49 and 0.63, respectively.

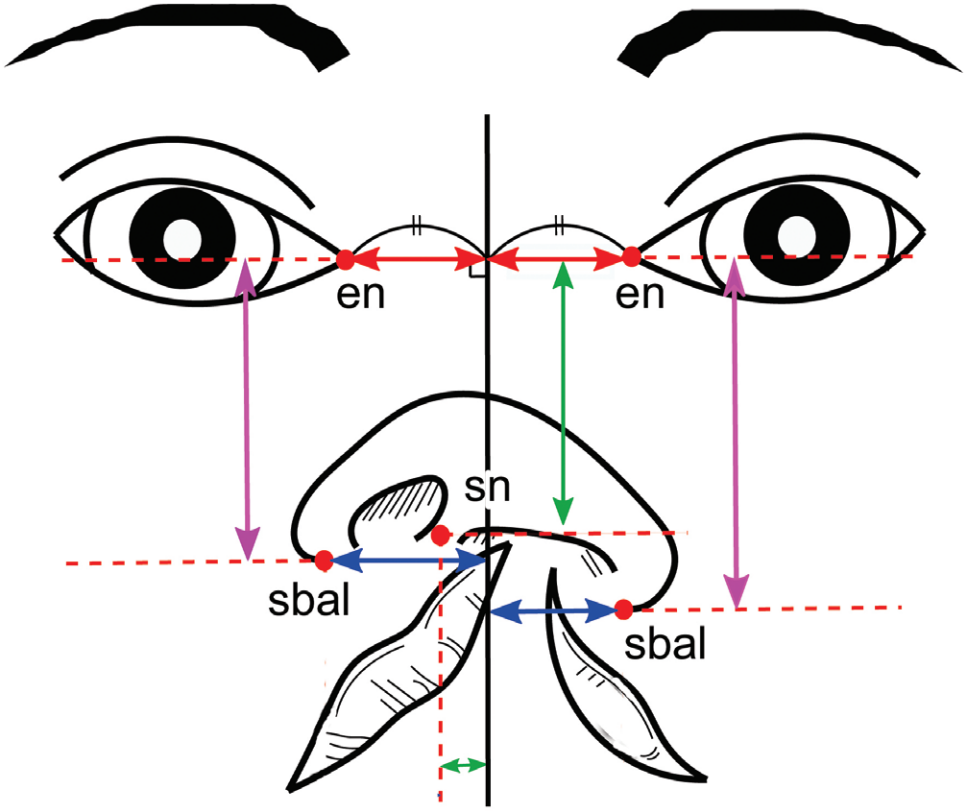

Fig. 2. Schema of the frontal view analysis. Standard anthropometric landmarks included the following: endocanthion (*en*), alar curvature point (*ac*), and subnasale (*sn*). The interendocanthion line defined the facial midline.

There were no significant differences between the sexes and left and right sides, as shown in Table 2. Furthermore, the patients with cleft lip were divided into 5 groups, including 92 patients with complete cleft lip and palate (CLCP), 28 with incomplete CLCP, 33 with complete cleft lip and alveolus, 73 with incomplete cleft lip and alveolus, and 19 with microform cleft lip (Fig. 3).

The vertical ratio on the noncleft side was significantly lower in all patient groups than in the control group ($P < 0.05$, for all groups). The ratio was the highest in the microform group (0.98 ± 0.02) and was significantly higher than those in the other groups ($P < 0.05$, for all groups); the ratio was the lowest in the complete CLCP group (0.88 ± 0.05) and was significantly lower than those in the other groups ($P < 0.05$, for all groups).

Table 1. Comparison of the Cleft Lip Group and the Control Group

	Control (n = 40)	Cleft Lip (n = 245)	*P*
Vertical ratio (cleft)		1.05 ± 0.05	<0.05
Vertical ratio (noncleft)	1.02 ± 0.02	0.91 ± 0.15	<0.05
Transverse ratio (cleft)	0.53 ± 0.03	0.49 ± 0.06	<0.05
Transverse ratio (noncleft)		0.64 ± 0.08	<0.05
Sn–transverse ratio	0.00 ± 0.00	0.29 ± 0.10	<0.05
Sn–vertical ratio	1.84 ± 0.08	1.81 ± 0.21	<0.05

Vertical ratio: sbal–endocanthal line/sn–endocanthal line.
Transverse ratio: sbal–facial midline/half of en–en.
Sn–transverse ratio: sn–sbal (noncleft)/sbal (noncleft)–facial midline.
Sn–vertical ratio: sn–endocanthal line/half of en–en.

The transverse ratio on the noncleft side was significantly higher in all patient groups than in the control group ($P < 0.05$ for all groups). The ratio was the lowest in the microform group (0.54 ± 0.01) and was significantly lower than those in the other groups ($P < 0.05$, for all groups); the ratio was the highest in the complete CLCP group (0.59 ± 0.05) and was significantly higher than those in the other groups ($P < 0.05$, for all groups).

Regarding the vertical ratio on the cleft side, there was no significant difference between the control group and the incomplete CLA (1.02 ± 0.03) and microform (1.02 ± 0.02) groups ($P = 0.11$ and 0.09, respectively). In contrast, the differences between the other groups and the control group were significant ($P < 0.05$).

The transverse ratio on the cleft side was significantly lower in all patient groups than in the control group ($P < 0.05$ for all groups). The ratio was the lowest in the complete CLCP group (0.47 ± 0.03) and was significantly lower than those in the other groups ($P < 0.05$ for all groups).

The results of the sn–transverse and sn–vertical ratios were similar to those of the transverse and vertical ratios on the noncleft side. These results suggested that compared with the control group, the alar base on the cleft side was displaced inward and downward; conversely, the noncleft alar base was displaced outward and upward. The displacement of the alar base on

Table 2. Comparison between Male and Female Patients and between the Left and Right Sides

	Male (n = 146)	Female (n = 99)	*P*	Left Side (n = 160)	Right Side (n = 85)	*P*
Vertical ratio (cleft)	1.05 ± 0.05	1.04 ± 0.05	0.19	1.05 ± 0.05	1.05 ± 0.05	0.70
Vertical ratio (noncleft)	0.90 ± 0.15	0.89 ± 0.13	0.31	0.90 ± 0.15	0.90 ± 0.13	0.83
Transverse ratio (cleft)	0.49 ± 0.05	0.49 ± 0.07	0.13	0.49 ± 0.04	0.49 ± 0.06	0.34
Transverse ratio (noncleft)	0.65 ± 0.08	0.65 ± 0.07	0.16	0.65 ± 0.08	0.65 ± 0.10	0.28
Sn–transverse ratio	0.31 ± 0.11	0.28 ± 0.07	0.07	0.28 ± 0.11	0.30 ± 0.07	0.52
Sn–vertical ratio	1.81 ± 0.12	1.78 ± 0.15	0.09	1.80 ± 0.20	1.80 ± 0.21	0.35

Vertical ratio: sbal–endocanthal line/sn–endocanthal line.
Transverse ratio: sbal–facial midline/half of en–en.
Sn–transverse ratio: sn–sbal (noncleft)/sbal (noncleft)–facial midline.
Sn–vertical ratio: sn–endocanthal line/half of en–en.

the noncleft side was wider than that on the cleft side. Additionally, the subnasale was displaced outward and upward, resulting in columella deviation. The amount of displacement was the highest in complete CLCP. This deformity could be confirmed in actual cases (Fig. 4).

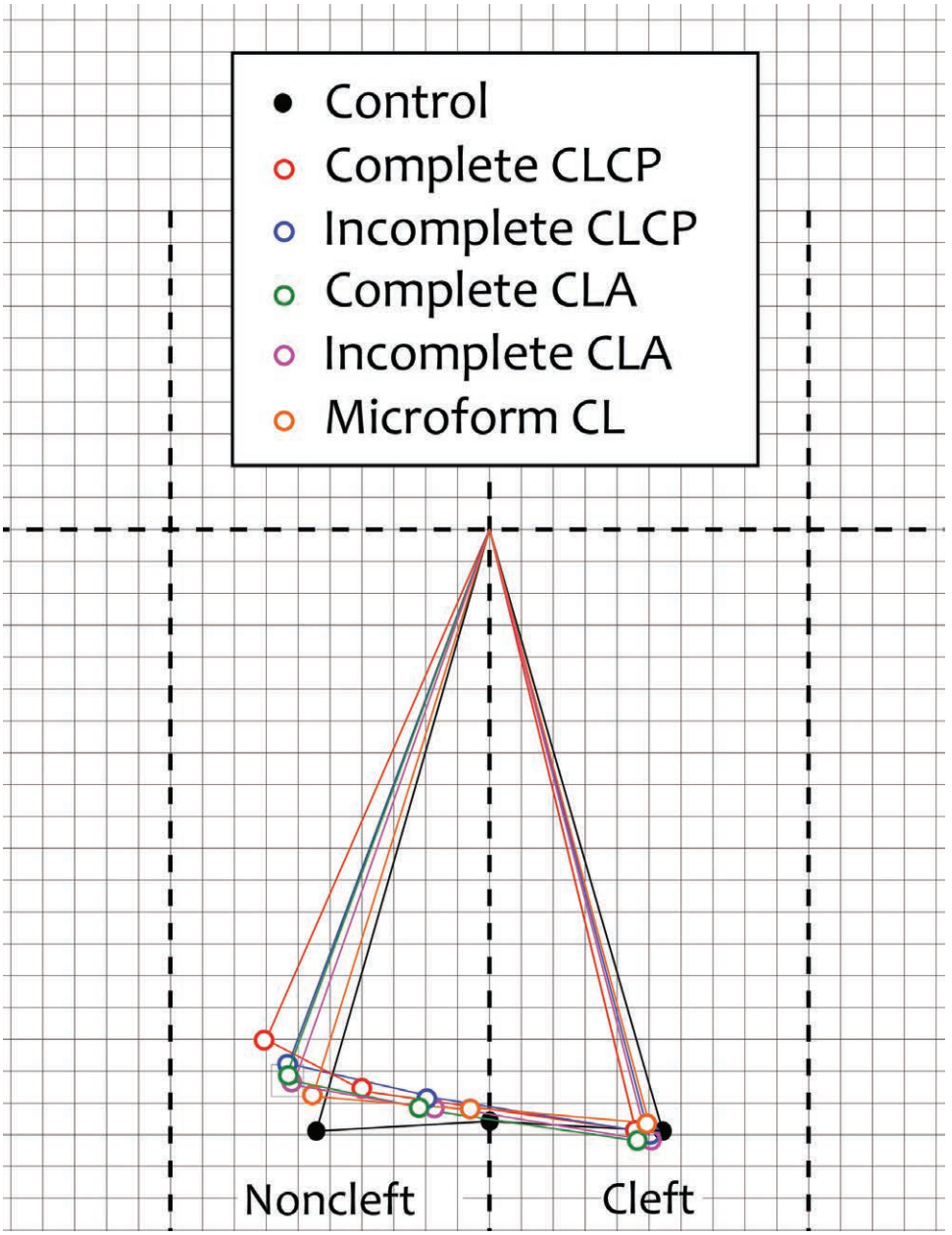

Fig. 3. Difference in cleft nasal deformities grouped by cleft type. Based on the endocanthal line and facial midline, the *sn* and *sbal* were plotted referring to the ratio.

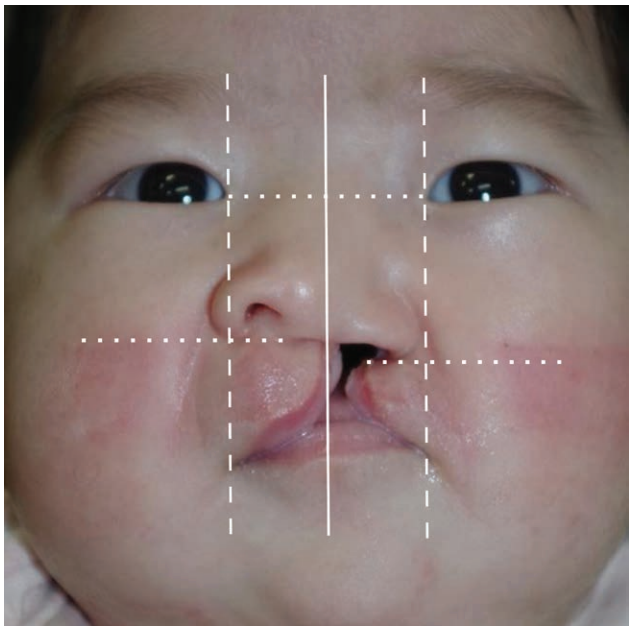

Fig. 4. The unilateral complete cleft lip nasal deformity of a representative case. The noncleft alar base is displaced outward and upward relative to the cleft alar base.

DISCUSSION

The deformities of the cleft lip nose have been well described, and the description of multiple anatomical alterations has been completed. Such deformities are characterized by the deviation of the columella toward the noncleft side, widening of the nasal floor, displacement of the alar base on the cleft side outward and downward, and flattening of the lower lateral cartilage.[12–15]

Great effort is presently exerted in primary surgery to minimize such deformities and prevent secondary cleft lip nose. The common concept of primary cleft lip repair and rhinoplasty is to obtain a symmetrical lip and nose by design using anatomic landmarks.[1–7]

According to these landmarks, to shorten the nasal floor, rotate the alar base on the cleft side inward and upward, the nasal septum cartilage, detached from the anterior nasal spine, is moved to the cleft side using columellar base–alar base cinch stitch. Using this maneuver, the deviation of the columella toward the noncleft side and the displacement of the cleft alar base outward and downward are simultaneously eliminated.

However, both in our cases and in the cases we located after extensive literature search regarding the long-term outcome of cleft lip repair, the alar base on the cleft side was inward almost universally. To formally investigate these observations, we hypothesized that the preoperative alar base position on the cleft side could not be evaluated correctly and that the direction of correction would be incorrect, and the preoperative alar base position was accordingly analyzed.

A similar hypothesis and study were first described in 1999,[16] although it only included 12 patients. Afterward, similar results were described based on 102 patients in 2020, and the authors concluded that the cleft alar base was normal in position but retruded, whereas the noncleft alar base was displaced laterally.[17] Furthermore, the cleft alar base was lower than the noncleft alar base. Additionally, it was found that the displacement of the alar base differed because of the severity of the cleft lip and the presence or absence of a cleft palate. Although we obtained very similar results, our findings showed that the alar base on the cleft side was displaced inward and downward, and the alar base on the noncleft side was displaced outward and upward.

This difference may be attributable to the number of patients, which was nearly twice that of the previous study.[17] In addition, it is noteworthy that the subalare may be difficult to locate depending on the morphology of the nasal alar, such as an incomplete cleft lip.[18] However, both results provide evidence against the previously held notion that the alar base is displaced outward. Namely, for a long time, we cleft lip surgeons were repositioning the alar base in the opposite direction. We propose that this is attributed to optical illusion because the previous study proposed the possibility of misjudging the alar base after cleft lip repair. According to the literature, the asymmetry of the nostril outline and a transverse nostril axis were linked, and the cleft side alar base looked wider, although the cleft side alar base was narrower than the noncleft side as measured using anthropometry.[19]

From the present and recent studies, it is considered that it would be preferable not to replace the cleft alar base inward. Accordingly, the repositioning of the septum to the midline of the face is of greater importance than the repositioning of the cleft alar base. By releasing or retaining the noncleft nasal floor periosteum,[20] the septum could be expected to be straighter without relapse. Moreover, to obtain a symmetrical alar base without applying excessive force to the cartilage, it is suggested that the noncleft and cleft alar bases should be replaced inward and downward and outward and upward, respectively. For this replacement, additional surgical incision around the noncleft alar base should not be performed because it would cause unnecessary scarring. Rather, detachment of the alar base from the previous cleft incision and fixation to the periosteum with a suture may be recommended. Overcorrection may be necessary to considering the possibility of relapse. In the future, a study of long-term outcomes is necessary to evaluate the effectiveness of this technique.

Secondary repositioning of the alar base is difficult; otherwise, alar reduction should be performed on the noncleft side. Irrespective of the manner revision surgery is attempted for lower lateral cartilage originally distorted because of the alar base, the nasal deformity will remain.

In conclusion, in this study, we measured cleft lip nasal deformity based on the inner canthus instead of the noncleft side. As a result, it was found that the alar base on the cleft side appeared to shift outward and downward because of optical illusion, but in fact, both alar bases shifted; the alar base on the cleft side was displaced inward and downward, and the alar base on the noncleft side was displaced outward and upward. We hope that this observation will

contribute to devising a new technique that will avoid persistent nasal deformity.

Yoshiaki Sakamoto, MD
Department of Plastic and Reconstructive Surgery
Keio University School of Medicine
35 Shinanomachi, Shinjuku-ward
Tokyo 160-8582, Japan
E-mail: ysakamoto@z8.keio.jp

REFERENCES

1. Tennison CW. The repair of the unilateral cleft lip by the stencil method. *Plast Reconstr Surg (1946).* 1952;9:115–120.
2. Randall P. A triangular flap operation for the primary repair of unilateral clefts of the lip. *Plast Reconstr Surg Transplant Bull.* 1959;23:331–347.
3. Millard DR. Extensions of the rotation-advancement principle for wide unilateral cleft lips. *Plast Reconstr Surg.* 1968;42:535–544.
4. Onizuka T. A new method for the primary repair of unilateral cleft lip. *Ann Plast Surg.* 1980;4:516–524.
5. Noodhoff MS, Chen YR, Chen KT, et al. The surgical technique for the complete unilateral cleft lip-nasal deformity. *Operative Tech Plast Surg.* 1995;2:167–174.
6. Nakajima T, Tamada I, Miyamoto J, et al. Straight line repair of unilateral cleft lip: new operative method based on 25 years experience. *J Plast Reconstr Aesthet Surg.* 2008;61:870–878.
7. Fisher DM. Unilateral cleft lip repair: an anatomical subunit approximation technique. *Plast Reconstr Surg.* 2005;116:61–71.
8. Salyer KE, Genecov ER, Genecov DG. Unilateral cleft lip-nose repair: a 33-year experience. *J Craniofac Surg.* 2003;14:549–558.
9. McComb HK, Coghlan BA. Primary repair of the unilateral cleft lip nose: completion of a longitudinal study. *Cleft Palate Craniofac J.* 1996;33:23–30; discussion 30.
10. Yoshimura Y, Okumoto T, Iijima Y, et al. Reduced nasal growth after primary nasal repair combined with cleft lip surgery. *J Plast Reconstr Aesthet Surg.* 2015;68:e159–e166.
11. Farkas LG. *Anthropometry of the Head and Face.* 2nd ed. New York: Raven; 1994.
12. Blair P. Nasal deformities associated with congenital cleft of the lip. *JAMA.* 1925;84:185–187.
13. Huffman WC, Lierle DM. Studies on the pathologic anatomy of the unilateral hare-lip nose. *Plast Reconstr Surg.* 1949;4:225–34.
14. Sykes JM, Jang YJ. Cleft lip rhinoplasty. *Facial Plast Surg Clin North Am.* 2009;17:133–44, vii.
15. Ha RY, Cone JD, Byrd HS. Cleft rhinoplasty. In: Rohrich RJ, Adams WP Jr, Ahmad J, et al, eds. *Dallas Rhinoplasty: Nasal Surgery by the Masters.* 3rd edition. St. Louis, MO: QMP/CRC Press; 2014:1305–1331.
16. Fisher DM, Lo LJ, Chen YR, et al. Three-dimensional computed tomographic analysis of the primary nasal deformity in 3-month-old infants with complete unilateral cleft lip and palate. *Plast Reconstr Surg.* 1999;103:1826–1834.
17. Tse RW, Knight R, Oestreich M, et al. Unilateral cleft lip nasal deformity: Three-dimensional analysis of the primary deformity and longitudinal changes following primary correction of the nasal foundation. *Plast Reconstr Surg.* 2020;145:185–199.
18. Kolar J, Salter E. *Craniofacial Anthropometry Practical Measurement of the Head and Face for Clinical, Surgical and Research Use.* Springfield: Charles C Thomas; 1997.
19. Isaac KV, Tan RA, Ganske IM, et al. Beware the alar base optical illusion in assessment of unilateral cleft lip nasal deformity. *Plast Reconstr Surg.* 2019;143:1157–1162.
20. Tse RW, Mercan E, Fisher DM, et al. Unilateral cleft lip nasal deformity: foundation-based approach to primary rhinoplasty. *Plast Reconstr Surg.* 2019;144:1138–1149.