

Nasoalveolar molding and their effects on the dentoalveolar arch: A systematic review

Mary Sheloni Missier¹, Ravindra Kumar Jain¹, M. P. Santhosh Kumar^{2*}

ABSTRACT

Various methods of the treatment of cleft lip and palate (CLP) have developed over the years. One among them is the nasoalveolar molding (NAM). The aim of this systematic review was to review the literature on the effects of NAM on the dentoalveolar arch form in CLP patients. For this review, electronic database PUBMED was searched up to 2016 and hand search of the orthodontic and dentofacial orthopedic journals also was utilized. Only those articles which met the inclusion criteria were selected. Finally, 11 articles were included for the review in the present study. Studies included were randomized controlled trials, case series, and case reports. All orthopedic appliances utilized in these studies were successful in reducing alveolar cleft distance and lip tension thereby preventing scarring and reducing the need for secondary alveolar bone grafting. The reduction in the alveolar cleft was up to 3–6 mm in all the studies. It can be concluded from this systematic review that NAM results in good alignment of the alveolar segment, shape of the alveolar arch, reduced interalveolar cleft distance, and lip tension, hence, facilitating the maxillary growth.

KEY WORDS: Cleft lip, Cleft palate, Nasoalveolar molding, Presurgical orthopedics

INTRODUCTION

There are various congenital deformities. One among them is the cleft lip and palate (CLP), which is the most common malformation of the head and neck. It is stated that 1 in 781 births are affected by CLP.^[1] Unilateral clefts occur 9 times more common than the bilateral clefts. Males are affected more by CLP, whereas females are most commonly affected by cleft palate.^[2] Management of cleft patients is approached as a teamwork and treatment is being split depending on their age group. Treating cleft deformity successfully has become a dream come true for many practitioners. Various methods of the treatment of CLP have developed over the years. One among them is the nasoalveolar molding (NAM). Although advancements in plastic surgery have corrected many deformities associated with CLP, persistent problems associated with a nasal deformity have given rise to the use of presurgical NAM (PNAM) in the cleft treatment protocol.^[3] The theory behind PNAME is that the nasal cartilage is still developing and is subject to repositioning within 6 weeks of life, since during this period there is

a high level of maternal estrogen. This estrogen triggers an increase in the hyaluronic acid which alters the cartilage and connective tissue elasticity by breaking the intercellular matrix, whereas after 6 weeks the level of hyaluronic acid drops.^[4,5] Based on this principle NAM works by molding the cartilage, stimulating the immature chondroblast thereby lessening the number of surgeries and scar formation.

HISTORY

The history of the treatment for CLP began in 317 AD, when Chinese general Weiyang chi corrected his cleft by stitching the edges of the cleft. Many others methods have been developed over centuries for the treatment of CLP. Pierre Franko was the first to give the detailed description of the indications, surgical techniques, and post-operative care of cleft lip patients. This was followed by the invention of Amboise pare who carried out lip repair using cleft lip pins.

Various inventions by many authors are as follows: ^[6-10]

- Hoffmann demonstrated the usage of facial binding for narrowing the cleft
- Default used the same technique to retract maxilla before surgical repair of clefts

Access this article online

Website: jrsolutions.info

ISSN: 0975-7619

¹Department of Orthodontics and Craniofacial Orthopaedics, Saveetha Dental College, Saveetha University, Chennai, Tamil Nadu, India, ²Department of Oral and Maxillofacial Surgery, Saveetha Dental College, Saveetha University, Chennai, Tamil Nadu, India

*Corresponding author: Dr. M. P. Santhosh Kumar, Saveetha Dental College, Saveetha University, 162, Poonamallee High Road, Velappanchavadi, Chennai - 600 077, Tamil Nadu, India. Phone: +91-9994892022. E-mail: santhoshsurgeon@gmail.com

Received on: 19-08-2018; Revised on: 24-09-2018; Accepted on: 26-10-2018

- Hullihen focused over the importance of presurgical preparation of cleft using adhesive tape
- Brophy approximated the end of the alveolus before lip repair by passing silver wire to the ends of the cleft alveolus and then progressively tightening the ends of the wire
- Pritchard states that the rate of bone healing is inversely proportional to the size of the gap
- McNeil molded the alveolar segment using a series of plates
- A technique was developed by Tennison to preserve the accurate position of cupid's bow
- McNeil technique was made popular by Burston who further developed it
- Cupid's bow and philtrum were brought into a symmetrical position by the rotation advancement technique of Millard
- Pin-retained active appliance was developed by Georgiade and Latham which can simultaneously produce retraction and expansion of the premaxilla and the posterior segments
- Hotz used passive orthopedic plates to align the cleft segments
- A new technique was described by Grayson which can presurgically mold the alveolus, lips, and nose in infants born with CLP.

The main aim of the nasal molding is to bring the alar segment anteriorly thereby increasing the length of the columella through a nonsurgical technique. This brings about an increase in the length of columella and retraction of the premaxilla thereby accomplishing the continuity of the posterior alveolar segment along with the mid-sagittal plane.

REVIEW

For this review, electronic database PUBMED was searched up to 2016 and hand search of the orthodontic and dentofacial orthopedic journals also was utilized. The keywords Used for Search were: "Infant orthopedics," "Presurgical infant orthopedics," "NAM," and "cleft palate." The inclusion criteria were studies including orthopedic appliances in presurgical phase and clinical trials. The exclusion criteria for the studies were studies not in English language, and studies with irrelevant data. Finally, 11 articles were included for the review in the present study [Figure 1]. Studies included were randomized controlled trials, case series, and case reports and their characteristics are described in Table 1.

TIMING FOR NAM THERAPY

NAM should be started soon after birth within the 1st and 2nd weeks. Molding of the tissue is much easier during this period due to raised level of hyaluronic acid and maternal circulating estrogen. Ideally, PNAM should be completed within 6 months of birth.^[11]

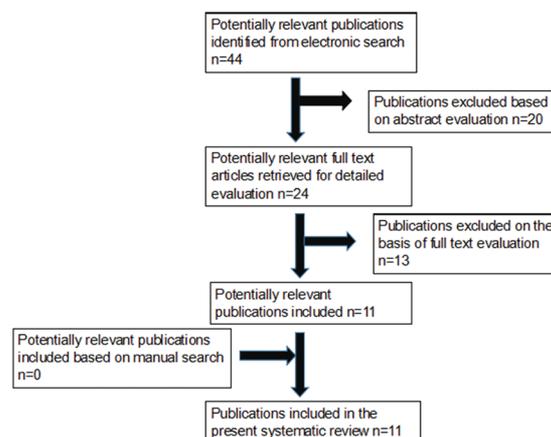


Figure 1: Search flowchart for selection of studies

IMPRESSION TECHNIQUE

A heavy body silicon impression material is used to take an initial impression for NAM appliance. The impression is usually taken soon after birth as the cartilage is plastic and easily moldable. There are various impression techniques which vary depending on the authors. Grayson and Maull^[8] held the infant in an upside down position to keep the tongue forward which permitted fluids to draw off the oral cavity and impression tray is placed. The tray should be placed until impression material just begins to extrude from the posterior border. Yang *et al.*^[6] used a pre-trimmed customized pediatric tray with the baby mainly in the erect position, being held by one of the parents. Utility wax is utilized to circumvent any sharp edges on the tray and to enhance adaption to the infant's mouth. Prashanth *et al.* and^[12] Mishra *et al.*^[13] obtained impression when the infant was awake in a prone position on the dental chair. The child is held on the lap of their parents with no anesthesia in an outpatient clinic.

Dubey *et al.*^[11] made an impression of the upper arch cleft region using ice cream stick and impression compound. The impression material is allowed to set, and then the tray is taken out of infant's mouth. The mouth is checked for remaining impression material. A cast or model is poured with a dense plaster material. The plate is made-up on the stone model. Using a special tray, and putty consistency polyvinyl elastomeric impression material final impression is made, with the same technique as of primary impression.^[11]

TYPES OF APPLIANCES

There are mainly two types of appliances which are active and passive appliances. They are also classified as pre- or post-surgical, active or passive, and intraoral or extraoral appliances.^[9] Active appliances help to move the alveolar segments under controlled force in

Table 1: Characteristics of included studies

S. No.	Author	Year	Parameters	Outcome
1	Cho	2001	Meet at point of the cleft, noncleft maxilla on the gingival ridge of the cleft, post gingival, width of the alveolar ridge cleft width of the hard palate cleft	Good symmetrical alignment of the malaligned alveolar segment
2	Catharine <i>et al.</i>	2005	Arch width depth, length, arch form, and vertical position of the lesser segment	No evident effect
3	Adam <i>et al.</i>	2006	Intersegment distance intraoral arch, width premaxillary protrusion, larger deft width, smaller deft width, and premaxillary deviation	Good alignment of the dentoalveolar segment and shape of the maxillary arch
4	Baek	2006	Linear variables, angular variable, midline deviation variable, distance variable, and area variable occurred in PAS	Dentoalveolar molding occurred in AAS and growth
5	Kecik <i>et al.</i>	2009	Linear, angular measurements	Good alignment and shape of the arch occurred
6	Abida <i>et al.</i>	2010	Linear, angular measurements	Significant alignment of the premaxilla
7	Stacey <i>et al.</i>	2011	Perpendicular distance from each canin to mid-line, intercanine width, intermolar width, maxillary arch width	No significant in dental arch configuration
8	Nazarian <i>et al.</i>	2011	Intersegmental alveolar deft distance and alveolar arch width	Significant decrease in intersegment alveolar cleft distance
9	Shetty <i>et al.</i>	2012	Alveolar width	Significant decrease in intersegment alveolar cleft
10	Andrea <i>et al.</i>	2015	Intersegmental alveolar distance and intersegmental lip distance	Narrowing of the alveolar segment
11	Shetty	2013	Intercanine width, intertuberosity width, and arch length	Significant reduction of the anterior portion of the maxillary arch

a predetermined manner whereas passive appliance does not deliver force but acts as a fulcrum over which the force from the surgical lip closure mold the alveolar segment.^[14-18]

Karimi and Mir stated that active appliances are fixed intraorally, and traction is applied by means of elastic chains, screws, and plates, whereas in passive appliance the distance between the two maxillary segments is maintained, and an external force is applied to reposition the posterior segments.^[15] There are other types of NAM appliance such as modified muscle-activated maxillary orthopedic appliances, NAM appliances with expansion screw, dynamic pre-surgical nasal remodeling intraoral appliance, and self-retentive appliance.^[14,18-20]

FABRICATION OF NAM APPLIANCE

The appliance is made up of self-cure acrylic with a retention button being fabricated at an angle of 40° to the plate. It is positioned anteriorly with the retention arm being positioned at the junction of lower and upper lips. In addition to the retention button orthodontic elastic and tapes helps in holding the molding plate in the mouth.^[14,18,21,22] In recent practices various other materials are being used for fabrication such as auto-polymerizing resin, light cure polymerizing material, heat cure polymerizing material, and thermoplastic base plate wax.^[6,15,23]

INSERTION OF NAM APPLIANCE

NAM appliance is being held extraorally with the help of orthodontic elastic bands and surgical tapes. The elastic bands are stretched twice their resting diameter and activated to a force of 100 g and held to the retention arm whereas the surgical tape is secured to the cheek. An additional horizontal tape may also be required for additional retention.^[6,22]

The appliance is being adjusted weekly once to bring about the alveolus segment together. In each and every visit, the appliance is being modified by removing 1 mm of the hard acrylic and by adding soft denture base material to the molding plate there by the alveolar segment is being directed to an optimal position which is to be obtained.^[6,7,23]

BENEFITS

NAM helps to attain better treatment outcome with less scar formation, decreases alar curvature, and increases the length of the columella. It is also known that it decreases the number of surgeries required to correct the nasal contour. Various studies have proven that with NAM the nasal shape is stable with better lip and nasal form, with a reduction of about 3–6 mm of alveolar clefts.^[24]

COMPLICATIONS

With NAM there are certain complications faced by the patients such as irritation of the oral mucosa,

inflammation of the nasal lining, ulceration, notching, and airway obstruction.

CONCLUSION

It can be concluded from this systematic review that NAM results in good alignment of the alveolar segment, shape of the alveolar arch, reduced inter-alveolar cleft distance, and lip tension, hence, facilitating the maxillary growth. However, the use of NAM is still questionable and debated around the globe. Hence, multi-centric studies involving various appliances and evaluation of their long-term effects are needed.

REFERENCES

- Sharma P, Sandhu HS, Kumar A. Presurgical nasoalveolar molding in unilateral cleft lip and palate patient. *Indian J Dent Adv* 2012;4:1024-30.
- Goodacre T, Swan MC. Cleft lip and palate: Current management. *Paediatr Child Health* 2008;18:283-92.
- Spengler AL, Chavarria C, Teichgraber JF, Gateno J, Xia JJ. Presurgical nasoalveolar molding therapy for the treatment of bilateral cleft lip and palate: A preliminary study. *Cleft Palate Craniofac J* 2006;43:321-8.
- Matsuo K, Hirose T. Preoperative non-surgical over-correction of cleft lip nasal deformity. *Br J Plast Surg* 1991;44:5-11.
- Murthy PS, Deshmukh S, Bhagyalakshmi A, Srilatha K. Pre surgical nasoalveolar molding: Changing paradigms in early cleft lip and palate rehabilitation. *J Int Oral Health* 2013;5:70-80.
- Yang S, Stelnicki EJ, Lee MN. Use of nasoalveolar molding appliance to direct growth in newborn patient with complete unilateral cleft lip and palate. *Pediatr Dent* 2003;25:253-6.
- Grayson BH, Shetye PR. Presurgical nasoalveolar moulding treatment in cleft lip and palate patients. *Indian J Plast Surg* 2009;42 Suppl: S56-61.
- Grayson BH, Maull D. Nasoalveolar molding for infants born with clefts of the lip, alveolus and palate. In: *Cleft Lip and Palate*. Berlin, Heidelberg: Springer; 2006. p. 451-8.
- Retnakumari N, Divya S, Meenakumari S, Ajith PS. Nasoalveolar molding treatment in presurgical infant orthopedics in cleft lip and cleft palate patients. *Arch Med Health Sci* 2014;2:36-47.
- Grayson BH, Garfinkle JS. Early cleft management: The case for nasoalveolar molding. *Am J Orthod Dentofacial Orthop* 2014;145:134-42.
- Dubey RK, Gupta DK, Chandraker NK. Presurgical nasoalveolar molding: A technique note with case report. *Indian J Dent Res Rev* 2011;2:66-8.
- Prashanth CS, Amarnath BC, Dharma RM, Dinesh AM. Cleft orthopaedics using liou's technique-a case report. *IOSR J Dent Med Sci* 2013;12:11-5.
- Mishra B, Singh AK, Zaidi J, Singh GK, Agrawal R, Kumar V. Presurgical nasoalveolar molding for correction of cleft lip nasal deformity: Experience from Northern India. *J Plastic Surg* 2010;10:443-57.
- Suri S, Tompson BD. A modified muscle-activated maxillary orthopedic appliance for presurgical nasoalveolar molding in infants with unilateral cleft lip and palate. *Cleft Palate Craniofac J* 2004;41:225-9.
- Karimi SV, Mir BP. Presurgical nasoalveolar moulding in a neonate with bilateral cleft lip and palate: Report of a case. *J Compr Ped* 2012;3:86-9.
- Reisberg DJ. Dental and prosthodontic care for patients with cleft or craniofacial conditions. *Cleft Palate Craniofac J* 2000;37:534-7.
- Daigavane PS, Hazarey P, Vasant R, Thombare R. Pre-directional appliance: A new approach to correct shifted premaxilla in bilateral cleft cases. *J Indian Soc Pedod Prev Dent* 2011;29:S39-43.
- Retnakumari N, Vargheese M, Madhu S, Divya S. A new approach in presurgical infant orthopaedics using an alveolar molding appliance in the management of bilateral cleft lip and palate patients: A case report. *IOSR J Dent Med Sci* 2013;12:11-5.
- Bennun RD, Figueroa AA. Dynamic presurgical nasal remodeling in patients with unilateral and bilateral cleft lip and palate: Modification to the original technique. *Cleft Palate Craniofac J* 2006;43:639-48.
- Singh K, Kumar D, Singh K, Singh J. Positive outcomes of naso alveolar moulding in bilateral cleft lip and palate patient. *Natl J Maxillofac Surg* 2013;4:123-4.
- Hassan MA, Nada A, Zahra S. Nasoalveolar moulding in unilateral cleft lip and palate deformity. *Kasr El Aini J Surg* 2010;11:1-6.
- Shetty KR, Bonanthaya K, Dharma RM, Viswapoorna VS. Presurgical nasoalveolar moulding in patients with unilateral clefts of lips, alveolus and palate-a case report. *Ann Essen Dent* 2011;3:50-2.
- Xiaoyu MA, Giacona MB. Nasoalveolar moulding as treatment for cleft lip and palate: A case report. *Columbia Dent Rev* 2008-2009;19:20-4.
- Laxmikanth SM, Karagi T, Shetty A, Shetty S. Nasoalveolar molding: A review. *J Adv Clin Res Insights* 2014;1:108-13.

Source of support: Nil; Conflict of interest: None Declared