

Prosthodontics Approach for the Fabrication of Feeding Plates in Cleft Palate Patients

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Abstract: Cleft lip and palate is most common congenital anomalies of the craniofacial region. Cleft lip and palate is an anomaly that affects several systems and functions which includes the facial growth, dentition, speech, hearing and genetic aspects because of the complex mode of inheritance. Cleft lip and palate forms a part of many syndromic and non-syndromic disorders like the Pierre-Robin sequence, etc. Early intervention provides a positive impact on the development of the infants with clefts. Adequate knowledge of the appliances which are available and the impression procedures which should be followed, leads to a better understanding and coordination of the efforts of the various specialties which are involved in cleft lip and palate care.

Keywords: Cleft Lip, Cleft Palate, Feeding Plate, Impression Materials

1. Introduction

Clefts lip and palate are considered as a common congenital abnormalities of the orofacial region. Cleft palate can be defined as a furrow in the palatal vault. This condition can affect the children and their families in many ways. It is estimated that the overall global prevalence of oro-facial clefts is one affected individual in every 800 new born babies. Cleft palate may be inherited as an autosomal dominant condition. Family history in first degree consanguinity increases the risk by a factor of 20 percent. When a child is born with a cleft, maintenance of nutritional balance, which is necessary for growth, development, and the infant's preparation for corrective final surgery, is a priority [1]. The oro-nasal communication due to the defect poses great problems for the newborn in suckling and also affects speech and the overall physical and mental growth of the child [2]. The rehabilitation of infants having cleft primarily involves the defect closure. So the first stage of management would be the fabrication of a feeding plate or passive maxillary obturator [3]. The crucial step in fabrication of any appliance or obturator is the impression procedure. Patient positioning, tray, and impression material selection are the

important factors to consider in any impression procedure. This is done because the cleft creates an opening in the roof of the mouth, and thus the infant are not able produce the necessary pressure in the oral cavity to suck [3]. One of the main problems with conventional preoperative maxillary orthopedic appliances in infants with cleft palate is synchronization of the soft palate extension with the activity of the muscles surrounding the defect during swallowing. When the appliance cannot adapt to the changing morphology of the defect, both the tolerance of the patient and the ideal seal are jeopardized [4]. So the first stage of management would be the fabrication of a feeding plate or passive maxillary obturator. The crucial step in fabrication of any appliance or obturator is the impression procedure. Patient positioning, tray, and impression material selection are the important factors to consider in any impression procedure.

2. Developmental Pathogenesis

Development of the lip and palate entails a complex series of events that require close coordination of programmes for cell migration, growth, differentiation, and

apoptosis. Neural crest cells, which delaminate from the neural folds, contribute to and migrate through mesenchymal tissue into the developing craniofacial region where, by the 4th week of human embryonic development, they participate in formation of the frontonasal prominence, the paired maxillary processes, and the paired mandibular processes, which surround the primitive oral cavity [3, 4]. Formation of the nasal placodes (ectodermal thickenings) by the end of the 4th week of embryogenesis divides the lower portion of the frontonasal prominence into paired medial and lateral nasal processes. By the end of the 6th week of development, merging of the medial nasal processes with one another and with the maxillary processes on each side leads to formation of the upper lip and the primary palate. Immediately before completion of these processes, the lateral nasal process has a peak of cell division that renders it susceptible to teratogenic insults, and any disturbance in growth at this critical time can lead to failure of the closure mechanism.

3. Etiology of Cleft Lip and Palate

- Most common etiological factor is genetic
- Detrimental forces can interfere with cell formation, replication or migration and produce craniofacial malformation including cleft lip and palate
- Environmental factors like maternal epilepsy, alcoholism, smoking
- Drug interactions like steroids, diazepam, phenytoin, acetate and folic acid deficiency also disturb metabolic rate and cellular activity and may alter normal development
- As a part of many syndromes, including Down's syndrome and Treacher Collins's syndrome

4. Problems of Cleft Lip and Palate Patients

- a) Social and emotional problems
- b) Diet and nutritional problems
- c) Dental, ENT and Speech problems

5. Steps in the Fabrication of Appliance

- Impression of the defect
- Fabrication of the appliance
- Insertion of the appliance
- Activation of the appliance

This article deals with the impression materials and impression methods used to fabricate a prosthesis.

- The Impression

The quality of a cleft lip and palate impression depends on two factors

- Complete inclusion of the lateral maxillary segments with a good reproduction of the mucobuccal fold
- Adequate extension of the impression into the cleft area.

The impression must extend into the nasal chamber and every available undercut. It is these undercuts that provide the retention capability of the appliance.

Materials Used

Impression materials which are used commonly are irreversible hydrocolloid impression material, putty elastomeric impression material, impression compound [5].

According to a study, alginate and cartridge delivery silicones provided excellent 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. The use of fast setting chromatic alginates has been suggested in these cases. Alginates however have poor tear strength which usually tear on removal, especially when alginate extrudes deep into the cleft undercuts. The 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 [5]. 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. Here Preliminary impression of the palate can also be made with an impression compound and low fusing impression compound (green stick). First the impression compound and green stick was soften in warm water and kneaded. With a finger impression material carried into the baby's mouth and pressed the material against the hard palate and into the buccal and labial vestibules, while the baby was held in prone position, in order to prevent aspiration in the event of vomiting and asphyxiation due to airway obstruction.

In silicone materials the best results with least flow were obtained with the addition of cure silicones. The condensation cure silicones were messier to handle and difficult to mix.

Impression methods

- Pre-prosthodontic considerations

All impressions were taken with the infant fully awake without anesthesia. Instructions were given to the parents in the visit prior to impression taking not to feed their baby for at least two hours [6]. If the impression will be taken in the first visit, it was advised to wait about two hours after the last meal to prevent the infant from vomiting during the procedure. Adequate suction apparatus should be available as a safety precaution, in the event that a piece of alginate is torn from the impression as it is withdrawn. This can be easily and quickly removed with a broad suction tip, avoiding the possibility of aspiration of the fragment

- Patient's Position During Impression Making[6]

A number of positions have been adopted for cleft palate

impression making in infants, including prone, facedown, upright and even upside down. The best view and access is obtained when the infant is lying back in a horizontal position. As the tray is inserted, some of the material will be expressed forward to envelop the premaxillary area. When the tray has been seated properly, the baby is raised to a sitting position. It is during this stage that assistance, usually by the mother, is quite necessary. The baby will now be crying quite actively, which is the best indicator for the operator that the airway is clear.

- Selection of the impression tray

The tray size is a very important factor when impressions of the cleft lip and palate are concerned. A set of perforated custom acrylic trays of different shapes and sizes, both unilateral and bilateral, can be easily made from different size casts, or size and shape can be roughly estimated and trays individually trimmed and perforated with a large round bur. Prefabricated tray are used for impression making as it can be adjusted according to size of cleft. 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 [7]. Shatkin and Stark 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.

- Preliminary impression making

Before taking impression, deeper undercuts of cleft should be blocked with wet gauze piece tied in suture thread so as to prevent unnecessary flow of material into cleft. The impression material is selected according to the case. Usually color-timed alginate impression material (fig 1) is used. This lets the operator know exactly when the mix is ready for placement, so that the impression will be ready for withdrawal within 15 to 20 seconds after placement of the tray^[5,7]. Usually one scoop of powder, lightly packed, is sufficient for most of these young children. The water should be slightly warmer than room temperature to accelerate setting. As the mix is first briskly spatulated, it turns a dark purple color, gradually lightening to pink. The tray is loaded at this time. The mix should feel rather thick in consistency, and is usually placed in the tray so that most of the bulk is in the center. This insures that there is enough material to provide a good impression of the important undercut areas in the cleft site. When the mix becomes white, the operator has approximately 30 seconds before it will be completely set. Withdrawal of the impression is accomplished by the fast snapping action typically used for impression removal [8]. Or else if using elastomeric impression material in putty consistency or impression compound of the cleft in infants, the materials can be supported with the fingers and placed in the patient's mouth till the material sets. After which the cast is poured in stone on which a custom acrylic tray was prepared. Before the fabrication of custom tray (fig. 2) the cast is blocked with wax if any undercuts are present. The tray was smoothened and polished to avoid rough areas.

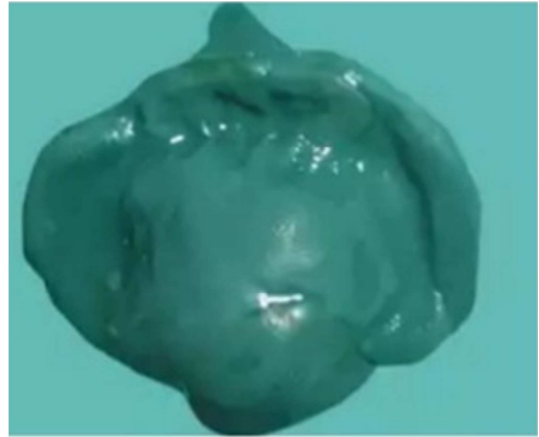


Fig. 1. Preliminary Impression.

- Secondary impression making

The putty wash impression (fig 3) 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 [8]. After taking impression, cast was prepared and unnecessary undercuts on the cast was blocked with stone plaster.



Fig. 2. Customized Special Tray.

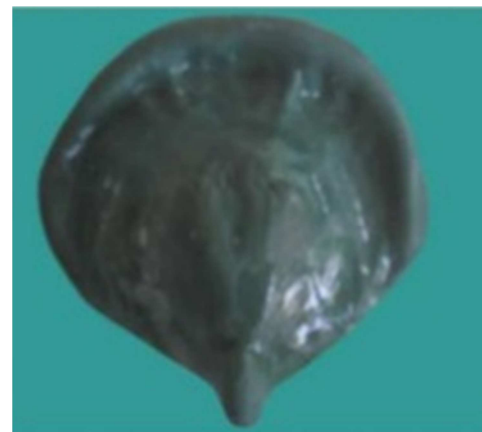


Fig. 3. Final Impression.

- Fabrication of prosthesis

A master cast was prepared using die stone (fig 4). A feeding plate was fabricated using clear acrylic resin material with a minimum thickness of 2mm [9]. All the border of the feeding plate were rounded and polished in order to avoid trauma. Two perforations were made on the peripherals of feeding plate for retention of floss thread or two retention stops (fig 5). These would facilitate the attachment of elastic traps on both sides.

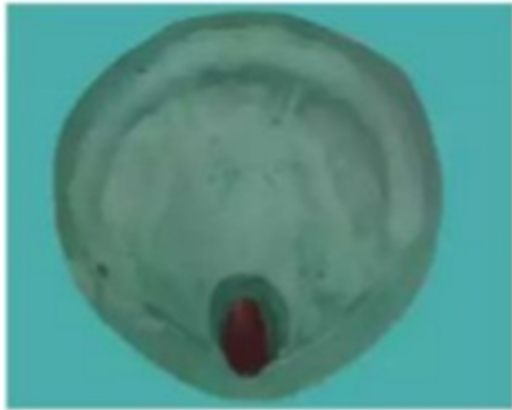


Fig. 4. Master Cast.



Fig. 5. Plate With Thread On Master Cast.

- Insertion of the appliance:

After insertion of appliance into the patient's mouth. The oral cavity was carefully examined for any blanching of soft tissues, whether proper relief was given for frenal attachments and if the extension of the molding plate was sufficient to serve the purpose. The appliance was placed in proper. Parents were demonstrated regarding the insertion and removal of appliance.

6. The Management of Complications During the Impression Procedure

The aspiration of the fragments of the impression material that inadvertently tear during the procedure may cause airway obstruction in infants [10]. The obstruction may be partial or complete. Three stages of symptoms result from the

aspiration of any object into the airway.

- Initial event[11] – 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 [12] – 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 maneuvers which are used to relieve 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. 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 [13]. 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 maneuver and if spontaneous breathing is absent and the chest does not rise on rescue breathing, then the maneuvers may be repeated till the foreign body is expelled or the child loses consciousness[14]. When the infant is unconscious, the airway is opened by using the tongue jaw lift maneuver 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 foreign body obstruction in infants include back blows, chest thrusts, and finger sweeps. Further pushing the fragments into the airway [15]. 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[16].

7. Discussion

Patients with cleft lip and palate defects requires a co-ordinated care involving multiple disciplines from the time of birth to adolescence. Cleft palate may be inherited as an autosomal dominant condition. Family history in a first degree relative increases the link by a factor of 20%. Environmental factors include maternal epilepsy, certain drugs like steroids, diazepam, phenytoin and folic acid deficiency. Cleft lip and palate also occur as a part of various syndromes which include Down's syndrome and Treacher Collin's syndrome [17]. Primary care plays a vital role in these patients, as they have numerous health related problems, including feeding difficulties, speech disorders,

chronic ear infections and dental & orthodontic problems. It is the general opinion of the plastic surgeon and prosthodontists that pre-surgical management should be undertaken as soon possible after birth. Simplified technique was put forward by Chang and Wang, for the fabrication of feeding plate [18]. The procedure described is easy, simple and minimizes any risks to the infant during the procedure.

Impression procedures in cleft infants pose a unique set of challenges including the size constraints imposed by the infant's oral cavity, anatomical variations associated with the severity of cleft and a lack of ability of the infant to cooperate and respond to commands. Various impression materials have been routinely employed for making impressions of neonates with oral clefts. An ideal impression material should exhibit certain characteristic in both clinical and laboratory settings. As primary impression usually color-timed alginate impression material is used. This lets the operator know exactly when the mix is ready for placement, so that the impression will be ready for withdrawal within 15 to 20 seconds after placement of the tray [5,7]. Usually one scoop of powder, lightly packed, is sufficient for most of these young children. The water should be slightly warmer than room temperature to accelerate setting. As the mix is first briskly spatulated, it turns a dark purple color, gradually lightening to pink. The material used for final impression was rubber base which has the advantage as it reproduces all the areas of interest with good surface details and resist tearing, more over its removal is atraumatic to the infant. Additionally, the material remains dimensionally stable and permits pouring of multiple casts.

Various techniques have also been used to enhance the retention of the plate. However, the retention of the obturator is not that critical, because it can be held in the baby's mouth during sucking, swallowing and the resting state by the tongue and by mouth closure. A regular follow up is required for the examination of oral mucosa which is very delicate and easily damaged by the obturator. It is indicated that a check up every 3-4 weeks is required at the bilateral sides of border to accommodate the growing arches. A new obturator should be constructed every three months to accommodate the enlarged craniofacial sutures at growth. The mother is advised to hold the infant upright or semi-upright position while feeding so that the swallowed air can be expelled during the feeding process [19].

A comprehensive management of children born with cleft lip and palate is best accomplished by the multidisciplinary team approach. Prosthodontist plays an important role in the team. However, prompt intervention by fabrication of feeding plate can eliminate the immediate problems and can bring about proper nourishment and prevention of any infections for the already debilitated infant [20, 21].

8. Conclusion

Adequate knowledge of the appliances and impression procedures is necessary for the management of patients with clefts involving lips and palate [22]. The feeding obturator

overcomes the factors that act as a stumbling block in the milestones of normal development and should be inserted as early as possible after birth. Feeding plate prosthesis reduce the stress of both parents and the baby, It can aid nursing, stimulate oral-facial development, helps develop the palatal shelves, prevent tongue distortion and nasal septum irritation, decrease the number of ear infections, expand the collapsed maxillary segment and promote neonate health which is important in preparing the baby later for the surgical procedures[23]. The feeding plate needs to be re-fabricated regularly due to the overall slow but constant growth of palate; which offers an interim treatment option till the palatal defect closed surgically[24, 25].

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