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NASOALVEOLAR MOLDING-A COMPREHENSIVE REVIEW AND CASE SERIES

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Cleft lip and palate constitutes one of the most common congenital anomalies (Hibbert and Field, 1996).[1] Indian studies have reported a wide range of incidence figures from 0.25 to 1.56 per 1000 live births. It is estimated that every year between 25,000 to 35,000 babies born in India have a cleft of the lip and or palate. Testimonies of cleft presence were reported even in antiquity and it is reported that Demosthenes (384-322 B.C.) suffered from cleft lip and palate and used pebbles for palate obstruction so as to enunciate correctly (Haralabakis, 1997).[2]

Cleft lip and palate is a common craniofacial anomaly, requiring complex multidisciplinary treatment and having lifelong implications for affected individuals. Children with cleft lip and/or palate are at risk for psychosocial problems due to multiple factors associated with the condition. Speech problems and facial appearances may create adverse reactions from others, which may further place psychological stress on the child resulting in issues with self-esteem and emotional development (Richman, 1983; Kapp-Simon et al., 1992; Millard and Richman, 2001).[3] Recent research has shown that there are neuropsychological patterns of specific strengths and weaknesses associated with clefting, and some of these have been related to direct neuromaturation differences through brain imaging (Nopoulos et al., 2007; Conrad et al., 2009).[4] Thus a team approach is required to manage a cleft lip and palate patient for a better care. Multidisciplinary management of CL/P, begins shortly after birth and often consists initially of genetic counselling, assessment, and presurgical treatment and is followed over the next few years by surgical repair of the cleft lip, orthodontic treatment, surgical treatment and repair of the cleft palate and other forms of assessment of speech, orthodontic and/ or skeletal issues that might warrant further intervention or surgical treatment (Bardach et al., 1992).[5]

Neonatal Maxillary Orthopedics

Presurgical orthodontics or neonatal maxillary orthopedics is a treatment modality in which distorted and displaced maxillary segments at birth are repositioned by series of orthopedic appliances to produce a normal appearing maxilla while reducing the cleft space in the alveolus and palate. This molding action would reduce nasal and lip distortion by bringing the palatal segments in closer relationships. The treatment is initiated during the first or second week following birth unless complications arise from other congenital anomalies or medical problems. This treatment may be carried out by the orthodontist, the pedodontist, or the prosthodontist. The molding was attempted several centuries back. In 1686, Hoffman described the use of a head cap with arms extended to the face to retract the premaxilla and narrow the cleft. The concept of an intraoral device to reposition the cleft alveolar segments is attributed to McNeil who introduced it in the early 1950s. However neonatal maxillary orthopedics still remains a controversial part of the comprehensive care for cleft lip and palate patients regarding its long term benefit among clinicians.

Nasoalveolar Molding

In 1993, Barry Grayson et al.[6] described a technique to correct the alveolus, lip, and nose in infants born with cleft lip and palate. This technique was different from the previous techniques of infant orthopedics where in a nasal stent was added to the intra oral plate enabling nasal and alveolar molding simultaneously. The combined oral plate and nasal stent produced a nasoalveolar molding appliance. The oral plate is used shortly after birth (approximately 7 days) and the nasal stent is added when the alveolar cleft is less than 0.5 cm. The patient is usually treated with nasoalveolar molding therapy for 3 to 4 months until the alveolar cleft is less than 3 mm and the nostril rim on the affected side had been repositioned. When the patient completes nasoalveolar molding therapy, primary lip, alveolar, and nasal surgery is performed. This technique has gained popularity and is routinely carried in many major cleft centres now days.

Principle

The original research for molding cartilage was performed by Matsuo.[7-10] He recognized that the cartilage in the newborn is soft and lacks elasticity. He believed that the high maternal level of oestrogen at the time of birth correlates with an increase in hyaluronic acid, which inhibits the linking of the cartilage intercellular matrix. This process may be necessary to relax ligaments, cartilage and connective tissue, enabling the foetus to pass through the birth canal. The level of oestrogen begins to decline immediately after birth. Matsuo used a stent in the form of a pair of silicone tubes to shape the nostrils, with some limitations. These include the need for an intact nasal floor, (Simon Arts band or lip adhesion) and the inability to direct the force since his stent expands circumferentially. Grayson adapted his nasal stent to extend from the anterior flange of an intraoral molding plate. The greatest advantage of this technique is that it enables the practitioner to apply force to precisely shape the nasal cartilage and in the case of bilateral cleft lip and palate, lengthen the columella. In addition, since the stent is extended from a molding plate, an intact nasal floor is not required.

OBJECTIVES

The principle objective of presurgical nasoalveolar molding is to reduce severity of the initial cleft deformity. This enables the surgeon to enjoy the benefits associated with repair of an infant that has a minimal cleft deformity. The goals include achieving lip segments that are almost in contact at rest, symmetrical lower lateral nasal cartilages, uprighting of the columella and adequate nasal mucosal lining that permits postsurgical retention of the projected nasal tip. Additional objectives of nasoalveolar molding include reduction in the width of the alveolar cleft segments until passive contact of the gingival tissues is achieved. As reduction of the alveolar gap width is accomplished, the base of the nose and lip segments achieves improved alignment. All these are achieved through the use of a nasal stent, intraoral molding plate and surgical tape.

In infants with bilateral clefts of the lip, alveolus and palate, the objective of presurgical Nasoalveolar molding includes the nonsurgical elongation of the columella, centring of the premaxilla along the midsagittal plane and retraction of the premaxilla in a slow and gentle process to achieve continuity with the posterior alveolar cleft segments. Additional objectives include reduction in the width of the nasal tip, improved nasal tip projection and decrease in the width of nasal alar base.

Procedure

There are many modifications been done and popularly used to the original Graysons technique. Figueroa et al. (1993)[11], Iino Mitsuyoshi et al (2004)[12], Cenk doruk & Banu kilic (2005)[13], Ricardo et al (2006)[14], Amornpong et al (2008)[15], Abida Ijaz et al (2010)[16], Quan Yu et al (2011)[17] are some of them who did the modifications. In our department we adopt the modified Figueroa technique in most of our cases.

Graysons Technique[18]

A heavy-bodied impression material is used to take the initial impression as soon after birth as possible. Impression is taken with the infant in the lap of the guardian in an inverted position (fig 1). Once the impression material is set, the tray is removed and the mouth is examined for residual impression material that may be left behind. A cast or model of the alveolar anatomy is made by filling the impression with a dense plaster material (dental stone). The molding plate is fabricated on the dental stone model. It is made of hard clear acrylic and lined with a thin coat of soft denture material. Care is taken to reduce the border of the plate in the area of the labial frenum attachments and other areas that may be likely to ulcerate. A 5-mm diameter hole is made in the centre of the acrylic palatal vault to provide an airway in the event that the posterior border of the plate drops down onto the tongue.

Fig.1

Parents are instructed to keep the plate in full time and to take it out for cleaning as needed, at least once a day. Initially, it may take longer to feed the infant with the plate in place, but the child quickly adjusts and parents report that they soon will not eat without it (Fig. 2).

The appliance is secured extraorally to the cheeks, bilaterally by surgical tapes, which have an orthodontic elastic band at one end. The elastics loop over a retention arm extending from the anterior flange of the plate (Fig. 3).

Fig.2 Patient comfortably feeding with the plate

Fig. 3 The retention arm is positioned approximately 40^{o} down from the horizontal plane to achieve proper activation and to prevent unseating of the appliance from the palate (fig 3).

The tapes and elastics are changed once a day. Appointments should be given every 2 Weeks to modify the molding plate in order to guide the alveolar cleft segments into the desired position. Care should be taken not to add the nasal stent before achieving laxity of the alar rim, as an increase of the nostril circumference may result. Only one retention arm is attached to the appliance for treatment of the unilateral cleft patient. Parents are instructed to place tapes in order to approximate the cleft lip segments. The tape should be applied at the base of the nose (nasolabial angle) and not low on the lip near the vermillion border. The tape should be applied to the noncleft side first, then pulled over and adhered to the cleft side, making an effort to bring the philtrum and columella to the midline.

When the cleft alveolar gap is reduced to 5mm or less, the nasal stent is added. The stent is made of .036 gauge round stainless steel wire and takes the shape of a "swan neck" with a kidney bean-shaped nasal bulb (Fig.4). The kidney bean-shaped nasal bulb has 2 parts: a relatively larger upper lobe that lies beneath the alar dome and a lower lobe that lies just.

Fig.4 NAM plate with nasal stent added

beneath the nostril rim. Incremental addition of soft denture reline material to the upper lobe and controlled activation of the upper neck portion of the nasal stent support and gently mold the collapsed alar dome, which is clinically reflected by its mild tissue blanching.

Non-surgical columella lengthening in bilateral cleft lip and palate

In bilateral cases, there is a need for two retention arms as well as two nasal stents which are similar in shape to the unilateral stent (Fig.5).

Fig. 5 Two nasal stents are added for a bilateral case

After adding the nasal stents in the bilateral cleft, the attention is focused on non-surgical lengthening of the columella. To achieve this objective, a horizontal band of the denture material is added to join the left and right lower lobes of the nasal stent, spanning the base of the columella. This band sits at the nasolabial junction and defines this angle as the nasal tip continues to be lifted and projected forward. The tape is adhered to the prolabium underneath the horizontal lip tape and stretches downward to engage the retention arm with elastics.

Modified Figueroa Technique

In our department we adopt Modified Figueroa Technique technique in most of our cases. It's similar to Grayson's technique except in few aspects. Figueroa suggest the addition of nasal stent to the intra oral molding plate in the first appointment itself without waiting for the cleft alveolus to get reduced to less than 5mm as been suggested by Grayson. The idea is to use the molding potential of the nasal cartilage without further delay. There are also some modifications done in the design of the plate (Fig 6) 1. A U loop is added to the nasal stent which gives control for the adjustment of the stent. 2. No retentive buttons used in the plate with tapes attached to hold the plate. We feel the loop added to the stent give some retention to the plate avoiding the need for a retentive button. If required zinc free adhesive powders can be give for retention. In bilateral cases, the attention is focused on non-surgical lengthening of the columella. The nasal molding stents are not added to the palatal plate until the premaxilla is retracted to a more ideal position to avoid interference with movement of the premaxilla .The premaxilla is retracted using an close link elastomeric chain covered with resilient denture liner(fig.11&12). The tape is adhered over the resilient denture along with approximation of the lips. Once the premaxilla is retracted two nasal stents are incorporated into the plate which is similar to the unilateral stent.

Fig 6 Figueroa's design

Fig 7 & 8. Patient with the bilateral appliance

Appliance adjustments

The baby is seen weekly to make adjustments to the moulding plate to bring the alveolar segments together. These adjustments are made by selectively removing the hard acrylic and adding the soft denture base material to the moulding plate. No more than 1 mm of modification of the moulding plate should be made at one visit (Fig. 9).

Fig. 9.Removing hard acrylic in the palatal side to retract the premaxilla in a bilateral case

Fig. 10 Addition of soft tissue liner

Fig. 11 Relined NAM plate

The alveolar segments should be directed to its final and optimal position. Care must be taken to prevent the soft denture material from building up on the height of the alveolar crest as this will prevent complete seating of the moulding plate. (Fig. 10 and Fig. 11).

Instructions for the parents

- Parents should be motivated & educated properly.
- They should be instructed to keep the plate in full time, and to take it out for cleaning as needed, at least once a day.
- Tapes and elastics are changed once a day.
- Ask to apply baby cream over cheeks while changing tapes.
- They are asked to examine the child's mouth regularly for any ulceration.

Duration of therapy

NAM therapy is done till the objectives are met. Surgical closure of the lip and nose is performed from 3-4 months of age.[19-22] Bilateral cleft patients tend to take one to two additional months to achieve presurgical clinical objectives. The duration of moulding therapy could also vary depending on the severity of the initial cleft deformity.

Figure 12 shows a case report of a complete unilateral cleft lip and palate in the left side treated with NAM therapy with its surgical outcome. Post NAM good amount of molding of nose, lip and alveolus was able to obtain.

PRE

POST

Fig. 12 Pre, Post NAM & Post surgery comparison extra oral photographs of a unilateral cleft lip & palate case

Nasal molding can be noticed by increased columella length and improved nostril form in the submental view of post NAM.

PRE

POST

Approximation of lip can be noticed post NAM

Pre and Post NAM comparison of the cast in the unilateral cleft lip & palate case

Approximation of the alveolus can be noticed in the study model.

Benefits

- Since the cleft deformity is reduced in size before surgery; a better and more predictable surgical result can be expected.
- It reduces the number of surgical revisions for excessive scar tissue, oronasal fistulas and nasal & labial deformities.
- Improved long-term nasal esthetics & reduced number of nasal surgical procedures.
- Permanent teeth have a better chance of eruption due to the approximation of alveolus.

CONCLUSION

Long-term studies of NAM therapy indicate that the change in the nasal shape is stable with less scar tissue and better lip and nasal form.[23-28] Since the initiation of NAM, there has been a significant difference in the outcome of the primary surgical cleft repair. Medical practitioners especially paediatricians should be made aware about the NAM therapy and its benefits. It should be made clear that NAM plates are not just feeding plates, but they do mould nose and alveolus as well. With proper training and clinical skills, NAM has demonstrated tremendous benefit to the cleft patients as well as to the surgeon performing the primary repair.

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