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REVIEW ARTICLE

Prosthetic Rehabilitation Of Cleft Compromised Newborns: A Review

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ABSTRACT

Cleft lip and palate is the most common congenital defect which affects the orofacial region. The treatment objective for patients with these defects is to restore the normal anatomy and function of the affected structures. Surgical closure of the defect is a viable option, but often, the approximation of the palatine halves has to be first achieved with orthopaedic appliances. A variety of appliances have been described for maxillary orthopaedics in infants. For the fabrication of such appliances, an impression of the defect is necessary. Impression making in infants with cleft lip and palate is a challenging task. This article briefly describes the appliances which are used for infant maxillary orthopaedics and the impression procedure for recording the defect.

KEY WORDS: Cleft lip and palate, impression procedure, infant orthopaedics, nasoalveolar molding.

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Introduction

Clefts of the lip and palate are common congenital abnormalities of the orofacial region. The oro-nasal communication due to the defect poses great problems for the newborn in the suckling of milk and speech and it may affect the overall physical and mental growth of the child. The rehabilitation of such infants primarily involves the closure of the defect [1]. Surgical repair of the lip is usually performed during 3 to 6 months of age and palate closure is done between 12 and 18 months of age. However, surgery alone may not prove to be beneficial, especially in larger clefts, as surgical closure may lead to an increase in tissue tension at the surgical site, which is not desirable. [2]. Infant maxillary orthopaedic procedures were pioneered by Burston [1] in Liverpool in the late 1950's. Infant maxillary orthopaedics provides presurgical benefits and helps to bring the cleft segments into an acceptable alignment to resemble a more normal configuration prior to lip surgery [2]. Molding facilitates the surgical team in easier lip repair, especially in bilateral cleft lip palate (BCLP) patients with a severely protruding premaxilla [3].

Prosthetic care of cleft patients

Prosthetic treatment in infants improves feeding, tongue function and speech development, it reduces the risk of aspiration as the oro-nasal communication is eliminated and it is an easier

surgical procedure with aesthetic results. It reduces the severity of dental and skeletal deviations and provides a positive psychological impact on the patients as well as on their parents [4]. According to a survey, cleft width was found to reduce and transverse maxillary arch width was found to remain unchanged posteriorly after orthopaedic treatment in unilateral cleft lip palate (UCLP) patients, probably due to the removal of the tongue influence, thus permitting the unrestricted growth of the palatal shelves [5]. A study on UCLP [6] concluded that pre-surgical orthopaedic treatment is able to align the maxillary segments and diminish the anterior cleft width prior to lip closure, to a variable extent. However, the effect seems to disappear over time, suggesting that surgery might be a more important factor in the maxillary arch form than PSOT itself. The question whether PSOT has a long-term effect on maxillary growth, remains uncertain due to the lack of long-term studies that have evaluated maxillofacial growth subsequent to infant orthopaedics [6]. There is also a lack of evidence as to whether pressure stimulation from presurgical orthopaedic treatment increases palatal growth beyond its inherent growth potential [7].

Many appliances have been described for infants with cleft palate. These appliances can be broadly grouped into active or passive, depending on whether the appliance places any force on the alveolar segments or not. The appliance to be used is decided after a proper evaluation of the case.

Passive plates

The passive plates [Table/Fig 1] do not apply any force, they serve to provide an artificial 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 due to the activity of the tongue. These devices consist of a piece of acrylic plate which closes the defect and is used in conjunction with a tape across the cleft lip, to help bring the lip segments closer together. However, passive plates do not allow for any adjustment of cleft, unlike the active plate designs which exert force to move the palatal segments to an ideal location.

[Table/Fig 1]: Passive feeding plate Molding plates

These devices also consist of a piece of acrylic which is formed to fit the palate and is used for the Presurgical Nasoalveolar Molding (PNAM) procedure. Acrylic is gradually added or removed to align the palate to a more normal configuration. The PNAM procedure, in addition to the 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 which are lined with soft relining material [8]. According to Matsuo *et al* [9], active soft tissue and cartilage molding therapy is possible, as neonatal levels of maternal oestrogen are high immediately after birth. This subsequently increases the levels of hyaluronic acid during the first three to four months after birth, resulting in high degree of plasticity in the neonatal cartilage during this period.

Latham's appliance

This is a type of “fixed” appliance [8] that is surgically attached to the palate under general anaesthesia and remains in place until the manipulation has been completed. This device [Table/Fig 2] consists of two acrylic pieces that fit over the alveolar segments. These pieces are connected posteriorly with 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 3/4th of a turn, every day until tight. This appliance can be used in BCLP infants to reposition the protruding premaxilla, while expanding the lateral maxillary segments.

[Table/Fig 2]: Latham's appliance

The advantage of this device is that it allows the manipulation of the palatal segments to the desired location, thereby helping to bring the clefts together, thus making the cleft lip repair easier. The appliance however, does not provide an artificial palate as it does not cover the defect.

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 the manipulation of the palatal segments to the desired locations and the screws also keep the tongue out of the cleft. They however do not allow the rotation of the alveolar segments into desired locations, as seen with the molding plates.

Steps in the fabrication of feeding devices for infants

Feeding devices are mostly passive plates which are placed in the infant's oral cavity to act as an artificial palate to aid in the infant's suckling and swallowing. It has a great effect on the physical as well as the psychological growth of the infant and also helps in achieving the mother-child bond, which is very important to establish a sense of security and to enhance the mental abilities of the child. The most important and critical step is the making of the impression of the cleft palate for making the plate. Various techniques and materials can be used as described below, for making the impression of the cleft in infants.

The impression procedure for infants with cleft palate Patient position

The most important part of the rehabilitation of a patient with cleft lip and palate is the impression making procedure. The making of the impression in an infant with a cleft palate is a critical procedure. For an accurate and safe impression procedure, a proper patient and dentist position are vital. A number of positions have been adopted for cleft palate impression making in infants, including prone [5], face down [8], upright [8], and even upside down [9].

Selection of the impression tray

The impression tray should be of enough size transversely, to include the lateral maxillary segments, to posteriorly cover up to the maxillary tuberosities and to provide a good reproduction of the mucobuccal folds. The 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 an additional bulk of material laterally, to avoid the sharp edges of the tray and also to provide a posterior dam to prevent the material from seeping posteriorly [8]. After their 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 [4]. Shatkin and Stark [10] have described the use of wax as impression trays in cleft lip and palate patients. Ice cream sticks can also be used to carry materials for infant impressions. While using elastomeric impression material in putty consistency or impression compound for making the impression of the cleft in infants, the materials can be supported with the fingers and placed in the patient's mouth till the material sets.

Materials used for the impression

Heavy body silicone impression material, polyvinyl siloxane impression material, low fusing impression compound and alginate have been routinely employed for making impressions of neonates with orofacial clefts. According to a

study, alginate and cartridge delivery silicones provided good replication of the 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 which were tested, were too fluid for use in cleft infants. The best results with least flow were obtained with the addition of cure silicones [11]. The condensation cure silicones were messier to handle and difficult to mix. The bite registration materials which were used in the study [11] reproduced the least of the surface details. During the removal of the impression, the alginates tended 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 which is decided uses the nasal undercuts for retention, then an adequate reproduction of these undercut areas is important. The use of fast setting colour timed alginates has been suggested in these cases. Alginates however have poor tear strength and may tear on removal, especially when the material extrudes deep into the cleft undercuts. The rapid rate of force application during removal improves tear strength and hence, a quick snap removal has been suggested. The impression compound has also been in use for the 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 as compared to other impression materials. Impression compound is a thermoplastic material 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, the leaching out of volatile components of the compound can be harmful to the infants and the use of a water bath may compromise sterility [11]. The putty wash impression can produce accurate impressions with good reproduction of the details and its biggest advantage is its greater tear strength and the possibility of making multiple casts with the same impression [Table/Fig 3], [Table/Fig 4].

[Table/Fig 3], [Table/Fig 4]: Putty wash impressions to record palatal clefts in infants

After the making of the impression, a cast is prepared [Table/Fig 5] on which the feeding device can be fabricated in heat cure acrylic resin material [Table/Fig 6], by using a long curing cycle to minimize the leaching out of the residual monomer.

[Table/Fig 5]: Master cast fabricated using the putty wash impression

[Table/Fig 6]:Master cast with the feeding device

Possible complications

The complications which are encountered while making impressions in cleft lip and palate infants arise primarily due to the fact that they are obligatory nasal breathers [1]. Chate [12] reported a difficulty in removal of the impression due to the engagement of the undercuts, the fragmentation of the impression during its withdrawal from the mouth, with subsequent respiratory obstruction due to its lodgment in the respiratory passage and cyanotic episodes due to asphyxiation as the common hazards which have been encountered by the dentists who are involved routinely in the care of CLP patients.

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's oral cavity before impression making and remove any intra oral remnants of impression material after the procedure.[13] The impressions for neonate/infants with clefts need to be taken in a hospital setting which is prepared to handle airway emergencies, with a surgeon present at all times. The impression is made when the infant is fully awake, without any anaesthesia 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 the unset material which is 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 had food for at least two hours prior to the procedure [8].

The management of complications during the impression procedure [14,15]

The aspiration of the fragments of the 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 the 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** – the foreign body becomes lodged, reflexes fatigue, and immediate irritating symptoms subside.
- **Complications** – obstruction, erosion or infection develops. The signs of complete airway obstruction include effective cough, increased respiratory difficulty accompanied by stridor, the development of cyanosis and the loss of consciousness. The maneouvers which are used to relive foreign body obstruction in infants include back blows [Table/Fig 7], chest thrusts [Table/Fig 8], and finger sweeps. When conscious, the infant is straddled over the arm with face down and with head lower than the trunk. The infant's head is supported with the rescuer's hand around the chest and the jaw.

[Table/Fig 7]: Back blows in infants for foreign body aspiration

[Table/Fig 8]: Chest thrusts in infants for foreign body aspiration

When the support is adequate, 4-5 back blows are rapidly delivered with the heel of the hand between the infant's shoulder blades. Following this, the free hand is placed over the infant's back, holding the infant's head. The infant is effectively sandwiched between the two arms and the hands of the rescuer. The infant is turned and held supine on the rescuer's thigh. The infant's head is expected to remain lower than the trunk all this time. Up to 5 quick downward chest thrusts are given in the same location and manner, as the external chest compressions which are given for cardiac arrest. The airway may now be opened by using the head tilt chin lift maneouver and if spontaneous breathing is absent and the chest does not rise on rescue breathing, then the maneouvers may be repeated till the foreign body is expelled or the child loses consciousness. When the infant is unconscious, the airway is opened by using the tongue jaw lift maneouver 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. The 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

Cleft lip and palate forms a part of many syndromic and non-syndromic disorders like the Pierre-Robin sequence[16], etc. Early intervention provides a positive impact on the development of the infants with clefts[17]. As multidisciplinary care is essential for the cleft patient, the role of the prosthodontist, pedodontist, orthodontist and the oral surgeon amongst the various other medical specialists, is becoming more defined. Adequate knowledge of the appliances which are available and the impression procedures which should be followed, leads to a better understanding, preparation and coordination of the efforts of the various specialties which are involved in cleft lip and palate care. A basic knowledge on managing complications makes us better equipped in handling emergencies if they arise.

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