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Maxillofacial Prosthesis: A Comprehensive Review

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ABSTRACT

Maxillofacial prostheses play a pivotal role in addressing the intricate challenges posed by orofacial defects, where the impact extends beyond mere physical appearance to encompass essential functions such as speech, mastication, and psychosocial well-being. The classification system, addressing both maxillary and mandibular involvement, facilitates a nuanced understanding of the diverse spectrum of orofacial defects .Etiological factors contributing to these defects are explored, acknowledging the multifactorial nature of orofacial issues. Factors such as congenital anomalies, trauma, and surgical interventions are examined to provide a holistic view of the underlying causes that drive the need for rehabilitation. Size considerations of oro-facial defects are scrutinized, recognizing that the extent of the defect is a crucial determinant in selecting the most appropriate intervention.

Surgical, prosthetic, and combined approaches are discussed in-depth, emphasizing the need for a multidisciplinary approach. Surgical interventions address anatomical reconstruction, while prosthetic solutions focus on restoring both form and function. Combined approaches leverage the strengths of both modalities, highlighting the importance of collaboration between surgeons and prosthodontists. In conclusion, this review serves as a comprehensive guide for practitioners involved in orofacial defect management, offering insights into classification, etiological factors, defect size considerations, and a range of rehabilitation options. By fostering a holistic understanding of orofacial defects, this review contributes to the advancement of effective and patient- centered care in this specialized field.

Keywords: Maxillofacial Prosthesis, Oro-Facial Defects, Classification, Etiology , Defect Size, Rehabilitation Options.

INTRODUCTION

Oro-facial defects, encompassing the partial or complete loss of anatomical structures in the maxillofacial region, create multifaceted challenges affecting both physical functionality and psychological well-being. These defects can arise from a range of etiological factors, including congenital anomalies, traumatic injuries, surgical interventions, and underlying pathologies. Maxillofacial deformities can significantly impact both the physical and psychological well-being of patients, potentially leading to serious emotional, social, and familial challenges.[1] These deformities encompass congenital issues resulting from developmental irregularities and acquired conditions stemming from necrotizing diseases, oncological surgeries, or trauma.[2]

The repercussions extend beyond the physical aspects, influencing vital functions like speech, mastication, facial aesthetics, and overall quality of life.[2] Responding to these intricate challenges, the field of maxillofacial prosthetics has emerged as a crucial discipline dedicated to reinstating form, function, and self-assurance among individuals grappling with orofacial defects. This review article endeavours to provide a comprehensive panorama of orofacial defects, encompassing their classification based on involvement in the maxilla and mandible, exploring the diverse etiological contributors, considering the implications of defect size, and delving into the spectrum of available rehabilitation options.

The intersection of surgical and prosthetic approaches underscores the complexity inherent in addressing orofacial defects and emphasizes the indispensable role of interdisciplinary collaboration in achieving favourable outcomes.[3] As we delve into the intricacies of orofacial defects and their rehabilitation, it becomes apparent that a nuanced comprehension of classification, etiology, defect dimensions, and rehabilitation modalities is paramount for holistic patient care. By traversing the landscape of maxillofacial prostheses within the context of orofacial defects, we seek to illuminate the delicate equilibrium between scientific knowledge, artistic finesse, and empathetic care essential to empowering individuals on their journey towards physical and emotional rejuvenation. The realm of maxillofacial prostheses is characterized by a multitude of materials, techniques, and clinical strategies. This review introduces a classification system for these prostheses, explores their diverse types and origins, traces their evolution, outlines contemporary materials and techniques, envisions future demands, and addresses avenues for refining this transformative therapeutic avenue.

OROFACIAL DEFECTS CLASSIFICATION

The classification of orofacial defects encompasses a comprehensive framework designed to categorize these anomalies based on various criteria. These classifications aid in understanding the nature and origins of these defects, thereby guiding appropriate diagnosis, treatment, and intervention strategies.[4]

Isolated Orofacial Clefts:

Typical Orofacial Clefts: This category includes cases of cleft lip (CL), unilateral or bilateral cleft lip and palate (CLP), and cleft palate (CP). These cases exhibit the primary cleft anomaly without any other major anomaly. Minor anomalies such as low-set ears or clinodactyly do not alter the classification as isolated.

Atypical Orofacial Clefts: Atypical clefts encompass conditions like median cleft lip and various forms of Tessier's facial cleft. Here, the focus remains on the cleft itself without major defects unrelated to the primary cleft anomaly.

Oro-facial Clefts in Sequences: This classification applies to cases where orofacial clefts are part of a sequence of anomalies stemming from a single defect that occurred during early embryonic development.

Orofacial Clefts in Chromosomal Aberrations: This group comprises cases with clinically significant chromosomal aberrations, either numerical or structural in nature.

Orofacial Clefts in Monogenic Syndromes : These are cases where orofacial clefts are part of recognized monogenic syndromes, including autosomal dominant, autosomal recessive, X-linked dominant, and X-linked recessive patterns. Also included are sporadic syndromes described as AD or AR.

Oro-facial Clefts in Known Environmental Syndromes: This category pertains to cases where the orofacial cleft is a component of a known environmental syndrome caused by a teratogens , such as fetal alcohol syndrome or Dilantin syndrome..

Oro-facial Clefts in Multiple Congenital Anomaly of Unknown Etiology : This group encompasses cases in which orofacial clefts are part of a broader spectrum of multiple congenital anomalies (MCA) with an uncertain etiology. The cases within this category are further classified into subgroups based on the likely origin of these anomalies, including malformation, deformation, disruption, and their combinations.

Oro-facial defects can be classified into those involving the maxilla (upper jaw) and the mandible (lower jaw). Maxillary defects may include partial or total loss of hard and soft tissues in the upper jaw, affecting the palate, maxillary sinuses, and surrounding structures. Mandibular defects similarly pertain to partial or complete loss of structures in the lower jaw, impacting functions like mastication and speech.[4]

Armany's classification: This system for maxillectomy defects, introduced in 1987, categorizes these defects into six classes based on their relationship with abutment teeth. Class I involves resection in the anterior midline with abutment teeth on one side, while Class II is a unilateral defect retaining anterior teeth on the opposite side. Class III describes a palatal defect in the central portion of the hard palate, potentially involving part of the soft palate. Class IV is characterized by a defect crossing the midline and affecting both sides of the maxilla with abutment teeth on one side. Class V represents a bilateral surgical defect posterior to the abutment teeth, possibly requiring labial stabilization. Finally, Class VI pertains to an anterior maxillary defect with abutment teeth present bilaterally in the posterior segment.

Spiro classification :This system that includes three categories:

Limited Maxillectomy: In this case, one wall of the maxillary antrum is removed.

Subtotal Maxillectomy: This involves the removal of at least two walls, including the palatal wall.

Total Maxillectomy: This category entails the complete resection of the maxilla.

The Cantor and Curtis classification : categorizes mandibular resection defects into six classes:

1. Class I: Mandibular resection involves an alveolar defect with the preservation of mandibular continuity.

2. Class II: Resection defects result in the loss of mandibular continuity distal to the canine area

3. Class III: The resection defect extends to the mandibular midline region.

4. Class IV: The resection defect involves the lateral aspect of the mandible but is augmented to maintain a pseudo-articulation of bone and soft tissues in the region of the ascending ramus.

5. Class V: The resection defect is limited to the symphysis and para-symphysis region but is augmented to preserve bilateral temporomandibular articulations

6. Class VI: Similar to Class V, but in this case, mandibular continuity is not restored.

Davis and Ritchie classification

The Davis and Ritchie classification divides cleft lip and palate into 2 groups, which subdivided into the extent of the cleft (eg, 1/3, 1/2), as follows:

Group I - Clefts anterior to the alveolus (unilateral, median, or bilateral cleft lip)

Group II - Postalveolar clefts (cleft palate alone, soft palate alone, soft palate and hard palate, or submucous cleft)

Velopharengeal dysfunction- The classification of Velopharyngeal Dysfunction (VPD) is detailed in the adapted figure based on the works of Trost-Cardamone (1989) and Peterson-Falzone et al. (2006). The classification encompasses various aspects of VPD, including structural issues, neurogenic factors, and mislearning.

Velopharyngeal Insufficiency (Structural)

1. Cleft VPD:

- Unrepaired cleft palate (overt or submucous).

- Postsurgical insufficiencies, such as a palate length too short post palate repair or VPI post-adenoidectomy.

2. Non-Cleft VPD:

- Mechanical interference, like excessive tonsils or posterior pillar webbing.

- Palatopharyngeal disproportion leading to a deep pharynx.

- Ablative palatal lesions, including conditions like cancer or traumatic injury.

Velopharyngeal Incompetency (Neurogenic)

1. Congenital or Acquired Motor/Neuromotor Control Issues:

- Dysarthria affecting primary motor/neuromotor control.

2. Motor Association/Motor Programming Issues:

- Apraxia affecting motor association and programming.

Velopharyngeal Mislearning

1. Phoneme-Specific Nasal Emission:

- Issues with specific phonemes resulting in nasal emission.

2. Persisting Postoperative Nasal Emission:

- Nasal emission continuing after surgery despite adequate closure ability.

3. Compensatory Misarticulations:

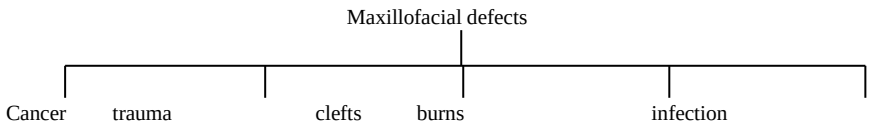
- Misarticulations developed as compensatory measures.

4. Deafness/Hearing Impairment:

- Velopharyngeal dysfunction associated with deafness or hearing impairment.

This classification provides a comprehensive overview of the diverse causes and manifestations of Velopharyngeal Dysfunction, encompassing structural, neurogenic, and mislearning aspects.

ETIOLOGY OF OROFACIAL DEFECTS



CONSIDERATIONS OF DEFECT SIZE IN OROFACIAL PROSTHETICS

The size of oro-facial defects is a crucial determinant in planning and executing effective prosthetic interventions. Defects in the maxillofacial region can vary significantly in size, ranging from minor tissue loss to extensive craniofacial deformities. The impact of defect size on prosthetic rehabilitation is profound, influencing treatment choices, materials selection, aesthetic outcomes, and overall patient satisfaction. The size of an orofacial defect directly correlates with the functional challenges faced by the patient.[5]

Larger defects can result in significant impairments in speech, mastication, swallowing, and overall oral function. These functional limitations can negatively affect the patient's quality of life and social interactions. Prosthetic rehabilitation aims to restore as much of these functional aspects as possible by carefully addressing the size-related limitations. Defect size plays a pivotal role in determining the aesthetic outcome of prosthetic rehabilitation. Larger defects can lead to more noticeable facial asymmetry and disfigurement. A well-designed prosthesis must not only restore function but also closely match the remaining facial features, ensuring a natural appearance. Aesthetic considerations become more intricate as the defect size increases, necessitating a meticulous approach to prosthesis design and fabrication.[6]

The choice of materials and fabrication techniques is strongly influenced by defect size. For smaller defects, lightweight and flexible materials like silicone may be appropriate, offering comfort and natural movement. In contrast, larger defects may require more robust materials like acrylic resin, capable of providing structural support and durability. Fabrication techniques such as digital scanning and 3D printing can be particularly beneficial for accurately replicating complex anatomical structures in cases of larger defects.[7] Larger defects often present challenges in achieving optimal prosthesis retention and stability. The absence of adjacent anatomical structures can compromise the mechanical support for the prosthesis. Implant-supported prostheses may be necessary for larger defects to enhance retention and stability.

Integrating osseointegrated implants into the prosthetic rehabilitation can significantly improve the functionality and comfort for the patient, especially in cases of extensive defects. The psychosocial impact of a larger orofacial defect can be more profound, potentially affecting the patient's self-esteem and body image. Prosthetic rehabilitation should consider not only the physical aspects but also the emotional and psychological well-being of the patient. Ensuring that the prosthesis effectively addresses the visual and functional aspects of the defect can contribute to boosting the patient's confidence and quality of life. Given the diverse range of defect sizes, each case requires an individualized approach to prosthetic rehabilitation. A thorough assessment of the patient's specific needs, functional requirements, aesthetic preferences, and anatomical considerations is essential. This approach allows the prosthetic team to tailor their interventions, materials, and techniques to create a solution that optimally restores both form and function.[8]

REHABILITATION OPTIONS FOR OROFACIAL DEFECTS

The rehabilitation of oro-facial defects is a multidisciplinary endeavour that involves a combination of surgical, prosthetic, and often, combined approaches. Each option brings unique benefits to the table, and the choice of rehabilitation depends on the nature and extent of the defect, patient preferences, and overall treatment goals.

Grafts- In the comprehensive landscape of orofacial defect rehabilitation, grafts, notably Iliac and Fibula grafts, play a pivotal role. This multidisciplinary approach encompasses surgical and prosthetic interventions, with the choice of rehabilitation contingent upon factors such as the nature and extent of the defect, patient preferences, and overall treatment goals. Iliac grafts, sourced from the iliac crest, offer a dependable supply of vascularized bone that provides structural support for reconstructing the maxilla and mandible. Their vascularity promotes graft survival and integration with surrounding tissues. The adaptability of size and shape allows surgeons to tailor grafts to specific defect requirements, facilitating dental implant integration for functional and aesthetic restoration. On the other hand, Fibula grafts, known for their longitudinal bone structure, are suitable for reconstructing larger defects in the maxilla or mandible. With dual vascular pedicles, the fibula graft ensures enhanced vascular supply, supporting graft viability. Its versatility allows for the creation of complex shapes, and the graft can often be harvested simultaneously with the primary surgery, minimizing additional interventions. Fibula grafts contribute to both functional restoration (such as chewing and speech) and aesthetic reconstruction, ultimately improving the patient's quality of life. When considering graft selection, factors such as the size and location of the defect, patient-specific considerations, and collaborative decision-making among specialists come into play. The collaborative efforts of surgeons, prosthodontists, and other experts are crucial in making informed decisions about graft selection and formulating a comprehensive rehabilitation strategy. In summary, Iliac and Fibula grafts serve as integral components in the multidimensional approach to orofacial defect rehabilitation, offering unique characteristics and applications that contribute significantly to achieving optimal functional and aesthetic outcomes for patients.[9]

Prosthetic Rehabilitation in Oro-facial Defects: Prosthetic rehabilitation is a vital aspect of managing orofacial defects, offering patients an opportunity to regain not only physical function but also a sense of normalcy and self-confidence. Orofacial defects, which can arise from congenital anomalies, trauma, surgical resections, or pathologic conditions, can have profound impacts on a person's quality of life. Prosthetic solutions tailored to the individual's unique needs and anatomical considerations play a significant role in addressing these challenges. Oro-facial prostheses are designed to restore the lost functions of speech, mastication, swallowing, and overall oral hygiene. By recreating the missing or damaged structures, patients can regain the ability to perform essential activities of daily life. Aesthetic considerations are paramount in prosthetic rehabilitation. The prostheses aim to closely mimic the natural appearance of the missing or damaged structures, minimizing visible deformities and enhancing the patient's facial symmetry and overall aesthetics. Orofacial defects can lead to psychological distress and diminished self-esteem. Prosthetic rehabilitation has a significant impact on improving the patient's self-image, boosting self-confidence, and facilitating social reintegration.[10]

Types of Oro-facial Prostheses:

Maxillofacial Prostheses: These prostheses address defects involving the oral and facial structures, including the nose, ears, and eyes. Examples include auricular (ear), nasal, and ocular prostheses, which are custom-designed to match the patient's features and restore the natural appearance.[11]

Combined Rehabilitation: In many cases, a combined approach involving both surgical and prosthetic interventions yields the best outcomes. This collaborative approach can offer enhanced functional and aesthetic results.

Prosthetic Enhancement after Surgery: In cases where surgical reconstruction has been performed, prostheses can be used to fine-tune aesthetics and restore natural contours.[12]

Oral Prostheses: Oral prostheses are used to replace missing intraoral structures such as teeth, palatal obturators (used to close openings in the palate), and mandibular or maxillary prostheses (for jaw reconstruction). These prostheses aid in speech, mastication, and maintaining oral health.

Obturator-Prosthetic interventions in orofacial defect rehabilitation encompass a range of options tailored to address specific challenges. The Obturator, a fundamental choice, is designed for patients with palatal defects resulting from surgery or congenital conditions, effectively managing speech difficulties, nasal regurgitation, and compromised oral function.

(i) **Interim obturators**- The Interim Obturator, created by a Maxillofacial Prosthodontist, is a prosthetic device worn by patients throughout the healing phase following surgical resection. This specialized prosthesis facilitates speech and swallowing for the patient, preventing the leakage of fluids and food into the nasal cavity.

(ii) **A Surgical Obturator**- expertly crafted by a Maxillofacial Prosthodontist, is a prosthesis designed for patients who have undergone the removal of a tumour from either the soft or hard palate. This specialized device empowers patients to speak, chew, and swallow, ensuring that food and liquids do not inadvertently enter the nasal cavity.

(iii) **A definitive Obturator** prosthesis for the maxilla is a permanent oral appliance created to address and rehabilitate a defect in the upper jaw. The primary goals of this prosthesis are to enhance speech, facilitate swallowing, and prevent oronasal regurgitation, thereby promoting overall functional restoration for individuals who have undergone surgical procedures or experienced abnormalities in the maxillary region.[13]

a) **Hollow bulb obturators**- The hollow bulb Obturator emerges as a valuable alternative, particularly for patients with extensive defects, offering improved comfort and reduced weight compared to solid obturators, while still addressing speech and swallowing challenges. Conventional dentures with attachments find their indications in cases where patients have lost multiple teeth but retain enough dentition for denture support, especially when implant placement is not feasible.[14]

b) **Implant supported & implant retained prosthesis**-For more complex cases, implant-supported obturators provide enhanced stability and retention through dental implants embedded in the jawbone. Similarly, implant-retained obturators offer stability through strategically placed implants without the need for a full implant-supported prosthesis.

The choice among these prosthetic options depends on factors such as the extent of the defect, patient preferences, clinical viability, and collaborative decision-making among prosthodontists, surgeons, and specialists. In conclusion, the diverse prosthetic armamentarium allows for a patient-centered and collaborative approach, ensuring the selection of the most appropriate option for optimal functional and aesthetic outcomes in orofacial defect rehabilitation.[15]

CONCLUSION

In conclusion, orofacial defects present complex challenges that extend beyond physical limitations, impacting an individual's functional abilities, aesthetics, and psychological well-being. The multifaceted nature of these defects requires a comprehensive approach to rehabilitation, encompassing surgical, prosthetic, and combined interventions. Understanding the classification, etiology, defect size considerations, and rehabilitation options is crucial for providing effective care and enhancing the quality of life for affected individuals.

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