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Review Article

Retention of maxillofacial prosthesis: A review

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ABSTRACT

The facial region defects caused by trauma, accident, tumor or congenital defects are treated with special facial prostheses. Retention is one of the most important factors that determines the success of a maxillofacial prosthesis. Retention has always been a problem in prosthodontics other than esthetics. Increased retention improves comfort as well as the confidence in the patient while wearing a facial prosthesis at work and in social settings thereby improving the long-term prognosis of the prosthesis. In the present article, the methods used for the retention of prostheses from past to present were researched, and the advantages of the retention procedures and the most commonly used current methods, were evaluated. The article describes different types of retentive aids in maxillofacial prosthesis.

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1. 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 placement. (GPT-9).[1]

In maxillofacial prosthetics there exists a broad variety of types of methods for gaining retention, stabilization, and immobilization as required. Proper evaluation of a case with the surgeon before and during surgery helps in finding means to create irregular defects for enhancing anatomic retention.[2]

2. Classification:[3,4]

Maxillofacial prosthesis can be classified as:

1. Tissue retained
2. Implant retained
3. Tooth retained
4. Implant or tissue retained

It can also be classified as:

1. Intra oral prosthesis:
   (a) Anatomic retention
   (b) Mechanical retention
2. Extra oral prosthesis:
   (a) Anatomic retention
   (b) Mechanical retention

3. Retention in Intraoral Prosthesis

3.1. Anatomic retention

It includes the use of both hard and soft tissues. Retention depends upon the size and location of the anatomic undercut areas. Retention comes from 3 sites:

1. Alveolar ridge
2. Within the defect
3. Teeth

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3.2. Alveolar ridge

The retentive capabilities of the edentulous residual maxillary arch must be evaluated by the same factors that contribute to acceptable retention of a conventional complete denture, i.e., Utilization of the physical properties of adhesion, Cohesion, Atmospheric pressure, and Interfacial surface tension.

The ridge size and shape influences retention. A large ridge with a broad ridge crest is more retentive than a small or tapering ridge crest. The palatal contour influences the ability to increase or decrease the interfacial surface tension. The broad and flat palate is more retentive than the high and tapering palate. The edentulous patient can benefit more than the dentulous patient if the premaxillary segment or the tuberosity can be retained on the defect side. These residual structures permit a better utilization of indirect retention principles.[2]

3.3. Within- the- defect

There are five intrinsic areas within and around the defect that can provide retention to the obturator:

1. Residual soft palate
2. Residual hard palate
3. Anterior nasal aperture
4. Lateral scar band
5. Height of the lateral wall

3.3.1. Residual Soft palate

The residual soft palate provides a posterior palatal seal which will minimize the passage of food and liquids above the prosthesis. Extension of the obturator prosthesis onto the nasopharyngeal side of the soft palate will help in retention. The amount of extension onto the superior surface of the soft palate is limited by the extent of the defect, the lateral and posterior pharyngeal walls. The larger the extension the more effective it will be for border seal and retention. Rotation of the pharyngeal extension into the defect may be necessary rather than a direct vertical path of insertion and removal. Overextension and the associated impingement of the pharyngeal musculature and blockage of the eustachian tube must be avoided. There must be positive contact of the pharyngeal extension with the superior surface of the soft palate if the extension has to be effective for retention and border seal.

3.3.2. Residual hard palate

Depending on the location of the line of palatal resection, there will be varied degrees of undercut along this line into the nasal and paranasal cavity. Engagement of the medial wall of the defect can increase retention. Obturator extension along this margin and into the undercut is best provided by a soft denture base material.

3.3.3. Anterior nasal aperture

Anterior nasal aperture can be entered unilaterally or bilaterally, depending on the extent of the defect to or beyond the midline and upon presence or absence of the nasal septum. Anterior extension from the medial portion of obturator prosthesis provides some resistance to vertical displacement of the anterior portion of the prosthesis. This is because this extension competes for insertion and removal with the extension over the soft palate.

3.3.4. Lateral scar band

A scar band results after surgical resection at about the level of the mucobuccal fold. Scar formation along the surgical margins can present favorable undercuts for retention. The skin superior to the band tends to stretch, creating an area above the scar band that can engage the obturator prosthesis. These tissues can tolerate limited amounts of pressure. The contouring should never impinge on any delicate unprotected structure.

3.3.5. Height of the lateral wall

There is a fulcrum line around which the obturator prosthesis rotates. A high lateral wall of an obturator will undergo less vertical displacement with a defect wall flexure than will a shorter prosthesis lateral wall. To obtain maximum of lateral retention, the lateral border of the obturator should be placed as high and as far away from the retentive axis as possible.

3.4. Teeth

Teeth provide good retention of the obturator prosthesis. Preparation of the remaining teeth provides the framework for positioning the retentive arm which plays a valuable role in the appliance. The number, position, and the periodontal status of the remaining teeth are the most critical factors in evaluating the amount of stress that the remaining teeth may be able to absorb. Fixed splinting of some or all the remaining teeth may be indicated for dissipation of the stress directed to primary abutment teeth. If the defect is small and the remaining teeth stable then intracoronal retainers might be considered. If the defect is large and some of the remaining teeth are weak, extracoronal retainers should be used.

4. Mechanical Retention

It is of two types:

1. Temporary
2. Permanent

4.1.

4.1.1. Temporary mechanical retention

These aids can be quickly adapted to a cast of the remaining teeth to retain the temporary prosthesis during the healing period. The wire clasps come preformed and can be readily incorporated into the acrylic plate of an obturator or existing denture. Other preformed stainless steel wire clasps include Adams, Akers or Roach. Preformed stainless steel bands or crowns may be adapted to a child or adult to increase retentive form of a mutilated or conical tooth. Bands with pre-welded brackets can be used to provide undercuts on these crowns for better clasp retention.

4.1.2. Permanent mechanical retention

It includes cast clasp, reciprocating clasp arm, occlusal rests etc.

4.2. Magnets

The use of magnets has been popular in dentistry because of its small size and relatively high retentive capacity. Magnets have been used in dentistry since 1960 as retentive devices for over dentures, removable partial dentures, implant-supported dentures and maxillofacial prosthesis.

Magnetic attachments offer many advantages:

1. Ease of cleaning.
2. Ease of placement for both dentist and patient.
3. Easy resetting.
4. Constant retention with number of cycles.
5. Dissipate lateral forces, preventing them from being transferred to the abutment tooth.
6. The newer coated magnets (Samarium iron nitride) and more recently Neodymium are corrosion-resistant which makes them an important tool in treating patients with severe intra-oral defects.

4.2.1. Classification of Magnets

1. Based on alloys used:
   (a) Cobalt containing
   (b) Non cobalt containing
2. Based on surface coating:
   (a) Coated
   (b) Uncoated
3. Based on the number of magnets used in the system:
   (a) Single
   (b) Paired
4. Based on the type of magnetism:
   (a) Repulsion
   (b) Attraction
5. Based on the type of magnetic field:
   (a) Open field
   (b) Closed field

The magnetic system may be an open or closed field. An open field system consists of cylindrical magnets with open ends. It can be either single or paired. Closed field consists of a magnet and a magnetizable metal commonly known as a keeper. Keepers are stainless steel end plates which join the unlike poles of the magnet. They can be oval or circular. The keepers provide a closed field pathway for the magnetic field and almost eliminate the external field. Magnetic retention is at the most an aid but not by itself an effective method to retain a non-stable denture. This consideration may be useful in a hemi-maxillectomy case or extremely atrophied ridges.[5–8]

4.3. Swing lock device

This retentive aid helps to gain partial retention from many loose or periodontally involved teeth. This retentive means can be used but most other methods should be considered first.

4.4. Suction cups

Inflatable balloon suction cups are used for maxillary resection. The balloon is inflated with air to fill the surgical defect. The appliance provides a perfect oro-nasal seal and is self-adjusting to changes in the shape of the tissues following surgery. The balloon may be inflated after insertion and therefore the appliance can be used when there is a severely limited opening.

4.5. Adhesives (intraoral)

These become necessary to aid retention when the surgical wound is large, the palate is flat, the anterior-posterior lateral septal wall is not undercut but rather angles away from the natural palate.[9] They enhance retention through optimizing interfacial force by

1. Increasing adhesive and cohesive properties and viscosity of the medium lying between the denture and its basal seal.
2. Eliminating void between the tissue surface of the prosthesis and the area on which it rests.[10]

4.5.1. Composition:[4]

1. Basic ingredient: Carbonyl methyl cellulose
2. Coloring agents
3. Flavoring agents: Menthol, peppermint
4. Plasticizer: Polyethylene, petrolatum
5. Dispersion agents: Sodium phosphate.

The basic ingredient swells and becomes viscous. The plasticizers are added to improve the handling properties and the dispersion agents prevent powders from clumping.

5. Retention in Extraoral Prostheses

5.1. Anatomic retention

Retention of the extraoral area depends on many factors for a successful result. These factors depends upon the location and size of the defect, tissue mobility, undercuts, and the material weight of the final prosthesis. Hard tissues act as a base, against which the prosthesis is seated, to provide a better seal of the prosthesis with the use of an adhesive. Soft tissues prove to be more troublesome because of their flexibility, mobility, lack of a bony basal support, lower resistance to displacement when a force is applied, and does not provide a firm base for securing the medical adhesives.

5.2. Anatomic retention in nasal prostheses

Partial removal of the nose can be treated with a patch type prosthesis using soft tissue projections into the undercuts for retention. In lateral nasal defects, maxillary sinus is exposed which provides additional retentive space. Total excision of the nose offers less opportunity for tissue retention.

5.3. Anatomic retention in auricular prosthesis

Partial removal of the ear or partial reconstruction leaves some tissue which may be adequate for retention and support of the prosthesis. Adhesives may be necessary to supplement the anatomic retention. In total ear prosthesis the open external auditory canal can be used for retention. But the extension into the auditory canal may diminish hearing on the affected side. [2,9,11]

5.4. Mechanical retention [4]

Mechanical retention of facial prostheses is the oldest method of retention reported in the field of facial prosthesis. Mechanical Retention includes:

1. Eye glasses and frames (Figures 1 and 2)
2. Extension from denture (Figure 3)
3. Precision attachments (Figure 4)
4. Elastic and non-elastic straps (Figure 5)
5. Magnets

5.5. Adhesives

According to GPT-9, maxillofacial prosthetic adhesive is "a material used to adhere external prosthesis to the skin and associated structures around the periphery of an external anatomic defect." Chemical retention is achieved by adhesives. [10]

Ideal properties of adhesives for maxillofacial prostheses:

1. Biocompatible, non-toxic and non-irritating
2. Odorless and moisture repellent.

Fig. 1: Nose prosthesis supported by eye glasses

Fig. 2: Ear prosthesis supported by eye glasses

Fig. 3: Extension from maxillary denture

Fig. 4: Precision attachments

Fig. 5: Elastic strap for maxillofacial prosthesis

3. Dried adhesive should be porous and absorbent to allow passage of secretions
4. Easy to apply
5. Dry quickly
6. Easy to remove without injuring the skin and prosthesis

   (a) Acrylic resin adhesives: Acrylic resin adhesives consists of acrylic resin dispersed in a water solvent which when evaporated leaves a rubber like substance. In order for these adhesives to be successful, one surface must be permeable to water to dry the dispersion and develop the bond. Other materials within the mixture include synthetic rubber, vinyl acetate, reclaimed rubber, vinyl chloride, styrene, and methacrylate.

   (b) Silicone adhesives: Silicone adhesives are a form of room temperature vulcanizing (RTV) silicones usually dissolved in a solvent. Once the adhesive is applied, the solvent evaporates and a tacky adhesive result, which may then be contact bonded to another surface such as a skin. These adhesives develop good resistance to moisture.

   (c) Pressure sensitive tapes: Pressure sensitive tapes used in the retention of facial prostheses are applied by finger pressure in the absence of heat or solvents. The tape has adhesive on both surfaces. The bond of the Bi face tape to skin is weaker than the acrylic resin adhesive.

   (d) Rubber based liquid adhesive: Rubber occurs in nature as latex, which is obtained by tapping the bark of rubber trees. The latex thus obtained is readily soluble in organic solvent, such as benzene or petroleum spirits, to form a natural rubber adhesive. This mixture quickly gels because of atmospheric oxidation.

The biggest problem as far as the patient is concerned is the removal of the remaining residual adhesive from the skin. Adhesives can be removed by the help of:

1. Plaster remover
2. Zoff prosthetic cleanser (Trichloroethane)
3. Acetone
4. Uni-solve adhesive remover
5. Isoparaffin
6. Isopropyl alcohol. [10,12,13]

5.6. Implants

The retention provided by the implants makes it possible to fabricate large prosthesis that rests on movable tissues. Patient acceptance is significantly enhanced. CT scan can be used to locate possible implant sites. Computed tomography in conjunction with an implant planning software is also a desirable planning tool. The software used is SIM / Plant

System (Columbia). A CT image is recorded and the image is reformatted through the Image Master application of this software. The reformatted image is then loaded into the SIM / Plant System where the implant surgery can be simulated.

5.6.1. Indications for implants in ***auricular reconstruction***

1. Major cancer resection
2. Radiation therapy
3. Severely compromised local tissue
4. Failed autogenous reconstruction
5. Patient preference

5.6.2. Indications for implants in nasal reconstruction

1. Failed autogenous reconstruction
2. Scarring at autogenous donor sites.
3. Following removal of adequate reconstruction due to tumor recurrence.
4. Patient preference.

5.6.3. Indications for implants in orbital reconstruction

1. Loss of globe and orbital contents
2. Severe enophthalmos
3. Unsatisfactory ocular prosthesis where surgical correction has not been successful
4. Patient preference.[9,11]

5.7. Bar design for Auricular Prosthesis (Figure 6)

The use of implants usually requires removal of ear remnants. The temporal bone has sufficient thickness to accept a 3 or 4 mm implant. A minimum of two implants are needed, approximately 18 mm from the centre of the external auditory meatus and 15 mm from each other.

Fig. 6: C- shaped bar design to connect abutments

5.8. Bar design for nasal prosthesis (Figure 7)

1. The anterior surface of the maxilla just inferior to the nasal cavity offers sufficient thickness of bone to accept a 4mm implant.
2. Longer implants of 6mm or greater can also be used.
3. Minimum of two implants are required, positioned in each lateral rounded nasal eminences.
4. The abutments connected by a bar which extends superiorly to about 10 -15 mm from the abutments.

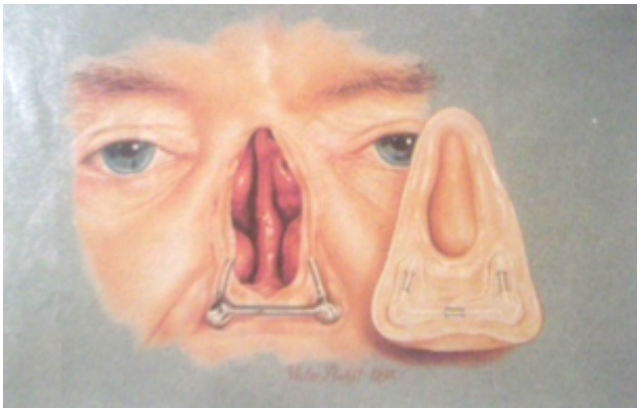

Fig. 7: Bar design for nasal prosthesis

Bar design for Orbital Prosthesis (Figure 8)

Fig. 8: Join the abutments with a bar design in large defects.

In orbital defects, the superior, lateral and the inferior orbital rims are the possible sites for 3 - 4 mm implants. Ideally three or 4 implants are needed. The long axis of the implants should be directed towards the centre of the orbit.[14]

Type of implants used in orbital prosthesis are:

Non-integrated (e.g.: - PMMA and Silicone implants)

Semi integrated (Allen implants)

Integrated implants (Cutler's implants)

Bio integrated (Hydroxyapatite, structures with or without integration porus polyethylene, with the prosthesis Aluminium oxide)

Biogenic implants (Dermis-fat graft the prosthesis Cancellous bone)[10]

From several studies conducted it is found that the implant survival rate is high for auricular prosthesis followed by nasal and orbital areas, the most common complication seen is peri-implantitis which is related to hygiene maintenance around the implant site.[15]

6. Conclusion

A variety of techniques and equipments are available to retain a maxillofacial prosthesis. To choose the right retentive aid, one needs to be familiar with the available options. It may be difficult to achieve good results in all the cases. Thorough evaluation of the situation and careful judgment and treatment planning can give acceptable quality of prosthesis which improves the patient's quality of life. The current situation is promising, and there are positive expectations for the future.

7. Conflict of Interest

There are no conflicts of interest in this article.

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None

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