Alternative Approaches to Managing the Cleft Alveolus

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The cleft alveolus component of the oral cleft deformity is addressed with a separate surgical stage. Several host and operator related factors affect the surgical outcome. When factors that increase the likelihood of secondary alveolar bone graft failure are identified, alterative methods like dentoalveolar distraction (DAD) may be employed. In infants, molding of the alveolar segments is possible and when a synergistic surgical approach is used, the possibility of successful alveolar cleft repair is increased. The authors present two case reports wherein the use of nasoalveolar molding (NAM) and DAD helped to tackle the alveolar cleft deformity.

Keywords: *Cleft palate, cleft alveolus, maxillary distraction, nasoalveolar molding, children.*

INTRODUCTION

Embryologic disturbances during the formation of the primary palate and its integration with the frontonasal process result in clefts of the alveolus. Alveolar clefts are seen distal to the lateral or central incisors. Reconstructive surgery is required to restore normal anatomy, aesthetics and function in cleft lip and palate. Primary osseous reconstruction of the cleft alveolus simultaneously with the repair of lip and palate is presently done in only a few select centres,[1] failing to gain widespread acceptance due to concerns of future maldevelopment.[2] Secondary osseous reconstruction of the cleft alveolus is done by placement of autogenous bone harvested from different sites, frequently the tibia. Successful alveolar bone grafting creates a bony bridge resulting in a single unit maxilla, permits eruption of tooth in the vicinity of the cleft that were held up for want of an adequate bony foundation, improves periodontal health and also enhances aesthetics by improving alar base projection.[3-5]

The successful outcome of alveolar bone grafting is based on a variety of host and operator related factors. Factors that have been cited in literature as predictors of successful alveolar bone graft uptake include presurgical cleft size, bone support of the teeth bordering the cleft, oral hygiene status and dental eruption status of the subject.[6-10] Dental age of the subject is an important factor taken into consideration when deciding the appropriate timing of secondary alveolar bone grafting (SABG).Large alveolar defects, previously failed attempts at grafting and tertiary bone grafting are areas of concern that may influence the success of grafting.

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Distraction osteogenesis (DOG) is a procedure that involves controlled intentional fracture of bone, followed by a period of rhythmic traction eventually resulting in the formation of new bone and associated soft tissue. The craniofacial region has found widespread application of DOG. Dentoalveolar distraction (DAD) involves the movement of the tooth bearing segment of bone. DAD has been successfully used to approximate the alveolar cleft.[11-13]

NAM is a presurgical infant orthopaedic procedure that is gaining widespread acceptance[14] wherein along with the lower lateral alar cartilage; active molding of the alveolar segments is done at infancy. NAM aims for a complete esthetic primary surgical correction of all areas of the cleft deformity, including the alveolus, eliminating or minimizing the need for secondary surgical interventions later in life.[15] Reports indicate that when combined with a surgical approach that builds up on the foundation laid down with NAM, bony bridging across the cleft alveolus was seen in a majority of subjects. Minor residual defects were also successfully eliminated in these subjects at the time of secondary bone grafting [15].When the subjects were investigated further, it was found that NAM coupled with gingivoperiosteoplasty did not produce any restriction of midfacial growth in early childhood.[16] However, conflicting reports have been published by other cleft centers.[17]

We employed DAD and NAM in an adolescent and infant cleft subject respectively to successfully approximate the alveolar cleft deformity.

Management in an adolescent post canine eruption with DAD

A current trend towards earlier grafting to provide support for the erupting lateral incisor is emerging.[18] However, in case subjects report late for SABG, attaining the goal of providing a bony foundation for the eruption of teeth is not possible once teeth in the vicinity of the cleft have erupted. A 12 year old CUCLP subject with a wide alveolar cleft measuring 9 mm reported for surgical consultation. The canine tooth bordering the cleft had erupted two years ago. Radiographs showed that only a thin shell of bone coverage was present on the mesial of the canine and distal of the central incisor, that was restricted to the apical third of the tooth. A decision to approximate the alveolar cleft with DAD was made.

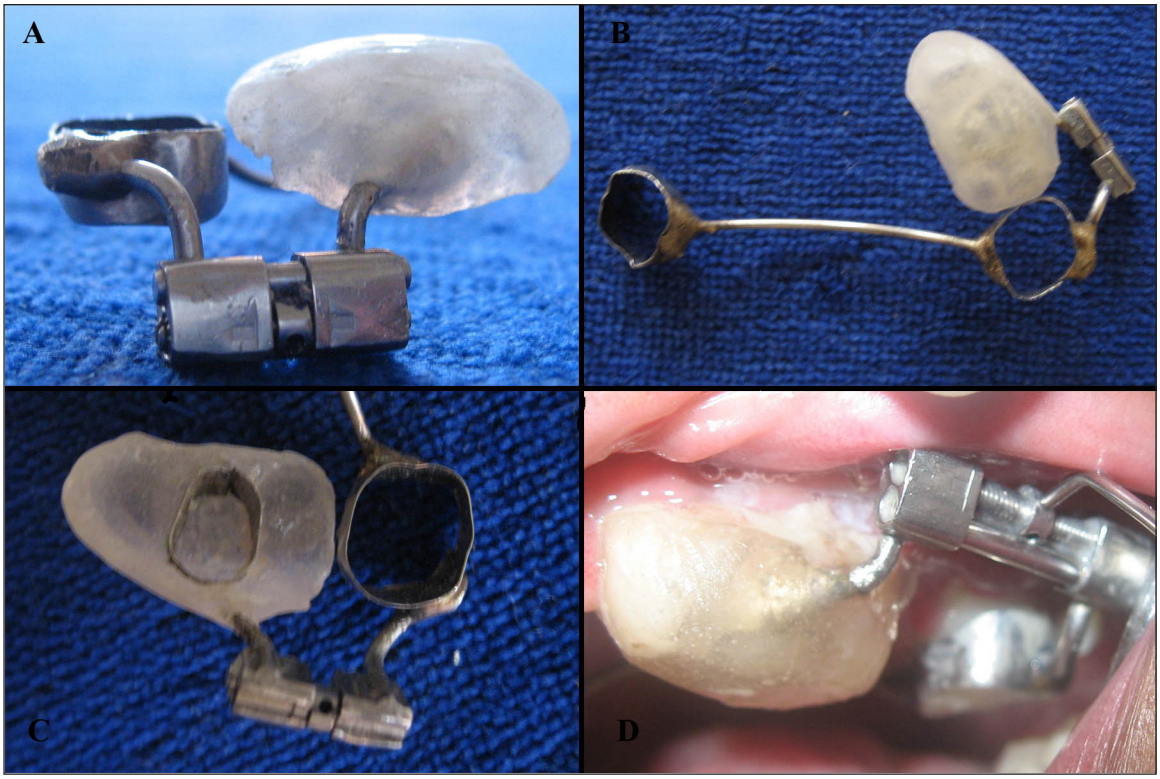

Figure 1. Different views of the distraction screw. A – Screw with 2 arms adapted and soldered. B- Distal arm soldered to the molar band with an offset. C- Transport segment reinforced in an acrylic casing D- Intraoral view of key inserted in screw for activation.

Distraction Device – Prior to fabricating the custom tooth borne distraction device a thorough analysis of the distraction vector is essential. This permits to fabricate and orient the distraction device appropriately. It is known that the primary vector of distraction is in the direction that the device points. The distraction device was made modifying a rapid palatal expansion screw. One half of the screw including two arms and a guide pin were sectioned using a cutting disc. The remaining two arms were bent and adapted using orthodontic pliers (Fig 1A). The distal arm of the screw was given a molar offset (Fig1 B), before soldering it onto the cervical aspect of the molar band .The mesial arm was closely adapted to the occlusal portion of the premolar band and soldered. The transport segment comprising the premolars and canine was reinforced into a single unit acrylic splint (Fig 1C).

When secured, the anterior end of the distraction screw pointed inferiorly and towards the midline. The resultant primary distraction vector was tilted anteriorly downward. Tipping of the transport segment has been reported during DAD, ultimately leading to the canine at a higher occlusal position post distraction[19] .With a rigid intraoral distractor, altering the direction of distraction midway is cumbersome and a separate stage of levelling is usually required. Orientation of the distractor in a favorable direction at the initial stage ensures that the transport segment reaches its intended final position, with no additional need for post distraction levelling.

Surgery – Under nasoendotracheal anaesthesia intraoral mucosal incisions were made to approach maxillary bone. Mucoperiosteal flaps were raised to expose the intended osteotomy sites. A vertical interdental osteotomy between the molar and premolar and a horizontal osteotomy 3 mm above the apex of the canine was made (Fig 2A). Care was taken to keep away from the tooth roots. After the completion of the osteototomies, mobility of the segment was evaluated. The distraction device was mounted and a trail activation done after which it was cemented in place with glass ionomer cement. Palatal mucosa was preserved intact to ensure adequate vascularity.

Distraction Protocol – The process of distraction osteogenesis includes a period of latency, period of distraction and a period of consolidation. The period of latency represents the period from osteotomy to the start of the distraction process. This seven day latency period allow for formation of the primary callus and primary healing of gingiva and oral mucosa. The process of distraction starts when the bone segment is carried anteriorly towards the cleft by activating the screw with a key (Fig 1D) until the cleft is eliminated. Thereafter follows a period of preserving the achieved condition

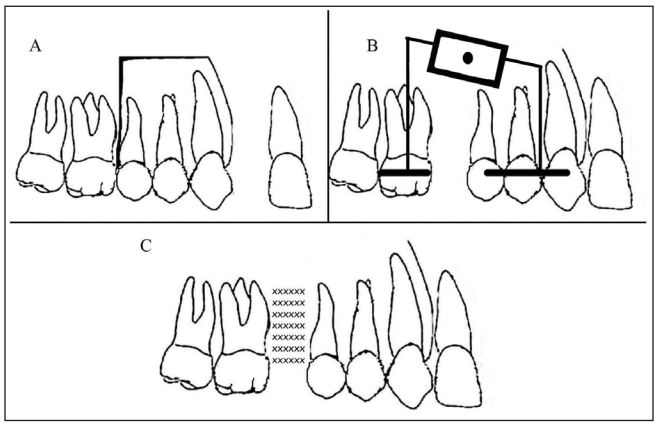

Figure 2. Illustration of the DAD procedure. A – Osteotomy design. B – Screw oriented according to distraction vector. C - New bone regenerate between the molar and premolar.

Figure 3. Occlusal and frontal views of the DAD sequence. A- Pre distraction. B- Mid distraction at 15 days. S C –Post consolidation at 3 months with new bone and soft tissue.

(consolidation) for a period of approximately 3 months to allow mature bone tissue to form from the primary callus. The distractors are then removed and post distraction orthodontics follows.

Clinically, complete approximation of the cleft alveolus occurred with soft tissue contact (Fig 3). When post consolidation radiographs were analysed, near bodily movement of the distracted segment with minimal tipping (Figs 4 and 5) was observed. The new bone regenerate showed growing resemblance to native bone in both quantity and quality.

Management in an infant with NAM

Once the infants parents are convinced of the benefits of NAM and give consent intraoral maxillary impression are made; the details of which have been previously reported by the authors.[20, 21] The alveolar cleft and any other undercut areas on the working models are blocked and cold cure acrylic resin (DPI-RR Cold Cure, India) is used to fabricate a plate not more than 2mm in thickness. All surfaces of the plate are verified for absence of any rough regions and a trial fit undertaken in the infant's oral cavity. Proper fit of the plate is evidenced by the infant making attempts at sucking on the plate or operators finger during the trial procedure. Choking or gagging during trial could mean an increase in posterior extension of the plate, which needs to be reduced. An acrylic retentive button on the labial flange of the plate is attached using cold cure resin. The retentive button connects the intraoral plate to the extraoral elastic tape force system.

Alveolar molding begins after two days once the infant is accustomed to the molding plate. Addition of soft liner (GC Corporation, Japan) and removal of acrylic from select areas of the plate in a timely fashion helps in alveolar molding. When the alveolar defect reduces to less than five millimetres, nasal molding stents are added for active nasal molding. Controlled sequential addition of soft relining material to; and removal of hard acrylic from select areas of the intraoral plate at the period of the infantile growth spurt, help

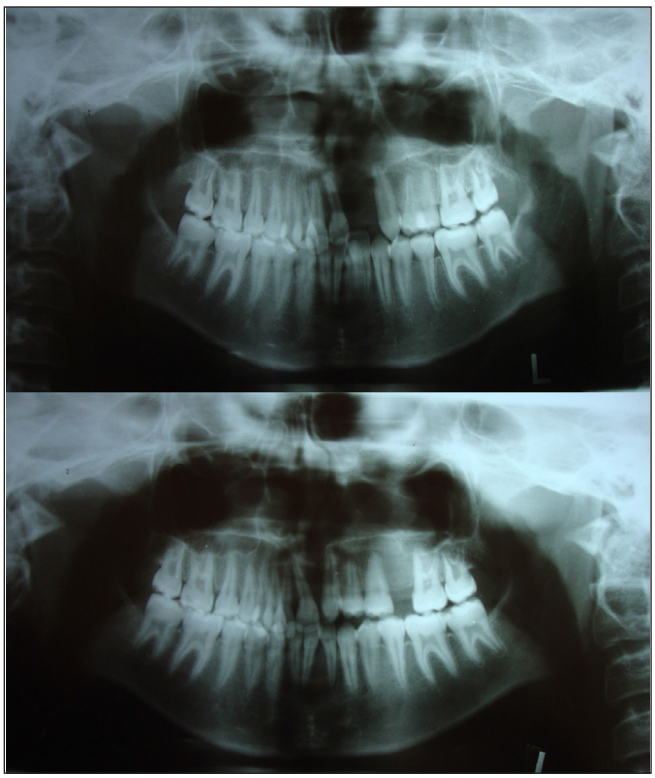

Figure 4. Panoramic radiograph pre DAD (top) and post DAD with radiopaque evidence of new bone in the site of distraction.

Figure 5. Occlusal radiographic view of new bone in between the molar and premolar.

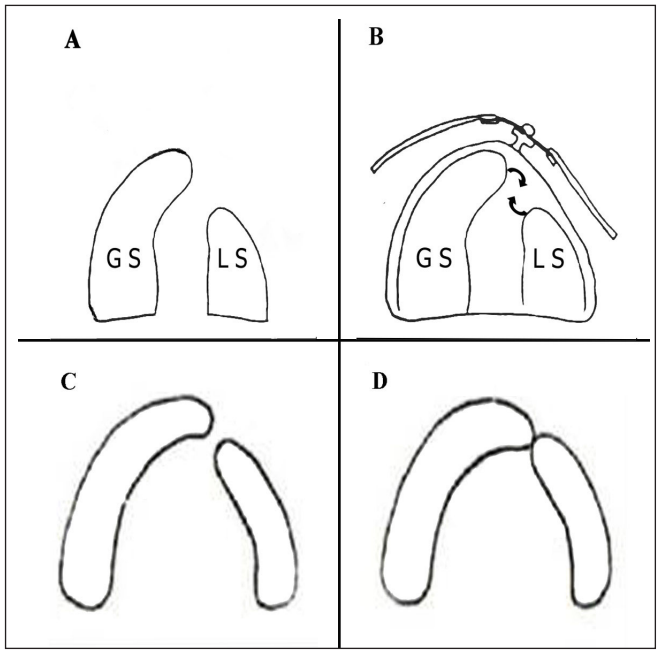

Figure 6. Illustration of the phases of alveolar molding in a UCLP infant with NAM.A – Pretreatment .B - NAM device with arrows indicating the movement of greater segment (GS) and lesser segment(LS) during molding. C- Reduction in cleft width. D – Approximation of alveolar cleft.

reduce the alveolar cleft (Fig 6). The summative effect of forces from extraoral lip taping (Fig 7A), sequential modifications to the intraoral plate on a regular basis and a final thrust from the reciprocal force of nasal molding finally help achieve a reduction in alveolar cleft width. At the level of the alveolus, the objective of NAM is to achieve a normal and harmonious alveolar arch form with close contact of the two alveolar segments prior to surgery. To help achieve this objective, parents are a additionally advised on the benefits of a prone sleeping position for infants as it has been reported that cleft and ridge widths decreased much faster.[22] We were able to successfully approximate a 10mm wide alveolar cleft to 1mm with NAM (Fig 8).

CONCLUSION

NAM and DAD may considered as viable alternatives to approximate the alveolar cleft deformity.

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Figure 7. A –Lip taping in NAM to approximate lips .B – Nasal stent improves the nasal morphology.

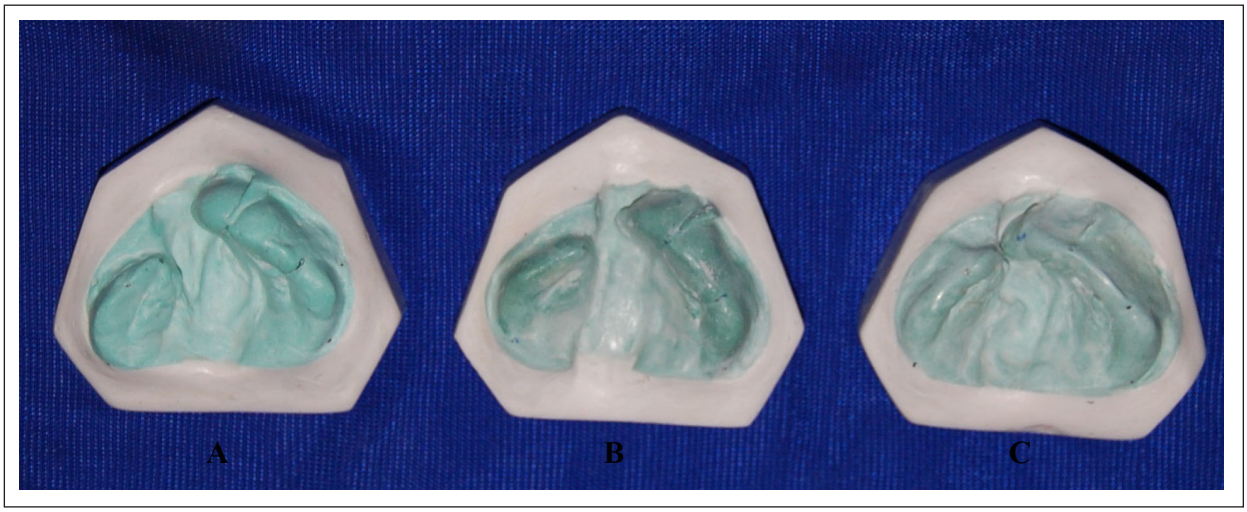

Figure 8. Models showing the progressive changes in alveolar morphology with NAM. A – Pretreatment alveolar cleft width 10 mm. B- Cleft width reduced to 5 mm and nasal stent fabricated. C- Post NAM cleft successfully approximated.

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