

Retentive Aids In Maxillofacial Prosthesis-A Review

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Abstract:

Maxillofacial prosthetics is a specialized field of prosthodontics focused on the rehabilitation of patients with congenital or acquired defects of the head and neck region, including intraoral and extraoral structures. A maxillofacial prosthesis serves to restore aesthetics, function, and psychological well-being by replacing missing or malformed craniofacial structures. Prostheses may be retained through anatomical, mechanical, adhesive, or implant-supported means, with retention being a critical factor influencing success. These prostheses can be classified based on their retention type—tissue, tooth, implant, or combined. Recent advances, including digital fabrication techniques, CAD/CAM technology, 3D printing, and improved implant designs, have enhanced the precision, retention, and patient outcomes of maxillofacial prostheses. Despite technological progress, challenges remain in material properties, aesthetic integration, cost, and access to specialized care. This review outlines the classification, design principles, retention strategies, and recent innovations in maxillofacial prosthetics, emphasizing the multidisciplinary approach required for optimal rehabilitation.

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I. Introduction:

Maxillofacial Prosthesis is defined as any prosthesis used to replace part or all of any stomatognathic and/or craniofacial structure. Retention is the quality inherent in the dental prosthesis acting to resist the forces of dislodgement along the path of placement¹. (GPT-9).

Mode Of Retention

- 1) For intra -oral prosthesis
 - a) Anatomical retention
 - b) Mechanical retention
 - i. For interim prosthesis
 - ii. For permanent prosthesis
- 2) For extra -Oral prosthesis
 - a) Anatomical retention
 - b) Mechanical prosthesis

Maxillofacial Prosthesis

INTRA ORAL PROSTHESIS		
1	Maxillary Defect	a) Hard palate – Surgical Obturator, interim Obturator, Definitive Obturator b) soft palate – Speech Appliance Meatus Obturator, Palatal Lift prosthesis
2	Mandibular Defect	Mandibular Resection Prosthesis. Guide Flange Prosthesis
3	Glossectomy	Tongue Prosthesis, palatal Augmentation.
4	Splints/Stents	Surgical Splints, Bite splints, TMJ Appliance.



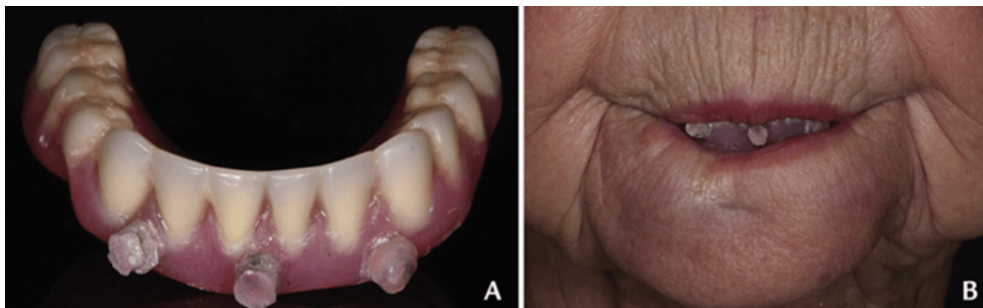
	EXTRA ORAL PROSTHESIS	COMBINATION PROSTHESIS
1	Orbital	Orbito-Maxillary
2	Nasal	Naso-maxillary
3	Auricular	
4	Mid-Facial	

1. Obturators (for Palatal Defects):

Surgical Obturator	Made before maxillary resection ² .
Definitive Obturator ²	Fabricated after 6–12 weeks of using an interim obturator.
Meatus Obturator ³	Static obturation; limited speech improvement in cleft palate cases.
Palatal Lift Prosthesis (PLP) ⁴	Elevates soft palate in cases of dysfunction; design varies for dentulous vs. edentulous patients.

2. Prostheses for Mandibular Continuity Defects:

- Mandibular Resection Prosthesis⁴



- Guide Flange Prosthesis⁴

3. Prostheses for Total/Partial Glossectomy:

- Tongue Prosthesis⁵



- Palatal Augmentation Prosthesis⁶

Acrylic Buttons	Mushroom-shaped projections fit into defect, prosthesis snaps onto them ¹² .
Retentive Clips	Metal/plastic clips over bar superstructures, offer strong breakaway force ¹³ .
Precision Attachments	Include bar clips, telescopic crowns, extra coronal ball attachments ¹⁴ .



B. Adhesives¹⁵

Types:

Liquid, paste, spray, double-sided tapes.

Mechanisms of Adhesion:

Mechanical – resin tags interlock with surface irregularities.

Adsorption – chemical bonding (ionic, covalent, hydrogen, van der Waals).

Diffusion – polymer chains intermix.

Electrostatic – attraction between charged surfaces.

Ideal Properties¹⁶:

Strong bond to skin and prosthesis

Biocompatibility

Easy to handle and remove

Compatible with prosthetic material and skin texture

Advantages:

Non-invasive, low cost, easy to apply

Disadvantages:

Potential for tearing, allergic reactions, pigment damage, less suitable for poor dexterity¹⁶

Problems:

Sebum, moisture, hair, and repeated solvent use reduce effectiveness¹⁶

Common Ingredients:

Karaya gum, tragacanth, polyethylene oxide, spirit gum, MDX silicone, etc.¹⁶

C. Implant Retention

Endosseous Implants:

Improve retention, stability, and support

Used in edentulous/partially edentulous jaws or in congenital, traumatic defects¹⁷

B. Extraoral Modes of Retention:

1. Anatomical Retention

Utilizes natural skin and bone undercuts in facial structures for passive prosthesis support.¹⁸

2. Implant Retention in Maxillofacial Prosthodontics

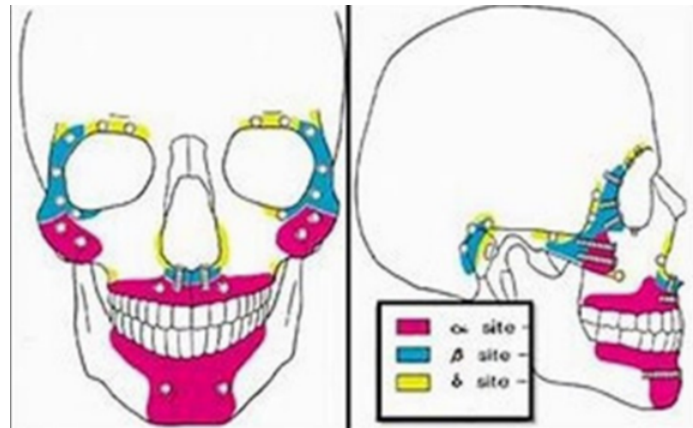
Preoperative Planning

Prosthetic nose attachment
fra

CT scans & implant planning software used to assess bone volume and density.¹⁹

Bone Site Classification (Asar et al., after Jensen et al.)

- ALFA sites: ≥ 6 mm bone (anterior maxilla, zygoma); suitable for standard implants.
- BETA sites: 4–5 mm bone (periorbital, temporal); use 4 mm implants.
- DELTA sites: ≤ 3 mm bone (frontal, medial orbit); use 3 mm or smaller implants.



Biomechanical Considerations²⁰

- Implant design (intraoral/craniofacial)
- Bone-implant integration
- Load distribution & stress transfer
- Implant surface, shape, stiffness
- Stability & osseointegration (measured by periotest, RFA)
- Surgical Procedures
- Single-stage: Recovery screws placed immediately.
- Two-stage: Healing after initial placement, followed by second-stage exposure.

Examples of Implant-Retained Extraoral Prostheses²¹

1. Auricular Prosthesis:

- Implant Site: Mastoid area, ~15 mm apart, 20 mm from auditory canal
- Retention Methods: Bar & clip, ball attachments, magnetic caps
- Healing Time: 3–4 months



2. Orbital Prosthesis:

Retention: Adhesive, spectacle frames, implants²²

Implant Sites: Outer/inner canthus, superior/inferior orbital rim, zygoma

Implant Length: 3–4 mm; spacing: 10–12 mm

Most common retention: Magnets

Healing Time: 6–8 months



Types of Orbital Implants:

- Non-integrated: PMMA, silicone
- Semi-integrated: Allen implants
- Integrated: Cutler's implants
- Bio-integrated: Hydroxyapatite, porous polyethylene, alumina
- Biogenic: Dermis-fat grafts, cancellous bone²²

3. Nasal Prosthesis

- Retention: Adhesive, spectacle frames, implants
- Implant Sites: Floor of nose, piriform rim, inferior orbital rim, glabella²²
- Implant Length: Typically ≥ 4 mm
- Special Implants: Bifunctional implants (support intraoral & extraoral prostheses)
- Common Retention: Mini magnets
- Healing Time: 6–8 months



Superior, lateral and inferior
favourable sites for implantation

Implant Applications for Maxillofacial Prosthesis:

Pre-Surgical Planning	All other treatment options must be considered first. Soft and hard tissues must be prepared for implants post-surgery. Bone preservation is key; reconstruction may be needed. Soft tissue quality at defect margins affects aesthetics and success ²³ .
Best Use Cases	Ideal for auricular, nasal, and orbital prostheses. Implants must stay within prosthesis borders for appearance and function. Use wax models, CT scans, and 3D planning for accurate placement ²³ .
Surgical Approach	Two-phase surgery is preferred for hygiene and healing. One-phase surgery is used in simpler cases (e.g., auricular defects). Healing caps placed after implant; second surgery exposes and attaches prosthesis. ²⁴
Healing time	Mastoid: 3–4 months Facial defects/radiotherapy cases: ≥ 6 months
	Implant Types Intra-oral (inside the mouth) ²⁴
Extra-oral	Zygomatic (anchored in cheekbone) ²⁴

Contraindications:

High-dose radiotherapy, systemic disease, psychological disorders, addictions, adolescence.²⁵

Retention Methods:

- Bar systems: Stronger retention, more complex hygiene.
- Magnet systems: Easier for patients with limited hand dexterity, but lose strength over time.

Complications:

Ejaculation (implant extrusion)²⁵

Exposition, migration, infection

Specific issues with porous implants and pin system

Implant Supported Prosthesis

Auricular Prosthesis Implants:

Implant Design & Features:

Craniofacial bone thickness: 3–4 mm

Implants are shorter than intraoral ones due to proximity to critical anatomy.

Flanged top prevents accidental perforation.

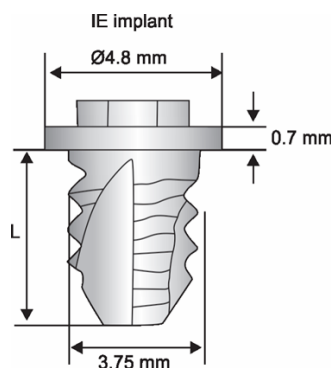
Reverse buttress thread resists push-out/pull-out forces.

Implant Placement Guidelines

Right ear: 8 and 11 o'clock positions

Left ear: 1 and 4 o'clock positions

Distance:



Solitary implant (root form implant)

20 mm from external auditory canal

15 mm between implants

If placed <20 mm: results in shallow concha

If >25 mm: requires extended acrylic base for proper ear positioning

Number of Implants:

Two implants are generally sufficient (15 mm apart)

Three used historically but no added benefit²⁵

Retention Systems

Bar & Clip System:

Strongest retention

Bar (0.2 mm gold) under antihelix²⁵

Cantilever ≤10 mm to avoid overload

Better for active patients

Magnet System:

Easier for patients with manual dexterity issues²⁵

Preferred for passive use

Simpler insertion/removal

Implant Types:

Solitary (root-form) implants:

Used in better bone quality

Made by Nobel Biocare, Straumann, Southern Implant²⁵

Collective (plate-form / epilates):

Suited for poor bone quality

Often used with magnet retention

Manufactured by Medicom

Special Considerations

Irradiated patients:

Delay implant placement: 6–18 months post-radiotherapy

Hyperbaric oxygen therapy may improve success by ~38%

Relative contraindications: diabetes, osteoporosis, irradiated tissue²⁵

Survival & Complications:

High survival rate in auricular region (better than nasal/orbital)

Main complication: Periimplantitis (due to hygiene issues)²⁵

Surgical Planning:

- Use waxed prosthesis to create surgical guide
- Temporal bone supports 3–4 mm impla
- Abutments exit beneath concha for natural ear contour
- C-shaped bar (10–15 mm extension) used to stabilize and retain prosthesis.

Orbital Prosthesis:

Implant Retention:

Magnets are preferred:

Less mechanical stress than bar-clip systems

Potentially extend implant lifespan

Retention choice depends on bone quality

Implant Sites & Placement

Implant sites: Superior, lateral, and inferior orbital rims²⁶

Implant size: 3–4 mm

Recommended: 3–4 implants

Implants should be angled toward the center of the orbit

Prosthesis Positioning Guidelines

Anterior position of ocular prosthesis:

5–8 mm behind supraorbital rim

0–2 mm behind infraorbital rim²⁶

8–12 mm in front of lateral orbital rim

Additional Retention:

Medial wall of defect can be used for extra support/stability when needed

Nasal Prosthesis:

Implant Sites & Type

Implant site: Anterior surface of the maxilla, just below the nasal cavity

Bone here allows:

4 mm implants typically

6 mm+ implants possible depending on bone availability

Minimum 2 implants placed in lateral nasal eminences²⁶

Surgical Preparations:

Split-thickness skin graft on defect sides:

Reduces soft tissue mobility

Provides stable, firm base for prosthesis

Anterior reduction of septal cartilage:

Creates space for prosthesis engagement with lateral nasal walls

Improves retention and stability²⁶

Retention & Prosthesis Design:

Bar system used due to implants being clustered (not evenly spaced)

Bar extension: 10–15 mm superiorly for enhanced distribution²⁶

Retentive options:

Clips (better retention)

Magnets (easier placement)

Acrylic housing in prosthesis holds retentive elements²⁶

Waxed try-in must be done pre-implantation to avoid contour compromise

Recent Advances in Maxillofacial Prosthetics:

Recent studies have highlighted significant progress in the treatment of congenital and acquired orofacial defects, emphasizing the role of modern technologies in enhancing prosthetic outcomes. Key advancements include:

Implant Integration in Prosthetics: The incorporation of implants in both intraoral and extraoral prostheses has been extensively studied. Ferreira has proposed the development of new prostheses that can substitute bone tissue without the need for bone grafts, thereby reducing morbidity and recovery time. These prostheses would leverage engineering, CAD-CAM, rapid prototyping, lasers, and surgical guides for their creation.

Digital Fabrication Techniques: While traditional methods still rely heavily on the artistic skills of prosthodontists, modern techniques such as 3D printing and digital imaging are revolutionizing the fabrication process. These technologies enable more accurate replication of patient-specific characteristics, eliminate the need for facial impressions, and simplify the sculpting of wax patterns. For instance, CAD/CAM systems have been successfully used to design and fabricate molds for silicone prostheses, surgical templates, and even the prostheses themselves, leading to improved precision and reduced treatment times.

Challenges and Future Directions: Despite these advancements, challenges remain, including the high costs of equipment, the need for skilled personnel, and limitations in material properties such as color matching and durability. Further research and development are essential to overcome these barriers and make these technologies more accessible and effective for maxillofacial reconstruction.

II. Discussion:

In a large number of studies point to some new techniques for the treatment of congenital and acquired orofacial defects. Recent studies identified several areas for further investigation into mode of retention in maxillofacial prostheses and their management. Also, there are studies suggesting the role of implants in intraoral and especially extra-oral prosthesis. Ferreira foresaw the development of new prostheses that substitute for bone tissue without requiring bone grafts, thus reducing the morbidity and the recovering time, as a possible future approach in maxillofacial reconstruction. According to Ferreira, these new prostheses should be produced using engineering, computer-aided design and manufacturing (CAD-CAM), Rapid Prototyping Technique, lasers and surgical guides. Several steps in the fabrication of maxillofacial prostheses still depend on artistic skill and time of prosthodontist. Modern techniques for ocular, auricular, nasal prosthesis fabrication, such as 3D printing and digital imaging, are able to reduce the treatment time, better replicate the patient characteristics, eliminate taking facial impressions, and reduce the complexity of wax pattern sculpting. However, modern techniques still need improvements, along with reduced cost and wider availability, to lead to a promising future for maxillofacial reconstructions.

III. Conclusion:

The success of most maxillofacial prosthesis depends on retention. The problem of retention in maxillofacial prosthesis a great challenge posed to a prosthodontist, so when a prosthesis is designed full consideration must be given to the retention of prosthesis. In maxillofacial prosthesis there exists a broad

variety of types of methods for gaining retention and stabilisation. so close evaluation of different types of retention aids helps to enhance retention in maxillofacial prosthesis.

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