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Management of Feeding Plates in Patients with Down Syndrome

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Down Syndrome, feeding plate, cleft lip and palate, management, orofacial rehabilitation

Abstract
Down Syndrome (DS) is a genetic disorder characterized by intellectual and physical developmental delays, often accompanied by craniofacial anomalies such as cleft lip and palate (CLP). These structural abnormalities impair feeding, swallowing, and oral functions, leading to nutritional deficiencies and growth challenges. This study explores the use of a feeding plate as a non-surgical intervention to improve feeding efficiency in DS patients with CLP. The research aims to evaluate the effectiveness of feeding plates in enhancing nutritional intake, stabilizing tongue position, and supporting craniofacial development. A case study was conducted on a 2-day-old male DS patient with palatoschisis. The feeding plate was fabricated under inhalation sedation, with impressions taken using putty material. The device was inserted and adjusted to ensure comfort and functionality. Parental education on usage and hygiene was emphasized. Findings revealed significant improvements in feeding efficiency, with the patient's weight increasing from 3 kg to 5.5 kg over three months. The feeding plate also reduced nasal regurgitation and aspiration risks while providing psychological relief to caregivers. Early intervention with feeding plates was shown to be crucial for preoperative preparation and overall quality of life. The study underscores the importance of multidisciplinary care and early prosthetic intervention in DS patients with CLP. Feeding plates serve as a transitional tool, bridging the gap until surgical correction, and highlight the need for tailored, family-centered approaches in managing syndromic craniofacial anomalies.

INTRODUCTION

Down Syndrome (DS) is named after John Langdon Down, a British physician who first described the features of this disorder in 1866. In 1959, a French physician, Jérôme Lejeune, identified the genetic cause of this anomaly. Down Syndrome, also known as Trisomy 21 (Hsa21), is a chromosomal abnormality that leads to intellectual disability, delayed mental development, and can also affect craniofacial growth and development. It is the most common chromosomal condition, occurring in approximately 1 in every 800 live births. Individuals with DS exhibit a wide range of phenotypes, including learning and memory deficits, congenital heart defects, and early-onset Alzheimer's disease.

Individuals with Down Syndrome consistently exhibit craniofacial dysmorphology, with nearly 100% penetrance (Kaczorowska et al., 2019). These features include midfacial hypoplasia (underdevelopment of the midface), flat nasal bridge, brachycephaly (shortening of the skull along the anteroposterior axis), micrognathia (small lower jaw), alterations in skull orbit shape, and hypodontia (congenitally missing permanent teeth) (Díaz-Quevedo et al., 2021). These orofacial characteristics are strongly associated with decreased quality of life, as they interfere with daily activities and can present significant challenges to functional tasks such as feeding, speech, and oral hygiene (Redhead et al., 2023).

Individuals with Down Syndrome are also at higher risk for congenital anomalies, including structural abnormalities of the face, such as cleft lip and palate. Studies have shown that these defects occur more frequently in individuals with DS compared to the general population. The co-occurrence of these conditions can further complicate feeding, speech, and breathing functions, requiring specialized intervention from an early age (Chouchene et al., 2021).

Cleft lip and/or palate is the most common craniofacial congenital anomaly worldwide, with a prevalence ranging from 0.28 to 3.74 per 1,000 live births (Duchi Valdez et al., 2023). These anomalies are influenced by both genetic factors and teratogenic environmental exposures. The male-to-female ratio for cleft lip (CL) is approximately 2:1, whereas cleft palate (CP) without cleft lip is more common in females. Orofacial clefts (OFCs) are anatomically classified into three subtypes: cleft lip (CL), cleft lip and palate (CLP), and cleft palate only (CPO). CPO is considered a distinct pathophysiological condition from CL and CLP. Around 30% of OFCs are syndromic, associated with known genetic syndromes, while the remaining 70% are non-syndromic.

One of the most common complications associated with cleft lip is difficulty in feeding. As a result, specialized feeding aids have been developed, such as the feeding plate, which can close the gap in the lip and create a stable platform for the infant to compress the nipple and extract milk (Akulwar, 2021). This significantly helps improve nutritional intake and weight gain during the critical early months of life, especially in infants with craniofacial abnormalities like cleft lip and/or palate (Lodhi et al., 2019).

Early rehabilitation is essential because syndromic cleft lip and palate significantly impact the child's quality of life (Tillman et al., 2018). Therefore, early conservative intervention must be implemented to reduce complications, promote weight gain, and minimize surgical risks. However, constructing feeding plates for infants presents multiple challenges, including anatomical variability in clefts, lack of patient cooperation, small oral cavity size, and the risk of aspiration during the impression-taking process (Hela et al., 2021).

To address these challenges during the neonatal period, feeding plates (FP) are recommended as an effective tool (Rathee et al., 2024). The FP acts as a rigid platform that allows the infant to compress the nipple effectively during breastfeeding or bottle feeding. It provides functional support during feeding and also helps guide the proper development of oral structures. The use of a feeding plate facilitates a more efficient and comfortable feeding process, helping to reduce fatigue and distress in both infants and caregivers (Vicente et al., 2020).

Feeding plates offer several advantages beyond improved feeding efficiency. These include normalizing tongue position, guiding maxillary growth, preventing the collapse of

maxillary segments, and offering psychological comfort to parents. The integration of feeding plates into early intervention protocols not only supports nutritional needs but also contributes positively to craniofacial development and overall well-being. As such, they represent a valuable part of the multidisciplinary care approach for infants with syndromic craniofacial anomalies such as those found in Down Syndrome

RESEARCH METHODS

This study employed a qualitative case study design to explore the effectiveness of a feeding plate in managing feeding difficulties for a Down Syndrome (DS) patient with cleft palate. The research focused on a single case to provide an in-depth analysis of the intervention process, outcomes, and challenges. The population consisted of infants diagnosed with both DS and cleft palate, while the sample was a 2-day-old male patient referred to a pediatric dental clinic. The sampling technique was purposive, as the case was selected based on specific criteria, including the presence of DS, cleft palate, and feeding difficulties requiring prosthetic intervention.

The primary research instrument was a clinical evaluation protocol, which included intraoral examinations, impression-taking procedures, and follow-up assessments. Additional instruments included medical records, radiographic data (thoracic X-rays), and laboratory reports (complete blood tests) to ensure the patient's suitability for sedation. A feeding plate was custom-fabricated using putty impression material and dental stone, with adjustments made during insertion to ensure proper fit and function. Parental feedback on feeding improvements and device usability was also documented.

Data collection techniques involved direct clinical observations, procedural documentation (e.g., sedation, impression-taking, plate insertion), and longitudinal monitoring of the patient's weight gain and feeding efficiency. Data were triangulated from medical records, caregiver reports, and clinical assessments to validate findings. The study adhered to ethical guidelines, with informed consent obtained from the parents. The qualitative approach allowed for detailed insights into the practical and psychosocial impacts of the feeding plate, contributing to evidence-based recommendations for similar cases.

RESULT AND DISCUSSION

Anamnesa

A 2-day-old male patient came escorted by his parents to the Pediatric Specialist Polyclinic of Pandega Pangandaran Hospital on November 20, 2023 with symptoms of a gap in the patient's palate and the patient having difficulty breastfeeding the mother. The patient is a referral from a pediatrician at Pandega Pangandaran Hospital. The patient was diagnosed by a pediatric specialist with Down Syndrome and Palatoschizis on November 18, 2023 after being sent a referral from the Mangunjaya health center. The patient's weight is 3 kg, Height 48 cm. Doctors Sp.A refer to dentists Sp.KGA to schedule a dental treatment plan so that patients can breastfeed properly. The patient is the 4th child of 4 siblings, where the patient's parents, the mother is 43 years old and the father is 48 years old.

The patient returned in June and is scheduled to do printing for the creation of the feeding plate on June 13, 2024. The patient entered the inpatient room of Pandega Pangandaran

Hospital on June 12, 2024. After consultation with the Sp.A and Sp.An doctors, the patient was continued for the upper jaw printing treatment plan under inhalation sedation on June 13, 2024.

The patient was scheduled to undergo treatment under inhalation sedation to facilitate maxillary impression taking, considering the accompanying systemic conditions. A comprehensive explanation of the treatment plan was provided to the patient's parents, including the therapeutic goals, detailed procedures, potential risks and complications, as well as available alternative treatments. The tools required for this procedure include an intraoral mirror, stainless steel bowl, clamp drape, basic dental instruments and Lecron carver, suction, impression tray, and spirit lamp. The materials used in this case include sterile gloves, non-sterile gloves, povidone iodine, NaCl solution, modeling wax, spirit, putty impression material, and Type III dental stone.

Case Management

On the first visit (November 20, 2023), the patient came to the dental polyclinic of Pandega Pangandaran Hospital, bringing a referral letter from a pediatrician for further examination and treatment by Sp.KGA. At the first visit to the polyclinic, the patient was not treated with dental care in consideration of the patient's general condition and avoided the risks that might occur during dental treatment, so this case was planned to be carried out under inhaled sedation. The patient's parents are given a complete explanation of the condition of the oral cavity and the comprehensive treatment plan to be carried out, as well as the advantages and disadvantages of inhalation sedation techniques. The patient's parents returned to the dental polyclinic in June 2024 then scheduled to come back to the pediatric dental clinic on June 12, 2024 (D-1 surgery).

On the second visit on D-1 (June 12, 2024), the patient again came to the dental polyclinic of Pandega Pangandaran Hospital for a plan for hospitalization and further examination with consultation with Sp.A doctors and Sp.An doctors, as well as consular letters for complete blood tests and thoracic X-rays as a condition for preparing for surgery. After obtaining approval for the oral preparation under inhalation sedation by the Sp.A doctor and the Sp.An doctor, the patient is scheduled by the admission department to get an operation schedule (June 13, 2024) and an inpatient room.

On June 12, 2024 at 19.00 WIB, the operator conducted a pre-operative visit to the inpatient room of Pandega Pangandaran Hospital. The pre-operative visit is to ask the patient's parents if there are any complaints, fever, allergy history, observation of vital signs, physical, extra-oral, intra-oral examinations for the treatment plan to be carried out.

Observation of vital signs showed a temperature of 36.5o C; respiration 30 x per minute; pulse 110 x per minute. The results of the extra oral examination obtained were the awareness of the compos mentis, the type of mesiofacial face; nasal bridge flat; symmetrical round face; symmetrical bilateral eyes with red conjunctiva; lymph nodes are not palpable and do not hurt; symmetrical bilateral ears; no signs of cyanosis, nor edema; effective breathing patterns; and the lip seal is incompetent. The results of the intraoral examination obtained were that there were no TMJ abnormalities, the palate had a gap.

Patients were instructed to fast 6 hours before the procedure, infusion of D5 1/4 NS maintenance, prophylactic antibiotics with ceftriaxone 50mg/kgBB per IV given 1 hour before the oral preparation procedure under inhaled sedation.

In the supporting examination, the following results were obtained:

1. Complete blood laboratory test

Hemoglobin 12.0 g/dL (normal), hematocrit 36.2 % (normal), platelets 337 x 103 cells/µL (normal), erythrocytes 4.02 million/µL (normal), leukocytes 9.8 cells/µL (normal), MCV 90.1 fL (normal), MCH 39.9 pg/cell (normal), MCHC 30 % (normal), Bleeding Period/BT 2 minutes (normal), Coagulation/CT period 3.30 minutes (normal).

2. X-rays of the thorax
    a. Trakhea in the middle
    b. Color: normal
    c. Sinuses and normal diaphragm
    d. Lung: After normal, normal bronchovascular patterns, visible patches infiltrate in the right paracardial bilateral periphilar.

On June 13, 2024, the operator will prepare pre-operative tools, materials, and medicines. Here are the steps of the upper jaw printing action performed in the operating room under inhaled sedation:

1. Preparation of operating rooms, tools, operators, and operator assistants
2. Patient preparation
    a. Patient wearing surgical gown
    b. The patient enters the operating room with an infusion of D5 1/4 NS already attached to the right hand.
    c. Installation of a vital sign monitor on the patient's right toe
    d. Vital signs: 100% SpO2; Pulse 112x/min
3. Inhalation induction with sevofluran 8% + 50% N2O using a face mask was carried out by the anesthesia team.
4. Preparation of the operator wearing a sterile gown and gloves
5. Time-out:
    a. Confirm all operator team members for their names and duties
    b. The operator verbally confirms the patient's name, patient's age, diagnosis, and surgical procedure
    c. Prayer recitation
6. Oral and intraoral extra-oral aseptic and antiseptic action using povidone iodine in circular motion from the inside out
7. The printing action on the upper jaw uses Putty 2 times to avoid printing errors.
8. Cleaning of extra oral areas using sterile gauze + NaCl
9. Monitoring and evaluation of the patient's condition and reflexes
10. The patient is conscious and taken to the recovery room

The patient is then taken back to the inpatient room and the patient is given the following postoperative instructions through his parents:

1. TTV Control
2. Milk is given little by little until BU (+), DU (+), FL(+).

On June 13, 2024 at 20.00 WIB, the operator conducted a post-surgery visit to the inpatient room of Pandega Pangandaran Hospital, Jerebung. Based on information from the patient's parents, the patient did not complain of pain or other discomfort. The patient has

started drinking milk little by little since he is fully conscious and has started drinking normally since the nurse's examination stated BU (+), FL (+), DU (+).

On June 14, 2024 at 09.00 WIB, the operator conducted a post-surgery visit to the inpatient room of Pandega Pangandaran Hospital, Jerebung. The general condition of the patient was declared good so that the patient was allowed to go home on June 14, 2024. Postoperative instructions are informed back to the patient's parents for follow-up 2 weeks after surgery to the Pediatric Dental Specialist Polyclinic to perform feeding plate insertion.

On June 28, 2024, the patient came to the dental polyclinic of Pandega Pangandaran Hospital, to continue the feeding plate insertion treatment. The patient had no post-inpatient complaints at the previous visit. The insertion of the feeding plate was carried out at the pediatric dental polyclinic of Pandega Pangandaran Hospital.

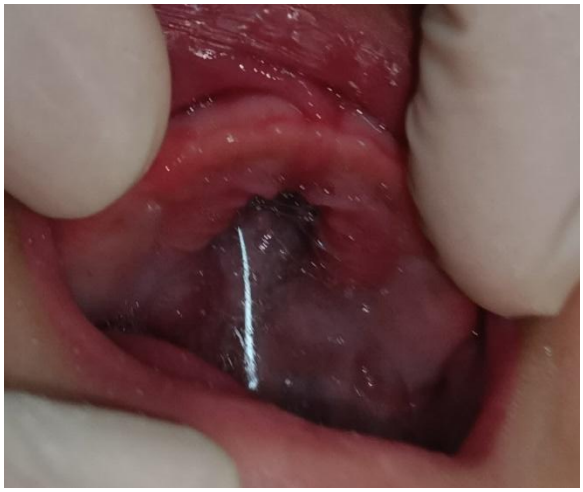

Figure 1. (A,B) *Cleft Palate* Before insertion *Feeding plate*

After the insertion of the feeding plate on the patient, the operator gives instructions on how to use the feeding plate to the patient's parents. The operator also explained how to use the feeding plate at any time and also how to clean the plate. After the patient's parents feel that the information provided is complete, the feeding plate insertion action is complete. And was instructed for control 1 week later.

Down syndrome (DS) is the most common genetic disorder due to trisomy on chromosome 21 (Ganguly, 2022). Individuals with DS exhibit a variety of phenotypic disorders, including intellectual developmental delays and craniofacial growth disorders. One of the hallmarks of orofacial in children with DS is midface hypoplasia, macroglossia, a high and narrow palate and cleft lip and palate which can all affect the ability to eat and speak normally (Heinke et al., 2021). Disorders of orofacial muscle and low muscle tone (hypotonia) in DS patients also affect the ability to suck and swallow. The combination of these factors makes DS babies more susceptible to growth failure, aspiration, and airway infections, especially when there are additional structural abnormalities such as a cleft palate (Javed et al., 2018).

Cleft palate (cleft in the palate) is a congenital disorder that occurs due to the failure of palatal fusion shelves during embryogenesis (Cabanas et al., 2023). This gap can occur as part

of a specific syndrome or as a non-syndromic disorder. The palate begins to form during the fifth week and does not complete until the twelfth week of pregnancy. The most critical stage is between weeks 6 and 9. During this stage, the upper jaw protrusions merge with medial nasal prominence below the nostrils, forming a wedge-shaped mass of mesenchymal tissue (Costello et al., 2012; Bernheim et al., 2006). Although the cleft palate is not the most common disorder found in people with DS, it can still occur and cause serious functional problems, especially in the process of breastfeeding. A cleft palate results in an open condition between the oral cavity and the nasal cavity, so the baby is unable to create the negative pressure necessary to breastfeed effectively. As a result, the baby's nutrition can be disrupted, leading to growth and development problems, such as failure to thrive (Cabanas et al., 2023; Heinke et al., 2021).

In this case, management using a feeding plate is one of the most important conservative prosthetic solutions in treating babies with a cleft palate, especially before corrective surgery can be performed (Akulwar, 2021; Lodhi et al., 2019). The device is designed to close the gap in the roof of the mouth, thus separating the oral cavity from the nasal cavity and allowing sufficient suction pressure to form during breastfeeding. The case of cleft palate that occurred in this patient caused the baby's very slow growth. At the beginning of birth, the baby's weight was 3 kg, after 6 months the baby only experienced a weight gain of 4 kg. So that in the last 6 months the baby has only increased by 1 kg. So that handling with a feeding plate is one of the options to increase the baby's weight. Feeding plates not only aid in the process of nutrient delivery, but also prevent nasal regurgitation and aspiration, and help direct the growth of the upper jaw more physiologically (Akulwar, 2021; Lodhi et al., 2019).

In the management of this case, the main challenge lies in the syndromic condition and uncooperative behavior of the child. Therefore, the feeding plate printing is carried out under inhalation sedation that is safe for pediatric patients, in accordance with the protocols recommended in the pediatric dental anesthesia literature (Chouchene et al., 2021; Rathee et al., 2024). This approach supports patient safety while allowing operators to obtain precise print results. The action under inhalation sedation was carried out at Pandega Pangandaran Hospital on June 13, 2024. The action under sedation is to print the jaw on the patient who has a cleft palate to get a negative print using a putty. The patient was instructed to return on June 28 after the feeding plate was finished manufacturing in the laboratory. Then the management of the insertion of the feeding plate on the patient is carried out, adjusting the acrylic plate on the patient's upper jaw, ensuring that there are no sharp parts and ensuring that the acrylic plate is not easily detached when the patient is breastfeeding.

After the installation of the feeding plate, the role of parental education becomes crucial. Education on the use of the appliance, usage schedule, and hygiene procedures should be provided thoroughly to ensure long-term effectiveness (Hela et al., 2021). The operator also ensures that the patient has felt better breastfeeding after the insertion of the feeding plate. So that the process of breastfeeding the baby can be better to increase the patient's weight. Studies show that active parental involvement in the use of feeding plates can accelerate infant weight gain and improve quality of life.

Several recent systematic reviews have shown that feeding plates significantly improve feeding effectiveness and patient quality of life. A report from Dash et al. (2023) shows that the use of feeding plates reduces feeding times, reduces the incidence of aspiration, and increases the volume of milk consumed by babies. The study from Jayanna et al. (2021)

supports these findings and highlights the importance of making plates tailored to the shape of the baby's slit and oral cavity. Chouchene et al. (2021) in their systematic review of the use of orofacial plates in children with Down syndrome showed that feeding plates play an important role not only in the aspect of eating, but also in the stimulation of oral muscles, respiration, and early sound production.

The patient only used the feeding plate for approximately 3 months. The patient's parents provide information that the baby no longer uses the feeding plate because he can breastfeed without the help of a feeding plate. During the use of the feeding plate, the baby's weight reaches 5.5 kg. So that the use of feeding plates can help the patient's weight growth reach 1.5 kg.

Handling children with a combination of DS and cleft palate requires a multidisciplinary and individualized approach. Feeding plates have proven to be an important transitional tool in preparing patients for definitive surgery, namely palatoplasty surgery. This prosthetic therapy becomes an integral part of early management, supporting the development of nutrition, orofacial function, and general well-being of the child.

CONCLUSION

Down syndrome is a genetic disorder caused by the presence of three copies of chromosome 21. This condition poses various health challenges, including developmental delays, impaired muscle coordination, and facial and oral deformities, such as cleft palate. When a cleft palate also occurs in children with Down syndrome, this can further complicate the breastfeeding process because the child is unable to form enough suction pressure, increases the risk of food entering the airway (aspiration), and inhibits optimal weight gain.

One solution that can be used early on is a feeding plate, which is a temporary prosthetic device designed to close the gap in the palate of the mouth non-surgically. The feeding plate is made individually, adapted to the shape of the child's oral cavity. This helps to create a more stable mouth space, direct the position of the tongue correctly, reduce the risk of food coming out of the nose, and make the breastfeeding process easier. Not only that, this tool also helps prepare the condition of the child's oral cavity before undergoing slit closure surgery.

The implementation of feeding plates requires cooperation from various parties, ranging from pediatric dentists, to full support from parents. Feeding plates that are made and installed in a timely manner, and followed by clear education to the family on how to use them, will greatly determine the success of the treatment. Thus, the feeding plate not only functions as a feeding aid, but also makes an important contribution to the quality of life and growth and development of children with Down syndrome and cleft palate.

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