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Nasoalveolar Molding and Long-Term Postsurgical Esthetics for Unilateral Cleft Lip/Palate: 5-Year Follow-Up

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Abstract

The nasoalveolar molding (NAM) technique has been shown to significantly improve the surgical outcome of the primary repair in cleft lip and palate patients. A 6-day-old female infant was managed with the presurgical NAM technique. Periodic adjustments of the appliance were continued every week to mold the nasoalveolar complex into the desired shape for the next 5 months. The 13 mm of alveolar cleft width was reduced to 1.5 mm. The depressed nostril on the cleft side was molded into the normal anatomy. The nose and upper lip were surgically repaired at the age of 5 months. The second stage surgery of palatal closure was performed at the age of 18 months. The patient was followed up regularly at 6-month intervals for the next 5 years.

The basic goal of any approach to cleft lip, alveolus, and palate repair, whether for the unilateral or bilateral anomaly, is to restore normal anatomy. Ideally, deficient tissues should be expanded, and malpositioned structures repositioned prior to the surgical correction. This provides a foundation for a less-invasive surgical repair. An approach of presurgical nasoalveolar molding (NAM) therapy includes not only reduction of the size of the intraoral alveolar cleft through the molding of the bony segments, but also the active molding and positioning of the surrounding soft tissues affected by the cleft, including the deformed soft tissue and cartilage in the cleft nose. NAM was developed at the Institute of Reconstructive Plastic Surgery at New York University Medical Center.[1] However, the pioneering research on neonatal molding of the nasal cartilage was performed by Matsuo and colleagues.[2-4] The objective of NAM is to reduce the size of the intraoral cleft and to actively mold and position the surrounding tissues affected by the cleft before surgical intervention.[5-7] The resultant tissue positioning by NAM improves postsurgical esthetics better than previously described presurgical orthopedic techniques in the cleft lip/palate do.[5] The purpose of this article is to describe a long-term (5-year) developmental and esthetic soft- and hard-tissue response after NAM and surgical repair of the unilateral cleft lip/palate.

Clinical report

A 6-day-old female infant was referred to the Department of Prosthodontics for presurgical NAM. A general physical checkup was done under the supervision of the physician, and consent was obtained to start the active molding therapy within the first week of birth. Initial examination revealed unilateral cleft lip and cleft palate on the right side (Fig 1). The distance between the two alveolar segments was 13 mm. The medical and family history of the parents was noncontributory. The complete procedure of NAM, along with the recall appointment schedule was described to the parents. The tentative timetable of the subsequent surgical appointments was also described.

The initial intraoral impression was obtained with a heavy-bodied polyvinylsiloxane impression material (Reprosil; Dentsply, York PA) as described by Brecht et al.[6] For fast setting of the impression material, two parts of base material can be mixed with one part of the catalyst with clinically acceptable properties.[6] The infant was held in an inverted position during impression making to prevent the tongue from falling back and to allow fluids to drain out of the oral cavity. The impression was made in the hospital setting with facilities to manage an airway emergency and with a surgeon present as part of the impression team.[6,8] High-volume evacuation was also ready at all times in the case of regurgitation of the stomach contents. Once the impression material was set, the tray was removed, and the oral cavity was examined for residual impression material. The impression was then poured with dental stone (Kalstone; Kalabhai Karson, Mumbai, India) to obtain an accurate cast (definitive cast). One more cast was obtained from the same impression and preserved as a permanent patient record. All the undercuts and the cleft space were blocked on the definitive cast with

Figure 1 Pretreatment view of the infant with cleft lip and palate at the age of 6 days.

Figure 2 NAM appliance without nasal stent in position.

Figure 3 Two months of active molding reduced the intersegmental width from 13 mm to 5 mm.

Figure 4 Complete NAM appliance with swan-neck-shaped nasal stent.

Figure 5 NAM appliance with nasal stent in position. Note the position of intranasal position of the nasal stent and horizontal lip banding.

Figure 6 Four months of active NAM reduced the intersegmental width to 1.5 mm.

the baseplate wax (Modelling wax; Deepti Dental Products, Ratnagiri, India). The molding prosthesis (2–3 mm thick) was fabricated using heat-polymerizing clear acrylic resin (DPI heat cure-clear; Dental Products of India, Mumbai, India). A retention button was fabricated and positioned anteriorly at an angle of 40° to the palate. The appliance was then secured extraorally to the cheeks and bilaterally by surgical tapes with orthodontic elastic bands (Fig 2). The use of skin barrier dressing-tapes (Tegaderm; 3M ESPE, St. Paul, MN) was advocated to reduce irritation on the cheeks. The surgical tape elastic was looped on the retention arm of the molding prosthesis, and the tape was secured to the cheeks. The elastics (inner diameter 0.25 inch, wall thickness heavy) were stretched to approximately two times their resting diameter, for a proper activation force of approximately 100 g. The patient's parents were instructed to keep the plate in the mouth at all times, except removal once daily for cleaning. The periodic recall appointments were scheduled at 1-week intervals. During each appointment, the intraoral examination was carefully carried out to check for ulcerations, inflammation, or swelling due to the active molding forces by the appliance. Sequential selective addition of 1 mm of the soft resilient liner material (Permasoft; Dentsply) on the palatal aspect of the lesser segment and buccal aspect of the greater segment and trimming on the palatal aspect of the greater segment and buccal aspect of the lesser segment was carried out during recall appointments at 2- to 3-week intervals.[6] Periodic measurement of the interalveolar distance was made either directly in the mouth or on the casts prepared at the 1-month recall appointment.

Once the width of the alveolar gap was reduced to about 5 mm, the NAM appliance nasal stent component was incorporated (Fig 3).[6] This addition was delayed because with the reduced alveolar gap, the base of the nose and the lip segment alignment was improved. The stent, made of 0.36 inch, round stainless steel wire, takes the shape of a "swan neck" (Fig 4).[6-8] The swan-neck shape provides access to tape the lip across the cleft.[6-8] The stent was attached to the labial flange of the molding prosthesis, near the base of the retention arm. A small loop was created to retain the intranasal hard acrylic component of the nasal stent. The hard acrylic component was shaped into a kidney-shaped bi-lobed form. A layer of soft denture liner was added to the hard acrylic for patient comfort. The upper lobe was inserted inside the nose and gently lifted forward of the dome until a moderate amount of tissue blanching was evident (Fig 5). The lower lobe of the stent lifted the nostril apex and defined the top of the columella. Periodic examination of the tissues and adjustment of the appliance was continued every week to mold the nasoalveolar complex into the desired shape. After 5 months, the width of the cleft between two alveolar segments at the crestal level was approximately 1.5 mm (Fig 6, 7). A 1.5 cm intercrestal distance ensures a clinically desirable approximation of the base of the alveoli of the opposing segments. Thus, the NAM procedure was completed, and the patient was referred to the plastic surgeon for the surgical repair.

General physical examination was carried out again, and the patient was found to be healthy for the surgery. Surgical closure of the lip and nose was performed at 5 months of age (Fig 8). The surgical technique was modified to take advantage of the NAM preparation. The approximation of the alveolar segments permits the surgeon to easily perform palatal and alveolar closure. At 18 months of age, a second surgery of palatal closure was performed in which both palatal and alveolar segments were closed (Fig 9). The patient was then followed regularly at 6-month intervals for the next 5 years. Soft- and hard-tissue examination was carried out during each appointment. The palate was closed completely with the second surgery, and no palatal perforation was observed as the patient grew. The lip and nose repair scars were minimal and less identifiable, giving the patient a normal facial esthetic appearance.

The last recall visit of the patient was at the age of 5 years. A complete set of primary teeth were erupted, except the right lateral incisor (in the cleft region) (Fig 10). Radiographic examination revealed that the right lateral incisor was congenitally missing. Mild lingual inclination of all erupted primary teeth on the right side (smaller segment side) was observed. The palate was well healed with normal anatomical contour (Fig 10). The cleft defect was found to have increased at the alveolar crestal region, without oronasal fistula formation (Fig 11). The alveolar defect was planned to be reconstructed with another surgical intervention to prevent the further increase in defect size and restore normal anatomical contour of the entire maxillary arch. An interdisciplinary treatment approach regarding the palatal expansion and correction of the lingual tilting of the teeth on smaller segment will be considered with the orthodontist. Improved esthetic appearance of the patient in the nostril region and upper lip was observed, and thus overall facial appearance was well appreciated (Figs 11, 12). The parents were pleased with the overall esthetic outcome.

Discussion

The goal of NAM in the orofacial orthopedic treatment of unilateral lip and palate clefts is to align and approximate the maxillary hemialveolar segments while simultaneously supporting and molding the deformed nasal cartilages, correcting and centering the nasal tip projection, and lengthening the deficient cleft-side columella in early infancy, before primary reparative lip surgery.[6-8] As in the case of neonatal auricular cartilage, active molding and repositioning of the nasal cartilages takes advantage of the plasticity of cartilage in the newborn infant.[5,9] The temporary plasticity of nasal cartilage in the neonatal period is believed to be caused by high levels of hyaluronic acid, a component of the proteoglycan intercellular matrix, found circulating in the infant for several weeks after birth.[5,9] The NAM technique in the treatment of cleft lip and palate deformity presents several benefits. The reduction in the size of the cleft gap facilitates the repair of the entire lip/nose/alveolus complex in one surgical procedure. Long-term studies of NAM therapy indicate that the change in nasal shape is stable with less scar tissue and better lip and nasal form.[10] In the presented case, the shape of the repaired nostril was identical to that of the opposite-side normal nostril, giving a symmetrical facial appearance when examined at the age of 5 years, indicating a stable nasal shape. Also, the scars on the upper lip were almost nonidentifiable. Future surgical interventions to correct the deformities to achieve soft-tissue esthetics can be minimized due to such improvement. Permanent teeth also can be expected to erupt in normal position.[7] In this clinical report, a well-aligned

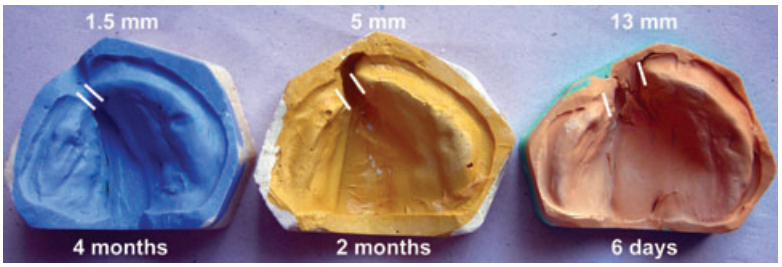

Figure 7 Casts prepared at the age of 6 days, 2 months, and 4 months as the patient's intersegmental distance reduced from 13 mm to 5 to 1.5 mm, respectively. Note the two parallel white lines on each cast indicating the intersegmental distance.

Figure 8 (A) Postsurgical esthetic outcome after first-stage surgery of lip and nose repair at the age of 12 months. (B) Inferior view of the face showing the repaired nose and lip.

Figure 9 Second-stage surgery of palatal closure at the age of 18 months.

Figure 10 Intraoral view of the patient at the age of 5 years, showing completely repaired cleft palate with desired anatomical form.

Figure 11 Inferior view of the patient's face showing completely repaired cleft lip/palate along with normal nasal form. Note a small defect in the alveolar segment which can be repaired by another surgical intervention.

Figure 12 Post-treatment esthetic outcome at the age of 5 years.

full complement of deciduous dentition was completely erupted (except the right lateral incisor, which was congenitally missing) at the age of 5 years with slight palatal inclinations of the teeth on the smaller segment of the alveolus. This will facilitate the alignment of the permanent dentition in a desirable position. Reduced need for alveolar bone grafting by NAM has been suggested by some authors.[11,12] In a bilateral cleft patient, NAM, along with columellar elongation, eliminates the need for columellar lengthening surgery.[13] Thus, NAM frequently simplifies surgeons' reconstruction in cleft lip and palate. Modified surgical techniques like gingivoperiosteoplasty followed by NAM ensures long-term postsurgical esthetics.[6,14] Lee et al[14] studied the long-term effect of NAM followed by gingivoperiosteoplasty on mid-face growth at prepuberty and concluded that the growth was not affected by NAM. Pai et al[15] assessed nostril symmetry and alveolar cleft width in infants with unilateral cleft lip and palate following NAM and found that NAM improved symmetry of the nose in width, height, and columella angle, compared to their presurgical status with some relapse of nostril shape in width (10%), height (20%), and angle of columella (4.7%) at 1 year of age. Nasal conformers were recommended by Liou et al[16] and can be placed for 4–6 months to compensate for relapse and the differential growth. A nasal stent plays an important role in such reshaping of the alar cartilage. The swan-neck shape of the stent provides the access to tape the lip across the cleft and allows controlled activation of the nasal stent to apply a gentle forward and upward molding vector to the dome of the lower lateral alar cartilage and a reciprocal alveolar molding vector on the medial hemialveolar segment.[6-8.]

Prahl et al studied the effect of infant orthopedics on maxillary arch form and position of the alveolar segments and concluded that infant orthopedics does not prevent collapse and can be abandoned as a tool to improve maxillary arch form.[17] Prahl et al similarly conducted a randomized clinical trial on the effect of infant orthopedics on facial appearance.[18] They concluded that infant orthopedics have no effect on facial appearance; however in both studies, the effect of passive maxillary plates, instead of active tissue molding like NAM, were evaluated. Bongaarts et al evaluated the effect of infant orthopedics on maxillary arch dimensions in the deciduous dentition in patients with unilateral cleft lip and palate and concluded that infant orthopedics had no observable effect on maxillary arch dimensions or on the contact and collapse scores in the deciduous dentition at the ages of 4 and 6 years.[19] In the presented case, lingual tilting of the deciduous teeth on the right side segment could not be prevented. Speech intelligibility is one of the important criteria to evaluate the early functional outcomes in cleft lip and palate patients. Van Lierde et al determined the intelligibility (words, sentences, storytelling), as judged by their parents, of 43 children (mean age 4.9 years) with unilateral cleft lip and palate who received a Wardill-Kilner palatoplasty, and concluded there was no significant difference in intelligibility for storytelling between children with cleft palate and the normative data.[20] The locked segment, nostril expansion, tissue ulceration, failure to retain the appliance, failure to tape the lip segment, and exposure of primary teeth are common complications that can be encountered throughout the molding procedure.[6] Parent cooperation is critical to success of the NAM procedure.

Though presurgical infant orthopedic devices remain controversial, numerous studies have shown that NAM provides safe, effective, and long-lasting improvements to the esthetics of the nasolabial complex in infants with cleft deformities.[10,13,14,21,22] Deng et al[23] performed NAM in 38 infants with cleft lip and palate and concluded that the NAM procedure can improve nasal profile and decrease the width of alveolar cleft. Similar results have been achieved in our case. Nakamura et al evaluated the short-term postoperative nasal forms after NAM followed by primary lip repair for children with complete unilateral cleft lip and palate and concluded that following NAM the lip closure procedure provide good nasal forms; however, long-term follow-up will be necessary to clarify effects on the growth of nasal tissues reconstructed in infancy.[24] This clinical report illustrated the long-term (over 5 years) follow-up to indicate the effects of growth on the reconstructed cleft lip and palate and found the therapy to be effective in maintaining the stability of the growing nasoalveolar complex. According to Aminpour and Tollefson, maxillary appliances have been used for 50 years; however, nasal molding is a relatively recent development that has shown progress but not without stalwart criticism.[25] Hence, more specific and longitudinal research is still needed to end the controversy about NAM and its clinical efficacy.

Conclusion

Long-term postsurgical esthetic results can be achieved in cleft lip/palate patients following the NAM procedure. Frequent surgical intervention to achieve the desired esthetic results can be avoided by presurgical NAM.

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