Long-Term Comparison of Four Techniques for Obtaining Nasal Symmetry in Unilateral Complete Cleft Lip Patients: A Single Surgeon's Experience

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Background: This study was the result of a constant evaluation of surgical techniques and results to obtain excellence in primary cleft rhinoplasty.
Methods: This was a retrospective study from 1992 to 2003 comparing the long-term outcomes of four techniques of nasal reconstruction. There were 76 patients divided into four groups: group I ($n = 23$ patients), primary rhinoplasty alone; group II ($n = 16$ patients), nasoalveolar molding alone; group III ($n = 14$ patients), nasoalveolar molding plus primary rhinoplasty; and group IV ($n = 23$ patients), nasoalveolar molding plus primary rhinoplasty plus overcorrection. The surgical results were analyzed using photographic records obtained at 5 years of age. A ratio of six measurements was obtained comparing the cleft and noncleft sides. A panel assessment was obtained to grade the appearance of the surgical results. All surgery was performed by the senior author (P.K.T.C.).
Results: The results are given for groups I to IV, respectively. The nostril height ratio was 0.73, 0.77, 0.81, and 0.95. The nostril width ratio was 1.23, 1.36, 1.23, and 1.21. The one-fourth medial part of nostril height ratio was 0.70, 0.87, 0.92, and 1.00. The nasal sill height ratio was 0.75, 1.02, 1.07, and 1.07. The nostril area ratio was 0.86, 0.89, 0.95, and 1.08. The nostril height-to-width ratio was 0.58, 0.58, 0.71, and 0.92. Finally, group IV had the best panel assessment.
Conclusions: The results revealed that group IV had the best overall result. Overcorrection of 20 percent was necessary to maintain the nostril height. Further technical modifications are necessary to minimize widening of the nostril width. (*Plast. Reconstr. Surg.* 126: 1276, 2010.)

Repair of the unilateral cleft lip nasal deformity is integral to achieving an aesthetically pleasing cleft lip repair. Performing primary cleft rhinoplasty at the same setting as the cleft lip repair had been accepted worldwide even before the advent of nasoalveolar molding.[1,2] The fact that nasoalveolar molding became increasingly popular was a testament to the fact that it did indeed help to reposition the cleft nostril, and there was an improvement in the surgical result, especially in cases of bilateral cleft lip. However, because nasoalveolar molding was initially a new procedure, it was uncertain as to how the combination of nasoalveolar molding and surgery would affect nasal symmetry in the long term. Thus, the senior authors (E.J.W.L. and P.K.T.C.), began to investigate and adapt the surgical technique of primary cleft nasal repair to the use of nasoalveolar molding. This study represents the senior author (P.K.T.C.) using four different techniques in the search for the perfect cleft nasal repair after a follow-up of 5 years. The progression of each technique used was the result of an ongoing evaluation of surgical results during patient follow-up.

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PATIENTS AND METHODS

This retrospective study, designed to investigate the long-term effect of nasoalveolar molding, primary rhinoplasty, and primary rhinoplasty with overcorrection, was approved by the Institutional Review Board of Chang Gung Memorial Hospital. Seventy-six complete unilateral cleft lip patients were randomly selected from four groups of children who underwent four different treatment protocols. They were treated at the Craniofacial Center of Chang Gung Memorial Hospital from 1992 to 2003.

The groups were numbered from I to IV and were a representation of a progression of technical modifications over a period of time. They were as follows: group I (n = 23 patients), primary rhinoplasty alone; group II (n = 16 patients), nasoalveolar molding alone; group III (n = 14 patients), nasoalveolar molding plus primary rhinoplasty; and group IV (n = 23 patients), nasoalveolar molding plus primary rhinoplasty plus overcorrection (Fig. 1). The inclusion criteria were as follows: (1) complete unilateral cleft lip–cleft palate, (2) no other craniofacial malformations or systemic disease, (3) nasoalveolar molding started within 2 weeks after birth, (4) primary cheiloplasty performed by the same surgeon (P.K.T.C.) and performed at 3 months of age, (5) postoperative nasal stent use for more than 6 months, and (6) available basilar view photograph obtained at approximately 5 years of age.

Nasoalveolar Molding

The nasoalveolar molding device was composed of a dental plate and a nasal stent. The alveolar and nasal molding was performed at the same time. Denture adhesive was used to stick the dental plate onto the palate and dental arches. The nasal component was a projection of stainless steel wire with a soft resin molding bulb on the top. The lip was held together by fingers while the wire was adjusted so that the cleft side lower lateral cartilage was supported rather than pushed by the molding bulb. The cleft lip was then approximated by applying external Micropore tape (3M, St. Paul, Minn.). The nasal molding bulb was adjusted weekly, and the lower lateral cartilage was molded accordingly to resemble the normal alar shape.[3]

Primary Cheiloplasty and Rhinoplasty

The lip was repaired using a modified rotation advancement cheiloplasty with a Mohler incision. The incision for the advancement flap was along the cleft margin, with no horizontal incision on the nasal floor or perialar extension. An L flap was developed based on the alveolus on the cleft margin. The incision was extended along the piriform aperture to mobilize the alar base on the cleft side. The nasal floor was reconstructed with the combination of an inferior turbinate flap, an L flap, and a C-mucosa flap on the noncleft side. The

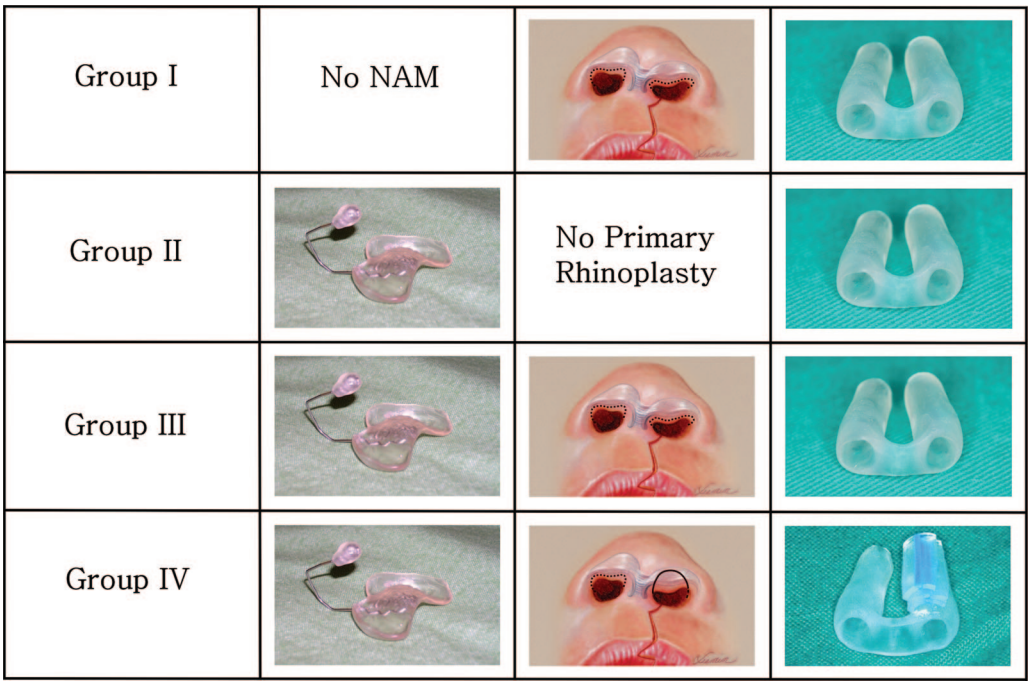

Fig. 1. Summary of four different techniques. *NAM*, nasoalveolar molding.

columella was lengthened with the C flap. The orbicularis muscle on both medial and lateral lips was adequately released and repositioned. The alar base on the cleft side was advanced medially and superiorly. The vermilion was reconstructed with a Noordhoff vermilion flap.[4] In groups I and III, lower lateral cartilage dissection was performed using bilateral rim incisions, followed by placement of interdomal sutures to relocate the displaced cleft side lower cartilage. In group II, there was no cartilage dissection of the lower lateral cartilage on the cleft side. In group IV, a rim incision was performed on the noncleft side and a Tajima inverted-U incision was performed on the cleft side. The lower lateral cartilage dissection was performed through the Tajima incision on the cleft side and rim incision on the noncleft side, followed by placement of interdomal sutures to place the displaced cleft side lower cartilage a little more higher than the noncleft side. The Tajima incision was used to resect the nasal webbing at the soft triangle to create the outline of the alar rims and columella to resemble the silhouette of a gull in gentle flight. Overcorrection was performed in terms of increased nostril height in anticipation of a reduced columella growth on the cleft side and a more narrow nasal width in anticipation of increased stretch of the cleft-side tissues resulting in a widened nasal width with time. The overcorrection was estimated visually during the operation to be approximately 20 percent higher than the noncleft side (Fig. 2).

Postoperative Nasal Stent

A silicone nasal conformer (Koken Co., Tokyo, Japan) was used for 6 months after surgery.[5]

Fig. 2. After initial correction, the cleft side nostril height appears higher than the normal side.

In group IV, overcorrection of the cleft side nostril was maintained with silicone sheets (cut from silicone tubings of 1-mm thickness) that were added during the first-, second-, and third-month visits and used for a total of 6 months (Fig. 3).

Records and Measurements

All measurements and data analyses were performed by the first author (C.S.C.), who acted as an independent and noninvolved observer. The first author was also blinded as to which group the patient was from. The standard basilar view photographs in a 1:1 ratio of each patient at 5 years old were used in this study. A horizontal reference line was constructed by connecting the most inward point at the outer lateral borders of the cleft and noncleft nostrils. All vertical measurements were measured perpendicular to this reference line, and all horizontal measurements were measured parallel to this reference line. The measurements were obtained using Photoshop CS3 extended version 10.0.1 (Adobe Systems, Inc., San Jose, Calif.). The ratio of the cleft side to the noncleft side was calculated. The measurements were as follows (Fig. 4):

Nostril height: the vertical distance between the horizontal reference line and the highest point of the nostril aperture.
Nostril width: the widest horizontal distance between the inner medial and lateral border of the nostril aperture.
One-fourth medial part of nostril height: this vertical line was drawn on the medial one-quarter part of the nostril width. The distance between the horizontal reference line and the intersection with the upper-inner nostril aperture was measured.
Nasal sill height: the vertical distance between the horizontal reference line to the lowest border of the nostril aperture.
Nostril area: the area presented by the nostril aperture.
Inner nostril height-to-width ratio.

Panel Assessment

A visual analogue scale was also used to assess the surgical outcome. Nasal symmetry was graded by five independent examiners, one plastic surgeon and four laypersons. All independent examiners were also blinded as to the group to which the patient belonged. The results were classified as (1) very poor (flat, obvious nasal webbing, obvious cleft ala deformity); (2) poor; (3) fair (oval with indentation); (4)

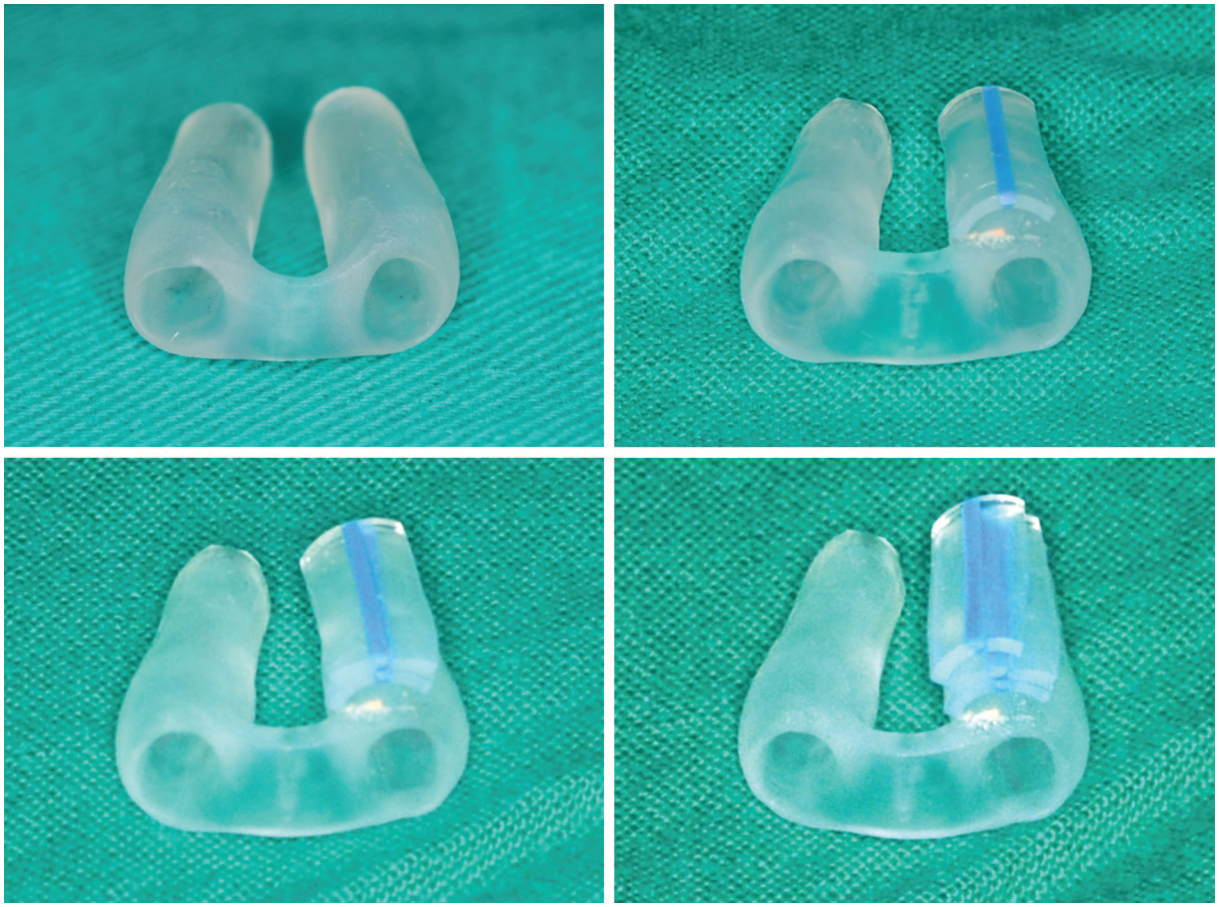

Fig. 3. Postoperative nasal retainer for group IV. (*Above*, *left*) On the seventh day after surgery, nasal stent 1 (Koken) is used. (*Above*, *right*) On the first month after surgery, one silicone sheet is added to the cleft side. (*Below*, *left*) On the second month after surgery, two silicone sheets are added to the cleft side. (*Below*, *right*) On the third month after surgery, three silicone sheets are added to the cleft side. The total treatment time is more than 6 months after surgery.

good; or (5) very good (rounded, no indentation, resembling a normal nostril).

Statistical Analysis

After the data points were collected, the ratio between the cleft side and noncleft side measurements was determined, and the four groups were compared. The measurements were analyzed with analysis of variance. For the visual analogue scale assessment, the interrater reliability was tested with the Cronbach α.

Method Errors

The method of errors was assessed for photograph variance; the ratios of nostril height and nostril width were measured and calculated in five different randomly selected patient's photographs. The two photographs of the same patient were taken 1 day apart. The ratios were analyzed with correlation analysis (Pearson's analysis) for the reliability of the photographs.

RESULTS

The method error showed a highly significant correlation for the nostril height ratio ($r = 0.994$, $p = 0.001$) and also a highly significant correlation for the nostril width ($r = 0.918$, $p = 0.028$) between the photographs.

Nostril Height

The ratio of nostril heights was 0.73, 0.77, 0.81, and 0.95 for groups I to IV, respectively. Group IV had nostril height that was most comparable with the noncleft side. Group I had the lowest nostril height (Tables 1 and 2). This indicated that overcorrection was necessary to maintain the nostril height over the long term.

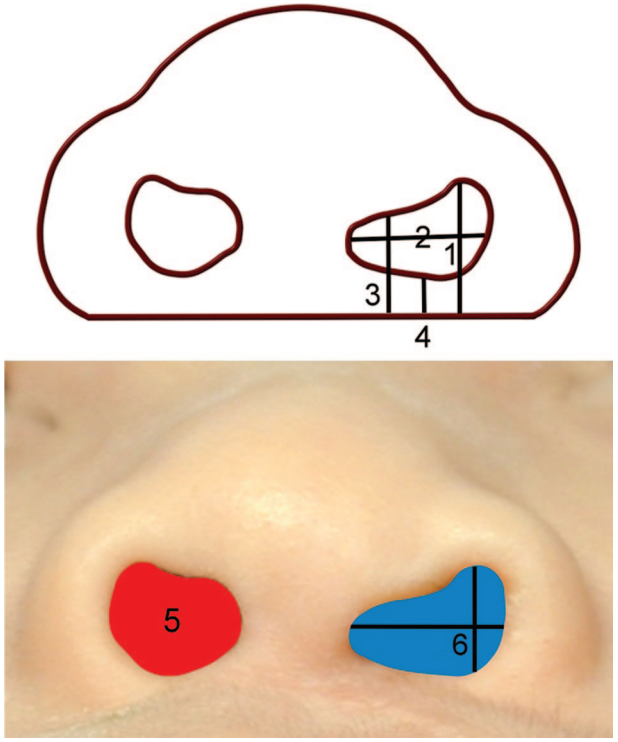

Fig. 4. The ratio of the cleft side to the noncleft side was calculated from the following measurements: *1*, nostril height; *2*, nostril width; *3*, one-fourth medial part of nostril height; *4*, nasal sill height; *5*, nostril area; and *6*, inner nostril height-to-width ratio.

Table 1. Ratio of Nostril Height between the Cleft and Noncleft Sides

Group	Mean	SD	Minimal	Maximal	*p**
I	0.733	0.115	0.483	0.957	0.00001
II	0.767	0.144	0.528	1.031	
III	0.806	0.113	0.615	0.963	
IV	0.947	0.061	0.833	1.035	

*Analysis of variance.

Table 2. Nostril Height Intergroup Comparison: Mean Ratio Difference; *p* Value Calculated by Using the Bonferroni Method

	Group		
Group	I	II	III
II	0.033		
	1.000		
III	0.073	0.04	
	0.288	1.000	
IV	0.214	0.181	0.141
	0.000	0.000	0.002

Nostril Width

The ratio of nostril widths was 1.23, 1.36, 1.23, and 1.21 for groups I to IV, respectively. All groups showed a wider nostril than the noncleft side. However, group IV had the narrowest nostril width at 5 years, although the difference was not statistically significant among the groups (Tables 3 and 4). It would appear that overcorrection in terms of a more narrow nasal width was more difficult to maintain than the overcorrection in nasal height.

One-Fourth Medial Part of Nostril Height

The ratio of one-fourth medial part between the cleft side and noncleft side was 0.71, 0.87, 0.92, and 1 for groups I to IV, respectively. Groups IV and III (to a lesser extent) showed a statistically significant difference from the other two groups (Tables 5 and 6). This showed that a rim incision after nasoalveolar molding could have some correction of nasal webbing that was almost comparable to the Tajima incision; in our hands, overcorrection was the best way to correct nasal webbing.

Nasal Sill Height

The ratio of nasal sill was 0.75, 1.02, 1.07, and 1.07 for groups I to IV, respectively. Groups II, III, and IV had a statistically significant improved nasal sill height on the cleft side compared with group I (Tables 7 and 8). There was a split between nasoalveolar molding and non–nasoalveolar molding groups, indicating that nasoalveolar molding may have helped to improve the appearance of the nasal sill in these patients.

Nostril Area

The ratio of nostril area was 0.86, 0.89, 0.95, and 1.08 for groups I to IV, respectively. Groups III

Table 3. Ratio of Nostril Width between the Cleft and Noncleft Sides

Group	Mean	SD	Minimal	Maximal	*p**
I	1.235	0.21	0.930	1.809	0.252
II	1.362	0.318	0.85	2.209	
III	1.235	0.345	0.713	1.944	
IV	1.205	0.127	0.938	1.44	

*Analysis of variance.

Table 4. Nostril Width Intergroup Comparison: Mean Ratio Difference; *p* Value Calculated by Using the Bonferroni Method

	Group		
Group	I	II	III
II	0.128		
	0.701		
III	0.000	–0.127	
	1.000	0.981	
IV	–0.029	–0.157	–0.029
	1.000	0.331	1.000

Table 5. Ratio of One-Fourth Medial Part between the Cleft and Noncleft Sides

Group	Mean	SD	Minimal	Maximal	*p**
I	0.706	0.106	0.462	0.933	0.000
II	0.872	0.155	0.685	1.167	
III	0.924	0.086	0.804	1.048	
IV	1.003	0.063	0.891	1.133	

*Analysis of variance.

Table 6. One-Fourth Medial Part Intergroup Comparison: Mean Ratio Difference; *p* Value Calculated by Using the Bonferroni Method

	Group		
Group	I	II	III
II	0.167		
	0.000		
III	0.218	0.051	
	0.000	1.000	
IV	0.296	0.129	0.078
	0.000	0.003	0.238

Table 7. Ratio of Nasal Sill between the Cleft and Noncleft Sides

Group	Mean	SD	Minimal	Maximal	*p**
I	0.748	0.248	0.25	1.214	
II	1.016	0.202	0.75	1.393	
III	1.066	0.234	0.79	1.444	
IV	1.070	0.227	0.682	1.625	0.000

*Analysis of variance.

Table 8. Nasal Sill Intergroup Comparison: Mean Ratio Difference; *p* Value Calculated by Using the Bonferroni Method

	Group		
Group	I	II	III
II	0.268		
	0.004		
III	0.318	0.05	
	0.001	1.000	
IV	0.322	0.054	0.004
	0.000	1.000	1.000

Table 9. Ratio of Nostril Area between the Cleft and Noncleft Sides

Group	Mean	SD	Minimal	Maximal	*p**
I	0.857	0.191	0.472	1.271	0.000
II	0.888	0.165	0.619	1.173	
III	0.949	0.205	0.591	1.312	
IV	1.084	0.12	0.851	1.264	

*Analysis of variance.

Table 10. Nostril Area Intergroup Comparison: Mean Ratio Difference; *p* Value Calculated by Using the Bonferroni Method

	Group		
Group	I	II	III
II	0.031		
	1.000		
III	0.092	0.061	
	0.718	1.000	
IV	0.231	0.2	0.144
	0.000	0.005	0.137

Table 11. Inner Nostril Height-to-Width Ratio of the Cleft Side

Group	Mean	SD	Minimal	Maximal	*p**
I	0.583	0.128	0.312	0.865	0.000
II	0.575	0.155	0.413	0.88	
III	0.712	0.179	0.457	1.196	
IV	0.924	0.143	0.682	1.213	

*Analysis of variance.

Table 12. Inner Nostril Height-to-Width Ratio Intergroup Comparison: Mean Ratio Difference; *p* Value Calculated by Using the Bonferroni Method

	Group		
Group	I	II	III
II	–0.008		
	1.000		
III	0.129	0.137	
	0.085	0.094	
IV	0.336	0.344	0.207
	0.000	0.000	0.001

and IV had statistically significant different nostril areas from groups I and II (Tables 9 and 10). Thus, both rim and Tajima incisions did not result in a particular difference in this aspect.

Inner Nostril Height-to-Width Ratio

The inner nostril height-to-width ratio was 0.58, 0.58, 0.71, and 0.92 for groups I to IV, respectively. Group IV demonstrated a more rounded cleft side nostril compared with the other groups (Tables 11 and 12).

Panel Assessment

For panel assessment, the interobserver reliability was assessed. The grade was analyzed with the Cronbach α for the interobserver reliability, and showed good interobserver reliability (Cronbach α = 0.8671, 0.9212, 0.8114, and 0.8158 for groups I, II, III, and IV, respectively). Group IV had the best panel assessment score compared with groups III, II, and I (Tables 13 and 14).

DISCUSSION

This study represents the senior author's (P.K.T.C.) accumulated surgical experience and

Table 13. Panel Assessment Scores

Group	Mean	SD	*p*
I	2.287	0.413	0.000
II	3.138	0.592	
III	3.843	0.409	
IV	4.443	0.455	

*Analysis of variance.

Table 14. Panel Assessment Scores Intergroup Comparison: Mean Ratio Difference; *p* Value Calculated by Using the Bonferroni Method

	Group		
Group	I	II	III
II	0.851		
	0.000		
III	1.556	0.705	
	0.000	0.001	
IV	2.157	1.306	0.601
	0.000	0.000	0.002

observation in his goal to improve the results of primary cleft rhinoplasty. The development of techniques can be broadly divided into four epochal time frames, punctuated by the adoption of nasoalveolar molding (with the help of E.J.W.L.) as a critical adjunct to the improvement of surgical results. Before nasoalveolar molding, the primary rhinoplasty technique used was through bilateral rim incisions. The fibrofatty tissue was released from the lower lateral cartilage. The lower lateral cartilage was fixed to the upper lateral cartilage at its base and to the skin with transfixation suture.[4]

Nasoalveolar molding was introduced by Grayson et al. in the 1990s.[6,7] Because nasoalveolar molding was able to reduce cleft severity before surgery, it rapidly gained popularity. Our orthopedics team started nasoalveolar molding in the late 1990s.

After the advent of nasoalveolar molding, there was a period when primary rhinoplasty was not performed because, following primary lip repair, the nose frequently looked satisfactory even without surgery. This was attributable to the ability of nasoalveolar molding to reposition the dislocated lower lateral cartilage and to push the nostril dome forward, thus increasing its symmetry with the noncleft side. However, nasoalveolar molding by itself was insufficient to maintain nostril symmetry over time. A study was published by Liou et al. in which the authors found that the repaired cleft nostril showed a reduced potential for columella growth and the nasal width widened with time.[8] Thus, the next step was the addition of primary rhinoplasty following nasoalveolar molding. However, it appeared that there was still relapse of the cleft nasal stigma. This led to the current technique, using not only nasoalveolar molding and primary rhinoplasty but, critically, the Tajima incision and overcorrection, not only in terms of an increased nostril height but also in terms of a narrower nostril width.

Group I underwent only primary rhinoplasty, and the only aspect similar to group IV was nostril width. The nostril width was controlled by only a single 5-0 polydioxanone suture from the cleft side orbicularis oris to the nasal septum. Moreover, there was no modification of nasal stent width for postoperative maintenance. This was similar across all groups; therefore, we can expect that the nasal width ratio would be similar across the groups. Equality of this parameter with the noncleft side appeared to be the most difficult to achieve, and it always seemed to become wider with time. However, a wider nostril is always easier to correct at a later stage than a narrower nostril if correction is necessary.

Group II had nasoalveolar molding alone without primary rhinoplasty. It would appear that if a surgeon did not perform primary rhinoplasty for various reasons, nasoalveolar molding alone could obtain results similar to those of primary rhinoplasty. Bennun et al. showed that nasoalveolar molding alone has better nostril symmetry in the long term and no alar cartilage luxation compared with primary nasal reconstruction without nasoalveolar molding.[9] In our study, nasoalveolar molding alone was superior to primary rhinoplasty regarding the ratio of one-fourth medial part of nostril height and nasal sill height, with the other measurements not statistically significant. This underlined the positive effect that nasoalveolar molding has on the cleft nose.

Group III had an addition of primary rhinoplasty to nasoalveolar molding with no overcorrection. When compared with group II, there was no statistical improvement in any of the measured parameters. This was surprising because one would assume that dissection and repositioning of the alar cartilages and soft tissues would result in a better result than nasoalveolar molding alone. In most Western craniofacial centers, where individual surgeons have adopted their own surgical techniques, overcorrection did not seem to be necessary to obtain nasal symmetry.[10] In our series, relapse after surgery might be because the alar cartilage in the Asian population has a different

configuration and the nose has thicker skin and a broader alar base.[11]

Group IV had the most symmetrical nose in terms of height, width, nasal web, nasal sill, nostril area, and nostril shape (Fig. 5). Table 15 shows all the other groups compared with group IV. Group I was comparable to group IV only in terms of nostril width. Group II was comparable to group IV only in terms of nostril width and nasal sill height. This indicated that nasoalveolar molding alone was insufficient to obtain long-term correction (5 years) of the other parameters. Group III was comparable to group IV only in terms of nasal width, one-fourth medial part of nostril height, nasal sill height, and nostril area. This showed that there were still deficiencies in the height and nostril shape in group III when overcorrection was not performed.

Table 15. Groups Statistically Similar to Group IV*

Parameter	Groups
Height	IV
Width	I, II, III, and IV
One-fourth medial (nasal web)	III and IV
Nasal sill	II, III, and IV
Ratio of area	III and IV
Shape	IV
Panel assessment	IV

*No statistical significance with group IV.

An important difference between groups III and IV was in the nasal incision used, the interdomal suture, surgical overcorrection, and

Fig. 5. (*Left*) Typical photographs of a group I patient at the first visit (*above*) and at age 5 years (*below*). The ratios of nostril height, nostril width, one-fourth medial part of nostril height, nasal sill height, nostril area, and inner nostril height-to-width ratio of this patient were 0.663, 1.16, 0.662, 0.375, 0.9, and 0.821, respectively. The cleft side nostril showed decreased nostril height, increased nostril width, decreased one-fourth medial part nostril height, decreased nasal sill, and some degree of nostril area asymmetry. (*Second from left*) Typical photographs of a group II patient at the first visit (*above*) and at age 5 years (*below*). The ratios of nostril height, nostril width, one-fourth medial part of nostril height, nasal sill height, nostril area, and inner nostril height-to-width ratio of this patient were 0.767, 1.323, 0.726, 0.917, 1.02, and 0.67, respectively. The cleft side nostril showed decreased nostril height, increased nostril width, decreased one-fourth medial part nostril height, and good nasal sill height. The nostril area asymmetry is not fully demonstrated in this patient. (*Third from left*) Typical photographs of a group III patient at the first visit (*above*) and at age 5 years (*below*). The ratios of nostril height, nostril width, one-fourth medial part of nostril height, nasal sill height, nostril area, and inner nostril height-to-width ratio of this patient were 0.869, 1.151, 0.896, 0.933, 1.102, and 0.83, respectively. The cleft side nostril showed some improvement of nostril height, increased nostril width, some improvement of one-fourth medial part nostril height, good nasal sill height, and improvement of nostril area asymmetry. (*Right*) Typical photograph of a group IV patient at the first visit (*above*) and at age 5 years (*below*). The ratios of nostril height, nostril width, one-fourth medial part of nostril height, nasal sill height, nostril area, and inner nostril height-to-width ratio of this patient were 1, 1.151, 0.896, 0.933, 1.102, and 0.83, respectively. The cleft side nostril showed good nostril height, good one-fourth medial part of nostril height, good nasal sill height, good nostril area symmetry, and the cleft side nostril is more rounded; however, the nostril width still increased.

maintenance of overcorrection with augmented nasal stents. In group III, the rim incision was used, whereas in group IV, the Tajima incision was used. In group III, the rim incision was behind the soft triangle. After lower lateral cartilage dissection, the dislocated cleft side lower lateral cartilage was sutured at the same level to the contralateral side through interdomal suture, whereas in group IV, the Tajima reverse-U incision goes upward in the junction of the columella and the soft triangle and then crosses the alar rim near the dome. After subcutaneous undermining, the reverse-U flap is reflected for correction of nasal webbing.[12] This Tajima incision affects mainly the vertical height of the nostril dome.[13] After lower lateral dissection, the cleft side lower lateral cartilage was sutured higher to the noncleft side lower lateral cartilage. Overcorrection would result in a more significant enlargement of the vertical height of the nostril; this may be a critical point of divergence between the two groups.[14] The removal of the alar web also improved the frontal view of the nostril ala and it could be more easily made to resemble a gull in gentle flight (this was not evaluated further in this study). Lastly, the overcorrection was maintained with the addition of silicone sheets to the domes of the nasal conformer, and this was used for at least 6 months.

The improvement of nasal symmetry might also be attributable to maturity and experience of the surgeon over time. We feel each technique used was better than the one that preceded it, leading to the last technique used as the overall best. Nasoalveolar molding is now a standard practice in many craniofacial centers worldwide.[15,16] Based on these results, the authors consider that group IV with overcorrection of an increased nostril height of the cleft side (of 20 percent) and a more narrow nostril width (of 20 percent) was best in our population. An improved method of maintaining nostril width is being evaluated at the moment.

The measurements obtained in this study were based on two-dimensional basal views of the nose because they were economical, convenient, and noninvasive. To minimize errors in this technique, the measurements were evaluated as ratios. Other techniques such as three-dimensional photographs or nasal impressions may be used in the future to obtain more accurate measurements.

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PATIENT CONSENT

Parents or guardians gave written consent for the use of patient images.

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