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Prosthodontic Perspective on Cleft Lip and Palate: A Review Article

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A B S T R A C T :

Cleft lip and palate (CLP) represent one of the most common congenital craniofacial anomalies, significantly affecting the orofacial structures, speech, mastication, esthetics, and psychosocial well-being of patients. From a prosthodontic perspective, the management of CLP extends beyond conventional dental rehabilitation, encompassing functional, esthetic, and interdisciplinary considerations. Prosthodontists play a critical role in the comprehensive treatment team by designing and fabricating obturators, feeding plates in neonates, speech-aid prostheses, and definitive prosthetic solutions for patients who cannot undergo surgical correction or require interim care. Advances in digital dentistry, materials science, and maxillofacial prosthetics have enhanced the precision and effectiveness of prosthodontic interventions in CLP patients. This abstract reviews the evolving role of prosthodontics in the multidisciplinary management of CLP, emphasizing individualized care strategies, timing of interventions, and the integration of prosthodontic treatment with surgical and orthodontic phases for optimal patient outcomes.

Keywords: Cleft lip, Cleft Palate, Prosthodontics, Obturator, Maxillofacial prosthetics, Interdisciplinary care, Congenital anomaly.

INTRODUCTION: -

Cleft lip with or without palate is the most common congenital birth defect occurring in the population. The prevalence ranges from 1 in 500 to 1 in 2500 live births. Orofacial clefts are more common among Asians and Native Americans than in Europeans, Hispanics, and African-Americans, however the frequency varies with race. The critical period for cleft development ranges from the 4th to the 12th week of intrauterine life. Primary palate clefts form between weeks four and seven of intrauterine life, whereas secondary palate clefts form between weeks eight and twelve of embryonic life.[1]

Cleft lip occurs when the frontonasal and maxillary processes fail to fuse, resulting in a cleft that varies in size through the lip, alveolus, and nasal floor (a complete cleft indicates that the alar base and medial labial element are not connected, whereas an incomplete cleft does not extend through the nasal floor).

Cleft palate occurs when the palatal shelves of the maxillary processes fail to fuse, separating the hard and/or soft palates. Clefts arise during the fourth stage of development. Their specific appearance is determined by the moments in embryologic life where development is disrupted, which determines the locations where the merging of separate facial processes fails.[2]

EPIDEMIOLOGY: -

A meta-analysis of the evaluated studies yielded a prevalence of cleft palate of 0.33 (95% CI: 0.28−0.38) per 1000 live births, according to the current worldwide research on cleft palate, which included samples from 59 studies totalling 21,088,517 persons. The total number of samples included in the 57 examined studies for cleft lip was 17,907,569 people. 17,894,673 samples in all were included in the 55 examined papers pertaining to cleft lip and palate. The prevalence of cleft lip and palate based on the meta-analysis of the studies reviewed in each 1000 live births was 0.45 (95% CI: 0.38−0.52).[3]

Cleft lip occurs more common in male than female whereas cleft palate occurs more commonly in female than in male. With 1.21 billion people, India is the second most populated country in the world. It is estimated that 24.5 million births occur there annually, and between 27,000 and 33,000 clefts are born there annually.[4]

ETIOLOGY: -

The following categories apply to the etiological causes of cleft lip and palate:

A. Non-genetic: They comprise a variety of environmental (teratogenic) risk factors that might result in cleft lip and palate.

B. Genetic: Genetic cause includes: -
(1) Syndromic: In this case, the cleft is linked to further malformations. Usually, a single gene (monogenic or Mendelian) disease is the cause.
(2) Non-syndromic: In this situation, the cleft is primarily an independent characteristic and affects up to 70% of people with cleft lip or palate. In this type, there is no known origin for the condition and no recognised pattern of deformity associated with a cleft. Non-genetic elements: In addition to genetic variables, environmental factors are crucial in the aetiology of CL/P. Various environmental factors includes: -Smoking, Alcohol use, Teratogens. [5] Factors that interfere with any of these events could lead to a cleft: -Vitamin A, Phenytoin, Ethanol, Hyperthermia, Ionizing Radiation, Hypoxia, Stress, Alcohol use, Anticonvulsants [6], Antimetabolites. [6,7]

CLASSIFICATION OF CLEFT LIP AND PALATE

Several classifications of cleft lip and palate were given by various authors. Basically, divided into two categories

1) Embryological classification.
2) Morphological classification

Embryological classification of cleft lip

Unilateral cleft lip results from failure of maxillary process to merge with medial nasal process on the affected side, bilateral cleft lip results from failure of maxillary process to merge When the medial nasal process fails to unite and create the intermaxillary segments, oblique cleft lip arises, while median cleft lip occurs with the medial nasal process on both sides from failure of the maxillary process to fuse with the lateral nasal process.

Embryological classification of cleft palate

An anterior cleft palate results from unfused lateral palatine processes with the primary palate, as well as from unfused lateral palatine processes with the nasal septum and one another causes a posterior cleft palate; and failure to fuse the lateral palatine processes with the nasal septum and primary palate causes a complete cleft palate (anterior and posterior).

MORPHOLOGICAL CLASSIFICATION

1. A) The Veau classification divides clefts of lip into 4 subtypes:

Group 1: Unilateral notching of vermillion

Group 2: Clefts involving vermillion and lip

Group 3: Clefts involving vermillion, lip and nasal floor on one side

Group 4: Bilateral clefting of lip complete or complete [8] (figure-1)

B) Veau classification divides clefts of lip into four major groups:

Group A: Cleft of soft palate.

Group B: From the incisive foramen to the secondary palate, there is a cleft between the soft and hard palates.

Group C: A complete unilateral cleft that extends through the alveolus on one side at the side of the eventual lateral incisor tooth from the uvula to the incisive foramen.

Group D: Complete bilateral cleft from the incisive foramen to the alveolus, the premaxilla remains suspended from the nasal septum.[9] (Figure-2)

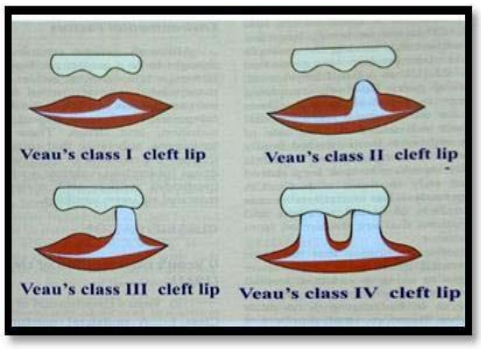

Figure-1
Veau classification clefts of lip

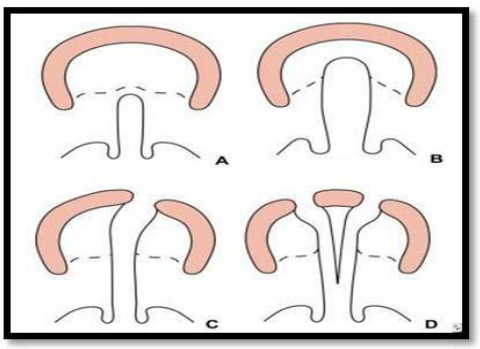

Figure-2
Veau classification clefts of lip

2. Kernahan and Stark Classified cleft lip and palate and it give the shape of stripped Y letter and include:

The right and left cleft lips are represented by blocks 1 and 4.

The alveolar clefts on the right and left are represented by blocks 2 and 5.
The left and right hard palate clefts are shown in blocks 3 and 6, respectively, in front of the incisive foramen.
The right and left clefts involving the hard palate posterior to the incisive foramen are shown by blocks 7 and 8.
Block9 represent cleft involving the soft.

3. Millard: - He gave a modification to Kernahan and Stark's classification. In addition, he added two triangles to the top of the stripped Y, one of which is an upright triangle that represents the cleft involving the nasal floor and the other an inverted triangle that represents the split involving the nose or nasal arch.[8]

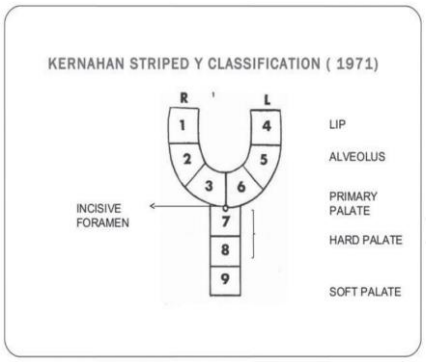

Figure-3

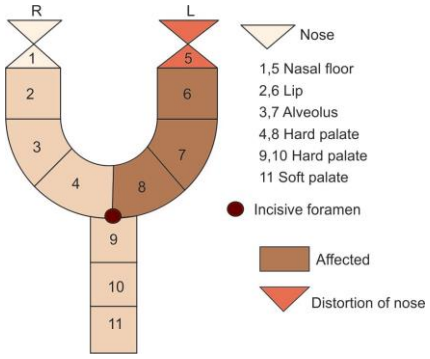

Figure-4

CLINICAL FEATURES: -

Dental problems in cleft lip and palate: - Natal and neonatal teeth, Microdontia, Taurodontism, Ectopic eruption, Enamel hypoplasia, Delayed tooth maturation.[10]
Other associated conditions: -Speech difficulties, hearing problems[11], Feeding problems[10,11], Airway and sleep-disordered breathing problems, Aesthetic problems, psychological problems, Fistulas Oronasal, Jaw growth problems. [11]

DIAGNOSIS

I. Prenatal Diagnosis: - A prenatal diagnosis of cleft lip and palate is critical to establish long-term treatment planning, prognosis, and appropriate parental counseling. For prenatal diagnosis of oral clefts, we have conventional ultrasound, three-dimensional ultrasound and magnetic resonance imaging (MRI).

II. Conventional and three-dimensional ultrasound: -This test is performed through the emission of sound waves that are capable of producing an image of the fetus, achieving a precise diagnosis of this malformation from the 13th week of gestation (second trimester of pregnancy), and the closer you are to the delivery date, the more evident the diagnosis will be through this study.

III. Magnetic Resonance Imaging: - MRI is the gold standard for the evaluation of possible associated intracranial abnormalities in the setting of cleft lip or cleft palate. Characterising and verifying the cleft and related intracranial and extracranial abnormalities can be aided by prenatal MRI.

IV. Clinical Diagnosis: - It is performed at birth, because its morphological defect is evident. Although, among the most evident findings at the time of diagnosis, are the deviation of the philtrum with respect to the vertical axis of the patient's face, which is directed to the altered nostril, the tip of the nose approaches towards the unaffected side.[11]

MULTIDISCIPLINARY CLEFT CARE: -

To maximise treatment results, people with cleft lip and/or palate need coordinated care from several specialities. A facility that treats cleft-related conditions from infancy to maturity and has a multidisciplinary cleft team is desirable.
Audiologists, dentists, geneticists, nurses, nutritionists/dietitians, oral surgeons, orthodontists, otolaryngologists, paediatricians, plastic surgeons, psychologists, social workers, and speech pathologists are typical components of a cleft team. The goal of cleft care is to eliminate as many steps in the treatment plan as possible by optimizing the outcome and benefit of each essential intervention. [12]

Prosthesis used in Cleft Palate Patients

A. Prosthesis in infancy period:

i. Feeding obturator,

ii. Premaxilla positioning appliances,

iii. Palatal lift prosthesis,

iv. The third and fourth were also provided to adult patients as speech aids or speech bulb prostheses.

B. Obturator: Obturator: Palatal obturator has meatus bulbs that are either solid or hollow.

C. Prosthesis for tooth replacement:

i. Removable prosthesis

ii. Complete dentures prosthesis

iii. Fixed prosthesis

iv. Implant prosthesis. [13]

A. Feeding Obturator

A prosthetic device intended to seal the cleft and create a division between the nasal and mouth canals.

1. It helps in feeding
2. Reduces nasal regurgitation
3. Prevents tongue from entering the defect
4. Allows spontaneous growth of palatal shelves
5. Contribute to speech development
6. lowers the prevalence of pharyngeal infections, including otitis media.

Studies have demonstrated while making impression the infant positioned face downwards is the best position to prevent airway obstruction and aspiration of impression material and choking.

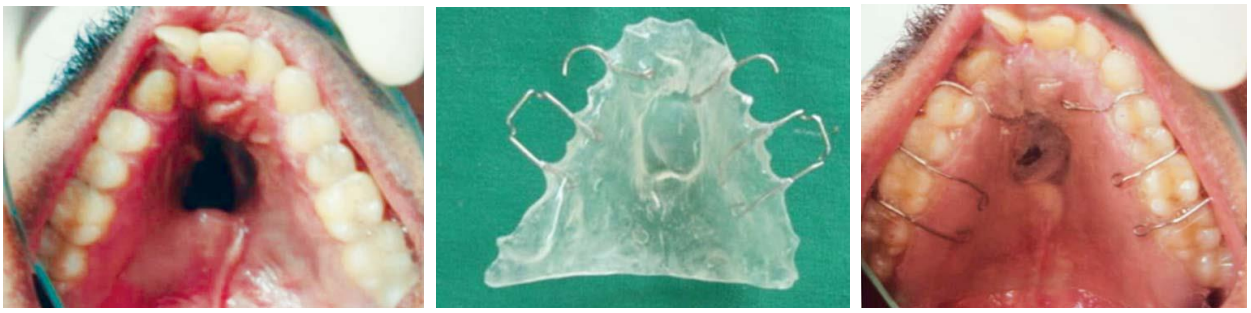

Figure5: -Cleft palate after surgery with residual oronasal communication

B. Premaxilla Positioning Appliances

Patients with complete bilateral cleft lip, the premaxilla and prolabium are protrusive and rotated upward. Due to the possibility of broad clefts and significant strain along the suture lines of the surgically repaired lip, surgical repair of these patients will be challenging. A nonsurgical method called the premaxilla positioning device rotates and retracts the malpositioned segment to a position that is better for lip healing.

C. Palatal Lift

When the surgically repaired soft palate is sufficiently lengthy yet immobile to elevate the soft palate, velopharyngeal incompetency results. Because the velopharyngeal closure is absent in this case, air escapes via the nose, impairing speech and creating unintelligible noises. In order to engage the soft palate, a palatal lift prosthesis extends posteriorly, covers the hard palate, and physically raises the soft palate to the appropriate position for closure. This prosthesis has advantage only when the soft palate has little muscle tone and offers less resistance to elevation else there can be an opposing onward muscle force that can dislodge the prosthesis.

D. Speech Bulb

This prosthesis is made when the soft palate is too short while having sufficient mobility, which results in a lack of velopharyngeal closure and air escaping via the nose, which impairs speech. The prosthesis is composed of two parts: the palatal section and the pharyngeal or bulb section. In order to enable appropriate velopharyngeal closure and aid in speech production, the bulb part extends posteriorly.

E. Obturator

After cleft palate surgery, there may be a residual oronasal communication. This may occur on the palate or in the alveolar ridge or labial vestibule. It usually does not cause a problem for feeding, but speech may be affected. It may allow undesirable nasal air emission or contribute to compromised articulation. A palatal obturator helps produce speech normally by covering the opening. It helps speech therapy correct compensatory articulations and gets rid of hypernasality. It is possible to make the obturating part solid or hollow. Effective retention, support, and stability of an obturator prosthesis in edentulous patients with maxillary defects must be achieved by engaging a sufficient undercut inside the defect and using remaining palatal anatomy. Patients benefit from a segmented, magnetically held hollow obturator prosthesis since it is lightweight and allows for simple insertion and removal. An author recently proposed using a strong neodymium magnet, which permits little horizontal movement and so lessens the transmission of stress to the defect's lateral walls, for the magnet held obturator's maximum efficiency.13 (Figure-5,6)

F. ADHESIVE FIXED DENTURE (AFD)

It is mostly recommended for tiny prosthesis spaces. The lateral incisor area may undergo an AFD, which mostly serves a cosmetic and phonetic purpose, if appropriate circumstances and favourable occlusion are met. The indication of these dentures should also take into account the fundamentals of fixed dentures, such as overjet and overbite (both requiring a minimum of 1 mm) and the amount of space needed for the framework; whether the dentures are made of ceramic or metal, the abutment teeth should have adequate enamel to permit preparation.

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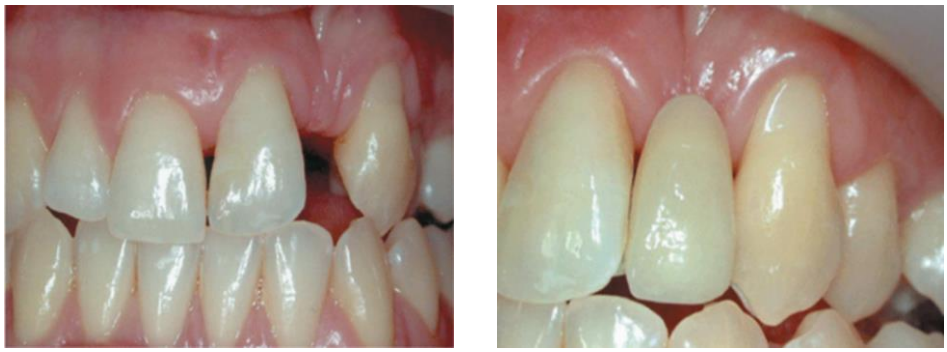


Figure-7

ADHESIVE FIXED DENTURE

G. FIXED PARTIAL DENTURE (FPD)

FPD therapy remains generally recommended, particularly when the alveolar bone transplant fails or its indication is not feasible. 14 (figure-8)

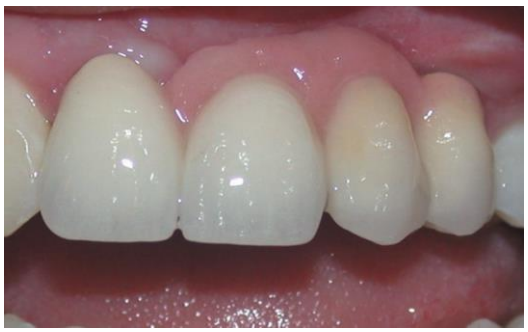


Figure-8

Fixed partial denture(fpd)

H. REMOVABLE PARTIAL DENTURE (RPD)

Because the maxillomandibular region does not always permit the indication of an optimum treatment with fixed or implant-supported dentures, RPDs have become a significant therapy choice for people with cleft lip and palate. They may be recommended in ambiguous and unfavourable circumstances because of their adaptability and relative simplicity. (figure-9)

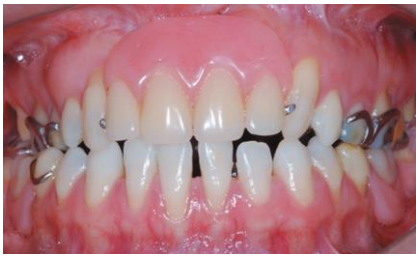


Figure-9

REMOVABLE PARTIAL DENTURE

I. OVERLAY DENTURE (OD)

When orthodontic therapy and orthognathic surgery could not be suggested, it was mostly recommended for those with cleft lip and palate, hypoplasia, and noticeable maxillary retrusion with tooth loss and/ or malpositioning. (figure-10)

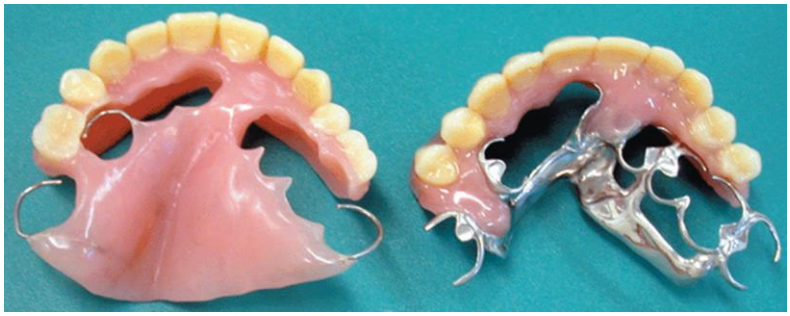
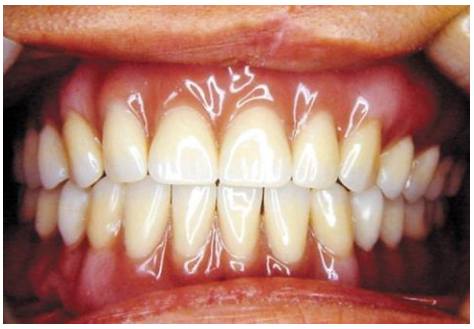


Figure-10

OVERLAY DENTURE

J. COMPLETE DENTURE (CD)

Professionals find CD rehabilitation difficult because of changes in the alveolar ridge of people with cleft lip and palate. Physical aspects including adhesion, surface tension, and cohesion are compromised, which leads to issues with denture stability and retention. These people are given dentures that have obturator, functional, and aesthetic qualities, which enhance their comfort, speech, and mental health.



DISCUSSION: -

Oral-facial clefting, which accounts for over half of craniofacial abnormalities, affects one in seven hundred live neonates. National Center for Health Statistics. The WHO estimates that OFC at birth ranges from 3.4 to 22.9 per 10,000 Cleft lip/ Cleft palate births and 1.3 to 25.3 per 10,000 CP births. The most difficult times for parents are the first year following the birth and the immediate post-diagnosis period.

Prenatal counselling and educating parents and prospective moms and dads are the main goals of CLP. Educating parents about their child's congenital defect is the main objective of prenatal counselling. Metabolic disorders, inherited or not, may play a role in the pathogenesis of clefting. However, factors such as genetics, tobacco, alcohol, ethnicity, maternal malnutrition and maternal age, among others, have been found to be related. Prenatal control is of great importance, not only for the prevention of this pathology but also to avoid maternal and perinatal morbidity.

CONCLUSION: -

A better understanding of the embryology, anatomy and genetics of orofacial clefting is crucial for better diagnosis and treatment of the effected individuals. Although the birth of a child is an emotional and stressful time for any new parent, requiring a significant transition and the establishment of new familial roles and routines, the birth of a child with a health condition places a significant additional burden on the family.

But important long-term goals should include an adult who is,

i. Functionally habilitated with acceptable speech, appearance, mastication, and educational attainment.

ii. Psychologically adjusted.

iii. An esthetically contributing, reasonably well aligned, has well settled occlusion, and a healthy dentition

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