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# PRE-SURGICAL NASOALVEOLAR MOULDING - A REVIEW

Maxillofacial Surgery

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## ABSTRACT

The most common congenital defects of the orofacial region involve the clefts of the lip, alveolus and palate which lead to a significant number of skeletal and soft tissue deformities of the lips, nose and facial bones. The clefts may be quite extensive , thus presenting a greater surgical challenge in the approximation of anatomic structures. Restoration of the normal anatomy and function serves as the primary goal of treatment in these patients. Presurgical Maxillofacial Orthopedics or Presurgical Nasoalveolar moulding is thus resorted to, with the help of custom made appliances and utilization of the growth potential of the baby. After an extensive search of literature, this review compiles and discusses the history and the principle behind PNAM along with the fabrication and application of the plate used to achieve nasoalveolar moulding .

## KEYWORDS

Cleft Lip, Cleft Palate, Pre Surgical Nasoalveolar Moulding, Cleft Alveolus, Nasal Stents

## INTRODUCTION

The most common congenital defects of the orofacial region involve the clefts of the lip and palate (CLAP). Restoration of the normal anatomy and function serves as the primary goal of treatment in these patients. [1] Significant skeletal and soft tissue deformities of the lips, nose and facial bones are associated with CLAP.[3] Moreover, bilateral clefts or wider, extensive clefts present a greater surgical challenge in the approximation of anatomic structures. In such cases, because of the difficulty in achieving the goals of primary repair due to wide discrepancies, presurgical maxillofacial orthopedics (PMO) is resorted to. [2] Presurgical Nasoalveolar moulding (PNAM) improves nasal asymmetry and a deficient nasal tip along with moulding the premaxillary segment into a more desirable alignment, thus reducing the size of the cleft lip, palate and the alveolus. Finally, the complexities of the subsequent surgeries are reduced and a more esthetic result may be achieved.

## HISTORY

The usage of PMO in the management of CLAP has been prevalent for centuries. The primary focus of the earlier techniques was on the elastic retraction of a protruded maxilla. [4] Hoffmann in 1689, introduced the concept of facial binding to narrow the cleft. [5] Adhesive tape binding was stressed upon by Hullihen in 1844. [6] Brophy in 1927, demonstrated the passing of a silver wire through both the ends of the cleft alveolus, thus approximating the ends by tightening of the wire.[7] McNeil in 1950,[8] used plates to actively mould the alveolar segments into the desired position, followed by Georgiade and Latham in 1975,[9] who introduced a pin-retained active appliance to simultaneously retract the premaxilla and expand the posterior segments. Using Silicone tubes to mould the nostrils was introduced by Matsuo et al. in 1989.[10] In 1993, Grayson et al. , using the same principle described a new technique to mould the lip, alveolus, and nose in CLAP infants with the help of an intraoral plate with nasal stents.[11]

## PRINCIPLE AND MECHANISM OF PNAM

PNAM is based on the theory that an increased content of hyaluronic acid is present in the cartilage of an infant, thus making it more pliable and plastic. By 3 months of age, the cartilage becomes more rigid with little plasticity. PNAM significantly improves the nasal symmetry by bolstering the alae, elongating the columella, narrowing the cleft and restoring the arch form of the alveolus. PNAM relies on the principles of negative sculpting and passive moulding of the alveolus, lip and nasal tissues. The process of negative sculpting involves fabrication of a custom-made plate via an impression followed by a series of modifications with the addition and deletion of the material at certain areas of the plate. [12]

## PNAM APPLIANCE

The Presurgical Nasoalveolar Moulding appliance consists of an intra-oral custom-made acrylic plate covering the cleft alveolus and the hard palate along with a nasal component. [1] A nasal stent is a stainless steel 20-gauge wire loop with an intranasal soft resin moulding bulb on the top. [3] The end of the nasal stent is extended into the nostril to support the deformed nasal alar cartilage.[13] An intra-oral acrylic plate is placed soon after the birth (approximately 7 days) and when the remaining size of the alveolar cleft is less than 0.5 cm in size, the nasal component is further added to the appliance.[11]

## IMPRESSION TECHNIQUE

The initial impression of cleft lip and palate is obtained within 7 days of birth and is usually obtained at the time of first visit (Figure 1 ) . A heavy body polyvinyl siloxane material is used for the initial impression. The impression is usually made in the presence of the anesthetist and in a setting where an airway emergency can be managed, if encountered at all. The impression is made while holding the infant in a prone position to keep the tongue forward. This position allows any material or saliva to drain out of the oral cavity and prevents aspiration. [3] The impression material should adequately cover the anatomy of upper gum pads. After the impression is completely made, the tray is removed and is poured with dental stone to acquire a detailed cast (Figure 2) . A proper intra-oral examination should be done for any residual material.[11]

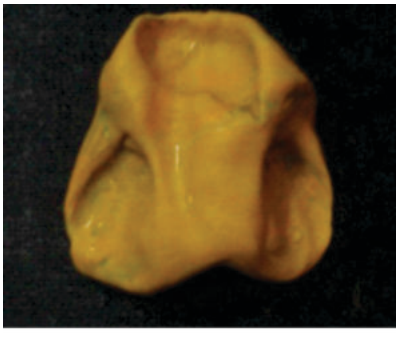

**Figure 1 : Impression of the cleft Infants' alveolus and palate**

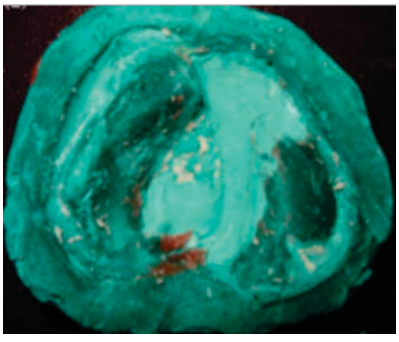

**Figure 2 : Cast poured**

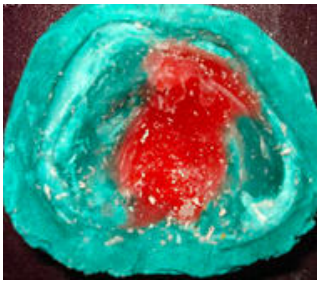

**Figure 3 : Block out of cleft space with modelling wax**

## APPLIANCE DESIGN AND FABRICATION

Dental stone models are used to fabricate the intra-oral moulding plates. These plates are made up of clear methyl methacrylate resin lined with a soft denture material. The cleft space and undercuts are blocked with the help of modeling wax on the cast (Figure 3) . The thickness of the moulding plate should be 2-3 mm so as to allow adjustments during the process of moulding. The borders of the plate should be trimmed and smoothened properly to avoid ulcerations (Figure 4) .

A retention button is made and placed anteriorly at an angle of 40° to the plate. A single retention arm is used in unilateral cleft patients and the position of the retention arm is decided at the chair side only. It should be placed vertically at the junction of the upper and lower lip. This further secures the moulding plate in the oral cavity with the use of orthodontic elastics and tapes. A 6-8 mm opening is made on the palatal surface to provide an airway if the plate drops down posteriorly.[3,11]

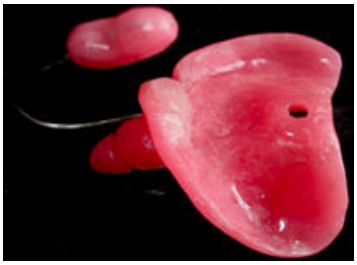

**Figure 4 : Fabricated PNAM plate with Nasal stent**

## APPLIANCE INSERTION AND TAPING

The PNAM is secured extra-orally to the cheek bilaterally with the help of surgical tapes which have orthodontic elastic bands at one end. Skin barriers like micropore (wound dressing tape) should be applied first before the application of surgical tapes to reduce the irritation of the cheeks. The elastic on the surgical tape is looped on the retention arm and is extended approximately in a 40-45º angle therefore, pulling the anterior flange postero-superiorly for vector activation. The elastics are stretched twice of their resting diameter to provide 2 ounces of traction force. The amount of force can vary according to the clinical objectives and soft tissue tolerance to ulceration. Then, the surgical tape is applied to the non-cleft side first and then pulled over the cleft side. It should be changed at least once a day. The infant may require some time to adapt to the NAM appliance in the first few days. [3,11]

Parents or caregivers are instructed to keep the appliance in place at all times except for daily cleaning.[1]

## INTRA-ORAL PLATE MODIFICATIONS

Weekly follow-ups are required to make a series of modifications on the surface of the plate, therefore, bringing the alveolar segments together. Selective grinding of acrylic material is done in the regions where alveolar segment movement is required and simultaneously adding the soft denture lining material to the plate which will direct the alveolar segments to the midline. Approximately 1 mm adjustments should be done per visit.[3,11]

## NASAL STENT

The nasal moulding is started once the gap of maxillary alveolar segments is reduced to 5mm. A nasal stent is incorporated in the existing moulding plate in the form of a stainless-steel wire projecting outwards going into the ala of the nose like a “swan neck”.[14] The hard acrylic component is shaped into a bi-lobed form which resembles the shape of a kidney. A layer of soft denture liner is added over the hard acrylic to increase comfort. The upper lobe enters 3-4 mm past the nostril aperture and gently lifts the dome forward until a slight amount of blanching is noted. Blanching can be noticed as the baby suckles which further activates the appliance. The lower lobe of the component lifts the apex of the nostril and defines the top of the columella. After adding the nasal stent appliance, a surgical tape is placed. The therapy is continued for 5–5½ months until the time of the surgery. [3,11]

## NASAL STENT IN UNILATERAL CLEFT

In patients with unilateral clefts, a single retentive arm is required and the location is decided by drawing the cleft lip segments together and centering the columella and philtrum. This point is marked and a retentive arm is attached to that location ( Figure 4).[15]

## NASAL STENT IN BILATERAL CLEFT

In patients with a bilateral cleft, 2 retentive arms and 2 nasal stents are required. Two retentive arms will aid in elongating the columella and stabilize the plate on either side of the premaxilla. The two nasal stents will assist in lifting the nasal ports, thereby creating a counterforce to extend the premaxilla (Figure 5 ) .[15]

The left and right lower lobe of the nasal stent is joined with a horizontal bar made up of soft denture tissue liner crossing columella. This band sits at the nasolabial junction and defines this angle as the nasal tip continues to be lifted and projected forward. A tape is placed at the prolabium beneath the horizontal lip tape and is pulled downwards to engage the retention arms and elastics. The downwards taping will aid in lengthening the columella and increase the length of the small prolabium. This prolabium taping is followed by horizontal taping. [11,15]

**Figure 5 : PNAM appliance with nasal stents for Bilateral CLAP infants**

## PRIMARY SURGICAL REPAIR OF THE ALVEOLUS, LIP AND NOSE

Negative sculpting and passive moulding are two main principles of PNAM therapy. Custom made plates are fabricated after the initial impression and various modifications are made to the surface of the appliance to get the desired shape of the alveolar arches and the nose. This process is known as Negative Sculpting. Passive moulding means growth of alveolar arches which is passively directed by the custom-made plates.[15] The primary objective of this therapy, which is approximation of maxillary alveolar segments and directing the nasal deformity, should be achieved before the surgical repair.[11] Surgical repair of the nose and lip is carried out at 3-4 months of age.[16-17] One or two additional months are required in bilateral cleft patients to accomplish the presurgical objectives. The severity of the initial cleft also plays an important role in deciding the total duration of the moulding therapy.[11] PNAM therapy increases the surgeon's ability to attain a good quality of surgical repair.[3,11]

## COMPLICATIONS

The most common problem encountered during PNAM therapy is soft tissue irritation or ulceration. Excessive pressure while taping may result in intra-oral ulceration. To prevent this, different types of tapes can be used and slight change in the position of tapes can be done.[15]

Another potential complication of PNAM includes overexpansion of the nostril and Mega nostril.[17] This complication usually results from application of the nasal component before the alveolar segment gap is less than 5 mm. Improper vectors of taping can also contribute to this complication.

Misdirected orthopedic forces can lead to a locked out segment which can be corrected by redirecting the forces.[15]

Dislodgement of the appliance can lead to an airway obstruction which can be prevented by creating a 6-8 mm diameter hole in the center of the appliance.[14]

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