Presurgical Nasoalveolar Molding: A Narrative Review of Early Management in Newborn Patient with Cleft Lip and Palate

Running title: Presurgical Nasoalveolar Molding…

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Abstract

Context: Orofacial clefts are one of the most common congenital birth malformations in the oral and maxillofacial area. Lip reconstruction or cheiloplasty is an important issue for these patients, and is performed around three months of age. Presurgical nasoalveolar molding have become part of the treatment protocol in many cleft centers to improve the treatment outcome and commonly employed to reduce the alveolar segments into proper alignment and to improve nasal symmetry in patients with cleft lip and palate
The aim of this article is to review the value of this technique as part of the treatment protocol for infants born with cleft lip and palate.

Evidence Acquisition: In this review, the electronic databases ISI, PubMed, and Google Scholar were searched. Articles published from 2000 to 2018 were retrieved and underwent abstract and full-text appraisal. The following search terms were used: "nasoalveolar molding", "cleft lip and palate", "presurgical orthopedics", and "nasal stent".

Results: Presurgical nasoalveolar molding can reduce the severity of the initial cleft deformity, wherein the bony segments are slowly moved to a more favorable position, lessening the amount of surgical correction that is needed to bring the lip segments together while simplifying the surgical approach for the nose.

Conclusions: The primary surgical repair of the lip and nose heals under minimal tension, thereby reducing scar formation and improving the esthetic result. Frequent surgical intervention to achieve the desired esthetic results can be avoided by presurgical nasoalveolar molding.

Keywords: Cleft lip and palate, presurgical orthopedic, nasoalveolar molding

1. Context

Cleft lip and palate (CLP) is the most prevalent structural abnormality that occurs during embryonic development and involves multiple professionals to reach satisfactory treatment outcomes (1).

The orthodontist initially is a part of this interdisciplinary team, delivering presurgical orthopedic and orthodontic treatments (2).

CLP is defined by incomplete tissue formation of the lip, alveolus, and soft and hard palate. The degree ranges from a small score in the lip to a full cleft spreading into the roof of the mouth and nose(3).

Several modern presurgical infant orthopedic methods to treat CLP have been introduced, beginning with McNeil in 1950, followed by Georgiade and Latham, Hotz et al. Matsuo et al. and Nakajima et al. (4-8). In 1993, Grayson et al. described presurgical nasoalveolar molding, which addresses not only the alveolus but also the lip and the nose (9). The nasoalveolar molding appliance is a modern presurgical orthopedic device that allows for positive growth of the alveolar ridges into a better arch shape as well as reshaping of the flattened nose into a more symmetrical profile. As a result of the presurgical appliance, the nose and lip are able to heal with the least tension, so decreasing scaring which would result in better esthetic outcomes (8). Therefore, surgical morbidity risks are decreased and the costs of secondary scar operations are eliminated (8). In the present study, we have reviewed the value of presurgical nasoalveolar molding as part of the treatment protocol for infants born with CLP.

2. Evidence Acquisition

For the purpose of literature review, we searched the international databases ISI, PubMed and Google Scholar, using the keywords: "nasoalveolar molding", "cleft lip and palate", "presurgical orthopedics" and "nasal stent", from 2000 to 2018. All of articles (either case control, cross-sectional, clinical trials, or review) were limited to English only and the abstract, brief, and full text that directly discussed presurgical nasoalveolar molding in newborn patients with CLP were selected. Next, duplicated and irrelevant studies, abstracts, and articles in languages other than English were excluded from the review process.

3. Result

We found 25 articles related to presurgical nasoalveolar molding. The qualitative results of the reviewed articles are discussed.

3.1. Psychological, Anatomic, and Surgical challenges

The birth of a child with a cleft can be a traumatic experience for families. Such family members may feel intense feelings of discontent, vulnerability, concern, and distress. In newborns with CLP,

the nose, lips, and maxillary arch are usually severely malformed and asymmetric. In those with unilateral CLP, the main challenges in reconstruction are in the asymmetric nostrils, deviated septum, and distorted maxillary arch form (10). Due to the non-existence of good surgical techniques for treating nasal deformity, several nasal surgical alterations are often required to arrive at near nasal symmetry. In bilateral CLP, the deficient columella and ectopic premaxilla are the chef concerns in reconstruction and because of the numerous nasal surgeries severe scarring at the columella prolabial junction and lack of nasal projection are common outcomes (11).

3.2. What is presurgical Nasoalveolar Molding?

Presurgical nasoalveolar molding is a non-surgical technique used to reshape the gums, lips and nostrils pre-CLP surgery, which reduced the degree of the cleft. Furthermore, it is painless and easy to perform. Before nasoalveolar molding, reconstructing the 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 nasoalveolar molding, the orthodontist can decrease the size of the cleft and shape the alveolar and nasal tissues into the right anatomic position(12). This technique involves actively 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 (13).

3.3. Technique of Nasoalveolar Molding

To make the nasoalveolar molding appliance a maxilla dental cast of the newborn is used to make a removable orthodontic acrylic alveolar molding (Fig. 1) and the first impression of the CLP infant is obtained within the first week of birth with heavy-bodied silicone. In order to do this, the surgeon holds the infant in an inverted position and the impression tray is placed into the oral cavity. The infant is held in this position to inhibit the tongue from rolling back and to permit liquids to drain out of the oral cavity. To fabricate the cast, 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(14).

Next, a retention button is made and placed anteriorly at a 40°angle to the plate. In the unilateral cleft only one retention arm is used. The precise position of the retention arm is decided at the chair side. It is placed in such a way to not disrupt the process of bringing of the cleft lips together. The vertical placement of the retention arm should be at the intersection of the upper and lower lip.

A slight opening of 6–8 mm in diameter is created on the palatal surface of the molding plate to allow for an airway in case the plate falls down posteriorly. Fabrication of the nasal stent is made after the cleft of the alveolus is reduced to about 5–6 mm in width(15).

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 be used 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.

The infant should be visited weekly to make modifications to the molding plate to 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 modification of the molding plate is not advised during each visit. The alveolar segments should be guided to its ultimate and optimal position.

The nasal stent component of the NAM appliance is amalgamated when the width of the alveolar gap is reduced to about 5 mm. The stent is 0.36 inches in the shape of a "swan neck" made of round stainless steel wire. It is adhered to the labial flange of the molding plate, near the bottom of the retention arm. The hard acrylic component is molded into a bi-lobed form similar to a kidney. A layer of soft denture liner is placed on the hard acrylic for comfort. The upper lobe enters the nose and carefully brings forward the dome until a modest amount of tissue blanching is apparent.

The length necessary to do the molding therapy is dependent on the degree of the initial cleft defect(15).

Figure 1. Nasoalveolar Molding appliance

3.4. Objectives of Nasoalveolar Molding

The main objectives of nasoalveolar molding in patients with bilateral cleft are facilitating intra-oral feeding, improving maxillary growth, improving the projection of the nasal tip, reducing nasal deformity, increasing the surface area of the mucosal lining, improving columella lengthening and uprighting, facilitating primary lip, nasal, and alveolar surgeries, and retracting and repositioning the premaxilla more posteriorly (16).

3.5. Advantages of Nasoalveolar Molding

The advantages of nasoalveolar molding include psychosocial benefits to the infant's family. Preliminary findings indicate that the frequent visits for nasoalveolar molding adjustments reduce anxiety felt by the caregiver and lead to a sense of empowerment. Nasoalveolar molding also reduces the overall cost of cleft care by reducing the number of secondary nasal revisions (17).
Nasoalveolar molding exploits cartilaginous plasticity and pliability, which is assumed to last for about the first three months in infants because of elevated estrogen and hyaluronic acid levels (18). Nasoalveolar molding allows gingivoperiosteoplasty during initial lip repair in over 90% of infants and eradicates secondary alveolar bone grafts in over 60% percent of patients (19). It has been postulated that nasoalveolar molding lessens tension on lip closure, as well as permitting some nasal correction that would otherwise be statistically impossible simply with surgery. The collective benefits of enhanced nasal symmetry and appearance and decreased number of nasal and dentoalveolar procedures allows for considerable financial savings and psychological wellness for the patient and family(20). Furthermore, no effect on the growth of midface in the sagittal and vertical plane has been recorded up to the age of 18 years in patients who have undergone this procedure(18).

3.6. Disadvantages of non- Nasoalveolar Molding:

The primary shortcoming of the nasoalveolar molding technique is that they neglect to address nasal cartilage deformity during cartilage plasticity. Ignoring severe nasal cartilage deformity during this period usually leads to more surgical revisions(21). Moreover, lip taping or surgical lip adhesion alone may not be the best procedure for patients with bilateral CLP. If the alveolar segments cannot be controlled then the premaxilla can descend vertically, and the anterior aspect of the posterior alveolar segments can collapse palatally(20).This can result in an impinging deepbite of the premaxilla, archform collapse, and incoordination with the mandibular arch(22). In addition, the malpositioned premaxilla can render fistula closure difficult. A persistent fistula can negatively impact speech production and make it possible for oral contents to enter the nasal cavity. These conditions lead to issues in surgical reconstruction, orthodontic management, and speech therapy(21). Another disadvantage of surgical lip adhesion is the increased trauma, morbidity, and associated surgical costs for the patient and family(23).

3.7. Common complications of Nasoalveolar Molding:

The most common problem seen in nasoalveolar molding therapy is irritation to the intraoral tissues of the oral mucosa, gingival tissue or nasal mucosa, which could become ulcerated because of the severe pressure applied by the appliance.

These are commonly found in the oral vestibule and on the labial side of the premaxilla(24).Therefore, it is recommended that the oral and nasal cavities of the patient be meticulously examined on each visit for such ulceration. In the event of irritation the necessary adjustments should be done to the molding plate to relieve sore spots. Also, the intranasal lining of the nasal tip is susceptible of becoming irritated under excessive pressure by the upper lobe of the nasal stent. The area under the horizontal prolabium band is also in danger of forming ulcers as well if the band is too tight. Another area of tissue irritation is the cheeks. Extreme care should be taken while removing the cheek tape to avoid any irritation to the skin; thus, skin barrier tapes are recommended. Slight relocation of the tape during treatment is also recommended to provide rest to the tissues in case they become irritated. Using an aloe vera gel on the cheeks to avoid irritation is also recommended when changing tapes(12).

4. Conclusion

Nasoalveolar molding therapy is effective not only for the induction of dental alveolar growth but also as a presurgical orthodontic treatment to improve the nasal shape and for better treatment results after the primary lip surgery. Although it is necessary to evaluate the long-term stability of these effects, it can be concluded that the use of nasoalveolar molding is desirable during the postnatal period when the nasal cartilages show high plasticity, and that this approach could provide good nasal shapes in patients with cleft lip and palate.

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