International Journal Dental and Medical Sciences Research
Volume 6, Issue 6, Nov - Dec 2024 pp 413-417 www.ijdmsrjournal.com ISSN: 2582-6018

An Overview of Retentive Aids in Maxillofacial Prosthesis-A Narrative Review

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Submitted: 10-12-2024 Accepted: 20-12-2024

ABSTRACT
Defects in the maxillofacial region can be intraoral (maxillary defects, mandibular faults that impair the continuity of the jaw, velopharyngeal defects) or extraoral (remaining ocular, auricular, orbital, cranial, nasal, or combination defects).
Maxillofacial abnormalities can be broadly classified into two categories: congenital and acquired deformities.
Maxillofacial prostheses are artificial substitutes used to restore form and function in patients with maxillofacial defects. The stability and functionality of these prostheses can be enhanced by using retentive aids.They help secure the prosthesis in place, ensuring comfort, durability, and natural appearance. Common types of retentive aids include magnets, adhesives, clips, and implants.
Keywords-intraoral prosthesis, extraoral prosthesis, implants, magnets, adhesives.

I. INTRODUCTION-

Surgical resections, congenital abnormalities, acquired illnesses such as leishmaniasis, burns, and traumatic loss can all cause facial deformities. Individuals with maxillofacial abnormalities frequently struggle with mastication, speaking, and deglutition. Intraoral defects in the maxillofacial region include maxillary flaws, mandibular defects that affect the continuity of the mandible, velopharyngeal defects or soft palate defects, and extraoral abnormalities such as residual ocular, auricular, orbital, cranial, nasal, or combination defects. Congenital defects and acquired defects are the two basic categories into which maxillofacial defects can be divided.[1]

The two main causes of congenital abnormalities are either the mother's harmful behaviour during pregnancy or genetics.The clefts in the maxillaare the most common, but they can also occur in the mandible or face. In the latter instance, several toxic compounds promote improper structural development by crossing the placental barrier as a result of smoking, alcoholism, and drug misuse.

On the other hand, acquired flaws appear throughout a person's lifetime. Trauma, illness, or any surgical procedure—such as the removal of a tumour—can cause them.

Restoration of maxillofacial defects can be accomplished either surgically, prosthetically or through a combination of both. Maxillofacial prosthodontics is a branch that deals with defects involving the facial region. The main aim of this branch is to restore function, esthetics and psychological state of the patient.[3]

Retentive aids in maxillofacial prostheses have been evolved over the last few decades adapting to the newer advancements in the field. The retentive aids used initially were extra oral like spectacles and head bands but after the introduction implants there have been better results in terms of comfort and esthetics. The more recent advancements in terms of CAD/CAM and 3D printing, even though in initial stages of development, hold promising results.

Classification of Maxillofacial Prosthesis

A. Depending on location
- Intraoral -eg:maxillaryobturators,speech appliance, palatal lift prosthesis
- Extraoral -eg:ear prosthesis, eye prosthesisetc
- Combination -oromaxillary,nasomaxillary.

B. Depending on the duration of usage
- Temporary
- Interim
- Permanent

C. Depending on the material
- Acrylic resin
- Acrylic copolymers
- Silicones [1]

Classification based on modes of retention
- Intraoral
  - Anatomical -undercuts and concavities
  - Mechanical -cast clasp,semipercision,precisionetc
- Extraoral

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- Anatomical
- Mechanical
- Adhesives
- Combination [1]

Intraoral prosthesis

Anatomical retention-Concavities and undercuts are examples of anatomical factors that can be employed. The prosthesis may be kept in place inside the surgical defect. Scar band, skin graft: Significantly better retention will result from the engagement of the graft and the scar band created at the skin-graft mucosal interface.
Mechanical retention-circumferentional clasp, barclasp, snap on attachments,acrylic buttons, overdentures, overlay, swing lock system and intraoral implants.

Extraoral prosthesis

Anatomical retention- using concavities, scar tissues.
Mechanical retention- using spectacles for eye prosthesis, straps, head bands[1]

Other methods of retention

Adhesives

A patient's malignant prognosis, weakened tissue beds, and budgetary constraints are some of the reasons why certain patients might not be suitable candidates for implant placement.
In those condition adhesives can be used as an alternative.
The most common way to categorize medical adhesives is by their intended purpose; for example, double-sided tape, glue, pastes, sprayers, and liquid systems are categorized based on the silicone substrate.
Ideal properties of adhesive materials
• The material should be biocompatible, non-toxic, and should not cause irritation on the tissue • The adhesive should keep the prosthesis in place for at least 12 h a day
• The material should be odourless and moisture-resistant
• The prosthesis should not damage tissue during removal from the skin
• The dried adhesive must have a porous structure to allow for the passage of secretions
• The sticker should be presented in a portable package
• The adhesive should be easy to apply
• The material should dry quickly[5]

Types of adhesives

Acrylic resin-Acrylic resin adhesives are made of acrylic resin dispersed in a very watery solvent that, when it evaporates, leaves behind a material that resembles rubber.

Silicone adhesive: Typically dissolved in a solvent, silicone adhesives are a type of room temperature vulcanizing (RTV) silicone. These adhesives have minimal water sorption and good resistance to weathering and dampness.

Figure1: silicon adhesives

Pressure-sensitive tapes: These are used to keep facial prostheses in place when they are applied with just finger pressure and no solvents or heating. These tapes are made up of a backing strip made of laminate, paper, film, foil, or cloth that has been covered with a pressure-sensitive adhesive.

Figure 2: Pressure sensitive tapes

Rubber-based liquid adhesive: Rubber is present in nature as latex, which is obtained by tapping the bark of rubber trees. In order to produce a natural rubber adhesive, the resulting latex is immediately soluble in organic solvents such as petroleum spirits or benzene.
Combination of adhesives: The previously described adhesives can be used alone or together.eg:Silastic MDX4-4210,Silastic adhesive silicone type A,Pros-Aide adhesive.[5]

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Implants

There are two options for implant placement: intraoral and extraoral.

The inadequate volume of bone presents a significant obstacle when placing facial implants. The bone thickness in the temporal and supraorbital regions, which are thought to be appropriate for implant insertion, normally ranges from 2.5 to 6 mm. In contrast to intraoral implants, extraoral implants are made to be 3–4 mm long and 5 mm in diameter. Longer implants, however, might be used in regions like the orbital and nasal bones that have enough bone mass. Wing extensions and perforations are features of extraoral implants that improve mechanical stability and retention. These wings have been observed to raise issues like infection, debris buildup, and bacterial involvement.

Implant application area a-bone regions: These areas, allowing for the use of dental as well as zygomatic implants, exhibit a bone volume of 6 mm or more. Examples include the anterior aspect of the maxillary, zygomatic arch, and zygoma.

b-bone zones: In regions with 4-5 mm bone volumes, 4 mm craniofacial implants can be applied. These areas are predominantly found in the superior, lateral, and inferolateral orbital margins, particularly the mastoid margin of the zygoma and temporal bone.

c-bone zones: Marginal areas with bone masses of 3 mm or less include sections of the temporal bone in the facial area, such as the pyriform edge, infraorbital margin, nasal bone, and zygomatic arch. Craniofacial implants of 3 mm or less are recommended for these regions.[3]

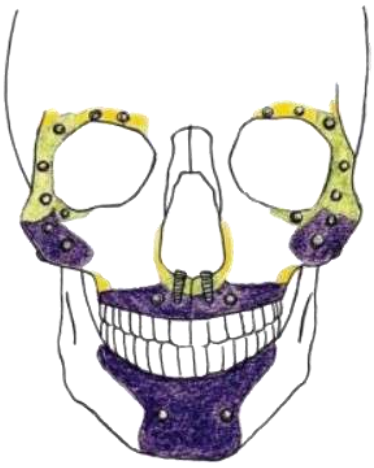

Figure 3: Implant placement of facial prothesis in frontal view

Auricular area

The precise placement of implants in the temporal region holds significant importance for the aesthetic outcome of auricular prostheses. To ensure proper retention within the confines of the auricular prosthesis, it is recommended to position implants at the anti-helix level. Two implants strategically placed in the temporal region can effectively secure the auricular prosthesis. In such instances, the two implants should be spaced approximately 15 mm apart, with each implant situated roughly 18 mm away from the center of the auricular duct. For the right ear, an implant should be positioned at 9 o'clock and another at 11 o'clock, while for the left ear, placements at 1 o'clock and 3 o'clock are suggested.[3]

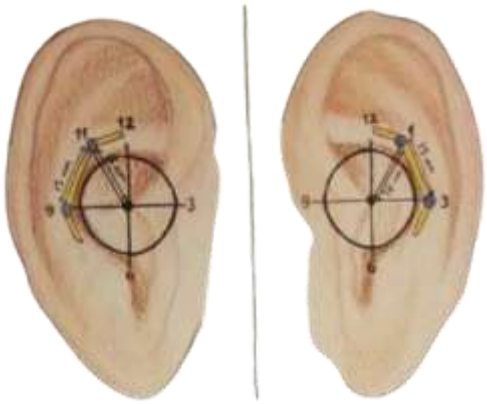

Figure 4: Implant placements and bar application in auricular prosthesis[3]

Implant system used in extraoral prostheses

Implant can be placed in two system

A. Solitary- single implant (ITI system, IMZ system)

B. Grouped – grid or plate system are present which can be secured by several screws. (epitec and epiplating system)

The retention can be applied by two systems.

1) Bar systems

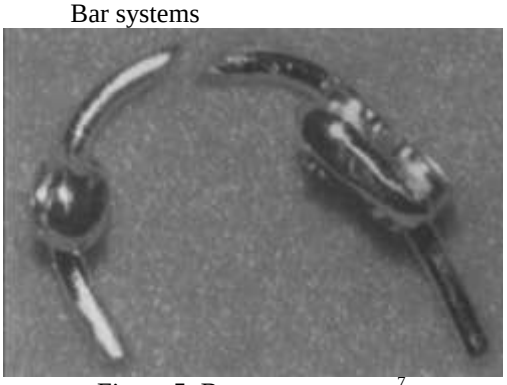

Figure 5: Bar superstructure[7]

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2) Magnetic system

Figure 6: Magnets used for retention of prosthesis[4]

Types of Osseointegrated Implant Used in Maxillectomy Patients
1. Conventional implants
2. Mini dental implants
3. Zygomatic implants

Magnets

Magnets have become useful instruments for stabilizing, preserving, and retaining integrated maxillofacial prostheses. Significant progress in maxillofacial materials and procedures has been made in the last ten years. Addressing the difficulties of designing a prosthesis that satisfies the patient's functional and cosmetic requirements while reducing the psychological anguish connected to face disfigurement is the main objective of a maxillofacial prosthodontist.

A. Based on Alloys used:
• Those containing cobalt (Examples: Alnico, Alnico V, Co-Pt, Co5Sm)
• Those not containing cobalt (Examples: Nd-Fe-B, samarium iron nitride)

B. Based on the ability to retain magnetic properties (intrinsic coercivity or hardness.
• Soft (easy to magnetize or demagnetize, less permanent) Examples: Pd-Co-Ni alloy, Pd-Co alloy, Pd-Co-Cr alloy, Pd, Co-Pt alloy.
• Hard (retain magnetism permanently) Examples: Alnico alloys, Co-Pt, Co5Sm, Nd-Fe-B.

C. Based on surface coating (materials may be stainless steel, titanium, or palladium):
• Coated
• Uncoated

D. Based on the type of magnetism:
• Open field
• Closed field
• Rectangular closed field sandwich design
• Circular closed field sandwich design

E. Based on the number of magnets in the system:
• Single
• Paired

F. Based on the arrangement of the poles:
• Reversed
• Non reversed[4]

Recent Advancements

- Many developments in the field of maxillofacial prosthesis have been developed in the last few decades, and these developments have improved patient comfort, aesthetics, and prosthesis retention.
- Computer-aided design/computer-aided manufacturing (CAD/CAM) technology has been transforming restorative dentistry for almost thirty years.
- Theuse of 3D bioprinting is becoming more prevalent.
- The characteristics of bioink, which is used in many fields, including maxillofacial prosthodontics, are among the most important considerations
- Maxillofacial anomalies, such as those resulting from craniofacial birth defects, trauma, and tumor resection, have been treated in the past decade with 3D printed prostheses of the eyes, nose, and ears, among other anatomically complex facial features.
- The advantages of using CAD data to design maxillofacial prostheses over traditionally invasive surgical techniques include reduced surgery time and unesthetic exposure, as well as a lowered risk for iatrogenic infection.[6]
- Rapid prototyping in calvarian reconstruction nasal prosthesis, laser scanning and 3D printing in ocular prosthesis are examples of other advancements.[11]

II. CONCLUSION

Maxillofacial prosthesis success extends beyond simple physical rehabilitation. It includes elements that ultimately contribute to a better and more satisfying life, including comfort, retention, functional restoration, visual appeal, convenience of use, and the beneficial effects on the patient's mental and nutritional health.

Prosthodontists can create maxillofacial prostheses that are specifically tailored to each patient's demands by carefully weighing and mixing these different retention aids, which will ultimately improve the prosthesis's success and long-term retention. Frequent follow-up

consultations enable alterations and revisions to preserve optimum comfort and function**.**

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