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Shaping the Future of Cleft Care: A Review Article on Presurgical Nasoalveolar Molding

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Abstract

Background: Alveolar segments, nasal cartilage, columella, and lip morphology are all significantly altered in cleft lip and palate, a common congenital craniofacial defect. In order to lessen the severity of the cleft deformity and improve the alignment of the nasal and alveolar structures prior to primary surgical repair, presurgical nasoalveolar molding (PNAM) has become a significant presurgical orthopedic intervention. The purpose of this study is to give a thorough understanding of the fundamentals, development, clinical applications, alterations, results, constraints, and new technologies related to PNAM in the treatment of newborns with unilateral and bilateral cleft lip and palate.

Materials and Methods: The historical evolution of presurgical infant orthopedics, the principles of passive molding and negative sculpturing, treatment timing, nasal and alveolar molding techniques, appliance modifications, complications, treatment compliance, and the integration of three-dimensional (3D) technologies into PNAM were all highlighted in the review of pertinent literature.

Results: Alveolar segment approximation, cleft gap reduction, nasal symmetry enhancement, correction of alar cartilage displacement, and nonsurgical columella elongation and alignment are all made easier by PNAM. Early treatment beginning, optimal appliance design, frequent adjustment, and multidisciplinary management are all crucial for attaining positive results, according to evidence compiled in the reviewed literature. Treatment, however, comes with a significant caregiver load, frequent follow-up appointments, difficulties with compliance, and sporadic hard-tissue and soft-tissue problems. Intraoral scanning, virtual treatment planning, CAD/CAM, 3D printing, stereophotogrammetry, and computer-assisted sequential appliance fabrication are

examples of recent developments in digital workflows that present chances to increase accuracy, decrease manual processes, and cut down on clinical visits. However, the technology may be more expensive and necessitates specialist knowledge.

Conclusion: PNAM is a crucial part of multidisciplinary cleft care, especially when it comes to easing primary surgical repair and enhancing presurgical nasoalveolar morphology. Although positive short-term morphological and esthetic results have been documented, it is challenging to draw firm conclusions on long-term benefits due to differences in techniques and gaps in the available data. Longer follow-up periods and well-designed prospective trials with standardized outcome assessments are needed in the future. By enabling customized virtual planning and more effective appliance manufacture, the integration of digital technology may further transform PNAM.

Keywords: Alveolar Molding, CAD/CAM; Cleft Lip And Palate, Digital Workflow, Nasal Molding, Presurgical Infant Orthopedics, Presurgical Nasoalveolar Molding, 3D Printing.

Introduction

Cleft lip and palate (CLP) is a congenital malformation of maxillofacial development in humans, which seriously affects a child's facial appearance and phonic function, even causing psychological problems.1 It has a worldwide prevalence of 1.5 per 1,000 live births and a reported prevalence of 1:10 per 1000 in India.CLP has a heterogenous etiology with both environmental and genetic factors playing important roles.[2]

Presurgical nasoalveolar moulding (PNAM) has emerged as a transformative approach in the realm of infant orthopaedics.13 PNAM was described as a modified approach to the conventional form of orthopaedics.8 Presurgical nasoalveolar moulding is a customized orthodontic technique used for moulding the nasoalveolar maxillary arch in infants suffering from unilateral or bilateral cleft lip and palate.[14]

The fundamental intent of PNAM therapy is to decrease the severity of the initial cleft defect by the method of serial negative sculpturing and passive molding of the alveolar fragments with an intraoral molding prosthesis and correction of soft tissue nasal deformity (nonsurgical elongation of columella) with the help of wire and acrylic nasal stent.[15]

PNAM is a nonsurgical way to reshape and align the gingiva, lip and nostrils to reduce the severity of the cleft before the conventional cleft lip and palate surgery.[7] PNAM therapy is predicated on the malleability of neonatal cartilaginous and soft tissue structures so that the molding device can guide the neonate's alveolar development.[6] However, PNAM has also been challenged for its burden of care, as the intraoral molding plate requires multiple impressions and adjustments in accordance with the infant's alveolar development.[6]

With the advent of 3D photography or stereophotogrammetry, care providers have developed robust methods of objectively measuring progressive morphological changes during PNAM therapy, thereby providing much needed evidence for its clinical utility.[6]

History

The earliest surgical treatment of cleft palate was documented in AD 317, when Chinese general Wei Yang Chi had his cleft lip amended by incising and sewing the edges of the cleft together.[12]

Presurgical infant orthopaedics encompasses any treatment of an infant's cleft deformity before the definitive primary lip surgery.[12] Since the introduction of presurgical infant orthopaedics in 1950 by McNeil, techniques and their results gave been changing.[12]

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In 1984, Matsuo et al explained a procedure to nonsurgically repair congenital auricular deformities, utilizing the plasticity of infant cartilage which is thought to be the result of elevated levels of circulating maternal estrogen in the infant's bloodstream.[12] With this concept of cartilage plasticity and the ability to permanently modify shape, the concept of NAM was created.[12]

In 1991, Dogliotti et al. described presurgical neonatal nasal remodeling with a modified intraoral plate.[2] Later, Grayson et al. popularized that method as presurgical NAM.[2]

It was in 1993 that Grayson et al explained an innovative procedure in which to nose, lip and alveolus are shaped prior to surgery in children affected by cleft lip and palate.[12] Grayson et al demonstrated that the deficient columella, misaligned alar cartilage, and deformed alveolar processes can be repositioned with the use of an intraoral molding plate and nasal stent.[6]

Presurgical NAM includes two concepts which are 'negative sculpturing' and 'passive moulding' of the nose, lips and alveolus.[12]

Grayson's PNAM technique is most commonly followed, and a number of studies have supported its application for correction of cleft lip and nose deformity.[17]

Smahel et al. (1988)

A cross-sectional study assessing facial growth. PNAM was not performed and nasal molding was not evaluated. Jaw growth was more favorable after primary periosteoplasty.[18]

Maull et al. (1999)

A retrospective study assessing long-term nasal shape. Presurgical molding was given for 4 months and increased nasal symmetry. Alveolar molding was not evaluated.[18]

Pai et al. (1988)

A prospective study assessing nostril symmetry and cleft width. PNAM was given until 4 months and improved nasal symmetry. Alveolar molding was not evaluated.[18]

Singh et al. (2005)

A prospective longitudinal study assessing 3D nasal changes. PNAM was given until 4 months and significantly increased nasal symmetry. Alveolar molding was not evaluated.[18]

Spengler et al. (2005)

A prospective study assessing PNAM in bilateral cleft lip and palate. PNAM increased bialar width and columellar dimensions. It also reduced premaxillary protrusion and cleft width.[18]

Baek et al. (2006)

A prospective study assessing alveolar molding and growth. PNAM was given for 13 weeks. Alveolar molding mainly affected the anterior segment, while growth occurred mainly posteriorly.[18]

Bongaarts et al. (2006)

A randomized controlled study assessing infant orthopedics. A passive plate was used, but no effect on maxillary arch dimensions was observed.[18]

Ezzat et al. (2007)

A prospective study assessing PNAM in nonsyndromic patients. PNAM improved nasal symmetry and decreased the intersegmental alveolar cleft width.[18]

Hsieh et al. (2010)

A retrospective study assessing gingivoperioplasty and facial growth. PNAM was followed by gingivoperioplasty, which adversely affected sagittal maxillary growth.[18]

Shetty V et al. (2012)

A longitudinal study assessing the timing of NAM. NAM was more effective when initiated before 1 month of age.[18]

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The last meta-analysis published by Hosseini in 2017 concluded that there is limited evidence to support the short- or long- term effectiveness of presurgical Nasoalveolar molding in cleft lip and palate patients.[4]

Principle of PNAM

PNAM works on the principle of **"**Negative sculpturing" and "Passive molding" of the alveolus and adjacent soft tissues. [7] In passive molding, custom made molding plate of acrylic is used gently to 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.[7]

Timing of PNAM

The onset of nasal moulding varies widely in terms of timing, while a few authors advise waiting until the majority of lateromedial correction of larger segment position has been completed, others describe beginning early or when there is reduction of 6mm or below of the alveolar cleft.[16]

Theoretically, molding nasal cartilage as soon as possible could be beneficial in order to achieve better durable molding of the plastic immature cartilage and prevent the elastic rebound that would arise from older, more mature, and less plastic cartilage.[16]

Shetty V et.al compared the effectiveness of early initiation of Nasoalveolar molding with older infants up to 1 year and concluded that better results were seen in patients who had started treatment before one month of age, than those who presented at 6 months to one year of age.[16]

Lip taping is done before NAM if the premaxilla is protrusive or in presence of neonatal tooth on cleft margin.[16]

Concept of Nasal Molding

In the treatment of cleft lip nasal deformity, the correction of nose continues to be the greatest challenge. In patients with unilateral cleft lip/ palate, the nasolabial defect influences the physical appearance of the child. Hence it is recommended to perform nasal molding prior to primary lip repair.[18]

Considering that nose is an important component of facial esthetics, correction of nasal symmetry and nasolabial fold is an important objective of nasoalveolar molding.[18]

Matsuo et al designed a nasal stent for the correction of the nasal deformity. However, a drawback of this stent was that it required an intact nostril floor.[18]

Another modification as suggested by Grayson was addition of nasal stent in the alveolar molding plate. This did not require the presence of intact nasal floor and as the stent was added to the plate, controlled force could be exerted.[18]

Studies performed by evaluating the casts after nasoalveolar molding revealed that this therapy significantly improved the nasal symmetry. Columella deviation, length and width were also significantly improved (Spengler AL et al 2006).[18]

Study conducted by Maull et al (1999) to determine changes in three-dimensional shape of the nose after nasoalveolar molding also showed improved symmetry of the nose.[18]

Concept of Alveolar Molding

The presurgical alveolar molding protocol for cleft patients has been described by Grayson et al (1993). In this protocol a conventional intra oral molding plate is fabricated after making the intra oral impressions. The molding plate is modified at weekly intervals. The appliance is selectively grinded in the areas where

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movement is expected at the same time soft denture liner is added in the region which require molding.[18]

The soft denture liner applies pressure on the alveolar ridge. The effectiveness is enhanced by lip taping. The lip taping produces controlled orthopaedic force which helps the molding plate to guide the alveolar segments in position.[18]

Study conducted by Ezzat et al has shown statistically significant reduction in the intersegmental distance i.e in the cleft gap. At the same time, it was found that the arch was not collapsed as there was an increase in maxillary arch width.[18]

Study conducted by Spengler et al on bilateral cleft lip and palate patients has shown that there is significant improvement in the nasal symmetry. It was also found that nasoalveolar molding forces the protruded premaxillary segment into alignment with dentoalveolar segments, thereby improving the shape of the arch.[18]

Three-dimensional analysis of effect of alveolar molding was done by Baek et al (2006). The results of the study suggested that the cleft gap was significantly reduced. It was also found that alveolar molding took place mainly in the anterior alveolar segment and growth occurred mainly in the posterior alveolar segment.[18]

As described by Matsuo, the earlier the intervention is initiated the better are the results.[18]

Although all studies evaluating the effect of nasoalveolar molding have shown significant improvement in the result, but the drawbacks of these studies are that they are performed on a smaller population group and they lack a control group i.e the subjects who do not undergo alveolar molding. Also, long term effects of nasolaveolar molding have not been evaluated. Hence further studies are required to conform the long-term effects of nasoalveolar molding.[18]

Appliance Design

The nasal stent armature is most commonly bent with 0.036 in (0.8-mm) stainless steel wire in a shape resembling a swan's neck. The nasal stent can be divided into the following essential parts or segments, each of which has a specific purpose:

The kidney bean-shaped nasal bulb has 2 parts:

1. a relatively larger upper lobe that lies beneath the alar dome
2. a lower lobe that lies lust beneath the nostril rim.

Incremental addition of soft denture reline material to the upper lobe and controlled activation of the upper neck portion of the nasal stent support and gently mold the collapsed alar dome, which is clinically reflected by its mild tissue blanching.

With progressive additions of soft reline to the upper lobe during the course of nasal molding, it will become larger than the lower lobe.[7]

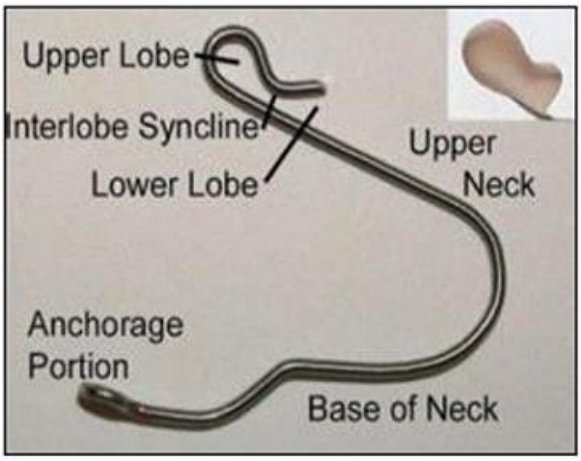


Figure 1: Parts of a Nasal Stent

Impression Technique/ Procedure

Treatment begins with the evaluation by the members of the multidisciplinary team. It is preferable to start the treatment as soon as possible to take advantage of the plasticity of the tissues.[8]

Immediate and long term goals and priorities are determined for the patient. Once the syndromic associations and systemic anomalies are ruled out, the

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patient is considered fit to undergo the presurgical treatment.[8]

Following the clinical examination, an impression of the intraoral cleft defect is made using a heavy bodied silicone elastomeric impression material in an infant acrylic impression tray.[8]

Patient positioning is an important part of the overall procedure. The infant is held upside down in the mother's lap in such a way that the infant's neck can be extended for the maximum exposure for the operator. Care should be taken to support the infant's head.[8]

Flow of the impression material should be controlled so that it does not go beyond the tray boundaries. Throughout the procedure it is made sure that the infant is actively crying. It helps to avoid the choking of infant's airway and also makes direct visualization of the cleft possible.[8]

Special care is taken to prevent the airway obstruction in the neonates when obtaining intra oral impressions. Impression is poured with the dental stone to obtain an accurate cast.[8]



Figure 2: Impression taken with condensation silicone impression material



Figure 3: Position of the infant while taking the impression

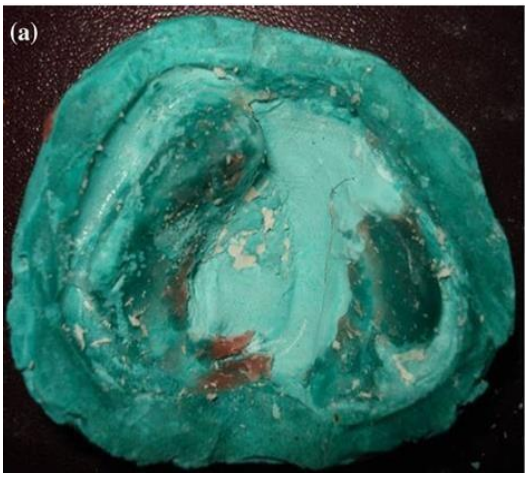


Figure 4 (a): Cast poured with dental stone

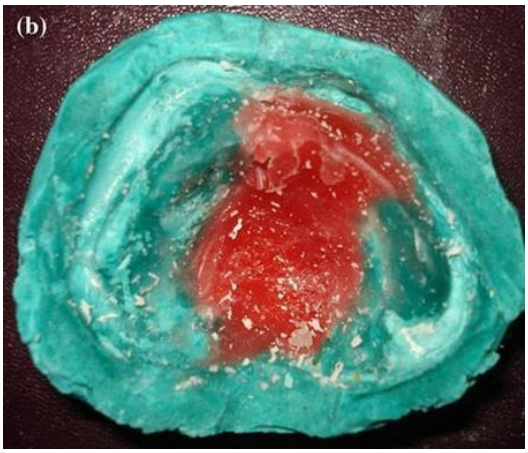


Figure 4(b): Blocked out of cleft space with modelling wax

Fabrication of the PNAM Appliance

A molding plate, made up of hard clear acrylic (RR cold cure, DPI, India), is fabricated on the dental stone model. The plate should have a thickness of 2–3 mm for the structural integrity.[8]

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Obliteration of the cleft space and the addition of wax spacer is the key modification. This modification prevents any need for weekly trimming of the occlusal appliance as described by Grayson.[8]

The molding plate is adjusted to gradually approximate the cleft alveolar segments. Alveolar molding and approximation is achieved only through the addition of soft acrylic at every follow-up visit. Thickness of soft acrylic added is 1 mm or less per visit.[8]

The activation force can vary depending on the stage of the treatment and the clinical judgement. At the same time cleft lip segments are approximated with the lip tapes to achieve a nonsurgical lip adhesion. Lip taping is also helpful in stabilizing the plate in wider clefts. Active movement of major segment is achieved by forces applied by stretched elastics and over build-up of soft liner on the labial flange of the appliance.[8]

The nasal stent extends as a projection from the labial flange of the oral molding plate. It is made up of 0.9 mm round stainless steel wire. The free end of the nasal stent extends into the nostril in such a way that it supports the deformed nasal alar cartilage adequately after the lip segments are approximated by the lip taping.[8]

Nasal molding is best begun as early as possible. Nasal stent is added to the occlusal plate at the beginning of the treatment when the cleft is 12 mm or less than that. If the cleft is wider than 12 mm, then it is preferable to reduce the alveolar cleft deformity before the nasal stent is added.[8]

Once the alveolar segments are approximated and the nose is molded as desired, there is no further activation of the appliance. The appliance is passively kept in place for 2–3 weeks for stabilization of the results achieved as the nasal correction is especially prone for relapse.[8]

The goals are, initially, to reduce the severity of alveolar cleft and to reposition the apex of the alar cartilages toward the tip of the nose and, later, to maintain the achieved morphologic changes.[8]

The appliance is worn continuously except for cleansing after feeding. The retention tapes and lip tapes are changed as soon as they become loose.[8]

Parents should be motivated & educated properly.

They should be instructed to keep the plate in full time, and to take it out for cleaning as needed, at least once a day.

They are asked to examine the child's mouth daily for any ulceration.[7]

The primary lip repair can usually be performed at approximately 4–6 months of the age. A primary nasal correction is an important part of the overall treatment to achieve ideal results with the nasoalveolar molding.[8]

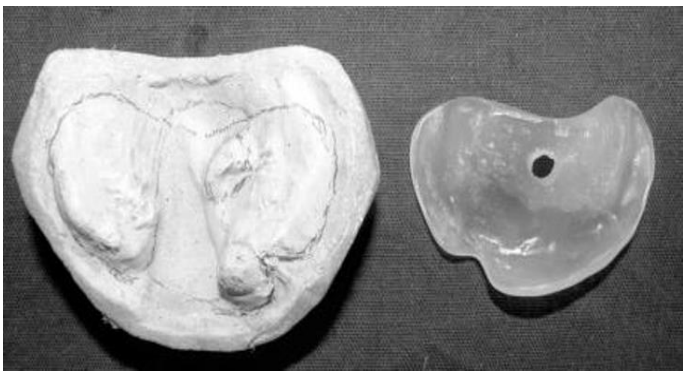
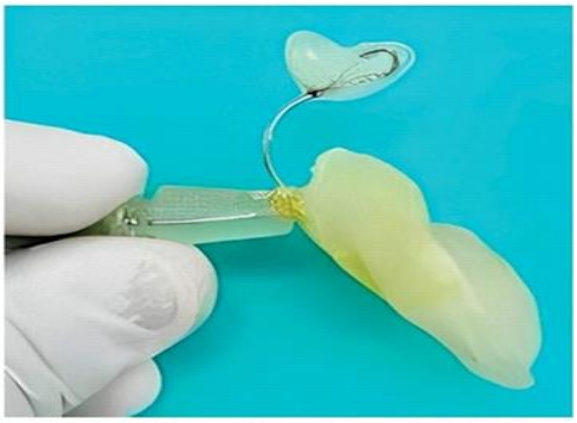


Figure 5: Occlusal plate is fabricated over the dental model, polished and properly relieved in the labial frenum region



Molding plate with retentive arm at 40° downward angulation

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Integration of the nasal stent for nasal molding

Figure 6:

Surgical Nasoalveolar Molding for Bilateral Cleft Lip Nose

Nonsurgical columella lengthening in cases of bilateral cleft lip & palate: Two retention arms along with two nasal stents are required for bilateral cleft cases which are comparable in form to the unilateral stent.[12]

Nonsurgical lengthening of the columella can be performed after the addition of the nasal stents in the bilateral cleft. This is done by adding a horizontal band of the denture material joining the both lower lobes of the nasal stent, extending over the columellar base.[12]

In Figueroa's technique, alveolar and nasal molding are achieved concurrently using an acrylic plate with rigid acrylic nasal extension. The premaxilla is retracted backward using rubber bands connected to the acrylic plate.[12]

The results showed that Grayson and Figueroa NAM similarly improve nasal defects and decrease the gap between the cleft segments; however, the Figueroa technique is associated with less oral mucosal complication and more efficiency.[12]

Spengler et al conducted a study in which measurements were made of the cleft size, columellar height and width, alar width before and after NAM. There was found to be significant improvement in the measurements improving the asymmetric nasal complex, maxillary arch and lip.[12]

The primary surgical repair should be performed after the objectives of NAM have been met. The extent of the initial cleft deformity determines the time required for moulding therapy.

Once the alveolar segments are aligned the surgeon can implement gingivoperioplasty.

As an inconvenient side effect to NAM therapy there can be soreness to the oral mucosal lining, gingiva or nasal mucosal lining. The disproportionate load exerted by the appliance may result in the ulceration of the intraoral tissues.[12]

The nasal stent can apply too much pressure resulting in ulceration of the intranasal lining. The area under the horizontal prolabium band is also prone to ulceration if the band is too tight.[12]

Dr. Rossell-Perry's (in 2020) proposed method has been named as the “Surgical Naso Alveolar Molding” because the surgical technique acts in a similar form as the presurgical NAM: the vestibule of the nose is expanded, and the premaxila and alveolar cleft segments are aligned.[4]

The V-Y-Z method allows the repositioning of the alar cartilage and lengthening of the columella on both sides. Lateral Z plasty prevents scar contracture of the vestibular incisions.[4]



Figure 7: The V-Y-Z technique for complete bilateral cleft lip nose repair.

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Figure 8: The V-Y-Z closure using transcutaneous stitches with bilateral medial V-Y plasty plus lateral Z plasty components

Statistically significant differences have been observed between the pre and post-operative alveolar and palatal gaps after using primary cheiloplasty or bilateral lip adhesion.[4]

Traditional Presurgical Nasoalveolar Molding Therapy

NAM's overarching objective is to reduce the severity of the cleft deformity prior to surgical repair. Grayson et al demonstrated that the deficient columella, misaligned alar cartilage, and deformed alveolar processes can be repositioned with the use of an intraoral molding plate and nasal stent.[6]

The molding plate's position and acrylic composition is modified at various intervals in order to guide the neonate's alveolar development.[6]

Adhesive tape is further employed to bring the lip segments closer together, gradually reducing the size of the cleft deformity, improving the symmetry between the nasal apertures, and bringing the columella to the midsagittal plane.[6]

According to Grayson et al, the nasal stent is added to the molding plate once the cleft deformity has been effectively reduced to 6 mm. One nasal stent is used for unilateral cleft lip with or without palate cases and 2 stents are used for bilateral cleft cases.

The nasal stent is then modified at weekly intervals to shape the nasal cartilages and improve nasolabial symmetry until the structures begin to normalize. Force is applied to the nasal stent when the infant breastfeeds. Thus, this method differs from prior presurgical orthopedic therapies such as the Hotz plate because of the NAM's use of medially directed pressure to actively mold the alveolar arch and nasal cartilages into a preferred alignment.

NAM therapy, primary lip-nose repair is performed in order to provide the patient with positive anatomic, aesthetic, and functional outcomes. Thus, NAM has been credited with reducing the number of secondary surgical corrections associated with traditional cleft care management.[6]

Despite the clinical benefits of NAM therapy, several studies have noted mild complications that are associated with this treatment modality.



Figure 9: Typical Nasoalveolar Molding Appliance (Shetty, Thakral, and Sreekumar. Nasoalveolar Molding at 1 Year of Age. (J Oral Maxillofac Surg 2015)

Levy-Bercowski et al state that soft tissue complications additionally include fungal infections and bleeding. While hard tissue complications appear in reference to the asymmetrical configuration of the alveolar arches.

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They also stated that 39% of subjects reported lack of compliance.

One way to modify this method is to replace the traditional stainless-steel wire used in Grayson's method with a titanium molybdenum alloy (TMA) nasal stent with a single loop design.[16]

Modifications

Many modifications of Grayson's NAM technique have been introduced inorder to improve its efficacy, reduce the occurrence of hard and soft tissue complications, and reduce the number of secondary visits.[6]

Certain techniques, like Bennun and Figueroa's modified dynamic presurgical nasal remodeling (DPNR), can be used for both bilateral and unilateral cases. In comparison to the Grayson technique, which initiates nasal molding when the alveolar gap is reduced to 6 mm, the Figueroa technique initiates nasal and alveolar molding at the same time.[6]

In 2015, Nagraj et al described a double-loop technique using titanium molybdenum alloy wire nasal stents designed to simplify the modification process of the NAM appliance.[6]

Bajaj et al describes the use of a 2- to 3-mm-thick occlusal molding plate for fabrication of the NAM appliance. The plate is designed with the addition of wax spacer to the cleft space of the molding plate, eliminating the need for weekly trimming of the appliance.[6]

In 2023, Serap Titiz Yurdakal et al., described the use of PNAM with modified nostril retainers. Here, the Grayson technique was employed with an intraoral plate to approximate cleft segments. Nasal molding was initiated before reducing the cleft width to 5 mm.[3]

NAM Treatment Modifications for Bilateral Cleft Lip and/or Palate

Bilateral cleft cases are more challenging to treat with NAM therapy because of the absence of soft tissue, mal position of the premaxilla, and severity of the cleft defect.

Ijaz et al were able to utilize a modified plate with an acrylic ring to retract the premaxilla by 3.80 + 1.3 mm and elongate the columella by 2.24 mm.

Modified PNAM (MPNAM) with a small premaxillary appliance connected with two elastic chains for the restoration and centralization of a severely protruding/deviated premaxilla in patients with complete BCLP was developed by Jiansuo Hao et al.,2022.[1]

The alveolar segments and nasal molding were molded simultaneously, and the nasal bulb was placed inside the cleft nostril.[1]

The average MPNAM treatment duration was 59.8 days. In all cases, the protrusive and deviated premaxilla was rapidly retracted and set into a suitable position after MPNAM treatment.[1]

Another method for Nasoalveolar molding was presented by Figueroa and Polley in 2006. This method involves the use of an intraoral plate composed of light-cured acrylic resin.[16]

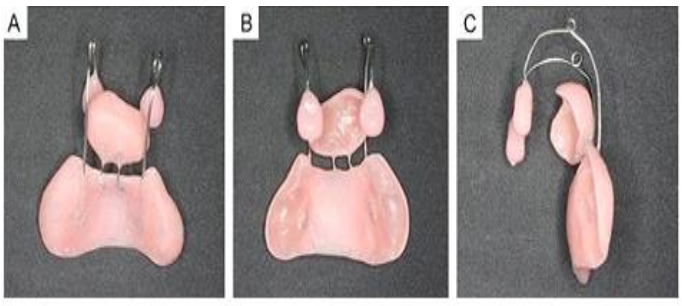


Figure 10: Photograph of modified PNAM device with the nasal segment at tached to the molding plate. A. Frontal view. B. Dorsal view. C. Lateral view

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In the era of digital orthodontics, in 2011, Yu et.al presented the concept of "computer-aided design/Nasoalveolar moulding" (CAD/ NAM) for the digital activation of NAM equipment. This method saves time and labor by using software to create a sequence of 3D printed models that mimic the activation processes.[16]

The 3D printed models facilitate the production of a range of NAM appliances.[16]

3D Technologies to PNAM Therapy

The advent of 3D technologies has spurred notable advances in NAM therapy. 3D photography, also known as stereophotogrammetry, has been utilized to quantitatively measure the progressive morphological changes that occur over the course of treatment. The adaptation of computer-aided design and computer-aided manufacturing (CAD/CAM) to NAM appliance fabrication has resulted in a production modality that is low-cost, efficient, and easier to use than other production techniques.[6]

Rapid prototyping (RP) and additive manufacturing have great potential for increasing technical refinement, precision, ease of use, and accessibility of medical devices compared to traditional manufacturing modalities.[6]

With regard to NAM therapy, various studies have documented the application of rapid prototyping and CAD/CAM additive manufacturing in efficiently producing versatile and structurally sound NAM appliances.[6]

CAD software is used to construct a 3D model from the data contained in the DICOM files. The dataset is exported to Stereolithography (STL) format and can then be segmented. Finally, a 3D virtual model can be printed after it has been refined in a process called “geometric surface preparation.”[6]

In the past several years, evidence has shown that 3D-printed NAM appliances can potentially minimize appointment length, improve precision, and reduce costs associated with 3D fabrication modalities. It has also been shown that the use of CAD-generated NAM appliances can achieve similar clinical outcomes and similar risk of hard and soft tissue complications compared to traditional NAM devices.[6]

The authors state that the rapid prototyping technique could significantly simplify the NAM appliance fabrication workflow by allowing the care provider to manufacture an entire set of NAM appliances for 1 patient at once with quantitative precision. This technique can effectively reduce the number of follow-on visits required for treatment.[6]

In a 2013 randomized control trial, Yu et al demonstrated that CAD-NAM therapy was effective in reducing the alveolar gap and correcting the maxilla’s sagittal length.[6]

The molding course would project changes to the alveolar segments in order to mini mize the alveolar gap by 1 mm at weekly intervals. Each corresponding maxillary cast would then be fabricated using 3D printing. In the study, the alveolar gap decreased significantly ($P < 0.01$) and the alveolar arch became more symmetrical ($P < 0.01$).[6]

More recent studies have investigated the integration of graphical user interfaces with CAD-CAM technology to automate the design of several intraoral molding plates from a single impression taking.[6]

In 2018, Grill et al applied the “RapidNAM” system to generate a virtual series of molding plates at once using a single impression. Compared to the manual CAD/CAM method, which takes upto 1.5hours per plate, the Rapid NAM system reported by Grill et al created each plate in 10 to 15 minutes.[6]

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In a comparison between 3D NAM and standard NAM, Ritschl et.al found that both approaches were equally effective.[16]

El-Ashmawi NA et.al compared the effectiveness of Nasoalveolar Molding (NAM) Using Grayson Method Versus Computer-Aided Design NAM (CAD/NAM) in Infants with Bilateral Cleft Lip and Palate and concluded that both the interventions were effective but the CAD/NAM required less chair side time compared to the NAM treatment.[16]

In addition to rapid prototyping technology, computer aided design (CAD) enables highly precise 3D measurements of nasal and alveolar development over the course of NAM treatment.[6]

Similarly, in 2007, Singh et al utilized digital stereophotogrammetry to collect 3D facial images of patients with unilateral cleft lip and/or palate. In their study, they were able to find that the 3D facial morphology of the cleft patients after NAM therapy was "virtually indistinguishable" from patients in the control group.[6]



Figure 11: 3D printed maxillary cast.



Figure 12: Sequential maxillary casts and NAMs demonstrating projected movements.

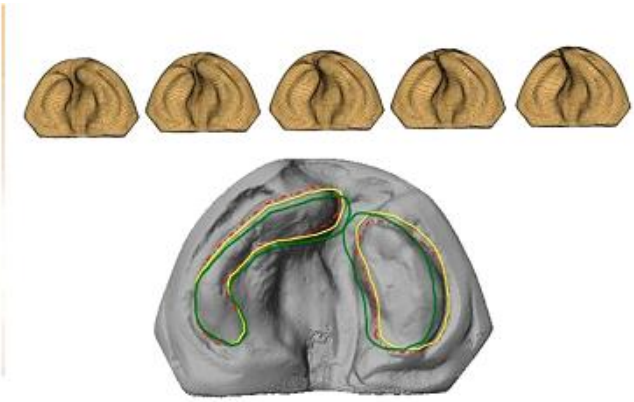


Figure 13: Computer-aided design of sequential maxillary casts.



Figure 14: 3D rendering of nasal stent with extraoral attachment

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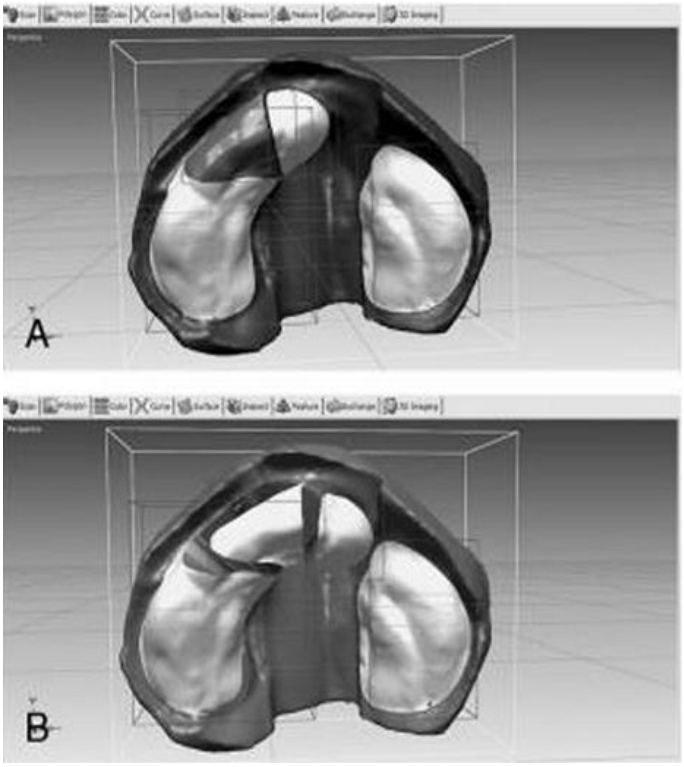


Figure 15: A- Digital Three-Dimensional Model of the Upper Alveolar was Constructed in Reverse Engineering Software. B-The Model was Split into Several Regions, which were Regarded as the Movement Alveolar Segments in NAM Treatment (Yu Q 2011)

Complications

Complications associated with NAM therapy may increase treatment time and could compromise the final aesthetic treatment outcome. Based on clinical experience, practice, and an intense review of the current literature, three main categories of complications associated with NAM therapy have been described: soft tissue, hard tissue, and compliance related.[7]

There are few serious complications associated with NAM. The most common is irritation of the oral mucosal or gingival tissue. Intraoral tissues may ulcerate from pressure or rubbing. Common areas of breakdown are the frenum attachments, the anterior premaxilla, and the posterior fauces as the molding plate is retracted.[5]

Intraoral soft tissue complications involve mucosal ulceration, bleeding, tissue fungal infections, and tissue irritation. Ulcerations may be caused by uneven flanges or under relieved areas on the intaglio surface of the molding plate.[7]

If the molding plate is not removed daily and cleaned regularly, a candidal infection may result.[7]

Fungal infestation is treated with Nystatin or Amphotericin ointment.[7]

Parents/caregivers must remove the appliance once or twice a day for proper hygiene.[7]

Care must be taken by the clinician to properly modify and monitor segment movements in order to avoid this problem.[7]

An additional complication of the hard tissues involves the premature eruption of primary maxillary incisors through overlying gingival tissue as a result of the pressure exerted by the molding plate.[7]

As with any orthodontic treatment, broken appointments often result in prolonged treatment or compromised final outcomes and may result in additional surgeries (Yang et al., 2003; Pai et al., 2005).[7]

Parents have the primary responsibility for maintaining proper positioning and activation of the appliance and for ensuring that it is adequately cleaned. In addition to caregiver/parent compliance, patient behaviour is critical to the success of NAM.[7]

There is a risk that the molding plate will become dislodged and obstruct the airway.[5]

There is only one reported instance in which this happened, causing a temporary airway obstruction. We place a 5-mm-diameter hole in the center of the molding plate at fabrication to provide for passage of air in the event that the molding plate drops down from the rear and causes obstruction.[5]

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Figure 16: Contact dermatitis

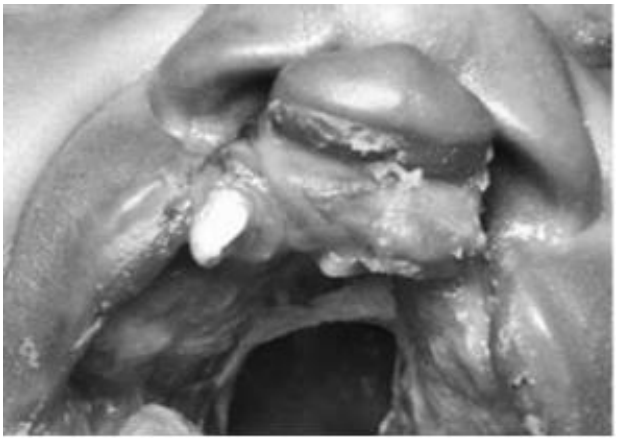


Figure 17: Premature eruption of primary maxillary incisors due to the pressure exerted by the molding plate in a patient with bilateral cleft lip and palate

Conclusion

NAM represents a promising approach in the management of UCLP. Early intervention, meticulous planning, and a multidisciplinary team approach contribute to successful outcomes.[13]

As research continues to evolve, NAM holds the potential to enhance the quality of life for individuals with UCLP by minimizing the impact of the initial cleft deformity and optimizing surgical outcomes.[13]

NAM therapy remained beneficial and had significant aesthetic results in reducing the cleft defect size. Because of this, it gained a big surgical advantage in reducing tissue tension, primary stability, and scar formation.[15]

The active NAM device is a safe, predictable, and effective technique for decreasing the lip and nostril gaps as well as repositioning the protruded premaxilla and elevating the depressed columella.[14]

Success of the NAM treatment depends upon the parent cooperation, age of the infant, proper diagnosis, extent of the cleft, operator expertise and appropriate interdisciplinary treatment approach.[7]

Presurgical nasoalveolar moulding not only improves the esthetics but also the number of surgical corrections required for the cleft lip and palate deformity. Individuals of the cleft team should provide parents and caregivers not only the technical training but also emotional and moral support and motivation during the NAM treatment.[12]

References

1. Hao J, Wan Q, Liu J, Wu W, Liu J, Luo C, Gao Z, Li F, Chen Y, Lu Z. Modified presurgical nasoalveolar molding for patients with neonatal complete bilateral cleft lip and palate having a severely malpositioned premaxilla. Am J Transl Res. 2022;14(6):3988–3994.
2. Kalaskar R, Bhaje P, Sharma P, Balasubramanian S, Ninawe N, Ijalkar R. Comparative evaluation of nasal and alveolar changes in complete unilateral cleft lip and palate patients using intraoral and extraoral nasoalveolar molding techniques: randomized controlled trial. J Korean Assoc Oral Maxillofac Surg. 2021;47:257–268.
3. Titiz S, Oral E, Gelgör İE. Outcomes of presurgical nasoalveolar molding using modified nostril retainers in patients with unilateral cleft lip and palate at an average follow-up of 2 years. Turk J Orthod. 2023;36(4):254–260.
4. Rossell-Perry P, Olivencia-Flores C, Delgado-Jimenez MP, Ormeño- Aquino R. Surgical nasoalveolar molding: a rational treatment for

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bilateral cleft lip nose and systematic review. Plast Reconstr Surg Glob Open. 2020;8:e3082.

5. Grayson BH, Maull D. Nasoalveolar molding for infants born with clefts of the lip, alveolus, and palate. Semin Plast Surg. 2005;19(4):294–301
6. Ahsanuddin S, Ahmed M, Slowikowski L, Heitzler J. Recent advances in nasoalveolar molding therapy using 3D technology. Craniomaxillofac Trauma Reconstr. 2022;15(4):387–396.
7. Mahajan N, Puri A, Singla A, Kumar D, Sharma S, Sureka S, Vaidyan MK. Nasoalveolar molding: A review. Int J Appl Dent Sci. 2022;8(2):451–454.
8. Bajaj A, Rao KS, Sharma SM, Shetty V. Modified presurgical nasoalveolar molding in the infants with complete unilateral cleft lip and palate: a stepwise approach. J Maxillofac Oral Surg. 2011;10(3):275–280.
9. Al-Lami HA, Al-Rudainy D, Mohammed-Salih HS, Salman SM. Presurgical management trends and nasoalveolar molding usage for infants with cleft lip and palate in the capital of a developing country. J Orthod Sci. 2024;13:4.
10. Abdarrazik MA. The nasoalveolar molding technique versus DynaCleft nasal elevator application in infants with unilateral cleft lip and palate. Arch Craniofac Surg. 2024;25(3):123–132.
11. Punga R, Sharma SM. Presurgical orthopaedic nasoalveolar molding in cleft lip and palate infants: a comparative evaluation of cases done with and without nasal stents. J Maxillofac Oral Surg. 2013;12(3):273–288.
12. Sivadas S, Rao A, Suprabha BS. Presurgical nasoalveolar moulding. Int J Adv Res. 2016;4(4):401–405.
13. Yadav L, Mattu N, Mehra P, Jain P. A comprehensive approach to unilateral cleft lip and palate management through presurgical nasoalveolar molding and surgical repair in a neonate. Contemp Clin Dent. 2024;15:213–216.
14. Mossaad AM, Abdelrahman MA, Waly SA, et al. Using an active screwed nasoalveolar molding device for defect rehabilitation in patients with bilateral cleft lip and palate. Cureus. 2024;16(8):e68204.
15. Taori KP, Niranjane P, Kamble R. Presurgical nasoalveolar molding and columella lengthening for early unilateral cleft lip and palate rehabilitation: a comprehensive clinical case report. Int J Clin Pediatr Dent. 2024;17(8):955–961
16. Karthika ES, Thimmaiah M, Madhusudhan V, Shailaja, Kumar DC, Handique S. A comprehensive review of nasoalveolar molding: from origins to future advances. Int J Innov Sci Res Technol. 2024;9(7).
17. Singh A, Thakur S, Singhal P, Diwana VK, Rani A. A comparative evaluation of efficacy and efficiency of Grayson's presurgical nasoalveolar molding technique in patients with complete unilateral cleft lip and palate with those treated with Figueroa's modified technique. Contemp Clin Dent. 2018;9(Suppl 1):S28–S33.
18. Murthy PS, Deshmukh S, Bhagyalakshmi A, Srilatha KT. Pre surgical nasoalveolar molding: Changing paradigms in early cleft lip and palate rehabilitation. J Int Oral Health. 2013;5(2):70–80.

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