Dynamic Changes in Nasal Symmetry after Presurgical Nasoalveolar Molding in Infants with Complete Unilateral Cleft Lip and Palate

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Abstract

Background: Presurgical nasoalveolar molding (PNAM) technique gave a new perspective to presurgical infant orthopedics. Nasal reconstruction presents a challenge for the plastic surgeons in case of patients with unilateral cleft lip and palate (UCLP). PNAM facilitates the reshaping of the nasal cartilage and molding of maxillary arch preoperatively. This therapy not only aids the surgical repair of lip but also enhances the overall postoperative results with negligible postoperative scar. Aim: The aim of the study was to analyze nasal changes before and after PNAM in patients with complete UCLP. Materials and Methods: This was a retrospective review of 22 ULCP patients who underwent PNAM before lip surgeries. A series of standard basilar view photographs in 1:1 ratio were taken, and linear measurements were done directly on the photographs. Results: After PNAM therapy, there was highly significant increase in the nostril height, nostril dome height, and columella length \( (P < 0.001^* ) \) and highly significant reduction in the nostril width and nasal basal width \( (P < 0.001^* ) \). Conclusion: Significant improvement in the nasal symmetry was found after PNAM therapy in patients with complete UCLP.

Keywords: Cleft, lip, palate, presurgical, nasoalveolar molding

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Presurgical nasoalveolar molding (PNAM) technique gave a new perspective to presurgical infant orthopedics. Nasal reconstruction presents a challenge for the plastic surgeons in case of patients with unilateral cleft lip and palate (UCLP). PNAM facilitates the reshaping of the nasal cartilage and molding of maxillary arch preoperatively. This therapy not only aids the surgical repair of lip but also enhances the overall postoperative results with negligible postoperative scar. Aim: The aim of the study was to analyze nasal changes before and after PNAM in patients with complete UCLP. Materials and Methods: This was a retrospective review of 22 ULCP patients who underwent PNAM before lip surgeries. A series of standard basilar view photographs in 1:1 ratio were taken, and linear measurements were done directly on the photographs. Results: After PNAM therapy, there was highly significant increase in the nostril height, nostril dome height, and columella length \( (P < 0.001^* ) \) and highly significant reduction in the nostril width and nasal basal width \( (P < 0.001^* ) \). Conclusion: Significant improvement in the nasal symmetry was found after PNAM therapy in patients with complete UCLP.

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Introduction
Achieving a symmetrical nose form from the deficient columella and malformed nasal cartilage in cleft patients presents a great challenge. This can be attained either by surgical repair alone or presurgical molding of cleft segments followed by surgical repair. Medial insertion gets separated from lateral insertion of alar cartilage on the cleft side in unilateral cleft lip and palate (UCLP) patients, causing depression and deviation of the nasal tip.¹⁻⁴ The columella is shorter on the cleft side and is directed over the cleft with the base inclined toward noneleft side.¹⁻⁷ This is most disfiguring and challenging component to treat. Multiple surgeries are required to achieve the nasal symmetry after lip and palate repair.

McNeil⁵ in 1950 was first to introduce presurgical infant orthopedics (PSIO). Thereafter, many techniques have evolved. Matsuo was the first researcher who described presurgical molding of the nasal cartilage in cleft neonates.⁹,¹⁰ Grayson et al. described the first presurgical nasoalveolar molding (PNAM) appliance, a new approach to the traditional method of PSIO for patients with unilateral and bilateral clefts.⁹,¹¹

There have been a number of reports on the effectiveness of PNAM in patients with UCLP.⁴,⁷,¹²⁻¹⁸ The purpose of this study was to quantify the effects of PNAM on nasal symmetry in UCLP.

The PNAM technique appreciably improves the nasal symmetry, and this is maintained till early childhood.¹⁻⁷ The aim of the present retrospective study was to analyze two-dimensional nasal changes before and after PNAM in patients with complete UCLP.

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MATERIALS AND METHODS

The patients who were treated in the Department of Paediatric and Preventive Dentistry, H.P. Government Dental College and Hospital, Shimla, India, were selected from the records by the following criteria: (i) nonsyndromic infants with complete UCLP, (ii) PNAM done between 2013 and 2017, and (iii) available clinical records and photographs for analysis (i.e., before PNAM and after cheiloplasty). These criteria were met by 22 patients who were included in the study.

The commencement of PNAM therapy was between 10- and 15-day-old infants, and the average duration of the therapy was 6 months. PNAM therapy was done by the same pedodontist, and primary cheiloplasty using the method of triangular repair most often described as P. Randall’s modification (1959) of C. W. Tennison’s original technique (1952) was done by the same plastic surgeon. There were eight right-sided and 14 left-sided clefts.

Presurgical nasoalveolar molding

The maxillary intraoral molding plate was made of orthodontic light-cured acrylic resin. Depending upon the defect, a nasal stent was attached to the plate for correction of nasal asymmetry. A soft denture liner was used to mold the alveolus, and the nasal stent was also lined to prevent irritation of nasal and palatal mucosa. Lip taping was done to apply a constant pressure on the maxilla for approximation of lip defect. Patients were recalled after every 10–15 days depending upon the defect, for the adjustment of nasal stent and molding of the plate with selective grinding and addition of soft liner. Molding of PNAM appliance was done until the alveolar defect is in close approximation, uniform arch form is achieved, and nasal symmetry is observed till the age of 6 months before cheiloplasty. The assessment of the treatment was done by taking intraoral impression using custom acrylic tray and putty impression material. The impressions were poured using Type III dental stone.

Records and measurements

A series of standard basilar view photographs in 1:1 ratio were taken for each patient at resting posture by tilting the infant’s head back to bring the alar domes to a level below the eyebrows but above the canthi [Figures 1 and 2]. Each photograph was taken at initial visit and another after cheiloplasty.

Indirect anthropometric five linear measurements [Table 1 and Figure 3] were made on digital photographs with the help of software (Solid works software).

Nasal symmetry was assessed by the “quantity of asymmetry.” The quantity of asymmetry (in millimeters) was the linear difference of each measurement between the cleft and noncleft (cleft–noncleft); a positive value indicates that the cleft side is longer/wider than the noncleft side, and a negative value indicates that the cleft side is shorter/narrower than the noncleft side.

Statistical analysis

Measurements were compared on the photographs before and after PNAM using paired t-test for analyzing the nasal asymmetry between cleft and noncleft side.

Figure 1: The anthropometric measurements: A, nostril height; b, nasal dome height; c, columella length; d, nostril width; e, nasal basal width

Figure 2: Preoperative photograph

Figure 3: Postoperative photograph

Error of the method

For the assessment of intraobserver and photograph reliability, the method error was done by doing double determination on 88 randomly selected photographs taken before and after PNAM therapy under standardized conditions. The photographs were taken twice and digitalized using a computer.
RESULTS
The method error showed a significant intraobserver correlation ($r = 0.75, P < 0.05$) for repeated measurements and also significant correlation ($r = 0.86, P < 0.05$) between the photographs. All measurements showed a significant difference on the cleft side before and after PNAM [Table 2].

Vertical measurements
Highly significant increase in nostril height ($P < 0.001$), nasal dome height ($P < 0.001$), and columella length ($P < 0.001$) after the treatment [Table 2] was observed.

Horizontal measurements
Highly significant reduction in nostril width ($P < 0.001$) and nasal basal width ($P < 0.001$) after the treatment [Table 2] was observed.

DISCUSSION
PNAM not only helps in the alignment of alveolar segments and lips but also corrects the cleft nasal deformity by amending the depressed alar cartilages, deviated septum, short columella, and widened alar base. Nasoalveolar molding works on the principle of plasticity and pliability of cartilage, which is present in the neonates during the initial months after birth, as there is increased level of estrogen and hyaluronic acid levels.[12] This nasal correction is statistically unattainable with surgery alone. Hence, the enhancement of nasal symmetry and the lesser number of nasal and dentoalveolar corrective procedures contribute to both financial and psychological support to the patient and their family.[13,14]

Conventionally, nasal morphology has been quantified on a two-dimensional photographs by establishing various linear and angular measurements on the landmarks.[15-18] Later, computers were used for more accurate measurements. A software program was designed by Coghlan et al.[21] and Laitung et al.[22] for measuring nasal symmetry two dimensionally by digital tracing of nasal shape in the frontal and anteroposterior view. Cutting et al.[23] in 1988 used laser light scanner by putting three-dimensional body surface data for planning and evaluating surgical procedures. Bush and Antonyshyn[24] digitalized human face model with the help of high-resolution surface scanner. Hence, the linear measurements were made using anthropometric points in three-dimensional space.

When nostril height was evaluated, it was found that, on the cleft side, nostril height, nostril dome height, and columella length increased significantly. However, nostril width and nasal dome width decreased significantly on the cleft side when compared with nonleft side. This increase was observed due to the positive pressure which was exerted against the alar to elongate the short columella. Hence, by the above findings, we can appreciate the nasal symmetry after PNAM treatment in our study.

CONCLUSION
The most striking improvement in nasal symmetry was observed in nasal height, nasal dome height, columella length, nasal width, and nasal base width. Nasal asymmetry significantly improved after PNAM therapy and was further improved after primary cheiloplasty.

Why this paper is important to pediatric dentists
• PNAM facilitates the reshaping of the nasal cartilage and molding of the maxillary arch preoperatively
• This paper highlights the improvement in nasal symmetry achieved after PNAM therapy
• With better nasal form, no surgery would be required in the future for nasal correction. This saves the parents from unnecessary financial burden and psychological trauma.

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Conflicts of interest
There are no conflicts of interest.

Table 1: Vertical and horizontal measurements

| Measurement               | Definition                                                                 |
|---------------------------|----------------------------------------------------------------------------|
| Vertical measurements     |                                                                           |
| Nostril height            | The vertical distance between the horizontal reference line and the       |
|                           | intersection point of the inner upper border of nostril and the           |
|                           | perpendicular bisecting line of the nostril width                         |
| Nasal dome height         | The vertical distance between the horizontal reference line and the       |
|                           | intersection point of the outer upper border of nostril and the           |
|                           | perpendicular bisecting line of the nostril width                         |
| Columella length          | The vertical distance between the most inferior-medial and                |
|                           | superior-medial points along the inner                                      |
|                           | medial surface of the nostril apertures                                    |
| Horizontal measurements   |                                                                           |
| Nasal basal width         | The horizontal distance between the outer lateral border and the           |
|                           | inner medial border of the nostril                                         |
| Nostril width             | The horizontal widest distance between the inner lateral and               |
|                           | medial borders of the nostril aperture                                     |

Table 2: Nasal asymmetry values pre- and post-operatively (n=22)

| Variables              | Preoperatively | Postoperatively | $P$ |
|------------------------|----------------|-----------------|-----|
| Nostril height (cm)    | $-1.3±0.9$     | $1.1±0.6$       | $<0.001^*$ |
| Nasal dome height (cm) | $-1.2±1.3$     | $1.5±0.9$       | $<0.001^*$ |
| Columella length (cm)  | $-0.8±0.6$     | $0.8±0.4$       | $<0.001^*$ |
| Nostril width (cm)     | $4.4±2.4$      | $1.4±2.7$       | $<0.001^*$ |
| Nasal base width (cm)  | $4.8±2.4$      | $1.4±2.8$       | $<0.001^*$ |

$P<0.05$ significant using paired t-test. Values are expressed as mean±SD, where SD: Standard deviation.
REFERENCES

1. McComb H. Primary correction of unilateral cleft lip nasal deformity: A 10-year review. Plast Reconstr Surg 1985;75:971-9.
2. McComb HK, Coghlan BA. Primary repair of the unilateral cleft lip nose: Completion of a longitudinal study. Cleft Palate Craniofac J 1996;3:23-30.
3. Fisher DM, Mann RJ. A model for the cleft lip nasal deformity. Plast Reconstr Surg 1998;101:1448.
4. Mau1l DJ, Grayson BH, Cutting CB, Brecht LL, Bookstein FL, Khorrambadi D, et al. Long-term effects of nasoalveolar molding on three-dimensional nasal shape in unilateral clefts. Cleft Palate Craniofac J 1999;36:391-7.
5. Millard RD Jr., Morovic GC. Primary unilateral cleft nose correction: A 10-year follow-up. Plast Reconstr Surg 1998;102:1331.
6. Salyer KE. Primary correction of the unilateral cleft lip nose: A 15-year experience. Plast Reconstr Surg 1986;77:558-68.
7. Bennun RD, Perandones C, Septiarsky VA, Chantiri SN, Aguirre MI, Dogliotti PL. Nonsurgical correction of nasal deformity in unilateral complete cleft lip: A 6-year follow-up. Plast Reconstr Surg 1999;104:616-30.
8. McNeil CK. Orthodontic procedures in the treatment of congenital cleft palate. Dent Rec (London) 1950;70:126-32.
9. Matsuo K, Hirose T. Non surgical correction of cleft lip nasal deformity in the early neonate. Ann Acad Med Singapore 1988;17:358-5.
10. Matsuo K, Hirose T. Preoperative non-surgical over-correction of cleft lip nasal deformity. Br J Plast Surg 1991;44:5-11.
11. Grayson BH, Santiago P, Brecht L, Cutting CB. Presurgicalnaso-alveolar molding in patients with cleft lip and palate. Cleft Palate Craniofac J 1999;5:139-9.
12. Matsuo K, Hirose T, Tomono T, Iwasawa M, Katohda S, Takahashi N, et al. Nonsurgical correction of congenital auricular deformities in the early neonate: A preliminary report. Plast Reconstr Surg 1984;73:38-51.
13. Pfiefer TM, Grayson BH, Cutting CB. Nasoalveolar molding and gingivoperiosteoplasty versus alveolar bone graft: An outcome analysis of costs in the treatment of unilateral cleft alveolus. Cleft Palate Craniomf J 2002;39:26-9.
14. Noor SN, Musa S. Assessment of patients’ level of satisfaction with cleft treatment using the cleft evaluation profile. Cleft Palate Craniomf J 2007;44:292-303.
15. Lindsay WK, Farkas LG. The use of anthropometry in assessing the cleft-lip nose. Plast Reconstr Surg 1972;49:286-93.
16. Horswell BB, Pospisil OA. Nasal symmetry after primary cleft lip repair: Comparison between Delaire cheilorhinoplasty and modified rotation-advancement. J Oral Maxillofac Surg 1995;53:1025-30.
17. Kyrkanides S, Bellohsen R, Subtelny JD. Asymmetries of the upper lip and nose in noncleft and postsurgical unilateral cleft lip and palate individuals. Cleft Palate Craniomf J 1996;33:306-11.
18. Thomson HG, Reinders FX. A long-term appraisal of the unilateral complete cleft lip repair: One surgeon’s experience. Plast Reconstr Surg 1995;96:549-61.
19. Coghlan BA, Laitung JK, Pigott RW. A computer-aided method of measuring nasal symmetry in the cleft lip nose. Br J Plast Surg 1993;46:13-7.
20. Eric Jein-WeinLiou EJ, Subramanian M, Chen KT, Huang CS. The progressive changes of nasal symmetry and growth after nasoalveolar molding: A three year follow-up study. Plast Reconstr Surg 2004;114:858.
21. Coghlan BA, Matthews B, Pigott RW. A computer-based method of measuring facial asymmetry. Results from an assessment of the repair of cleft lip deformities. Br J Plast Surg 1987;40:371-6.
22. Laitung JK, Coghlan BA, Pigott RW. A comparison of computer versus panel assessment of two groups of patents with cleft lip and palate. Br J Plast Surg 1993;46:18-21.
23. Cutting CB, McCarthy JG, Karron DB. Three-dimensional input of body surface data using a laser light scanner. Ann Plast Surg 1988;21:38-45.
24. Bush K, Antonyshyn O. Three-dimensional facial anthropometry using a laser surface scanner: Validation of the technique. Plast Reconstr Surg 1996;98:226-35.