Original Article

Achievement in Nasal Symmetry after Cheiloplasty in Unilateral Cleft Lip and Palate Infants Treated with Presurgical Nasoalveolar Molding

Seema Thakur, Anjali Singh, Narbir Singh Thakur[1], Vijay Kumar Diwana[2]

Department of Paediatric and Preventive Dentistry, H.P. Government Dental College and Hospital, [1]Department of Oral Pathology, H.P. Government Dental College and Hospital, [2]Deparment of Plastic Surgery, Indira Gandhi Medical College and Hospital, Shimla, Himachal Pradesh, India

Abstract

Background: The presurgical nasoalveolar molding (PNAM) technique gave a new perspective to presurgical infant orthopedics. Nasal reconstruction presents a challenge for the treating 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. **Aims and Objective:** The aim and objective of the present retrospective study was to analyze two-dimensional nasal changes before and after PNAM in patients with complete UCLP. **Materials and Method:** Twenty-two ULCP patients who underwent PNAM before lip surgery were considered in this study. A series of standard basilar view photographs in 1:1 ratio were taken and linear measurements were done digitally. **Results:** After PNAM therapy, there was a significant increase in nostril height ($P = 0.003$) and highly significant increase in columella length ($P = 0.001$). There was also a highly significant decrease in nostril width ($P = 0.001$) and a significant decrease in nasal basal width ($P = 0.02$). **Conclusion:** There was a significant increase in nostril height and columella length and a significant decrease in nostril width and nasal basal width on the cleft side when treated with PNAM therapy in patients with complete UCLP. Hence, this therapy helps in improving the nasal symmetry in such patients and also aids in surgical procedures.

Keywords: *Presurgical nasoalveolar molding, unilateral cleft lip and palate, nasal symmetry*

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 by presurgical molding of cleft segments followed by surgical repair. The lower lateral alar cartilage in patients with unilateral cleft lip and palate (UCLP) is depressed and concave in the alar rim. It gets separated from the noncleft-side lateral alar cartilage, 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] The presurgical nasoalveolar molding (PNAM) technique appreciably improves the nasal symmetry, and this is maintained till early childhood.[4-7]

McNeil[8] in 1950 was the first to introduce presurgical infant orthopedics. Thereafter, many techniques 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 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.[4,7,11-18] The purpose of this study was to quantify the effects of PNAM on nasal symmetry in UCLP.

The objective of the present retrospective study was to analyze two-dimensional nasal changes before and after PNAM in patients with complete UCLP.

Materials and Methods

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

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Address for correspondence:
Dr. Seema Thakur, Department of Paediatric and Preventive Dentistry, H. P. Government Dental College, Shimla - 171 001, Himachal Pradesh, India.
E-mail: cima2009@hotmail.com

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criteria were met by 22 patients who were included in the study.

The patient's family consent was obtained. The age of the patients on commencing PNAM therapy was between 10 and 28 days, and the average length of the therapy was 97 days (15–180). PNAM therapy was done by a single pedodontist, and primary cheiloplasty using the method of triangular repair most often described as Randall's modification (1959) of Tennison's original technique (1952) was done by a single plastic surgeon.

Presurgical nasoalveolar molding

The maxillary intraoral molding plate was made of orthodontic light-cured acrylic resin. Depending on 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 the irritation of nasal and palatal mucosa. Lip taping was done to apply a constant pressure on the maxilla for the approximation of lip defect. Patients were recalled after every 15 days to 1 month depending on the defect, for adjustment of nasal stent and molding of 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 a 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.[19] Each photograph was taken at initial visit and another after cheiloplasty.

Indirect anthropometric five linear measurements [Table 1 and Figure 1][20] were made on digital photographs with the help of software (Solid Works Software, Dassault Systemes, Concord, Massachusetts, USA).[20]

Nasal symmetry was assessed by the "quantity of asymmetry." The quantity of asymmetry (in millimeters) was the linear difference of each measurement between 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. The quantity of asymmetry before and after PNAM therapy was analyzed for the significant improvement by paired *t*-test ($P < 0.05$).

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.

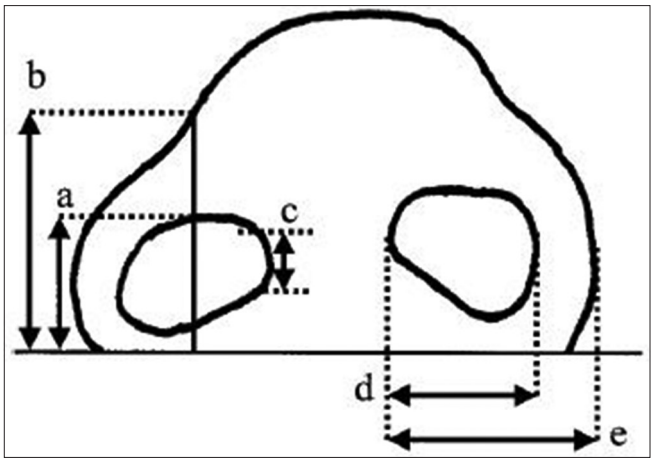

Figure 1: The anthropometric measurements. a: Nostril height; b: Nasal dome height; c: Columella length; d: Nostril width; e: Nasal basal width

Table 1: Vertical and horizontal nasal measurements (adapted from Liou *et al*)[20]

Vertical measurements a. 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*.
b. 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*.
c. Columella length	the vertical distance between the most inferior-medial and superiormedial points along the inner medial surface of the nostril apertures.
Horizontal measurements	
d. Nostril basal width	the horizontal distance between the outer lateral border and the inner medial border of the nostril.
e. Nostril width	the horizontal widest distance between the inner lateral and medial borders of the nostril aperture.

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 [Figures 2 and 3].

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 cleft side before and after PNAM [Table 2].

Figure 2: Preoperative photograph

Figure 3: Postoperative photograph

Table 2: Nasal asymmetry values pre- and postoperatively (*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. SD: Standard deviation

Vertical measurements

There was a 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].

Horizontal measurements

There was a highly significant reduction in nostril width ($P < 0.001$) and nasal basal width ($P < 0.001$) after the treatment [Table 2].

Discussion

PNAM molding not only helps in 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 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 lesser number of nasal and dentoalveolar corrective procedures contributes to both financial and psychological supports to the patients and their family.[13,14]

Conventionally, nasal morphology has been quantified on 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 frontal and anteroposterior views. 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.

The objective of this study was to analyze the anatomic changes in the nasal symmetry occurring in the unilateral cleft lip nose before and after PNAM. Digital analysis of standardized photographs was done for the evaluation of nasal changes.

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 the noncleft side. This increase was observed due to the positive pressure which was exerted against the alar rim to elongate the short columella. Hence, by the above-mentioned 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 width, nasal base width, and columella length. These results assess the nasal asymmetries in ULCP which are mainly due to deviated anterior septum, malpositioned alar cartilage arch, and dislocated inferior and lower lateral cartilages. Hence, nasal asymmetry significantly improved after PNAM therapy and was further improved after primary cheiloplasty. This paper highlights the improvement in nasal symmetry achieved after PNAM therapy. This is a preliminary study; the follow-up study to evaluate the postsurgical outcomes of these patients in future is needed.

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Conflicts of interest

There are no conflicts of interest.

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