

# A Longitudinal Study of The Nasal Symmetry in Unilateral Cleft Lip And Palate Patients Treated With Nasoalveolar Molding

Tulasi Nayak<sup>1</sup> Renu Parmar<sup>2</sup> Krishnamurthy Bonanthaya<sup>2</sup> Pritham Shetty<sup>2</sup>

<sup>1</sup>Department of Oral and Maxillofacial Surgery, Dayananda Sagar College of Dental Sciences, Jayanagar, Bengaluru, India

<sup>2</sup>Department of Oral and Maxillofacial Surgery, Smile Train Cleft Centre, Bhagwan Mahaveer Jain Hospital, Bangalore

**Address for correspondence** Nayak Tulasi, BDS MDS, Department of Oral and Maxillofacial Surgery, Dayananda Sagar College of Dental Sciences, Jayanagar, 4th T Block, Bengaluru, 560041, India (e-mail: drtulasinayak@gmail.com).

Indian J Plast Surg:2020;53:371–376

## Abstract

**Background** Nasoalveolar molding (NAM) has been extensively used as a presurgical technique in the treatment of unilateral cleft lip and palate (UCLP) over the last two decades. It has proven to be a useful tool to reduce the cleft size, improve nasal symmetry, and increase the columellar length. The long-term stability of these findings has not been conclusively proven.

**Methods** In this longitudinal study, the nasal symmetry of 24 NAM treated UCLP patients was evaluated to assess the 5-year stability of NAM. The basal photographs were shot postcheiloplasty (T1), at 1-year follow-up (T2), at 3-year follow-up (T3), and 5-year follow-up (T4) appointments.

**Results** In this study, we found that NAM was a useful adjuvant in achieving nasal symmetry in patients with UCLP in the immediate postoperative period. However, as the patients aged, there was a gradual loss of mean nasal height (by 22.83%) and columella length (by 24.89%), a mean gain in nasal width (by 40.25%) and alar base width (by 40.69%), and an increase in the columella deviation (by 3.46%) from the T1 to the T4 follow-up.

**Conclusion** Although there is no conclusive evidence, the loss of symmetry may be due to the unequal growth on the cleft and noncleft sides. These patients will be followed-up till end of growth for a definite conclusion on the long-term effect of NAM.

## Keywords

- ▶ cleft lip
- ▶ cleft nose
- ▶ long term
- ▶ nasal symmetry
- ▶ nasoalveolar molding

## Introduction

The unilateral cleft nasal deformity is a common technical challenge faced by surgeons around the world. Although multiple techniques<sup>1-5</sup> have been used with varying success rates to improve symmetry, absolute long-term symmetry still remains an elusive goal. The presurgical nasoalveolar molding (NAM) technique proposed by Grayson<sup>6</sup> has been gaining popularity over the last two decades due to its utility in reducing the severity of the of clefts in early infancy.<sup>7</sup> Although multiple short-term studies,<sup>8-12</sup> have shown an increase in the columella length, molding of the deformed nasal cartilages, and obtaining arch approximation, the

retention of the results obtained have not been conclusively established.<sup>1</sup> We have conducted this longitudinal study to ascertain the 5-year stability of the nasal symmetry achieved by NAM in unilateral cleft lip and palate (UCLP) patients.

## Methodology

This research was conducted in accordance with the Helsinki Declaration. In this retrospective study, consecutive NAM-treated UCLP patients from 2012–2013, whose serial photographs were available, were studied. Patients with incomplete clefts and other craniofacial anomalies were

published online  
August 4, 2020

DOI <https://doi.org/10.1055/s-0040-1714768>  
ISSN 0970-0358.

©2020. Association of Plastic Surgeons of India.

This is an open access article published by Thieme under the terms of the Creative Commons Attribution-NonDerivative-NonCommercial-License, permitting copying and reproduction so long as the original work is given appropriate credit. Contents may not be used for commercial purposes, or adapted, remixed, transformed or built upon. (<https://creativecommons.org/licenses/by-nc-nd/4.0/>).

Thieme Medical and Scientific Publishers Pvt. Ltd. A-12, 2nd Floor, Sector 2, Noida-201301 UP, India

excluded from this study. All infants who had arrived at the center before 6 weeks of age were treated with Eric Liou's technique of NAM<sup>13</sup> for an average of 4 months. The patients were called every 2 weeks to make adjustments to the device. Six weeks was used as a cutoff, since the pliability of the nasal cartilage reduces as the child ages (►Figs. 1 and 2).<sup>14</sup> The patients were treated with modified Millard's cheiloplasty at an average age of 6 months of age without primary rhinoplasty or gingivoperiosteoplasty. One-stage palatoplasty was carried out along with Bardach's technique, with repositioning of the soft palate musculature (Sommerlad).<sup>15</sup> All the surgeries were performed by the same two surgeons. A total of 24 patients were included in this study. Standardized 2D full-face frontal view and worm's eye photographs were shot by the same experienced cleft worker postcheiloplasty (T1),

at 1-year follow-up (T2), at 3-year follow-up (T3), and 5-year follow-up (T4) appointments (►Fig. 3–6). No rhinoplasty had been conducted on any of the patients during the follow-up period.

A ratio of 1:1 basal photographs were used for various measurements, as mentioned in literature.<sup>12,16,17</sup> A horizontal reference line was constructed by connecting the most inward points at the outer lateral borders of the cleft and noncleft nostrils.<sup>17</sup> Four linear measurements (nostril height, nostril width, alar base width, and columella height) and one angular measurement (columella deviation angle) were measured directly on the photographs (►Fig. 7–11). To minimize errors in this technique, the linear measurements were evaluated as ratios. All measurements were done by a single independent surgeon who had not treated any of the patients in this study.



**Fig. 1** NAM–basal photograph pre-NAM. Abbreviation: NAM, nasaloalveolar molding.



**Fig. 3** NAM–basal photograph postcheiloplasty (T1 follow-up). Abbreviation: NAM, nasaloalveolar molding.



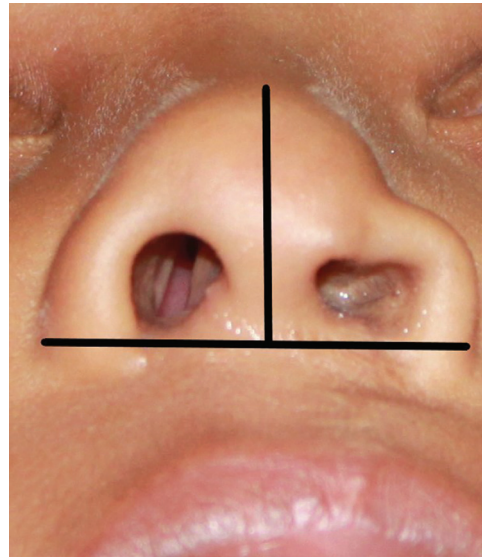
**Fig. 2** NAM–basal photograph post-NAM. Abbreviation: NAM, nasaloalveolar molding.



**Fig. 4** NAM–basal photograph at 1-year follow-up (T2 follow-up). Abbreviation: NAM, nasaloalveolar molding.



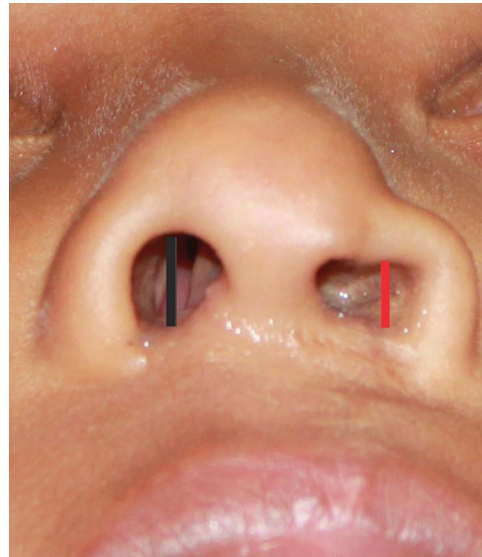
**Fig. 5** NAM-basal photograph at 3-year follow-up (T3 follow-up). Abbreviation: NAM, nasoalveolar molding.



**Fig. 7** Columella deviation angle measurement.



**Fig. 6** NAM-basal photograph at 5-year follow-up (T4 follow-up). Abbreviation: NAM, nasoalveolar molding.



**Fig. 8** Nasal height measurement (red–cleft side, black–noncleft side).

Data collected from the study group was analyzed with SPSS version 18 and repeated measures of ANOVA were used to compare the nasal symmetry at each of the intervals to the baseline values. The level of significance was set at  $p < 0.05$ .

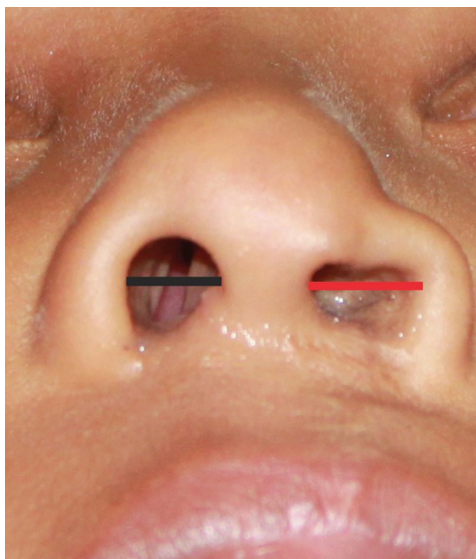
## Results

In this retrospective study, the basal photographs of 24 consecutive NAM-treated UCLP patients were studied longitudinally to evaluate the stability of NAM. The nostril height ratio, nostril width ratio, hemicolumella height ratio, alar base width ratio, and columella deviation angle were measured in each of the follow-up photographs.

In the immediate postcheiloplasty period (T1), the nasal height ratio, the nasal width ratio, hemicolumella height and

alar base width ratio were almost perfectly symmetrical, and the mean columella deviation angle was  $89.97^\circ$  (► **Table 1**). In comparison to the baseline values obtained postoperatively (T1), the loss of symmetry was significant across all parameters at all the time durations (T2, T3, and T4) (► **Table 3**). The mean columella deviation angle was lost by  $1.58^\circ$  at the end of T2 follow-up ( $p=0.009^*$ ),  $2.81^\circ$  at the T3 follow-up ( $p=0.002^*$ ) and  $3.46^\circ$  at T4 follow-up ( $p < 0.001^*$ ). The nostril height on the cleft side was lost by 15.03% at the T2 follow-up ( $p < 0.001^*$ ), 18.90% at T3 follow-up ( $p < 0.001^*$ ), and 22.83% at the T4 follow-up ( $p < 0.001^*$ ). The nostril width on the cleft side increased by 37.1% at the T2 follow-up ( $p < 0.001^*$ ), 40.42% at the T3 follow-up ( $p < 0.001^*$ ), and 40.25% at the T4 follow-up ( $p < 0.001^*$ ). The hemicolumella length on the cleft side was lost by 13.48% at the T2 follow-up ( $p < 0.001^*$ ), 19.36% at the T3 follow-up ( $p < 0.001^*$ ), and 24.89% at the T4

follow-up ( $p < 0.001^*$ ). The alar base width on the cleft side increased by 18.89% at the T2 follow-up ( $p < 0.001^*$ ), 26.14% at the T3 follow-up ( $p < 0.001^*$ ), and 40.69% at the T4 follow-up ( $p < 0.001^*$ ).



**Fig. 9** Nasal width measurement (red–cleft side, black–noncleft side).

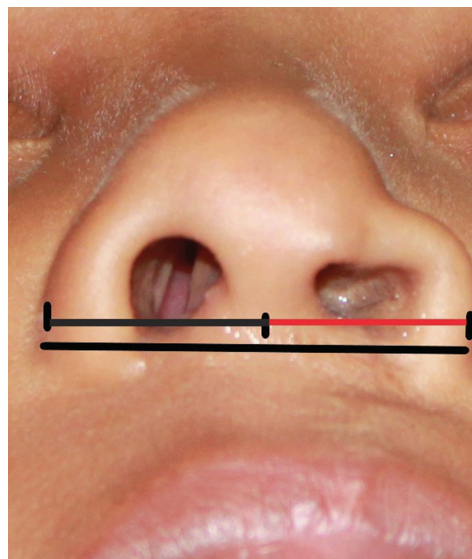


**Fig. 10** Columella length measurement (red–cleft side, black–noncleft side).

## Discussion

Grayson's technique of NAM gained popularity as it provided the prospect of reducing the anatomic difficulty and improving the nasal symmetry in early infancy. Although short-term studies have shown positive clinical effects,<sup>8-12</sup> the technique is relatively new, and fewer studies have documented the stability of the technique in long-term studies. In this retrospective study, we evaluated the stability of the nasal symmetry obtained by NAM at sequential intervals on 2D photographs. Although 2D photographs are dependent on patient position, and may be distorted by parallax effect, they are easy to obtain, inexpensive and noninvasive. Standardized photographic technique and ratios were obtained to minimize errors.

In this study, we found a gradual loss of the mean nasal height, mean gain in nasal width and alar base width, and an increase in the columella deviation from the T1 to the T4 follow-up. Our T2 results were similar to the 1-year results reported by Pai et al,<sup>16</sup> the 9-month results reported by Tang et al,<sup>1</sup> and the 1-year results reported by Liou et al.<sup>17</sup> Although the methodology of these studies differed, a loss of symmetry was recorded irrespective of whether only NAM was used—as in our study, a combination NAM and rhinoplasty,<sup>17</sup> NAM and postoperative nasal stents,<sup>17</sup> or NAM with rhinoplasty and postoperative nasal stents was used.<sup>1</sup>



**Fig. 11** Alar base width measurement (red–cleft side, black–noncleft side).

**Table 1** Angle and ratios of the various parameters measured

Parameter	Postcheiloplasty	1-year follow-up	3-year follow-up	5-year follow-up
Columella deviation angle	89.75°	88.31°	87.21°	86.60°
Nasal height ratio	1.01	0.84	0.80	0.76
Nasal width ratio	1.04	1.38	1.41	1.41
Columella length ratio	1.07	0.92	0.85	0.79
Alar base width ratio	0.97	1.13	1.21	1.34

**Table 2** The % of change in the various parameters from the baseline

Parameters	% variation	1 year	3 years	5 years
Columella deviation angle	% <sup>-</sup>	1.58%	2.81%	3.46%
Nasal height ratio	% <sup>-</sup>	15.03%	18.90%	22.83%
Nasal width ratio	%	37.10%	40.42%	40.25%
Columella length ratio	% <sup>-</sup>	13.48%	19.36%	24.89%
Alar base width ratio	%	18.89%	26.14%	40.69%

Postcheiloplasty follow-up (T1), 1-year follow-up (T2), 3-year follow-up (T3), and 5-year follow-up (T4).

Although the study by Liou et al<sup>17</sup> reported a statistically significant loss of symmetry at the 1st year follow-up, with a 10% loss of the nostril height, a 20% gain of the nostril width and a 4.7° deviation of the columella angle, in contrast to our study, they found a subsequent stability of the nasal symmetry at the 2nd and 3rd year follow-up appointments. This result may be due to the fact that unlike our patients, the NAM treated patients in Liou's study<sup>17</sup> had received primary rhinoplasty, which may have maintained the results for a longer duration.

The 5-year follow up study reported by Chang et al<sup>2</sup> consisted of 76 UCLP patients divided into four groups based on the treatment provided. The first group treated with closed rhinoplasty and postoperative nasal stents. The second group treated with NAM and postoperative nasal stents. The third group with NAM, closed rhinoplasty and postoperative nasal stents. The fourth group with NAM, semiopen rhinoplasty with Tajima's incision, a 20% surgical overcorrection, and postoperative nasal stents. Our results were similar to their second group which had received NAM and postoperative nasal stents. The nostril height was 0.76 in both the current study and in their study, and nostril width ratio was 1.41 in the current study and 1.36 in their study. Interestingly, although the second group showed a statistically significant improvement in comparison to the first group, there was no statistically significant difference between the second and third groups. Finally, their study concluded that the best symmetry was observed in the patients who had received NAM, semiopen rhinoplasty with 20% overcorrection and postoperative stents.

Although the methodology used, population studied, and surgeon factors differed in all the previous studies, there seems to be an indication that the differential growth between the cleft and noncleft sides, rather than the initial technique, is responsible for the loss of symmetry.<sup>17</sup> Although primary rhinoplasty appears to stabilize the results in the early follow-up duration,<sup>17</sup> the continuing growth may probably override the initial symmetry gained. The 20% overcorrection suggested by Chang et al<sup>2</sup> probably equals the lag on the cleft side due to which the results were symmetrical in their study.

### Limitations

This study was retrospective and done on 2D photographs. Although the conventional photography offers the benefit of low-cost and quick data collection, it is limited by patient head position and the parallax effect. The photographs were

also studied in the basal view which is generally not viewed in social circumstances. The method of measurement has not been validated. The study also stops at 5 years of age and includes only 24 patients.

### Conclusion

In this study, we found that NAM was a useful adjuvant in achieving nasal symmetry in patients with UCLP in the immediate postoperative period. However, as the patients aged, there was a gradual loss of symmetry. Although there is no conclusive evidence, the loss of symmetry may be due to the unequal growth on the cleft and noncleft sides. These patients will be followed-up till end of growth for a definite conclusion on the long-term effect of NAM.

### Conflict of interest

We have no conflict of interest to declare.

### References

- 1 Tang PM, Chao NS, Leung MW, Kelvin KW. Changes in nasal configuration following primary rhinoplasty: Direct anthropometric measurement in patients with complete unilateral cleft lip and palate. *Cleft Palate Craniofac J* 2016;53(5):557–561
- 2 Chang CS, Por YC, Liou EJ, Chang CJ, Chen PK, Noordhoff MS. Long-term comparison of four techniques for obtaining nasal symmetry in unilateral complete cleft lip patients: a single surgeon's experience. *Plast Reconstr Surg* 2010;126(4):1276–1284
- 3 Hosseini B, Rubin MS, Clouston SAP, et al. Comparative analysis of three-dimensional nasal shape of casts from patients with unilateral cleft lip and palate treated at two institutions following rotation advancement only (Iowa) or nasoalveolar molding and rotation advancement in conjunction with primary rhinoplasty (New York) *Cleft Palate Craniofac J* 2018;55(10):1350–1357
- 4 Salyer KE, Genecov ER, Genecov DG. Unilateral cleft lip-nose repair: a 33-year experience. *J Craniofac Surg* 2003;14(4):549–558
- 5 Lu TC, See UC, Chen PKT, Noordhoff MS. Unilateral Complete Cleft Lip Repair with Primary Semi-open Rhinoplasty. In: Anh Tran T, Panthaki Z, Hoballah J, Thaller S, eds. *Operative Dictations in Plastic and Reconstructive Surgery*. Springer, Cham; 2017
- 6 Grayson BH, Santiago PE, Brecht LE, Cutting CB. Presurgical nasoalveolar molding in infants with cleft lip and palate. *Cleft Palate Craniofac J* 1999;36(6):486–498
- 7 Grayson BH, Shetye PR. Presurgical nasoalveolar moulding treatment in cleft lip and palate patients. *Indian J Plast Surg* 2009;42(1(Suppl)):S56–S61
- 8 Lee CT, Garfinkle JS, Warren SM, Brecht LE, Cutting CB, Grayson BH. Nasoalveolar molding improves appearance of

- children with bilateral cleft lip-cleft palate. *Plast Reconstr Surg* 2008;122(4):1131-1137
- 9 Liou EJ, Subramanian M, Chen PK. Progressive changes of columella length and nasal growth after nasolabial molding in bilateral cleft patients: a 3-year follow-up study. *Plast Reconstr Surg* 2007;119(2):642-648
  - 10 Meazzini MC, Rossetti G, Morabito A, Garattini G, Brusati R. Photometric evaluation of bilateral cleft lip and palate patients after primary columella lengthening. *Cleft Palate Craniofac J* 2010;47(1):58-65
  - 11 Nazarian Mobin SS, Karatsonyi A, Vidar EN, et al. Is presurgical nasolabial molding therapy more effective in unilateral or bilateral cleft lip-cleft palate patients? *Plast Reconstr Surg* 2011;127(3):1263-1269
  - 12 Zuhair M, Bonanthaya K, Parmar R, Shetty PN, Sharma P. Presurgical nasolabial moulding in unilateral cleft lip and palate. *Indian J Plast Surg* 2016;49(1):42-52
  - 13 Chen PK-T, Noordhoff MS, Liou EJW. Treatment of Complete Bilateral Cleft Lip-Nasal Deformity. *Semin Plast Surg* 2005;19:329-342
  - 14 Matsuo K, Hirose T. Nonsurgical correction of cleft lip nasal deformity in the early neonate. *Ann Acad Med Singapore* 1988;17(3):358-365
  - 15 Sommerlad BC. A technique for cleft palate repair. *Plast Reconstr Surg* 2003;112(6):1542-1548
  - 16 Pai BC, Ko EW, Huang CS, Liou EJ. Symmetry of the nose after presurgical nasolabial molding in infants with unilateral cleft lip and palate: a preliminary study. *Cleft Palate Craniofac J* 2005;42(6):658-663
  - 17 Liou EJ, Subramanian M, Chen PK, Huang CS. The progressive changes of nasal symmetry and growth after nasolabial molding: a three-year follow-up study. *Plast Reconstr Surg* 2004;114(4):858-864