A New Classification System for Unilateral Cleft Lip and Palate Infants to assist Presurgical Infant Orthopedics

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The proposed advantages of pre-surgical naso-alveolar moulding (PNAM) are easy primary lip repair which heals under minimum tension reducing the scar formation and improving the aesthetic results in addition to reshaping of alar cartilage and improvement of nasal symmetry.However, the anatomy and alveolar morphology varies for each cleft child; the procedure for PNAM differs accordingly. In an attempt to categorize unilateral cleft lip and palate cases as per anatomical variations, a new classification system has been proposed. This classification aims to give an insight in unilateral cleft morphology based on which modification in PNAM procedure could be done.

Key words: Pre-surgical naso alveolar molding; Classification, Unilateral cleft lip and palate

INTRODUCTION

Cleft lip with / without palate is the second most common congenital deformity. Over the years, various treatment modalities have been attempted in these patients so as to achieve satisfactory outcome. McNeil (1956) [1] and Burstone (1958)[2] were the modern day pioneers of presurgical infant orthopaedics and the concept was further improved by others[3-8].

At present, there are two competing philosophies. One involves surgical correction alone, while the other involves surgical correction in conjunction with pre-surgical moulding of the cleft segments. Based on the work of Matsuo et al (1959) [9] who described the mouldability and plasticity of neonatal nasal cartilage in the early months of an infant's life, Grayson et al (1990, 1999) [10, 11], proposed the combination of pre-surgical orthopaedics and nasal moulding as a new technique called pre-surgical nasoalveolar molding (PNAM) for approximating the alveolar segments and improving the nasal deformity preoperatively.

This technique has generated considerable interest and is being used as an alternative to the traditional methods of managing infants with cleft.

In our institute PNAM for cleft lip and palate infants is being practised for the last 8 years. During routine follow up, it was observed that 60 % children were developing anterior as well as posterior crossbites. When the pre PNAM casts were re-evaluated retrospectively, it was found that the type, intensity of cleft defect and position of alveolar segments differed from case to case. Hence it would be improper to apply one universal technique for all types of cleft cases. The need was felt to categorize unilateral cleft lip and palate patients so that PNAM procedure could be individualized for the patients.

A new classification has been proposed based on the length of greater and lesser alveolar segments and position of the segments with respect to each other.

Type	Description
A	Greater and lesser alveolar segment are of sufficient length (small alveolar defects)
B	Greater alveolar segment is of sufficient length but lesser alveolar segment is small and/or placed posteriorly
C	Greater and lesser alveolar segments are of small length or parallel to each other
D	Greater alveolar segment is overlapping the lesser alveolar segment

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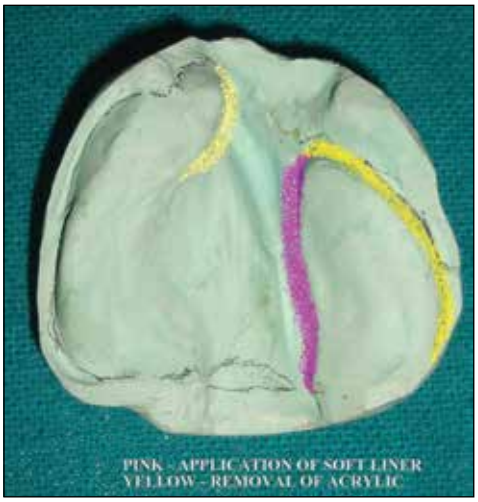
Based on the type of arch, The PNAM technique modification and the biomechanics is as follows

PNAM appliance for Type A arch

In this category, the greater and lesser alveolar segments are of sufficient length, the alveolar defect is less than 8mm and the posterior alveolar segments are not curved palatally. The maxillary tuberosities are well expanded and are used for support of the plate. About 1.5mm of acrylic is removed from inner surface of anterior 1/3rd of greater segment to create space for the inward movement of the segment. The outward projection of anterior 1/3rd of greater segment (extending from its anterior most tip to the canine bulge) is then moulded inward with the help of lip taping. Soft liner is applied on the inner surface of mid 1/3rd and posterior 1/3rd of lesser segment for expansion. Equal amount of the acrylic is removed from opposite side of the segments to make space for the alveolar ridge to move (Figure 1).

Fig 1: Type A

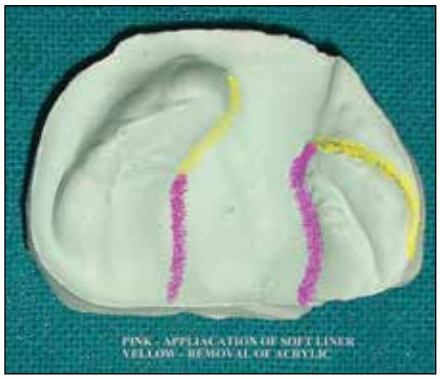


PNAM appliance for Type B arch

In this category, the greater segment is of sufficient length but lesser segment is small and/or placed posteriorly, the alveolar defect is more than 10mm, tuberosities are curved and appear constricted. During moulding, care is taken not to approximate the two segments or close the defect. Arch form should be maintained. The greater segment should be moulded as in type A, while the small or posteriorly positioned lesser segment should be expanded transversely for which soft liner is added on inner surface of mid and posterior 1/3rd of the lesser segment. Equal amount of the acrylic is removed from opposite side of segments to make space for the alveolar ridge to be moved laterally. Acrylic is trimmed in the area of alveolar defect. Thus a space is created in the desirable direction so as to allow the inherent growth of lesser segment to take place and close the defect. Any attempt to achieve closure of alveolar segments, may lead to arch constriction (Figure 2).

This modification will prevent the constriction of arch which is considered to be one of the drawbacks of PNAM.

Fig 2: Type B



PNAM appliance for Type C arch

Here, the greater and lesser alveolar segments are of small length or parallel to each other. A wide defect appears in the middle of the arch. At times, it becomes difficult to identify the segments as greater or lesser. This is mostly seen in midline cleft with rudimentary or absent premaxilla. Deep impressions are advised. Appliance must reproduce the undercuts and vomer. The transverse width of the arch is maintained and the alveolar segments are expanded with soft liner. No attempt must be made to close the alveolar defect so as to prevent arch collapse. Closure with a flap can be done later, or the defect can be sealed with an obturator(Figure 3).

Fig 3: Type C

PNAM appliance for Type D arch

Here, the greater segment is either overlapping or in close proximity with lesser segment. These locked segments are commonly seen in cases with cleft of lip and alveolus only. If overlap is mild to moderate, consideration should be given only to nasal moulding. The inherent transverse growth of the maxilla will unlock the overlapping. But in cases with severe overlapping where the greater segment is protruding out of the lip and the surgical approximation is difficult; invasive technique like Latham's appliance can be considered(Figure 4).

Fig 4: Type D

Securing the appliance

The appliance is retained extra-orally. As the appliance is passive it tends to fall on the tongue, this stimulates the tongue for suckling and swallowing movements. This makes the mandible functional, and also helps in normal growth and development. The combined tongue and mandibular movement activate the appliance which moves the nasal stent up, giving a forward and outward thrust to the nasal alar cartilage for nasal moulding. Alveolar moulding is done by application of the soft liner to the appliance. The inferior movement of the appliance posteriorly produces force on the anterior alveolar segment and the soft liner applied on the inner surface of the appliance forcefully pushes the greater segment inside for moulding. The horizontal lip taping with lips in approximation helps repositioning of columella in the midline thus moulding the lip tissue which also moulds the greater alveolar segment[12].

DISCUSSION

Thorough knowledge of prenatal and postnatal growth and development in cleft lip and palate infant is the key to any treatment modality. Obtaining facial and nasal symmetry in cleft patients is a challenge for any health professional. Most of the research concerning long term results on PNAM focus on maxillary arch development, nasal symmetry, facial growth, dental development, and feeding[13,14].

Some of claimed advantages of pre-surgical infant orthopaedics are facilitation of surgical lip closure with better aesthetic results, support for speech development, less risk for aspiration, less severe skeletal and dental deviations resulting in less orthodontic and surgical treatment later on, and psychological support for the parents [15,16]

Opponents to this technique claim that PNAM does not enhance maxillary growth and its orthodontic benefits are limited[13,14,17-21].

There has been concern that early dissection and manipulation of the nasal cartilage interferes with nasal growth [22]. But Berkeley [23] (1959), Eric [24](2004) noted good primary correction of the nose and long term esthetics after presurgical infant orthopedics. Boo-Chai [25] (1985), Salyer [26] (1985), felt that since clefting is an interruption of embryogenesis, proper relationship and closure of the involved structures should be achieved as soon as possible so that normal growth of the face can take place and PNAM works in this direction [27,28]. Long term studies also have documented that nasal symmetry is improved and maintained in PNAM treated cases [29,30]. Recent long term studies have also indicated a positive effect of PNAM on nasal symmetry [31,32].

One must consider these appliances also as a psychological aid for the mother. She feels secure in handling and feeding the baby, knowing that she is doing something positive and beneficial for her baby [33]. Further, parent's continual contact with the team, observation of step by step orthopaedic and surgical results gives them deeper and more realistic insight into their baby's problem and constantly reinforces their hope of a normal future of the child.

Though maxillary constriction has been reported in cases treated with PNAM, it is necessary to give a thought to why this is happening? Whether all unilateral cleft cases were similar pertaining to the length of the alveolar segments and their position on the maxillary base? Whether a similar moulding protocol be followed for every case?

The answer to these questions is that each case should be considered differently with implication of different mechanics. Hence, based on the critical evaluation of the PNAM treated cases over last 8 years, the cases are categorized into four types and considering each case as different and accordingly the mechanics to mould the alveolar ridges are discussed in this study.

The advantages of this new proposed classification are that it is simple to use and also it provides a quick insight about the type of unilateral cleft arch form so that the case can be treated accordingly with the specific corresponding appliance.

The authors have now started categorizing the unilateral cleft infants according to the proposed new classification and are applying the corresponding proposed biomechanics in these infants for PNAM. The authors are positively looking forward for the validation of this classification. Further long term studies are required to prove the validity of the proposed classification so that the new classification can be included in the routine treatment protocol for PNAM in unilateral cleft infants.

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