

Presurgical Nasoalveolar Molding: A Review

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Abstract

Cleft lip and palate (CLP) is the most common structural abnormality in the embryonic period of life, with an incidence of approximately one per 500-700. 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. Pre-surgical nasoalveolar molding (PNAM) is a non-surgical

procedure performed early after birth in CLP patients to normalize the upper lip, alveolus, and nostrils by using a palate device attached to a nasal stent. Several benefits of PNAM have been reported in the literature, including the fact that pre-surgical reduction of the alveolar cleft gap helps surgeons to perform successful gingivoperiosteoplasty. Present review of literature is aims to discuss PNAM in detail.

Keywords: Cleft lip, Cleft palate, PNAM

Introduction

Cleft lip and palate are among the most common types of birth defects. Two-thirds of all cases of clefting involve the lip with or without involvement of the palate; whereas, one-third of all cases occur as an isolated deformity of the palate. Males predominate within the CLP group (60-80% of cases); whereas, females constitute the majority within the cleft palate (CP) group. CLP deformity is strongly associated with bilateral cleft lips (CLs) (86% of cases); the association decreases to 68% with unilateral CL. The left side is most commonly involved in unilateral CL cases. Interracial differences exist in the incidence of CLP versus CP. The mean incidence of CLP is 2.1 cases per 1,000 live births among Asians, one case per 1,000 live births among white people, and 0.41 cases per 1,000 live births among black people. A high incidence of the CLP is seen in North American populations of Asian descent, such as Indians of the southwestern United States and the west coast of Canada.^{1,2}

Over the years various treatment modalities have been attempted in these patients so as to achieve satisfactory outcome. Surgical treatment of cleft lip and palate has been documented since 317AD, when Chinese General Wei Yang Chi had his cleft lip corrected by cutting and stitching the edges together. Since then various authors described the different surgical techniques for correction of cleft lip (Pierre Franco 1556, Ambroise Pare 1575, Tennison 1952, Millard's technique 1960). To further improve the esthetic result of lip repair, the concept of presurgical infant orthopedics was developed. Presurgical infant orthopedics plays a significant role in neonatal cleft lip and palate treatment. Mc Neil articulated the modern concept of presurgical maxillary orthopedics in 1950 when he described the use of serial

appliances to approximate alveolar cleft segment. From Mc Neil's concept of alveolar molding to concept of nasopalveolar molding many changes have taken place in appliance designs. These appliances could be classified as – Active or Passive; Presurgical or Post surgical; and Intra oral or Extra oral (Huener and Liu 1993). Active appliances move alveolar cleft segments in a predetermined manner with controlled forces whereas passive appliances deliver no force but act as a fulcrum upon which forces created by surgical lip closure, contour and mold the alveolar segments in predictable fashion.³

In 1993, Grayson et al. described a new technique of presurgical moulding of the alveolus, lip and nose in infants born with cleft lip and palate.^{4,5} At present, there are three different PNAM techniques routinely used, namely; Grayson's technique,⁶ Figueroa's technique⁷ and Liou's technique.⁸

Presurgical Nasopalveolar Molding

Presurgical NAM is a non-surgical technique used to reshape the gums, lips, and nostrils before the CLP surgery to reduce the degree of the cleft; moreover, it is painless and easy to perform. Before NAM, reconstructing a large cleft necessitated numerous operations starting from birth and continuing through adolescence, placing the patient at risk for psychological and social adjustment issues. However, following the emergence of NAM, the orthodontist can decrease the size of the cleft and shape the alveolar and nasal tissues into the right anatomic position. This technique involves active shaping and changing the placement of the alveolar processes, retracting and centering the premaxilla, approximating the lip segments, lengthening the columella, improving the nasal tip projection by adjusting the plate and using nasal stents and tapes.^{9,10}

Principle of PNAM

PNAM works on the principle of 'negative sculpturing' and 'passive molding' of the alveolus and adjacent soft tissues. In passive molding, a custom-made molding plate of acrylic is used to gently direct the growth of the alveolus to get the desired result later on. While in negative sculpturing serial modifications are made to the internal surfaces of the molding appliance with addition or deletion of material in certain areas to get desired shape of the alveolus and nose.

It has been shown that correction of nasal cartilage deformity and non-surgical elongation of a deficient columella can be achieved in combination with moulding of alveolar process with premaxillary retraction through PNAM. This is possible because the cartilage has a high degree of plasticity in the neonatal period.^{11,12}

According to Matsuo et al. auricular cartilage could be molded with permanent results if treatment was started within 6 weeks of life. During this period there are high levels of maternal estrogen in the fetal circulation which triggers an increase in the hyaluronic acid. Hyaluronic acid alters the cartilage, ligament and connective tissue elasticity by breaking down intercellular matrix. Levels of estrogen start dropping at 6 weeks of age. Matsuo applied this concept for the correction of nasal deformities in cleft lip patients. It is on this principle that the concept of nasoalveolar molding works. It is also suggested that nasolaveolar molding stimulated immature nasal chondroblasts, producing an interstitial expansion that is associated with improvement in the nasal morphology.^{13,14}

Objective of PNAM^{1,10,11}

- The main objectives of NAM in patients with bilateral cleft are facilitating intra-oral feeding
- Improving maxillary growth
- Improving the projection of the nasal tip
- Reducing nasal deformity
- Reduces the need for secondary alveolar bone grafts
- Increasing the surface area of the mucosal lining
- Nonsurgical lengthening of the columella
- Facilitating primary lip, nasal, and alveolar surgeries retracting and repositioning the premaxilla more posteriorly

Technique of PNAM

Impression: To make the NAM appliance, first, a maxilla dental cast of the newborn is used to make a removable orthodontic acrylic alveolar molding. The first impression of the CLP infant is obtained within the first week of birth.¹

The infant is held in an inverted position to prevent the tongue from falling back and to allow fluids to drain out of the oral cavity. The tray is seated until the impression material adequately covers the anatomy of the upper gum pads. He used a heavy body silicone impression material as it has good tear strength. Prasanth et al. (2011)¹⁵ and Retnakumari et al. (2014)¹ used heavy body silicone impression material for taking impression, and the infant was kept in supine position during the procedure.

Considerations for tray selection

The impression tray should be of enough size transversely, to include the lateral maxillary segments, to posteriorly - cover up to the maxillary tuberosities and to provide a good reproduction of the mucobuccal folds. The anterior tray border is not critical, as the impression material flows forward far enough to cover the structures

as the - tray is seated. Rimming of the entire tray with utility wax has been suggested to provide an additional bulk of material laterally, to avoid the sharp edges of the tray and also to provide a posterior dam to prevent the material from seeping posteriorly. A good high vacuum suction is of utmost importance. Four handed dentistry is almost always necessary to restrain unwanted movements of the newborns head, hands and legs. Breast feeding is advised after, rather than before, the procedure as vomiting and aspiration is of concern.

Fabrication of PNAM Appliance

To fabricate the cast, the dental stone is put into the impression. The resulting cast is then used to make the molding plate. The plate is composed of hard, clear self-cure acrylic.¹⁶ Various materials have been substituted for auto-polymerizing resin in fabrication of the appliance by various researchers. They are light-cure polymerizing material, heat-cure polymerizing material and thermoplastic base plate wax.^{17,18,19}

Retention button is fabricated and positioned anteriorly at an angle of 40 degree to the plate. The vertical position of the retention arm should be at the junction of the upper and lower lip. The retention button adequately secures the molding plate in the mouth with the help of orthodontic elastics and tapes. A small opening measuring 6-8 mm in diameter is made on the palatal surface of the molding plate to provide an airway in the event that the plate drops down posteriorly.^{18,19}

Insertion of Appliance

Using surgical tape with orthodontic elastic bands at one end, the appliance is fastened extraorally to the cheeks. Skin barrier tapes on the cheeks are recommended to prevent irritation on contact with the cheeks. The elastics (inner diameter 0.25 inch) should be stretched approximately two times their resting diameter for

proper activation force. Parents are directed to keep the plate in the mouth at all times and to only take it out for daily cleaning.¹

Adjustment of Appliance

The infant should be visited weekly to modify the molding plate and bring the alveolar segments together. The modifications are done by carefully taking out the hard acrylic and putting the soft denture base material on the molding plate. More than 1 mm of adjustment of the molding plate is not advised during each visit. The alveolar segments should be directed to their ultimate and optimal position.¹

Incorporation of Nasal Stent

A silicone nasal conformer suggested by Matsuo and Hirose can be used as a tool for presurgical nasal molding when the patient has an incomplete CL. The height of the conformer can be adjusted by gradually adding some soft resin or flat silicone sheets on the domes. This is a method to increase the columella height gradually by adding silicone sheets to the domes of the nasal stent. It can be used for presurgical elongation of the columella in incomplete clefts or postoperative maintenance of the nostril configuration.^{1,20}



Figure 1: PNAM Appliance (Pandey Ret al.)²¹

Complication of PNAM

Few complications can be associated with PNAM. Most common is the irritation of the oral mucosal or gingival tissue, ulceration of intraoral tissues. 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.

Another common complaint with nasoalveolar molding is rash like area of erythema and chafing on the zygomatic process areas due to extraoral taping. These are generally self limiting. The best way to prevent these rashes is to wet the tape thoroughly before removal of the same.²²

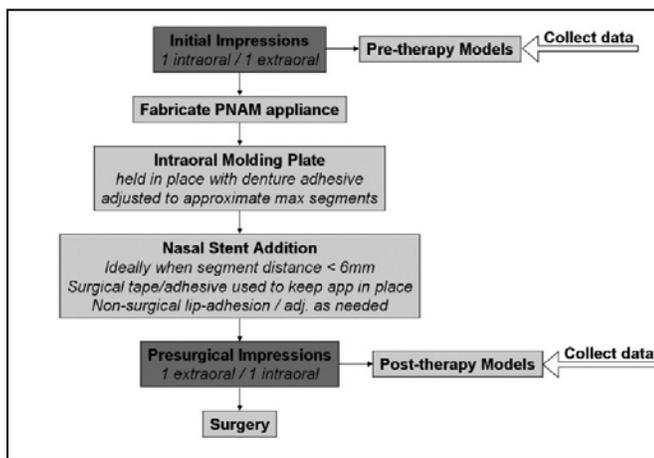


Figure 2: Protocol for PNAM (According to Retnakumari N et al.)¹

Advantage of PNAM

One of the advantages of PNAM is the moldability of alveolar processes to guide the segments into a normal position. In addition, pre-surgical reduction of the alveolar cleft gap facilitates the performance of gingivoperiosteoplasty due to the probability of forming an osseous bridge.²³

Ross and MacNamera advocated another possible benefit of presurgical infant orthopedics. As the maxillary segments are guided to the normal position,

the lip segments come closer, thereby making cheiloplasty simpler to perform. The advantages of PNAM might also include psychosocial benefits to the infant's family.²³

In addition, there are several other advantages to using a prosthetic device to place a premaxilla in a more anatomically correct position before surgical closure of the lip. First, soft tissue will be carried with the segment, leading to a decrease in the width of the defect. Second, a centrally positioned premaxillary segment provides a more ideal base for lip closure.²²

Disadvantage of PNAM

Positive attitude of the caregiver is mandatory as it is imperative that parents become active members of the treatment team. Poor compliance by the parents can cause loss of valuable treatment time. 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.^{18,23}

Conclusion

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. The PNAM technique has been significantly shown to improve the surgical outcome of CLP patients compared with other techniques of presurgical orthopedics. PNAM has proved to be an effective adjunctive therapy for reducing hard and soft tissue cleft deformity before surgery.

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