Review Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2019;9:2s:80-87.

# Presurgical Nasoalveolar Molding (PNAM): A Review Article

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## ABSTRACT

**Background**: Cleft lip and palate (CLP) are the most common types of birth defects. Two- thirds of all cases involve the lip either with or without involvement of the palate; and one- third of all these cases occur as an isolated deformity of the palate. The NAM technique significantly shown to improve the surgical outcome of cleft patients compared with other techniques of pre-surgical orthopedics. NAM is an effective adjunctive therapy for reducing hard and soft tissue cleft deformity before surgery. The malleability of the para-oral structures in the early age is utilized for selectively controlling growth patterns with the use of NAM techniques. Such molding of the nasal cartilage, premaxilla and alveolar ridges in the early age serves as an adjunct to the surgical procedures and results in better esthetics and reliable long-term results.

**Keywords:** Orthodontics, nasoalveolar molding, PNAM.

## INTRODUCTION

A thorough knowledge in the present times for the changing concepts regarding NAM and timing of the initiation of the same is essential for early and successful rehabilitation of the cleft.[5] Males predominate within the CLP group (60-80%); whereas, females constitute the majority with the cleft palate (CP) group. CLP deformity is strongly associated with bilateral cleft lips in 86% of cases. [1] The left side is most commonly involved in unilateral CL cases. Interracial differences exist in the incidence of CLP versus CP. A higher incidence of the CLP is found in North American populations that are descents of Asian, such as Indians of the south-western United States and the west coast of Canada.[1]

The management of cleft patients is approached as a multidisciplinary team. It has evolved in recent years because of advanced surgical techniques, timing, and integration of methods like pre-surgical orthopedics. The basic treatment objective is to restore normal anatomy. In past decade, it has been known that improvement of nasal abnormality by elongating of the nasal mucosal lining, and attainment of nonsurgical columella lengthening can be united with shaping of the alveolar process in cleft patients.[2,3]

CLP along with nasal deformity is one of the common anomalies occurring during the embryonic development of face. By the end of the 4th week in gestational period of human embryo, bilateral swellings and nasal placodes develop on the lower part of the frontonasal prominence.[1]

The medial and lateral nasal prominences develop as peripheral thickenings of the mesenchymal tissue of the nasal placodes, producing two central depressions, and nasal pits. Failure of the nose to develop completely is associated with failure of the nasal placodes to develop. Between the 4th and 8th weeks, the paired medial nasal prominences fuse with each other, with the paired lateral nasal prominences, and with the cells in the maxillary prominences. Successful fusion of the medial nasal and maxillary prominences is essential for continuity of the upper lip and primary palate. Failure of fusion of one or both medial nasal and

**Received:** Dec. 3, 2018**: Accepted**: Jan. 25, 2019
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pISSN 2278-0076
eISSN 2321-9270

maxillary prominences results in unilateral or bilateral CL.[1]

CP results from the failure of fusion of these paired lateral palatine processes as a result of a defect in any of the three major stages of palatal formation — palatal shelf outgrowth, elevation, or fusion. Unilateral complete clefts are characterized when there is disruption of the lip, nostril sill, and alveolus (complete primary palate).[1]

PNAM is a non-surgical method that is used for reshaping the gums, lips and nostrils prior to CLP surgery and thus reducing the severity of the cleft. Before the introduction of the newer concept of PNAM, repair of a huge cleft involved several surgeries between birth and 18 years of age. With PNAM multiple surgical procedure is bypassed, and better results are obtained, with only one or two surgeries.[4]

## HISTORY

In 317 AD, Chinese general Wei Yang-Chi corrected his CL by cutting and stitching the edges. Many methods over the centuries have been accepted to recover the location of the cleft alveolar segments [Table 1].[5,6]

| Table I : History details | |
|---|---|
| 1556 | Pierre Franco gave the first detailed description of the indications, surgical technique, and post-operative care of the CL. |
| 1575 | Amboise Pare proposed a technique that bears his name involving lip repair with cleft lip pins. |
| 1689 | Hoffmann demonstrated the use of facial binding to narrow the cleft and prevent postsurgical dehiscence. |
| 1790 | Desault used similar technique to retract the maxilla before surgical repair in patients with bilateral cleft repair. |
| 1844 | Hullihen gave the importance of pre-surgical preparation of clefts using an adhesive tape binding. |
| 1927 | Brophy demonstrated that the passing of a silver wire through both the ends of the cleft alveolus, and then progressively tightened the wire to approximate the ends of the alveolus before lip repair. |
| 1946 | Pritchard seen that the rate of bone healing was inversely proportional to the size of the gap. |
| 1950 | McNeil used a plates series to actively mold the alveolar segments into the desired position. |
| 1952 | Tennison proposed a technique that preservs the accurate position of Cupid's bow. |
| 1958 | Burston, further developed McNeil's technique and made it popular. |
| 1960 | Millard's technique of rotation advancement closure brought the Cupid's bow and the philtrum into a symmetrical position. |
| 1975 | Georgiade and Latham introduced an active appliance with pin retained to simultaneously retract the premaxilla and expand the posterior segments. |
| 1987 | Hotz suggested the use of a passive orthopedic plate to slowly align the cleft segments. |
| 1993 | Grayson et al. described a new technique to pre-surgically mold the alveolus, lip and nose in infants born with CLP. |

## PRINCIPLE

NAM is the nonsurgical, passive method which brings the gum and lip together by redirecting the forces of natural growth. It is non-painful and ease of use and it allows for correction of the flattened nose prior to surgery and thus facilitates repair of nose at the time of lip repair. It works on the principle of 'negative sculpturing' and 'passive molding' of the alveolus and their adjacent soft tissues. In passive molding, a custom-made acrylic molding plate is used to gently direct the growth of the alveolus to get the desired result afterwards. While in negative sculpturing step wise modifications of the are internal surfaces of the molding appliance are made with addition or deletion of material in certain areas to get desired shape of the alveolus and nose.[4,7]

### Objectives of NAM technique

1. Reduction of cleft size by guiding growth and functional rehabilitation.
2. Restore physiologic continuity of the dental arch to maintain dental and oral health.
3. To gain an optimal alignment of the cleft segments within the first few months of infancy prior to cheiloplasty.
4. To allow a surgical repair with minimal tension.
5. To reduce the protrusive position of the alveolar processes.
6. To prevent tongue from seating into cleft palatal region thus facilitating transverse growth of palatal shelves.
7. To actively mold and reposition the deformed nasal cartilages.
8. To lengthen the columella.
9. To straighten the columella and correction of alar cartilage displacement.
10. To reduce the need for secondary alveolar bone grafting.

## PROCEDURE FOR NAM THERAPY

The treatment outcome of pre-surgical NAM therapy depends on proper selection of case, appropriate design of appliance and proper motivation of the caretakers. Once the above criteria are met, then the commonly followed steps in NAM are:[1]

- Impression technique
- Fabrication of appliance
- Insertion of appliance
- Adjustment of appliance
- Incorporation of nasal stent
- Final impression

**Impression technique**

The initial impression is made with a heavy-bodied silicone impression material(fig.1). It should be taken as soon as possible after birth as the cartilage is plastic and is moldable. The presence of the surgeon is utmost important during the procedure to help an airway emergency. **Grayson and Shetye**[6,8] held the infant upside down while taking the impression and then the impression tray is inserted into the oral cavity. The infant is held in an inverted position to prevent the tongue from falling back so the fluids are allowed to drain out of the oral cavity and the tray is seated till the impression material adequately covers the full anatomy of the upper gum pads. He used a heavy body silicone impression material because of its good tear strength. **Prasanth et al**.[9], and **Retnakumari et al.**[1] also used heavy body silicone impression material for impression, and the infant was kept in supine position during the procedure.

**Dubey et al**.[4], kept the baby in mother's lap with head facing downward and mother hands supporting baby's chest and lap region while making the impression. **Yang et al.**[5] took alginate impressions using a pre-trimmed customized pediatric tray. Utility wax was employed to avoid any kind of sharp edges on the tray and to better adapt to the newborn's mouth. The impression was taken with the baby in the most upright position, being held by one of the parents. Alginate impression when used in thin sections has the disadvantage of breaking away from the impression tray when the tray is removed from the mouth. Such broken pieces may remain in deeper section of the cleft and possibly even enter the nasal cavity making their removal difficult.

**Karimi et al**[10] used red impression compound to take the preliminary impression. **Splengler et al**.[11] took intraoral and extraoral alginate impression with the patient under general anesthesia. This method is generally not recommended as the patient is hospitalized for an impression procedure.

Fig 1: Heavy body silicone impression.

**Fabrication of NAM appliance**

The NAM plate as discussed by **Grayson and Shetye**[6] is made up of hard, clear self-cure acrylic and trimming is done with a denture soft material. A retention button is fabricated and positioned anteriorly at an angle of 40 degrees to the plate. The vertical position of the retention arm should be kept at the junction of the upper and lower lip. The retention button should 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 condition that the plate drops down posteriorly and this is the most commonly used NAM appliance. Various materials have been substituted for fabrication of the NAM appliance by various researchers. They are light-cure polymerizing material (**Yang et al.)**[5]**,** heat-cure polymerizing material (**Ma et al.**[12] and **Karimi et al**.[10]) and thermoplastic base plate wax (**Upadhyay et al**)[13].

**Insertion of appliance**

The PNAM appliance is secured extraorally to the cheeks and bilaterally by surgical tapes with the help of orthodontic elastic bands at one end(fig.2). The elastic which are on the surgical tape is looped on retention arm of the molding plate and then secured onto the cheeks(fig.3 and 5). The elastics (inner diameter 0.25 inch, wall thickness heavy) made to be stretched approximately by two times of their diameter for their proper activation to produce a force of about 100 g. Depending on clinical objective and the mucosal tolerance to ulceration the amount of force could vary. To secure the horizontal tape to the cheeks additional tapes may be necessary.[6,12]Some authors advice that the application of liquid adhesive on cheeks will help to secure the Steri tapes for better retention of the appliance.[5] Denture adhesive and tape-elastic system has been used by **Shetty et al**.[14] for the very same purpose.

Fig 2: Tape with elastics at one end **.**

Fig 3: Attachment of tape on retention stop.

**Adjustment of appliance**

The new born baby is seen every week to make adjustments to the molding plate for bringing the alveolar segments together. These adjustments are made by selectively removing the hard acrylic and adding the soft denture base material to the molding plate(fig.4). Modification of not more than 1 mm of molding plate should be made at one visit.[1,4]

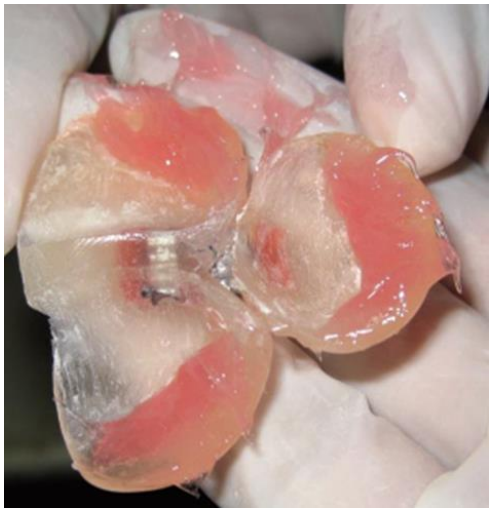

Fig 4: Adjustment of appliance by selective relining and grinding.

Fig 5: Insertion of appliance.

**Incorporation of nasal stent**

The incorporation of nasal stent is recommended when the alveolar gap width is decreased to 5mm and is made up of 0.036 gauge round wire and resembles kidney shape and added to the vestibular shield of the appliance. The tip of stent is pointed in the direction of the medial wall of the defective

nostril. Wire is allowed to extend into the nostril, and then it is curved back to create a small loop which helps in retaining the intranasal portion(fig.6). The upper lobe when enters the nose should lightly elevates the dome until a reasonable amount of tissue blanching is apparent. The lower lobe elevates the nostril apex and delineates the top of the columella. The alar rim, stretched at birth will demonstrate a little laxity, and with the nasal stent, this is elevated into a proportioned and convex form. Major surgical closure of the lip and nose are performed between 3 and 5 months of age. As the alveolar segments are in approximation, a gingivo-periosteoplasty (GPP)is simple to perform, which avoids widespread dissection and not affecting growth of the mid-face.[6,8,15,16]

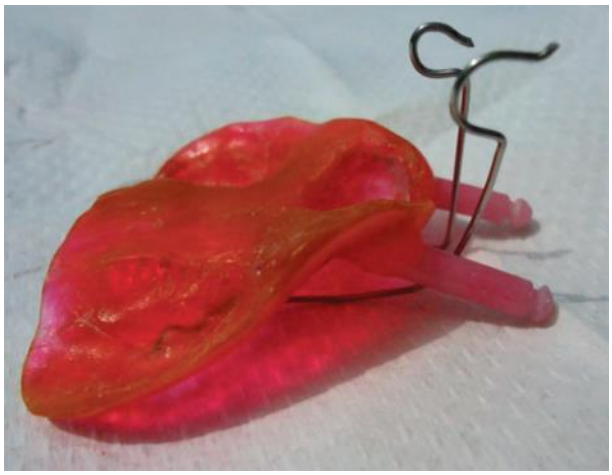

Fig 6: NAM appliance with two retention stops and two nasal stents for bilateral cleft lip and palate cases.

**ACTIVE AND PASSIVE APPLIANCES**

Appliances are classified into active or passive or semi-passive depending on the requirement of the force. Active appliances are ones which are fixed intra-orally and apply traction theirby mechanical means such as elastic chains, screws, and plates. Passive appliances are ones which maintain a minimum distance of 2 mm between maxillary segment while external force is applied primarily to reposition the segments posteriorly. External taping of the lip, head cap with elastic straps across the prolabium, or a surgical lip adhesion applies external forces. Use of controlled forces by active maxillary appliances to move the alveolar cleft segments in a predetermined manner, but passive appliances act only as a hinge on which the forces produced by surgical lip closure, shape and mold the alveolar segments in an expected manner.[17,18,19]

Neligan and Buck described two dentofacial orthopedics namely passive and active. In this, passive strategies that include presurgical NAM and active strategies that include latham appliance which is an custom- made intraoral active appliance on the infant's plaster cast of the palate.[20]

**MODIFICATIONS**

Modified muscle-activated maxillary orthopaedic appliance used by Suri and Tompson[17] for NAM therapy; dynamic presurgical nasal remodeling intraoral appliance designed by Bennun and Figueroa[21]; extra-oral nasal molding appliance by Doruk and Kiliç[22]and self-retentive appliance with orthodontic wire used by Singh et al.[23] and Ijaz[24] in presurgical infant orthopaedics; Retnakumari et al.[25] discussed alveolar molding appliance with incorporation of expansion screw.

**COMPLICATIONS**

The complications associated with NAM therapy are as follows;[26,27,32]

- Irritation to the oral mucosa.
- If more force is applied by the upper lobe of the nasal stent, it may lead to inflammation of intranasal lining of the nasal tip.
- If the lower lobe is not positioned correctly notching and expansion can occur along the alar rim.
- If the band is too tight, the region under the horizontal prolabium band may become ulcerated.
- If parent's compliance is poor then there is loss of valuable treatment time.
- The risk of dislodgement of the molding plate may obstruct the airway.
- Possibility that the posterior limit of the NAM plate may drop down onto the tongue if the arms are taped too horizontally or with inadequate activation.
- Pressure from molding plate may cause premature emergence of the labial surface of maxillary deciduous central incisors.
- Exposure of primary tooth bud may occur due to the pressure applied during active molding.

**BENEFITS**

The benefit of NAM therapy is that it enables the surgeon to attain a better outcome with a lesser scar tissue formation. It decreases the cleft side alar curvatures and meanwhile increases the length of columella and makes the prolabium more visible. Studies show that the nasal shape is stable with better lip and nasal form.[28] NAM decreases the number of surgical revisions for correction of oronasal fistulas, excessive scar tissue, and nasal, labial deformities. Adult teeth erupt in a good position with sufficient periodontal support.[29] Studies show that patients who were treated with NAM and GPP did not necessitate secondary bone grafting.[30] NAM has proven to be cost effective for families due to the fewer number of surgeries[31] and is a chance for the parents to take part keenly in the habilitation of their child.[29]

## CONCLUSION

NAM technique has been significantly shown to improve the surgical outcome of CLP patients compared with other techniques of presurgical orthopedics. It has proved to be a simple yet effective adjunctive therapy for reducing hard and soft tissue cleft deformity before surgery. However, it is crucial that members of the cleft team provide the parents and caregivers adequate training, education, active support, and encouragement during NAM treatment. Lack of parent or caregivers' compliance and commitment results in less than ideal clinical outcomes. It is reported in the literature that the pre-surgical molding used to reduce the cleft deformity does not inhibit mid-face growth. Despite the relative paucity of high-level evidence, NAM appears to be a promising technique that deserves further study.

## CONFLICT OF INTEREST

No potential academic conflict of interest relevant to the above article was reported.

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