Caring for cleft lip and palate infants: Impression procedures and appliances in use

Review Article

V. P. Sabarinath, P. V. Hazarey, Ramakrishna Y.[1], Vasanth R.[2], Girish K.[3]

ABSTRACT

The treatment goal for cleft lip and palate (CLP) patients is to restore the normal anatomy of the affected structures. Many surgical procedures and infant maxillary orthopedic appliances have been described to achieve these goals. A variety of appliances have been described for maxillary orthopedics in infants. Prior to the fabrication of any of these appliances, we are faced with the challenge of the impression procedure in the CLP infant. This article attempts to briefly describe the appliances in use for infant maxillary orthopedics and the impression procedures followed prior to their fabrication.

KEY WORDS: Cleft lip and palate, impression procedure, infant orthopedics, nasoalveolar molding, Latham's appliance

DOI: 10.4103/0972-4052.55248

INTRODUCTION

Clefts of the lip and palate are the most common congenital defect involving the orofacial region.[1] The aim of treatment in cleft patients is to restore normal anatomy and a variety of procedures have been advocated to achieve this goal. Surgical repair of the lip is usually done between 3 and 6 months of age and though there is lack of uniform agreement, palate closure is done between 12 and 18 months of age.[2] Surgery alone may not prove to be beneficial especially in cases where the size of the cleft is large. In such cases, surgical closure may lead to an increase in tissue tension at the surgical site, which is not desirable. Infant maxillary orthopedic procedures were pioneered by Burston[1] in Liverpool in the late 1950's. Presurgical maxillary orthopedics helps to bring the cleft segments into a more acceptable alignment and resemble a more normal configuration prior to lip surgery.[2] The contemporary view is that when used as an adjunctive procedure to definitive lip repair, infant maxillary orthopedics provides presurgical benefits. Molding facilitates the surgical team in easier lip repair especially in bilateral cleft lip palate (BCLP) patients with a severely protruding premaxilla.[3] Several benefits have been attributed to the use of maxillary orthopedic procedures in infants. The claimed benefits include normalization of feeding and tongue function, better speech development, reduced risk of aspiration, easier and more esthetic lip surgery, and reduced severity of dental and skeletal deviations providing a positive psychological impact on parents.[4] Studies have shown that cleft width reduced and transverse maxillary arch width remains unchanged posteriorly in unilateral cleft lip palate (UCLP) patients probably due to the removal of the tongue influence permitting unrestricted growth of the palatal shelves.[5] Based on an study of presurgical orthopedic treatment (PSOT) in UCLP,[6] it was concluded that PSOT is able to realign the maxillary segments and diminish the anterior cleft width prior to lip closure to a variable extent. After lip repair, the effect however seems to disappear over time, suggesting that surgery might be a more important factor in maxillary

Departments of Orthodontics and Dentofacial Orthopedics, [1]K. D. Dental College and Hospital, Mathura and [2]Oral and Maxillofacial Surgery, [3]Prosthodontics, Sharad Pawar Dental College and Hospital, Sawangi (Meghe), Wardha – 442 004, Maharashtra, India

Address for correspondence: Dr. V.P. Sabarinath, Department of Orthodontics and Dentofacial Orthopedics, Sharad Pawar Dental College and Hospital, Sawangi (Meghe), Wardha – 442 004, Maharashtra, India. E-mail: sabari23@rediffmail.com

arch form than PSOT itself. The question whether PSOT has a long-term effect on maxillary growth remains uncertain. There is lack of consensus as some researchers have questioned the claimed benefits of orthopedic procedures, mainly due to the lack of long-term studies that evaluated maxillofacial growth subsequent to infant orthopedics, lack of adequate outcome measures as well as inadequate sample size.[6] There is also lack of evidence whether pressure stimulation from presurgical orthopedic treatment increases palatal growth beyond its inherent growth potential.[7]

APPLIANCES

Many different appliances have been described for use in the cleft infant for maxillary orthopedics and the use of a particular appliance is decided after a team evaluation of the case. Some of the designs used obtain retention from the nasal undercuts;[8] others are retained with extra oral aids[9-11] or may be pin retained/"fixed".[12] Appliances may also be broadly grouped under active or passive appliances depending on whether the appliance places any force on the alveolar segments or not.

Passive plates

The passive plates do not alter the dimensions of the cleft and serve to provide a "false palate" for the infant and permit functions like swallowing and feeding in a more normal manner.[1] They also serve to prevent the widening of the cleft from activity of the tongue. These devices consist of a piece of acrylic that simulates a normal palate and are often used in conjunction with a tape across a cleft lip, to help bring the lip segments closer together. However, passive plates do not allow for any adjustment of cleft unlike active plate designs which move the alveolar segments to an ideal location.

Molding plates

These devices also consist of a piece of acrylic formed to fit the palate. Acrylic is gradually added and/or removed to realign the palate to a more normal configuration. The Zurich plates[13] and the Presurgical Nasoalveolar Molding (PNAM) plates[9-11] [Figure 1] fall in the category of molding plates. The molding plates in addition to providing a false palate also allow a controlled manipulation of the palatal segments to desired locations. However, these appliances require multiple clinical visits for modifications. The PNAM procedure in addition to repositioning of the alveolus and lengthening of the deficient columella especially in BCLP also actively molds the deformed nasal cartilages with the use of acrylic nasal stents lined with soft relining material. Matsuo *et al.*[14] have explained that this is possible as neonatal levels of maternal estrogen

Figure 1: BCLP infant wearing PNAM plate

are high immediately after birth. This subsequently increases the levels of hyaluronic acid making active soft tissue and cartilage molding therapy possible during the first three to four months after birth because of the high degree of plasticity in neonatal cartilage during this period.

Latham's appliance[12]

This is a type of "fixed" appliance that is surgically attached to the palate under general anesthesia and remains in place until the manipulation has been completed. This device [Figure 2] consists of two acrylic pieces that fit over the alveolar segments. These pieces are connected in the posterior by way of a hinged bar. The palate is manipulated by rotating the hinged pieces. A screw is present in the area of the cleft. Over a period of 2-3 weeks, the screw is turned 3/4 of a turn everyday until tight. The screw pushes on the back bracket to rotate the two side brackets upward and together. This appliance can be used in BCLP infants to reposition the protruding premaxilla while expanding the lateral maxillary segments. The

Figure 2: Latham's appliance

advantage of this device is that it allows manipulation of palatal segments to the desired location thereby helping to bring the cleft together, making the cleft lip repair easier. As it is easily adjustable; it reduces the number of clinical visits as parents themselves are able to turn the screw. The appliance however does not provide a false palate.

Jackscrew devices

These devices consist of acrylic pieces that fit over the alveolar segments. The acrylic pieces are manipulated by single or multiple jackscrews to adjust the position of the alveolar segments. They allow manipulation of palatal segments to desired locations and the screws also keep the tongue out of cleft. Like the molding plates, multiple clinical visits are required to manipulate the device and replace jackscrews. They however do not allow rotation of the alveolar segments into desired locations as seen with the molding plates. A bilateral cleft palate appliance using jackscrews placed in the center of a Y shaped acrylic plate has been recently described.[15] It helps to reduce the cleft, obturates the nasopalatine fistula, and also retracts the anteriorly protruded prognathic segment.

IMPRESSION PROCEDURES

Different impression procedures have been reported in literature for CLP infants. Patient positioning, tray, and impression material selection are the important factors to consider in any impression procedure.

Patient positioning

For an accurate impression proper patient and dentist position are vital. A number of positions have been adopted for cleft palate impression making in infants including prone,[9] face down,[11] upright,[16] and even upside down.[10].Some authors prefer the impression of the newborn infant to be taken in the hospital crib as it provides good work surface at a convenient height.[8]

Tray selection

As with any impression procedure tray selection is an important step. The tray should be of enough size transversely to include the lateral maxillary segments, posteriorly cover up to the maxillary tuberosities and provide a good reproduction of the mucobuccal folds. Anterior tray border is not critical as the impression material flows forward far enough to cover the structures as the tray is seated. Rimming of the entire tray with utility wax has been suggested to provide additional bulk of material laterally, avoid sharp edges of the tray and also provide a posterior dam preventing material from seeping posteriorly.[8,16] After size and shape have been roughly estimated, perforated custom acrylic trays can be fabricated. Prefabricated trays that are commercially available (Coe laboratories, Chicago) for cleft palate impressions in infants have also been described.[17] Shatkin and Stark[18] have described the use of wax for impression trays in cleft lip and palate patients. Anecdotal reports also mention the use of ice cream sticks to carry materials for infant impressions.

IMPRESSION MATERIALS

Heavy body silicon impression material,[10] polyvinylsiloxane impression material,[11] low fusing impression compound[19] and alginate[8,13,17,20] have been routinely employed for taking impressions of neonates with orofacial clefts.

Different impression materials (alginates, addition cure putty, condensation cure putty, cartridge delivery, bite registration materials) were analyzed on a wet soaped stone model of a neonate with a cleft of the hard palate.[19] Results of this interesting study showed that:

- Most of the alginates and cartridge delivery silicones tested provided good replication of surface detail.
- Though cartridge delivery systems were expected to be better in neonatal cleft impressions due to better mixing and reduced chances of cross infection, all the cartridge delivery silicones tested were too fluid for use in cleft infants.
- The best results with least flow were obtained with the addition cure silicones. The condensation cure silicones were messier to handle and difficult to mix.
- The bite registration materials used in the study reproduced the least of surface details.
- During removal of the impression, the alginates tend to tear the most and the bite registration materials proved to be the most difficult to remove as they set very hard.

If the appliance decided makes use of the nasal undercuts for retention then an adequate reproduction of these undercut areas is important. The use of fast setting color timed alginates has been suggested in these cases. Alginates however have poor tear strength,[21] and may fragment on removal especially when the material extrudes deep into the cleft undercuts. Rapid rate of force application during removal improves tear strength and hence a quick snap removal has been suggested. Impression compound has also been in use for impressions of infants with oral clefts. The advantage of its use in infants with oral clefts are that it can be removed before it sets in case of any emergency and it has better resistance to tearing compared to other impression materials. Impression compound is a thermoplastic material (softens when heated and hardens on cooling) and is usually heated in

a water bath in a piece of cloth at around 60°C. This can lead to problems as overheating can lead to scalding or burns in infants, leaching out of volatile components of the compound which may be harmful to the infants and the use of a water bath may compromise sterility.[19]

Possible complications

Complications encountered when taking impressions in cleft lip and palate infants arise primarily due to the fact that they are obligatory nasal breathers.[1] Chate[22] reported the following hazards have been encountered by dentists involved routinely in the care of CLP patients:

- Difficulty in removal of impression due to engagement of undercuts
- Fragmentation of the impression during withdrawal from the mouth with subsequent respiratory obstruction due to lodgment in the respiratory passage
- Cyanotic episodes of which few resulted in asphyxiation and fortunately no fatalities were reported.

Precautions

As the old adage says prevention is better than cure and the same applies to impression making in cleft infants. A dental mouth mirror is an effective tool for depressing the tongue during the impression procedure thereby maintaining airway patency. Clean cotton tipped ear buds may be used to clean the infant oral cavity before impression making and remove any intra oral remnants of impression material after the procedure.[23] Impressions for neonate/infants with clefts need to be taken in a hospital setting prepared to handle airway emergencies with a surgeon present at all times. The impression is made when the infant is fully awake without any anesthesia or premedication.[8-11] Infants should be able to cry during the impression procedure and absence of crying may be indicative of airway blockage. A finger motion may be used to clear unset material posterior to the tray to prevent the infant from closing down on the tray and compromising the airway. High volume suction should also be ready at all times in case of regurgitation of the stomach contents. It is preferable that the infant has not eaten for at least two hours prior to the procedure.[8]

Management of complications[24,25]

Aspiration of fragments of impression material that inadvertently tear during the procedure may cause airway obstruction in infants. The obstruction may be partial or complete. Three stages of symptoms result from aspiration of any object into the airway.

- Initial event – violent paroxysms of coughing, choking, gagging and possibly airway obstruction occur immediately when the foreign body is aspirated.
- Asymptomatic interval – foreign body becomes lodged, reflexes fatigue, and immediate irritating symptoms subside.
- Complications – obstruction, erosion or infection develop.

Signs of complete airway obstruction include ineffective cough, increased respiratory difficulty accompanied by stridor, development of cyanosis and loss of consciousness.

Maneuvers to relive foreign body obstruction in infants include back blows [Figure 3], chest thrusts [Figure 4], and finger sweeps. When conscious, the infant is straddled over the arm with face down and head lower than the trunk. The infants head is supported with the rescuers hand around the chest and the jaw. When support is adequate 4-5 back blows are rapidly delivered with the heel of the hand between the infants

Figure 3: Back blows in infants for foreign body aspiration

Figure 4: Chest thrusts in infants for foreign body aspiration

shoulder blades. Following this the free hand is placed over the infants back, holding the infants head. The infant is effectively sandwiched between the two arms and hands of the rescuer. The infant is turned and held supine on the rescuers thigh. The infants head remains lower than the trunk all this while. Up to 5 quick downward chest thrusts are given in the same location and manner as external chest compressions for cardiac arrest. The airway may now be opened by using the head tilt chin lift and if spontaneous breathing is absent and chest does not rise on rescue breathing the maneuvers may be repeated till the foreign body is expelled or child loses conscious. When the infant is unconscious the airway is opened using the tongue jaw lift and if a foreign body is seen it is removed with a finger sweep. Blind finger sweeps should not be performed in infants as it poses the risk of further pushing the fragments into the airway. Rescue breathing is then attempted. If the chest does not rise adequately the back blows and chest thrusts are repeated till ventilation is established. Adjuncts for airway and ventilation include oxygen delivery devices, suction devices, appropriately sized oropharyngeal airways, bag valve mask systems and in rare situations cricothyrotomy.

CONCLUSION

Early intervention provides a positive impact on the development of infants with clefts. As multidisciplinary care is essential for the cleft patient, the role of the prosthodontist, pedodontist, orthodontist and oral surgeon amongst the various other medical specialists, is becoming more defined. Adequate knowledge of the appliances available and the impression procedures followed leads to better understanding, preparation and coordination of the efforts of the various specialties involved in cleft lip and palate care. A basic knowledge of managing complications makes us better equipped in handling emergencies if they arise.

REFERENCES

1. Proffit WR, Fields HW, Ackermann JI, Thomas PM, Tulloch JF. Contemporary Orthodontics. Vol. 74. St. Louis: CV Mosby; 2000. p. 287-8.
2. Subtelny JD. Early Orthodontic Treatment. Quintessence Publishing; 2000. p. 218-9.
3. Graber TM, Vanarsdall RL. Orthodontics - Current principles and techniques.4th ed. St.Louis: Mosby; 2000. p. 1101-2.
4. Prahl-Andersen B. Dental treatment of predental and infant patients with clefts and craniofacial anomalies. Cleft Palate Craniofac J 2000;37:528-32.
5. Ball JV, DiBiase DD, Sommerlad BC. Transverse maxillary arch changes with the use of preoperative orthopedics in unilateral cleft palate infants. Cleft Palate Craniofac J 1995;32:483-8.
6. Kuijpers-Jagtman AM, Long RE. The influence of surgery and orthopedic treatment on maxillofacial growth and maxillary arch development in patients treated for orofacial clefts. Cleft Palate Craniofac J 2000;37:527.
7. Berkowitz S. A comparison of treatment results in complete bilateral cleft lip and palate using a conservative approach versus Millard – Latham PSOT procedure. Semin Orthod 1996;2:169-84.
8. Jacobson BN, Rosenstein SW. Early maxillary orthopedics for the newborn cleft lip and palate patient: An impression and an appliance. Angle Orthod 1984;54:247-63.
9. Grayson BH, Santiago PE, Brecht LE, Cutting CB. Presurgical nasoalveolar molding in infants with cleft lip and palate. Cleft Palate Craniofac J 1999;36:486-98.
10. Grayson B, Shetye P, Cutting C. Presurgical nasoalveolar molding treatment in cleft lip and palate patients. Cleft J 2005;1:4-7.
11. Grayson B, Brecht LE, Cutting CB. Nasoalveolar Molding in Early Management of Cleft Lip and Palate. In: Taylor TD, editor. Clinical maxillofacial prosthetics. Chapter 5. Quintessence; 63- 84.
12. Georgiade NG, Latham RA. Maxillary arch alignment in the bilateral cleft lip and palate infant, using the pinned coaxial screw appliance. Plast Reconstr Surg 1975;52:52-60.
13. Hotz M, Gnoinski W. Comprehensive care of cleft lip and palate children at Zurich University: A preliminary report. Am J Orthod 1976;70:481-504.
14. Matsuo K, Hirose T, Tomono T, Iwasawa M, Katohda S, Takahashi N, *et al*. Nonsurgical correction of congenital auricular deformities in the early neonate: A preliminary report. Plast Reconstr Surg 1984;73:38-51.
15. Available from: www.oc-j.com/june06/cleft.pdf [last accessed on 2007 Jan 15].
16. Yang S ,Stelnicki EJ, Lee MN. Use of nasoalveolar molding appliance to direct growth in newborn patient with complete unilateral cleft lip and palate. Pediatr Dent 2003;25:3:253-6.
17. Jacobson BN, Rosenstein SW. Cleft lip and palate: The orthodontist's youngest patient. Am J Orthod Dentofacial Orthop 1998;90:63-6.
18. Rana RE, Puri VA, Aiyer PM, Baliarsing A. Preparation of plaster moulage (cast) in plastic surgery patients. Indian J Plast Surg 2003;36:26-9.
19. Doubleday B. Impression Materials. Br J Orthod 1998;25:133-40.
20. Rosenstein SW. A new concept in the early orthopedic treatment of cleft lip and palate. Am J Orthod 1969;55:765-75.
21. Anusavice KJ. Phillips Science of Dental Materials. 11thed. Elsevier; 2004. p. 227-8.
22. Chate RA. A report on the hazards encountered when taking neonatal cleft palate impressions (1983- 1992). Br J Orthod 1995;22:299-307.
23. An Integrated Approach to the Primary Lip/Nasal Repair in Bilateral cleft Lip and Palate – Operative Syllabus DVD. Noordhoff Craniofacial Foundation.
24. Meharban S. Medical emergencies in children. Sagar Publications; 2000. p. 31-3.
25. Behrman RE, Kliegman RM, Jenson BH. Nelson Textbook of Pediatrics. 17th ed. Saunders; 2004. p. 286-91.

Source of Support: Nil, Conflict of Interest: None declared.