Presurgical nasoalveolar molding: A boon to facilitate the surgical repair in infants with cleft lip and palate

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Abstract

Cleft lip and palate (CLP) is the most common congenital craniofacial anomaly. Rehabilitation of CLP generally requires a team approach. Alveolar and nasal reconstruction for these patients is a challenge for the reconstructive surgeon. Various procedures have been attempted to reduce the cleft gap, so as to obtain esthetic results postsurgically. The presurgical nasoalveolar molding (PNAM) technique, developed by Grayson, is a new approach to presurgical infant orthopedics. PNAM reduces the severity of the initial cleft alveolar and nasal deformity. Thus, it enables the surgeon and the patient to enjoy the benefits associated with repair of a cleft deformity that is minimal in severity. This article presents a brief insight into PNAM with a case series of three different cases (one unilateral and two bilateral) which underwent PNAM treatment and gave an excellent surgical prognosis.

Keywords: Bilateral cleft lip and palate, presurgical nasoalveolar molding, unilateral cleft lip and palate

Introduction

Cleft lip and palate (CLP) is the most common congenital craniofacial anomaly caused by abnormal facial development during gestation. According to the global epidemiological survey, one newborn in every 600 suffers from cleft palate, incidence being highest among the Asians followed by Caucasians and Africans. The incidence in India was reported to be over 3500 CLP/year.

CLP though treatable, the kind of treatment depends on the type of cleft and the severity of the cleft. Children with CLP are monitored by a cleft palate team or craniofacial team from birth to young adulthood. The overall care of affected infant is relied on interdisciplinary team decisions rather than a series of independent, critical events by individual specialists on a team.[1] The surgical treatment of CLP has been documented since AD 317, when Chinese general Wei Yang-Chi had his cleft lip corrected by cutting and stitching the edges together. From there on, the surgical techniques went on refining to the currently practiced surgical techniques.[2]

However, as the clefts are deficient in hard and soft tissue elements, they present a significant surgical challenge to achieve a functional and cosmetic outcome. Even a mild incomplete unilateral cleft lip in the absence of a cleft palate can be associated with a nasal deformity. Most surgeons would agree that their chance of achieving a finer surgical scar, good nasal tip projection, and more symmetrical and precisely defined nasolabial complex would be better in an infant who presents with a minor cleft deformity. A finer scar forms when a surgical incision heals under less tension.[3] Thus, presurgical nasoalveolar molding (PNAM) can be an adjunct to facilitate surgical repair in infants with CLP.

Presurgical nasoalveolar molding

The primary aim of PNAM is a reduction in the soft tissue and cartilaginous cleft deformity to facilitate surgical soft tissue repair in optimal conditions under minimum tension to minimize scar formation.[4,5] It allows stimulation

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and redirection of growth for the controlled predictable repositioning of the alveolar segments and gives the ideal arch form, normalizes the tongue position, aids in speech development, improves appearance and gives a psychosocial boost, and improves feeding and bone contour.[1]

The PNAM appliance consists of a removable alveolar molding plate made of orthodontic acrylic from a dental cast of the infant's maxilla. The nasal stent is bent at the end of a 0.032 inch stainless steel wire that is embedded into the anterior portion of the alveolar molding plate. The nasal stent and the intraoral molding plate are adjusted weekly or biweekly to gradually correct the nasal and alveolar deformities, giving rise to the name nasoalveolar molding. PNAM can be applied to the entire range of cleft deformities including complete clefts without an intact nasal floor.[6]

Objectives of presurgical nasoalveolar molding

- To provide symmetry to severely deformed nasal cartilages
- To achieve projection of the flattened nasal tip
- To provide nonsurgical elongation of the columella
- To improve the alignment of the alveolar ridges and reduce the distance between the cleft lip segments.[6]

Here, we make an attempt to show how the above-mentioned objectives of NAM can be practically accomplished with the help of three different cases.

Case Reports

Case 1

A 3-month-old male child was referred to the Department of Pedodontics and Preventive Dentistry, by a plastic surgeon for PNAM. The birth weight of the baby was 2.75 kg and medical history was unremarkable. On examination, unilateral cleft involving lip, alveolus and palate, natal tooth on the greater segment in the anterior region, collapsed left nasal rim, and deviated nasal septum toward right side were noted [Figure 1a and b]. Active PNAM was carried out for a period of about 3 months [Figure 1c-e] till the time patient became eligible for surgical repair. During the course of treatment, the natal tooth was extracted. After 3 months of PNAM, alveolar molding achieved was satisfactory [Figure 1f-i], whereas much of nasal molding could not be achieved. Primary lip repair surgery was performed when the patient was 6-month-old, and primary palate repair was done when patient became 1-year-old [Figure 1j-m].

Case 2

An 8-day-old male child was referred to the Department of Pedodontics and Preventive Dentistry from a nearby hospital for PNAM. Birth weight of the child was 2.8 kg with unremarkable medical history. On examination, the patient was found to have bilateral cleft involving lip, alveolus and palate, deviated and rotated premaxilla to left side, rudimentary columella, and underdeveloped alveolar

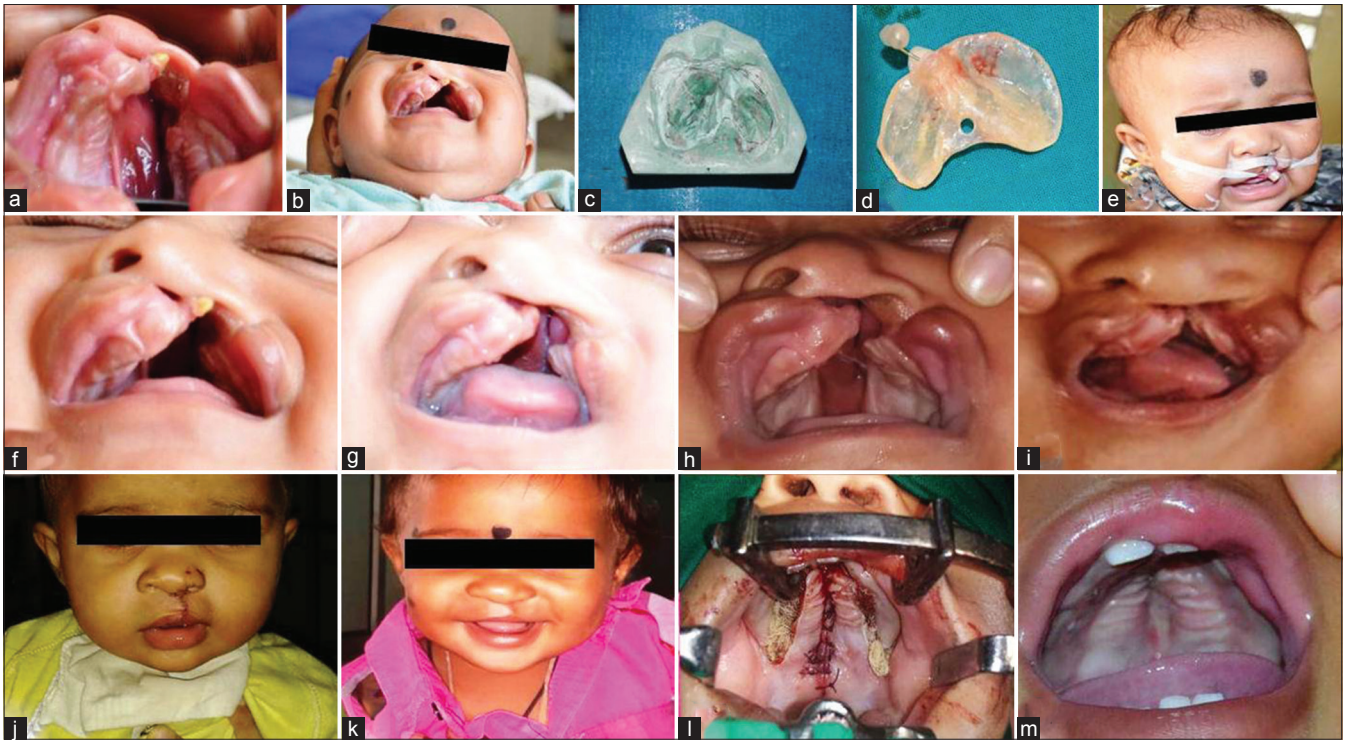

Figure 1: (a and b) Preoperative intraoral and extraoral view; (c) master cast; (d) alveolar molding plate; (e) appliance *in situ*; (f) pre-presurgical nasoalveolar moulding; (g) After 1 month; (h) after 2 months; (i) after 3 months; (j) immediately after lip repair; (k) 5 months after lip repair; (l) immediately after palate repair; (m) 1 month after palatal repair

segments [Figure 2a and b]. The PNAM appliance given in this case was a modified one, using open coil NiTi spring of thickness 0.030 inch which separated the premaxillary part from the rest of the alveolar molding plate for bringing the rotated premaxilla to desired position (predirectional PNAM appliance). It was changed to the traditional alveolar molding plate upon the achievement of centralization of premaxilla [Figure 2c-f]. Active alveolar and nasal molding were carried out for 5 months [Figure 2g and h], which resulted in excellent alveolar molding and nasal molding [Table 1]. Columella was elongated and rotated premaxilla was brought back to the normal position [Figure 2i and j]. Primary lip repair surgery was carried out when the patient was 6-month-old, and primary palate repair was done when he was 11-month-old [Figure 2k and l].

Case 3

A 3-day-old male child was reported to the Department of Pedodontics and Preventive Dentistry with bilateral CLP. On examination, the child was found to have deviated and rotated premaxilla to the left side, presence of a rudimentary columella, and underdeveloped alveolar segments [Figure 3a-c]. The baby was weighing 2.25 kg, and the medical history was not significant. The appliance used in this case was conventional PNAM appliance but with a modified nasal bridge. The modified design contained an acrylic button to which elastic chain was attached [Figure 3d-f] for bringing about aggressive nasal molding with an increased range. Following 102 days of PNAM, we could achieve retraction and centralization of premaxilla along with prolabium along with excellent nasal and alveolar molding [Figure 3g-i and Table 2].

Discussion

The concept of PNAM was developed with this understanding of infant's cartilage plasticity as a result of elevated levels of circulating maternal estrogen in the infant's bloodstream, and the ability to permanently modify its shape. As the plasticity of the cartilage fades over the first 6 months of age, a state of elasticity eventually sets in, maintaining the shape of the nasal cartilage at that point.[6] Thus, best results will be visualized, if PNAM is started as early as possible after the birth as done in Case 2 and Case 3. However, in Case 1, when the child reported, it was already 3-month-old and thus nasal molding was unsatisfactory.

Table 1: Changes observed in arch dimensions post-presurgical nasoalveolar molding when compared to pre-presurgical nasoalveolar molding

	Pre-PNAM (mm)	Post-PNAM (mm)
Width of premaxilla	17	18
Antero-posterior projection of premaxilla	30	22
Anterior arch width	11	18
Intercanine width	27	29
Posterior arch width	34	39
Width of the nasal septum just posterior to the premaxilla	9	9

PNAM: Presurgical nasoalveolar molding

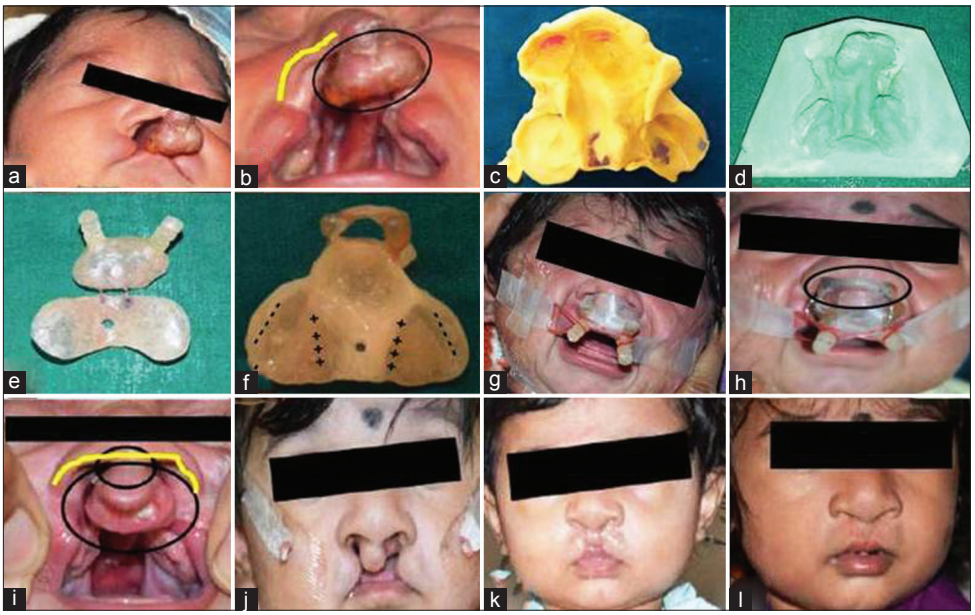

Figure 2: (a and b) Pre-presurgical nasoalveolar molding; (c) Impression made (d) master cast; (e) predirectional presurgical nasoalveolar molding appliance; (f) traditional presurgical nasoalveolar molding appliance; (g) appliance *in situ*; (h) nasal stent and nasal bridge *in situ*; (i and j) post-presurgical nasoalveolar molding; (k) 1 day after lip repair; (l) 5 months after lip repair

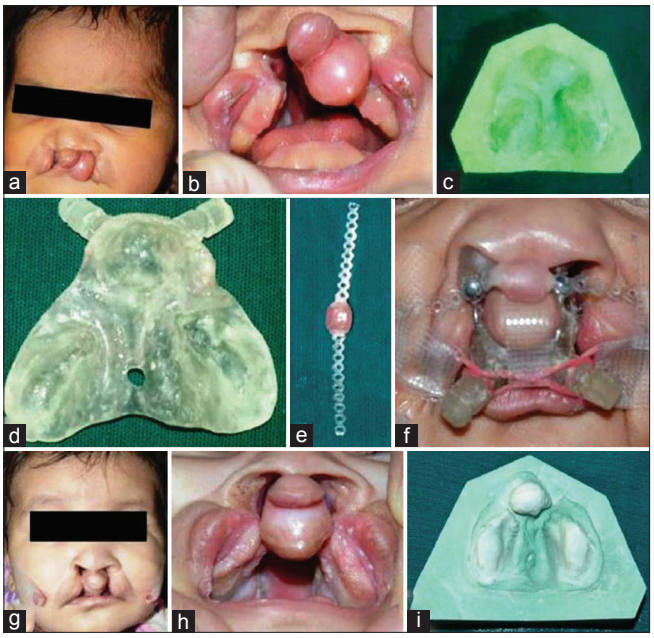

Figure 3: (a-c) Pre-presurgical nasoalveolar molding; (d) alveolar molding plate; (e) modified nasal bridge; (f) appliance *in situ*; (g-i) post-presurgical nasoalveolar molding

However, alveolar molding could be achieved and thus the attempt of PNAM even in a 3-month-old baby, helped the surgeons to a great extent.

Presurgical nasoalveolar molding versus nonnasoalveolar molding presurgical infant orthopedics

All nonnasoalveolar molding presurgical infant orthopedics (PSIO) techniques neglect to address the nasal cartilage deformity during the period of cartilage plasticity which often results in the need to perform more surgical revisions. Use of pin-retained PSIO, such as the Latham device is associated with added disadvantages such as increased cost and morbidity because of the invasiveness of appliance insertion, removal, and sometimes sedation anesthesia. Lip taping or surgical lip adhesion alone can be a disadvantage for patients with bilateral cleft lip and palate. If control of the alveolar segments is not achieved, the premaxilla can descend vertically, and the anterior aspect of the posterior alveolar segments can collapse palatally. This can result in an impinging deep bite of the premaxilla, arch form collapse, and in coordination with the mandibular arch. In addition, the malpositioned premaxilla can render fistula closure difficult. A persistent fistula can affect the production of speech and allow oral contents to enter the nasal cavity. The practice of PNAM not only avoids most of the above-mentioned disadvantages but also offers some significant benefits such as best possible esthetics, nasal symmetry, and unaffected nasal growth.[6] In the present case series, Case 1 and Case 2 showed excellent prognosis following primary lip repair surgery and primary palate repair, and the plastic surgeon credited all the success to PNAM, with the expectation of similar outcome even in Case 3. Both the Cases (1 and 2) showed minimal or no scar formation after surgery, along with achieving near normal anatomy of the lip and palate.

Table 2: Changes observed in arch dimensions post-presurgical nasoalveolar molding when compared to pre-presurgical nasoalveolar molding

	Pre-PNAM (mm)	Post-PNAM (mm)
Width of premaxilla	11	13
Antero-posterior projection of premaxilla	28	21
Anterior arch width	14	15
Intercanine width	25	31
Posterior arch width	34	32
Width of the nasal septum just posterior to the premaxilla	8	4

PNAM: Presurgical nasoalveolar molding

Long-term studies have indicated that the change in nasal shape is stable[7] with less scar tissue and better lip and nasal form. This improvement reduces the number of surgical revisions for excessive scar tissue, oronasal fistulas, and nasal and labial deformities.[8] With the alveolar segments in a better position and increased bone bridges across the cleft, eliminates the need for secondary bone grafting while giving a better chance for the teeth to erupt in a good position with adequate periodontal support.[9] Thus, PNAM might also reduce the overall cost of cleft care by reducing the number of secondary nasal revisions.

The advantages of PNAM might also include psychosocial benefits to the infant's family.[6] Caretaker's compliance is an essential factor with this method of treatment. In all the three cases of ours, parents were very cooperative and sincerely followed all the instructions given. The preliminary findings of the study by the National Institutes of Health to evaluate caregivers' responses to PNAM indicate that the frequent visits for PNAM adjustments reduce caregivers' anxiety and lead to a sense of empowerment. These changes arise as the caregiver develops increased skill in managing the PNAM appliance, observes improvement in the baby's appearance, and receives support and counseling from weekly visits to the cleft team.[6] Positive attitude of the caregiver is mandatory as it is imperative that parents become active members of the treatment team.[2] Poor compliance by the parents can cause loss of valuable treatment time.[3] Furthermore, if the appliance is lost or not worn, a cleft gap that had been closed early during molding therapy may widen again as the infant places his or her tongue into the cleft.[2]

Complications – Precautions and preventions

However, few complications can be associated with PNAM. Most common is the irritation of the oral mucosal or gingival

tissue, ulceration of intraoral tissues[2] which even we observed in Case 2 and Case 3. Thus, the infant should be checked at each visit, and the molding plate should be properly relieved in all areas that are exerting excessive pressure.[2] In our cases, we even prescribed antiseptic gel (Orasep). Other complications might include inflammation of the intranasal lining of the nasal tip, if too much force is applied by the upper lobe of the nasal stent, notching along the alar rim, if the lower lobe is not positioned or shaped correctly, ulceration of the area under the horizontal prolabium band, if the band is too tight. The most common area of soft tissue irritation is the cheeks. Thus, tapes should be removed slowly and carefully to avoid skin irritation. Tape removal solvents or warm water can facilitate the removal of tapes. There is a risk of molding plate to become dislodged and obstruct the airway. Taping the arms too horizontally or with inadequate activation increases the possibility of posterior border of the molding plate to drop down onto the tongue. In such eventualities to prevent airway obstruction, 5 mm diameter hole should be placed in the center of the molding plate at fabrication. This centrally located hole on the palatal portion of the molding plate, will in most instances allow adequate airflow.[2]

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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