Original Article

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 postsurgical 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

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 noncleft side.[5-7] This is most disfiguring and challenging component to treat. Multiple surgeries are required to achieve the nasal symmetry after lip and palate repair.

McNeil[8] 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.[4,11]

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.[4-7] 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].[19] Each photograph was taken at initial visit and another after cheiloplasty.

Indirect anthropometric five linear measurements [Table 1 and Figure 3][20] 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.

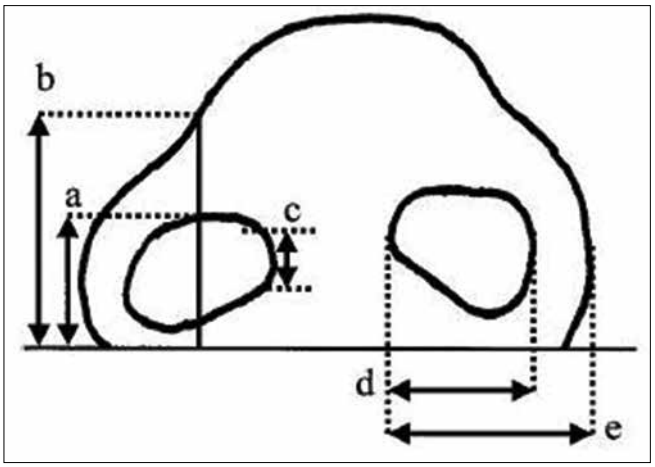

Figure 1: The anthropometric measurements: *A*, nostril height; *b*, nasal dome height; *c*, columella length; *d*, nostril width; *e*, nasal basal width

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 noncleft 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.

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

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.

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