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Nasoalveolar Molding with Active Columellar Lengthening in Severe Bilateral Cleft Lip/Palate: A Clinical Report

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Abstract

Severe bilateral cleft-lip/palate patients are difficult to manage even if nasoalveolar molding therapy is advocated before surgical repair. A 5-day-old male infant with bilateral cleft-lip-palate was managed with the nasoalveolar molding technique. Periodic adjustments of the appliance were continued every week to mold the nasoalveolar complex into the desired shape for the 5 months of infancy. The cleft width of 12 mm on the right and 14 mm on the left side was completely reduced, and the absent columella was lengthened to 6 mm with the active molding appliance. The horizontal bar of the nasal stent of the appliance was modified by adding an additional 1 mm layer of resilient liner on the tissue surface to achieve rapid columellar lengthening. In severe bilateral cleft-lip/palate cases, simple modifications in the appliance can achieve rapid results.

The basic goal of cleft-lip/palate reconstruction, whether for a unilateral or bilateral anomaly, is to restore normal form, function, and esthetics.[1] A presurgical nasoalveolar molding (NAM) therapy approach 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, based upon the pioneering research of Brecht et al[1] and Matsuo et al.[2] The objective of NAM is to reduce the severity of the original cleft deformity, thereby enabling the surgeon to achieve better repair of the alveolus, lip, and nose.[1,3,4] Bilateral cleft lip/cleft palate is associated with nasal deformities typified by a short columella.[5] In a bilateral cleft patient, NAM, along with columellar elongation, eliminates the need for columellar lengthening surgery.[6] Modifying the NAM plate may reduce the presurgical treatment time for the bilateral cleft-lip and palate patient.[7] Long-term postsurgical esthetic results can be achieved in cleft-lip/palate patients following the NAM procedure.[8] Frequent surgical intervention to achieve the desired esthetic results can be avoided by presurgical NAM.[1]

Clinical report

A 5-day-old male infant was referred from the Department of Gynaecology and Obstetrics to the Department of Prosthodontics for presurgical NAM. The general physical examination was carried out under the supervision of the physician. The patient was diagnosed with a bilateral cleft lip and cleft palate (Fig 1). The distances between the two lateral segments and premaxilla (middle segment) on the right side and left side were 12 and 14 mm, respectively. The family and medical history was noncontributory. The parents were made aware of the treatment objectives, recall appointment schedule, home care measures, and safety measures. The tentative postmolding surgical plans were also described to the parents.

The preliminary intraoral impression was obtained with a medium-bodied poly(vinyl siloxane) impression material (Reprosil; Dentsply, York, PA) as described by Brecht et al.[1]

Figure 1 (A) Pretreatment frontal view of the infant with cleft lip and palate at the age of 5 days; (B) Pretreatment left lateral view; (C) Pretreatment occlusal view of the nasoalveolar complex.

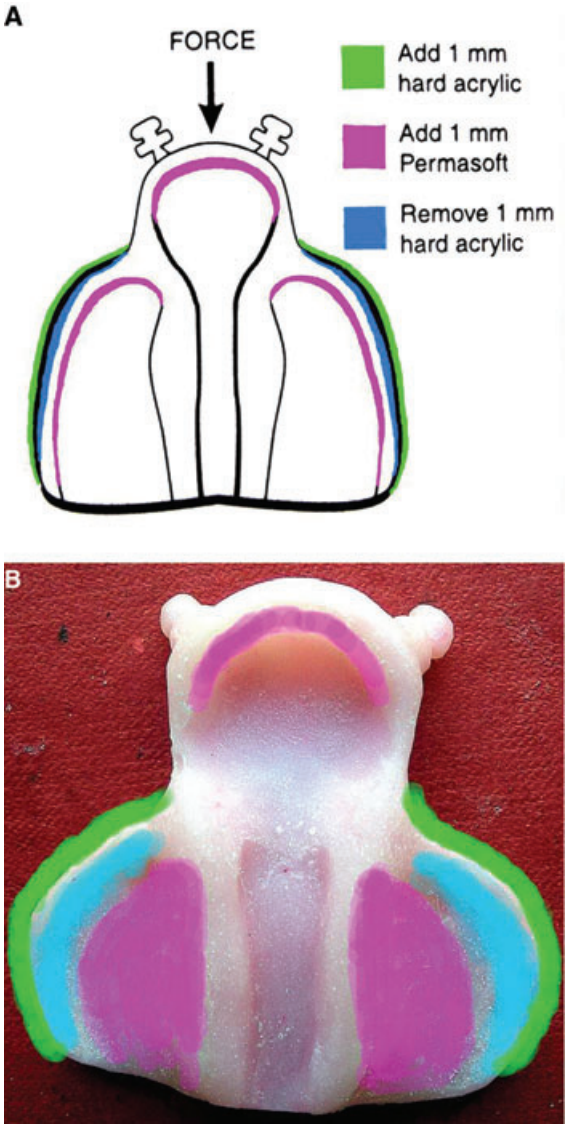

Figure 2 (A) Schematic diagram showing the NAM appliance with areas to be modified; (B) NAM appliance without nasal stent. Note the areas color-coded according to the schematic diagram.

Care must be practiced during impression making to prevent and manage any type of airway emergency. The impression was made in the hospital with an airway emergency kit available.[1,9] High-volume evacuation was also kept ready. During impression making, the infant was held in an inverted position to prevent the tongue from falling back and to allow fluids to drain out of the oral cavity. Two casts were obtained from the impression out of which one was used as a definitive cast and the other was preserved as a permanent patient record. The molding prosthesis was fabricated using heat-polymerizing acrylic resin (DPI heat cure; Dental Products of India, Mumbai, India) following the guidelines described by Brecht et al.[1] Two retention buttons were positioned anteriorly at an angle of 40° to the palate on both sides of the pro-labium area (Fig 2). Selective addition of 1 mm of the soft resilient liner material (Permasoft; Dentsply) on the anterior aspect of the middle segment and palatal aspect of the lateral segments, and 1 mm trimming on the buccal aspect of the lateral segment and posterior aspect of the middle segment was carried out (Fig 2).[1] The appliance was secured to the cheeks on both sides with the skin barrier dressing tapes (Tegaderm; 3M ESPE, St. Paul, MN) looped across the orthodontic elastic bands (Fig 3). The use of skin barrier dressing tapes was advocated to reduce irritation on 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 reminded to keep the appliance seated in the active form at all times, except removal of it once daily for cleaning. The patient was recalled every week. During each recall appointment, the intraoral examination was carefully carried out to check for ulcerations, inflammation, or swelling due to the active molding forces. Sequential addition (of the resilient liner) and removal (of the hard resin) on the indicated sites of the appliance was performed at a 2- to 3-week interval. Sequential modifications facilitate the active movement of the two lateral segments laterally to make sufficient room for the middle segment. Simultaneously, the middle segment also starts moving posteriorly between the lateral segments facilitating the alignment of all three segments in a normal alveolar arch without any cleft gap. The alveolar gap between two lateral segments was allowed to increase until the space required for the middle segment was achieved. In some situations, this gap was sufficient to accommodate the middle segment. Once the cleft width reduced to the minimum width of 6 mm between the middle segment and two lateral segments bilaterally, the nasal stents were incorporated as described by Brecht et al.[1] In bilateral cases, two stents of similar shape are required. The stent, made of 0.36 inch, round stainless steel wire, was manipulated in the shape of a "swan neck" (Fig 4A).[1,4,9] The stents were

Figure 3 (A) Frontal view of the NAM appliance in position; (B) Left lateral view of the NAM appliance in position.

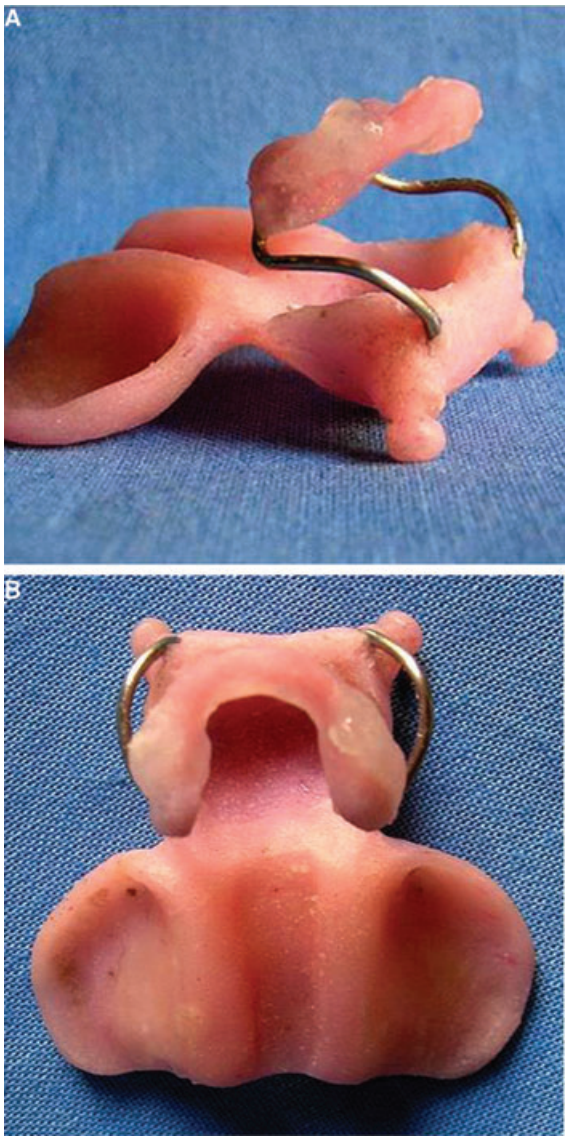

Figure 4 (A) Front-lateral view of the appliance with swan-neck-shaped nasal stent; (B) Complete NAM appliance; note the shape of the horizontal bar.

attached to the labial flange of the middle segment, near the origin of the retention arms (Fig 4B). A small loop shaped into a kidney-shaped bilobed form was created in the wire to retain the intranasal hard acrylic component.

After attachment of nasal stents, the treatment was focused toward the nonsurgical columella lengthening. Lower lobes of both the nasal stents were joined with a hard acrylic resin bar passing horizontally over the junction between the tip of the nose and premaxilla (base of the columella). This bar was fabricated to fit at the nasolabial junction (Fig 5A). The tape was attached to the prolabium underneath the horizontal lip tape and stretched downward to engage the retention arm with elastics. This vertical pull provides a counter stretch to the upward force applied to the nasal tip of the nasal stent. The horizontal lip tape was added after the prolabium tape was in place. A layer of 1 mm resilient denture liner was added to the hard acrylic buttons and horizontal bar for the cushioning effect. An extra layer of 1-mm thick resilient liner was applied on the tissue contact area of the horizontal bar to ensure additional pressure at the junction of the nasal tip and premaxilla. Addition of the extra thick resilient liner layer facilitates the active additional pressure. This applies active pressure at the base of the nasal tip, helping lengthen the columella more rapidly than a conventional NAM appliance (Fig 5B). The adjustment of the appliance and tissue care was practiced every week to mold the nasal tissues into the desired shape.

The distance between the right lateral segment and middle segment was reduced from 12 to 4 mm, and the distance between the left lateral and middle segment was reduced from

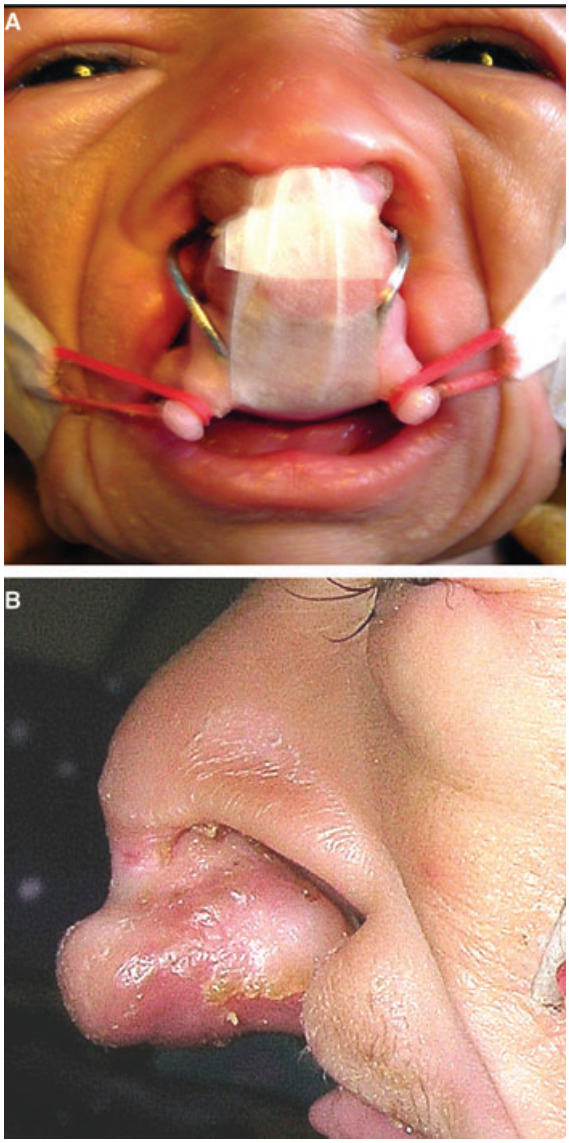

Figure 5 (A) The NAM appliance with nasal stent and vertical banding in position; (B) Columellar area showing tissue blanching caused by the active horizontal bar of the appliance.

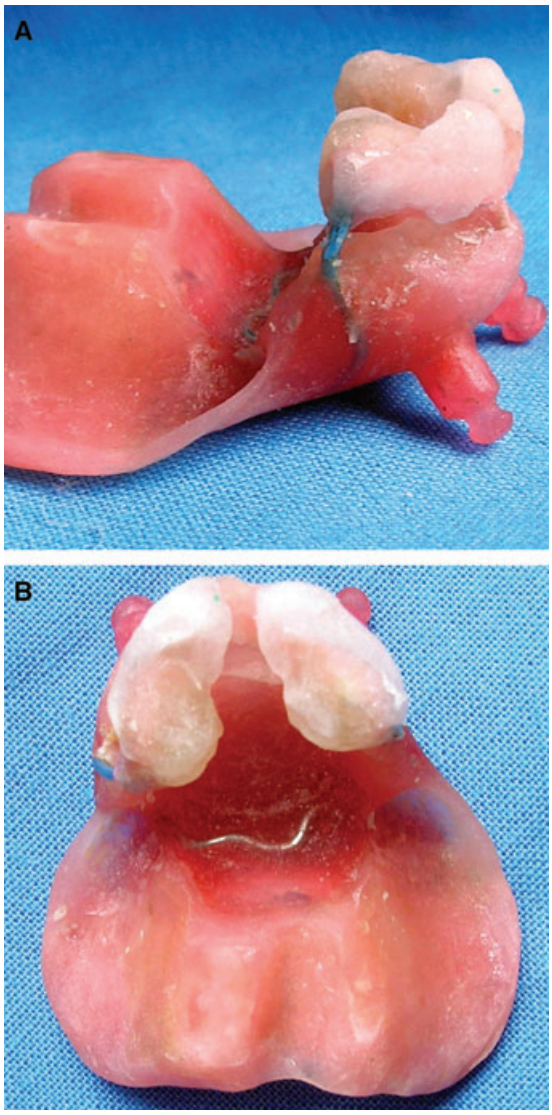

Figure 6 (A) Second NAM appliance; note less exaggerated swan-neck-shaped nasal stent; (B) Second NAM appliance; note the shape of the horizontal bar and the space created by removing hard acrylic in the anterior middle portion of the appliance.

14 mm to 5 mm after 2 months. The new second appliance was fabricated in a similar way (Fig 6). This time the wire needed to be manipulated with mild swan-neck curvatures due to a retracted middle segment. After 5 months, the middle segment was completely retracted, and the cleft width between the middle lobe and two lateral lobes was completely reduced (Fig 7). Thus, the NAM procedure was completed with a total 6 mm of columella lengthening (Fig 8). Duration of the NAM could vary depending on the severity of the initial cleft deformity.[1,4] The patient was referred to the plastic surgeon for surgical repair. The primary surgical repair of the alveolus, lip, and nose can be carried out soon after completion of the NAM treatment (5 months in this case).[4] Unfortunately, we were unable to locate the patient by any means thereafter, and hence could not follow up to observe surgical results.

Discussion

The goal of NAM in the orofacial orthopedic treatment of bilateral cleft-lip/palate clefts is to align and approximate the maxillary alveolar segments while simultaneously supporting and molding the deformed nasal cartilages and lengthening the deficient columella in early infancy, before primary reparative lip surgery.[1,4,9] In the bilateral cleft deformity NAM therapy consists of three phases: retraction of the premaxilla, repositioning the apices of the alar cartilages, and lengthening of the columella. The cleft deformity (12 and 14 mm on right and left side, respectively) was completely reduced, and all three segments were aligned in a normal arch. One of the most significant benefits of the bilateral application of NAM is the nonsurgical lengthening of the absent columella. The columella

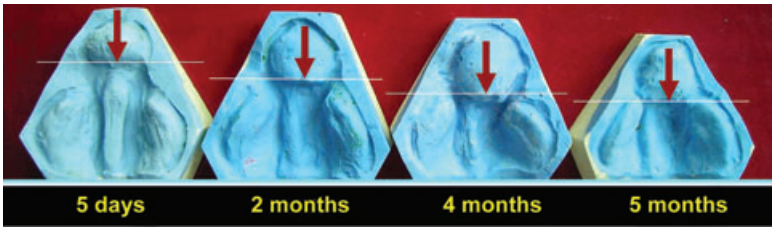

Figure 7 Casts prepared at the age of 5 days, 2 months, 4 months, and 5 months as the patient's intersegmental width completely reduced from 12 mm on right side and 14 mm on left side. Note the white lines indicating the sequential retraction of the middle segment in the direction indicated by the arrows.

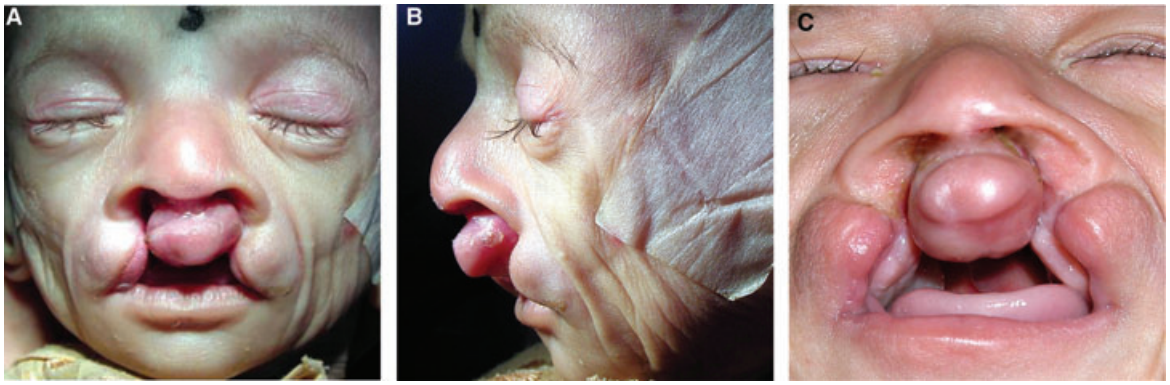

Figure 8 (A) Completion of the NAM treatment facilitates easy surgical repair; (B) Posttreatment left lateral view; (C) Posttreatment occlusal view.

may be nonsurgically lengthened about 4 to 7 mm using NAM therapy.[12] In this case, the columella was nonidentifiable and was merged with the nasal tip-prolabium junction, which was lengthened to 6 mm in 5 months. The horizontal bar of the nasal stent of the appliance was modified by adding an additional 1 mm layer of resilient liner on the tissue surface to achieve rapid columellar lengthening. In severe bilateral cleft-lip/palate cases simple modifications in the appliance can achieve rapid results.

Plasticity of cartilage in the newborn infant permits the repositioning of the nasal cartilages.[3] 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.[3,10] In severe bilateral cleft-lip/palate patients, columella lengthening should be achieved in the prescribed limited period of time (about 5 to 6 months). Close attention to regular patient recall, and meticulous sequential modification in the appliance can help achieve quick results. The reduction in the cleft width facilitates the repair of the entire lip/nose/alveolus complex in one surgical procedure. Long-term studies indicate that stable and better nasal tissue forms with less scar tissue.[11] The approximation of the alveolar processes before surgery also enables the surgeon to perform the primary repair successfully. A reduced need for alveolar bone grafting by NAM has been suggested by some authors.[12,13] Thus, the surgical-construction procedure often gets simplified in cleft lip/palate. Modified surgical techniques like gingivoperiosteoplasty followed by NAM ensures long-term postsurgical esthetics.[1,15] Lee et al[15] studied the long-term effect of NAM followed by gingivoperiosteoplasty (a modified surgical treatment) on mid-face growth and concluded that growth was not affected by NAM. Series of multiple surgical interventions to correct the deformities (to achieve the desired esthetics) can be minimized due to the good results of presurgical NAM. Although 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.[14-17]

Conclusion

Nonsurgical columellar lengthening can be achieved in severe bilateral cleft-lip/palate cases with a NAM appliance with a simple alteration. Regular patient follow-up and meticulous sequential modifications in the NAM appliance/s can help achieve quick results in complex cleft lip/palate cases.

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