Case Report

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Impression techniques in neonates with cleft lip and palate: An illustrative case series and narrative review.

Abstract:

One of the most significant challenges in infants born with cleft lip and/or palate (CLCP) is inadequate feeding, which can be remedied with the use of a feeding plate. However, the creation of a feeding plate involves a crucial component known as the impression procedure, which presents a number of challenges. Hence, this case series and narrative review outlines three distinct cases depicting various methods for obtaining accurate impressions in newborns with CLCP, while also emphasizing on the importance of patient positioning, impression tray selection, and impression material choice. Additionally, it delves into the complexities of newborns born with CLCP and the difficulties that infants with this condition may encounter. Potential complications during the impression-making process are also discussed, alongside their corresponding management strategies.

Key-words: Cleft Lip and Palate, Feeding Plate, Impression procedure, Obturator

Introduction:

Cleft lip and/or palate (CLCP) is one of the most common congenital deformities of the craniofacial (CF) region, with a world-wide prevalence of 1.5 per 1,000 live births. [1] Infants with CLCP present with varying degrees of difficulty in feeding, chewing, swallowing, and speaking, along with issues related to facial growth, tooth development, and social and psychological well- being. [1] Among these challenges, insufficient feeding in infants is a significant concern that has been documented for many years. [2]

Palatal cleft hinders an infant's suckling by disrupting negative pressure generation in the oral cavity due to the opening in the roof. [3] Infants compensate for this difficulty by pressing the nipple between the tongue and palate. This maneuver is rendered ineffective by the entrapment of the nipple in a wide cleft palate, leading to milk trapping, nasal regurgitation, and excessive air intake during feeding and fatigue of the oro-facial musculature. [3, 4]

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Rehabilitation of these infants entails surgically closing the defect, among other treatments. However, the timing of surgery varies depending on the severity of the defect(s) and can range from three to eighteen months of age. [5] Before surgical intervention, it is crucial to ensure adequate nutrition to promote normal infant growth so that the child is prepared for surgery. [6] Feeding plates have been utilized for this purpose, as they cover the cleft and establish a seal separating oral and nasal cavities, enabling the infant to effectively compress the nipple. This appliance not only controls the flow

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of milk but also prevents further widening of the cleft, corrects tongue function, promotes speech development, provides positive guidance for growth and development of the upper jaw segments, and has a positive psychological impact on the parents. [6]

Creating a feeding plate involves a critical step called the impression procedure. Making impressions of a cleft defect in a neonate presents considerable challenges like patient positioning, selection of impression tray, and handling of impression material, in addition to keeping the infant calm and managing the airway during the impression. The tray must be small enough for gentle insertion yet sufficiently broad to cover lateral maxillary segments, extend posterior to the tuberosities, and accurately replicate mucobuccal folds. To obtain an accurate impression of the cleft area and anatomical structures, one-step and two-step impression techniques have been suggested. The latter involves making a preliminary impression to fabricate a customized secondary tray. While a prefabricated commercial tray may serve this purpose, [7] it is not always suitable for obtaining an impression of the infant's maxillary arch due to anatomical variations associated with the severity of the cleft. [8] As a result, several alternative tray designs have been reported for obtaining impressions in infants with CLCP, including those based on wax and ice-cream sticks, [9] stock poly-methyl-methacrylate (PMMA) impression trays, [9] and light-polymerizing acrylic resins. [10] In this case series, we present three different techniques for obtaining impressions in infants with CLCP.

Case Presentation

Case 1:

A five-day-old male infant weighing 2.5 kg with a complete unilateral CLCP (left) (Figure 1a) was referred to the Department of Pediatric and Preventive Dentistry. The parents expressed concern about the infant's poor feeding ability, managed currently with a naso-gastric tube. The medical history revealed no familial congenital or genetic anomalies. To address feeding challenges, a feeding plate was recommended and the parents consented to the proposed treatment plan. Before the impression procedure, the infant was positioned in a prone position on the mother's lap to prevent aspiration and airway obstruction. High viscosity rubber base impression material (Dentsply Aquasil soft putty regular set, India) was loaded on the operator's index finger (Figure 1b); inserted into the mouth, and molded under finger pressure. After the initial set, the finger with the impression material was removed from the oral cavity (Figure1c). The infant's crying during the procedure indicated a patent airway.

The impression was cast in Type III Dental stone (Kalabhai, India), and after blocking undercuts with wax (Figure 1d), a separating medium (Cold mold seal, Isolate, Prevest Den Pro, India) was applied. Acrylic resin (DPI cold cure, India) prosthesis was fabricated using the salt and pepper technique (Figure1e-f). The prosthesis was finished and polished. Pressure spots on the intaglio surface were identified and relieved. A string of dental floss was passed through the eyelet present on the labial flange and tied for easy retrieval by the parents, in case of accidental dislodgement. Parents were educated about inserting, removing, and cleaning the appliance after every feed. Feeding with the obturator in-situ (Figure 1g) was demonstrated with the infant in a semi-upright position. Post-feeding, parents were advised to remove the obturator, clean the oral cavity and cleft with a soft cloth soaked in warm water. The patient and appliance were reviewed after one week to examine for any oral ulcerations or any other difficulty in using the appliance, followed by monthly reviews for three months. This comprehensive approach aimed to enhance the infant's feeding ability and set the foundation for the broader management of CLCP, aligning with contemporary protocols.

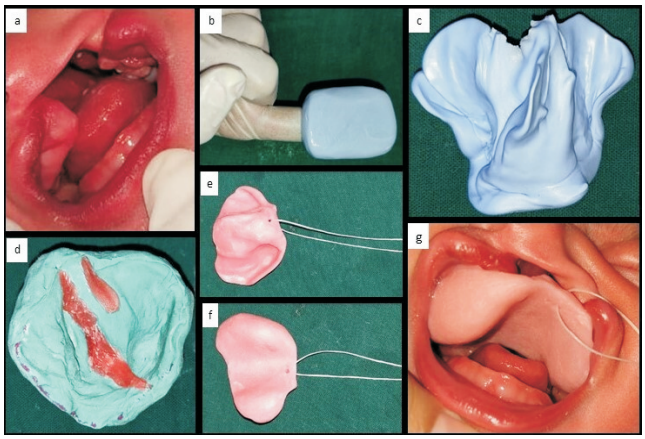

Figure 1: A 5-day-old male infant with cleft lip and palate (a) Extra-oral photograph showing complete unilateral cleft lip and palate (left) (b) High viscosity rubber base impression material loaded on operator's finger (c) Impression removed after initial set (d) Dental cast poured in type III dental stone with undercuts blocked using utility wax (e) Feeding appliance cum obturator intaglio surface with attached dental floss (f) Feeding appliance cum obturator polished surface with attached dental floss (g) Feeding appliance cum obturator in –situ.

Case 2:

The Department of Pedodontics was requested to create a feeding appliance for a newborn female infant with a complete bilateral cleft lip and palate (Figure 2a). Weighing 1.6 kg and born just a few hours prior, the distressed parents

sought assistance for the infant's inability to suckle and consented to the fabrication of a feeding plate. No similar cases of congenital or genetic anomalies were reported in the family. To efficiently capture the cleft defect in a single-step impression, an infant-sized impression tray was fabricated using cold cure acrylic resin (DPI cold cure, India). The tray approximately one inch wide and one inch long, was designed to mimic the palatal curvature, with upturned and rounded borders resembling the maxillary jaw. A long handle, also made of the same material, facilitated easy handling at a 30-degree angle (Figure 2 b). This unique tray design eliminated the need for a primary impression.

Considering the infant's feeding challenges, the procedure was conducted without waiting for the customary two hours after the last attempt at feeding. Soft putty material (DENTSPLY Aquasil soft putty regular set, India) was applied to the custom tray, and the impression was made (Figure 2c) with the infant in an inverted position, ensuring continuous neck support. Visual inspection and the infant's crying were monitored to ensure un-obstructed airways. The impression was cast in Type III dental stone (Kalabhai, India), and a feeding plate was constructed using cold cure acrylic resin (Figure 2d) (DPI cold cure, India), following the same procedures as described in Case 1. Hooks made of 22 gauge stainless steel wire were embedded in the resin on both sides.

A soft satin ribbon was used to secure the appliance by tying it to the hooks and passing it across the back of the infant's head. The parents were given instructions on appliance usage and care. This approach aimed to address the infant's feeding difficulties promptly and form part of a comprehensive treatment plan that further included naso-alveolar molding, surgical repair, and orthodontic treatment.

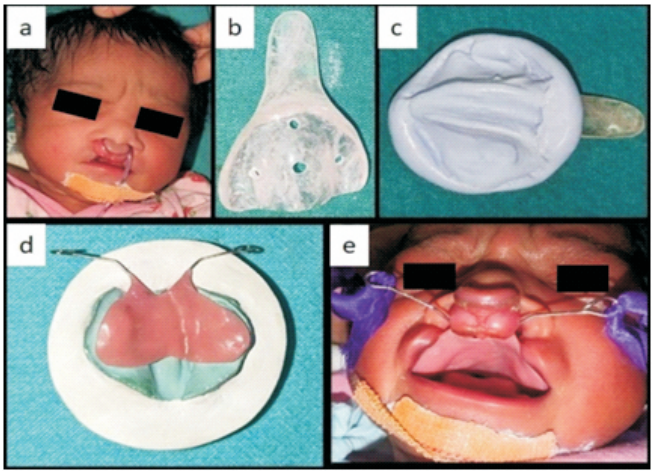

Figure 2: A newly born female infant (few hours from birth) (a) Extra-oral photograph showing complete bilateral cleft lip and palate with nasogastric tube placed in left nostril (b) An infant sized perforated acrylic resin impression tray approximately one inch wide and one inch long (c) Single step impression using soft putty (d) Feeding appliance cum obturator fabricated on a dental cast poured in Type III dental stone, (e) Feeding appliance cum obturator in situ.

Case 3:

Two-month-old male infant was referred to the Department of Pediatric and Preventive Dentistry due to difficulty in feeding and nasal regurgitation. The infant was born with a tracheo-oesophageal fistula and was operated for the same. Intra-oral examination showed a complete median cleft of the soft palate extending into the hard palate but not reaching the incisive foramen. The mouth opening was limited to 15 mm (Figure 3a).

The parents reporting no familial anomalies, consented to the fabrication of a feeding plate. Prior to the impression procedure, parents were advised not to feed the infant for at least 2 hours. The limited mouth opening necessitated an initial impression using soft putty material (DENTSPLY Aquasil soft putty regular set, India) loaded on the operator's index finger with the infant placed in a prone position on the mother's lap to prevent aspiration (Figure 3b). Type II dental stone (Kalabhai, India) was poured into the primary impression to create a dental cast model (Figure 3c).

An individualized PMMA custom tray (DPI cold cure, India) was fabricated (Figure 3d), and a second impression was taken using rubber base material (Figure 3e) and poured in Type III dental stone (Kalabhai, India) (Figure 3f). Subsequently, a feeding plate was fabricated from cold-cure polymerized PMMA (DPI cold cure, India) (Figure 3g-h), following the same protocol as described in Case 1. This approach aimed to address the infant's feeding challenges resulting from the unique oral anatomy and surgical history.

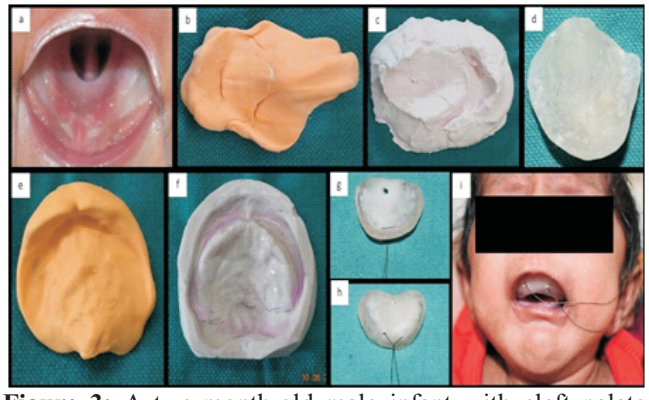

Figure 3: A two-month-old male infant with cleft palate (a)Intra oral maxillary occlusal view showing complete median Cleft of the soft palate extending into the hard palate

but not reaching up to the incisive foramen (Veau's group II Cleft Palate defect) with a limited mouth opening of approximately 20 mm (b) Initial impression made with soft putty © Dental cast poured in Type II dental stone (d) An individualized impression tray fabricated using poly-methyl methacrylate resin (e) Secondary impression made with a rubber base impression material loaded on the individualised infant tray (f) Dental cast poured in Type III dental stone with separating medium applied (g) Intaglio surface of the feeding appliance cum obturator with a hole made in the centre of the acrylic palatal vault to provide an airway, fabricated using cold cure polymerized polymethacrylate resin attached with dental floss (h) Polished surface of the feeding appliance cum obturator attached with dental floss, (i) Feeding appliance cum obturator in situ.

Discussion:

Impaired suckling in infants with CLCP poses significant challenges affecting feeding, speech, and overall growth. Breast feeding difficulties arise due to the palatal opening, hindering suction and milk intake. Oro-nasal communication leads to nasal regurgitation, risking aspiration pneumonia. The cleft's severity correlates with feeding complexity in infants with CLCP. To overcome the feeding difficulties, mothers of infants with CLCP are advised to adopt the modified football hold at a 45° angle to minimize nasal regurgitation. [11] Numerous feeding devices, including plastic squeeze bottles, soft nipples, specialized nipples with enlarged openings, and wide-based nipples, assist in effective feeding by sealing the cleft lip and enhancing milk intake.[12]

McNeil introduced feeding obturators as an early treatment for CLCP infants, sealing the oral and nasal cavities to control milk flow. [13] Feeding obturators reduce nasal regurgitation, shorten feeding time, and enhance weight gain, improving care for CLCP infants.[4] This device, positioned on the infant's hard palate, eases nipple compression for milk expression, aiding feeding. Prevention of nasal regurgitation also decreases the incidence of otitis media and nasopharyngeal infections. [12]

Feeding plates play a crucial role in positioning the tongue correctly, supporting jaw development, and advancing speech skills. They positively impact the physical and psychological development of infants, fostering a strong mother-child bond. This contributes to early-stage security, enhanced mental abilities, and an overall improved quality of life. These factors are vital pre requisites for subsequent surgical repair of orofacial defects. [2] To obtain a plate that is effectively adapted to the patient's anatomical structures, it is necessary to acquire a precise impression of the cleft. [12] Impression procedures in infants with cleft defects pose challenges like anatomical variations, difficulty in securing cooperation, difficulty in retaining impression material within the tray, and tearing of impression material during removal. In addition, the operator needs to execute the process swiftly. Neonates being obligatory nasal breathers necessitate maintaining airway patency. Four-handed dentistry is crucial to restrain unwanted movements and support the infant's neck. Breastfeeding is recommended after the impression to avoid regurgitation and inhalation risks, highlighting the delicate nature of these procedures.

Patient Position:

For an accurate impression, proper patient and dentist positions are vital. A number of positions have been adopted for obtaining impressions in infants with cleft palate including prone, facedown,[13] upside down,[14] and even upright. [15] Jacobson and Rosenstein suggest making impressions of newborns in hospital cribs for a convenient work surface.[9] Neonatal and infant cleft impressions should be done in a hospital setting with airway emergency capabilities in the presence of a pediatric surgeon or neonatal specialist. Impressions are made while the infant is awake and without administering anesthesia. Crying during impressions is taken as a positive sign, indicating clear airways.

Impression Tray:

Selecting the right tray for impressions in CLCP patients is crucial. The tray must have sufficient transverse dimensions, covering lateral maxillary segments, extending posterior to maxillary tuberosities and ensuring accurate reproduction of muco-buccal folds. The anterior tray border is less critical as the material naturally flows forward to cover the structures as the tray is seated. Various impression trays with modifications have been described in literature. One recommended approach involves applying utility wax around the metal tray to add lateral bulk, eliminating sharp edges, and serving as a posterior dam to prevent material flow. [9] Prefabricated trays designed especially for CLCP are commercially available. [8] These trays come in a range of sizes and shapes suitable for different types of clefts, are made of chromium-cobalt-molybdenum alloy, can be cleaned and sterilized easily, are more durable, but add to the inventory, which needs to be managed by a dental practitioner, and may not necessarily be feasible for stand-alone dental practices. Shatkin and Stark have described the use of wax as impression trays in CLCP patients. [15]

Additionally, unconventional methods such as ice cream sticks, a sterilized teaspoon with a hole in the middle, the back of a small-sized [u-0] impression tray, [16] and an alginate spatula have been suggested for carrying materials during

infant impression. [17] These materials can be sterilized easily, are cost-effective, and do not require any additional equipment. Impression material loaded on a finger covered with gauze has also been reported. [18] Customized impression trays can be fabricated with preliminary compound impressions of the patient's maxilla made with impression compound carried on acrylic trays or the fingers of the operator. [19] A set of perforated custom acrylic trays fabricated on casts of different size and shape can be stocked and individualized by trimming the acrylic or adding resin, as required. [9] Impression trays made of PMMA-based resins distort easily during autoclave sterilization and require being freshly fabricated regularly.

Impression Materials:

Heavy-body silicon impression material, polyvinyl siloxanes, low-fusing impression compound and alginate have been routinely employed for making impressions of neonates with orofacial clefts. [19] One study analyzed alginate, addition-cure putty, condensation-cure putty, cartridge delivery, and bite registration materials on a wet soaped stone model of a neonate with a cleft of the hard palate. [16] It was observed that alginate and cartridge delivery silicones reproduced surface details accurately, while the bite registration materials displayed the poorest surface reproduction. [16] Although cartridge delivery systems were expected to outperform other impression materials in neonatal cleft impressions due to better mixing and reduced cross-infection risks, all tested cartridge delivery silicones were deemed excessively fluid for use in cleft infants. Addition-cure silicones exhibited optimal flow, while condensation-cure silicones were challenging to mix. This material also offers the advantages of superior tear strength and the capability to generate multiple casts from the same impression. [19] In the same study, alginates were prone to tearing during removal, and the bite registration materials posed the greatest difficulty in removal due to their hard-setting nature. A quick 'snap' removal to improve tear strength and the use of fast-setting alginates have been recommended to overcome its limitations. [16] Impression compound offers advantages such as the ability to be removed for setting in emergencies and greater resistance to tearing compared to the materials, but it also carries the risk of causing scalding or burns in infants, potential leaching of volatile components harmful to infants, and raises concerns about compromising sterility when using a water bath. [20]

In the first case described in this case series, the use of fingers to carry and mold the impression material provided poor control over the flow of the material; complete defect was not captured, and the impression was difficult to remove. Using an infant acrylic resin impression tray and customizing it to adequately cover the palate and cleft defect as described in the second case proved very efficient. In this way, the authors were able to limit the number of procedures in a newborn infant while still obtaining an adequate impression in a single attempt, allowing immediate fabrication of a feeding plate. In the third case, due to the limited mouth opening and rigidity of orofacial tissues, a primary impression was obtained with impression material loaded on the fingers of the operator. A customized tray was fabricated, which was then utilized to make the final impression.

Potential Complications:

Chate surveyed consultant orthodontists in the United Kingdom, reporting adverse events during impression-making for CLCP infants.[19] Challenges in removing impressions due to the involvement of undercuts and respiratory obstruction due to fragmentation of impressions were among the most commonly reported difficulties. Eighty-nine cyanotic episodes, with some resulting in asphyxiation, were also reported, though fortunately no fatalities were reported.

Prevention and Management of Complications [20]

A dental mouth mirror is a valuable instrument for depressing the tongue during the impression process, ensuring the maintenance of airway patency. Clean cotton-tipped ear buds are recommended for cleansing the infant's oral cavity before impression-making and for removing any residual intra-oral impression material after the procedure. Employing a finger-sweeping motion is effective in clearing unset material located posterior to the tray, preventing the infant from closing down on the tray and compromising the airway. High-volume suction should be readily available at all times to address the possibility of regurgitation of stomach contents. It is advisable that the parents refrain from feeding the infant for at least two hours before the procedure. As mentioned earlier, a hospital setting is preferable for neonate impressions.

Signs of a complete airway obstruction include an ineffective cough, heightened respiratory difficulty accompanied by stridor, the onset of cyanosis, and loss of consciousness. Methods to relieve foreign body obstruction in infants include back blows, chest thrusts, and finger sweeps. Additional tools for airway and ventilation support encompass oxygen delivery devices, suction devices, appropriately sized oropharyngeal airways, bag-valve-mask systems, and in rare instances, cricothyrotomy.

Conclusions:

Inadequate nourishment due to feeding challenges significantly impacts the health and development of infants with CLCP. Early intervention is essential for successful

surgical repair and positive growth. Effective feeding appliances restore feeding and improve nutritional and developmental outcomes. Our case series demonstrates the superiority of acrylic resin infant impression trays in combination with addition silicone putty for CLCP impressions. However, there is no one-size-fits-all approach; adaptations and modifications must be tailored to meet theunique needs of each case. Understanding available appliances and impression procedures and having a basic knowledge of managing complications and emergencies enhances interdisciplinary CLCP care co-ordination.

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