

 <p>ISSN NO. 2320-5407</p>	<p>Journal Homepage: - www.journalijar.com</p> <h2>INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)</h2> <p>Article DOI: 10.21474/IJAR01/12918 DOI URL: http://dx.doi.org/10.21474/IJAR01/12918</p>	 <p>INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR) ISSN 2320-5407 Journal Homepage: http://www.journalijar.com Journal DOI: 10.21474/IJAR01</p>
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RESEARCH ARTICLE

RETENTION IN MAXILLOFACIAL PROSTHESIS: A LITERATURE REVIEW

Dr. Saranya YS¹, Dr. Suja Joseph³, Dr. Aby Mathew T², Dr. Annie Susan Thomas³, Dr. Aswati Soman¹ and Dr. Minnu Harshakumar¹

1. PG Resident ,Department Of Prosthodontics and Crown & Bridge, Pushpagiri College Of Dental Sciences, Thiruvalla, Pattanamthitta , Kerala, India.
2. Professor and Head , Department Of Prosthodontics and Crown & Bridge, Pushpagiri College Of Dental Sciences, Thiruvalla, Pattanamthitta , Kerala, India.
3. Professor , Department Of Prosthodontics and Crown & Bridge, Pushpagiri College Of Dental Sciences, Thiruvalla, Pattanamthitta , Kerala, India.

Manuscript Info

Manuscript History

Received: 25 March 2021
Final Accepted: 29 April 2021
Published: May 2021

Key words:-

Retention, Adhesives, Maxillofacial Prosthesis, Auricular Prosthesis, Ocular Prosthesis, Intraoral Prosthesis

Abstract

Defects in the maxillofacial region can be congenital or acquired, and may negatively affect their physical and psychological health, hence such defects require rehabilitation to improve the quality of life. Maxillofacial prosthesis helps in substituting these missing body parts. The mode of retention is always challenging. Apart from the various modes of retention available, a thorough treatment planning can give a better quality of maxillofacial prostheses. The type of retentive to be given depends on several factors such as the shape and size of the defect, the systemic conditions and the age of the patient. Using ideal retentive aids along with the aesthetic, functional and economic factors helps in achieving successful outcomes.

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Introduction:-

Prosthodontist plays a major role in rehabilitation of maxillofacial defects. Maxillofacial deformities are embarrassing to the patients and may negatively affect their physical and psychological health, resulting in serious psychiatric, familial and social problems. These deformities may be congenital caused by malformations and developmental disturbances or acquired, due to trauma or as a result from treatment of neoplasms¹.

Prosthetic reconstruction of a defect is highly challenging and it depends on various factors such as size, site, aetiology, extension, age, patient's comfort, satisfaction and cost factor. Maxillofacial prostheses improves the patient's quality of life and self-esteem. The prostheses allow individual to reintegrate into their social and familial environment, making them happier and more confident².

Maxillofacial reconstruction involves implanting artificial substitute for intracoronal and extra coronal structures such as the eyes, ears, nose, maxilla, mandible, oesophagus, cranial bones, and palate. The materials used for rehabilitation have travelled a long way from wood to polymers and the retentive aids used from metal bands to implants³.

Any prosthesis serves its purpose only if it is retentive. The best mode of retention possible for a maxillofacial prosthesis should be decided based on the knowledge, skill and experience of a surgeon and prosthodontist. Proper

Corresponding Author:- Dr. Saranya YS

Address:- PG Resident ,Department Of Prosthodontics and Crown & Bridge, Pushpagiri College Of Dental Sciences, Thiruvalla, Pattanamthitta , Kerala, India.

evaluation of the defect before and during surgery will help to modify the irregular defects to aid in retention in some cases. In cases of large maxillofacial defects, movement of prosthesis poses a real challenge. A careful treatment planning can give a better quality of maxillofacial prostheses, which improves the patient's quality of life. A team effort is essential for the effective treatment of patients with maxillofacial problems¹.

The type of retentive to be given depends on several factors such as residual soft and hard tissues in trauma or post-surgery defect, concavities and protrusions in auricular or orbital region and the zygoma support. After evaluating the adjacent anatomical tissues, various methods have been tested depending on the shape and size of the defect, the systemic conditions and the age of the patient. The most commonly used retentions methods include adhesives and implants^{1,3}.

This article reviews the various methods to retain the maxillofacial prosthesis.

Epithesis are those prosthesis that replaces the soft tissues. Such a prosthesis are retained mainly by 4 ways:

1. Adhesives
2. Anatomically
3. Mechanically
4. Surgically.

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." Adhesives are considered as the most popular retentive aid in maxillofacial prosthesis retention as they are readily available, easily applied and can provide satisfactory retention for limited period of time.

The selection of an adhesive is based on certain criteria⁴. They include-

1. Bond strength of the adhesive.
2. Biocompatibility.
3. Prosthesis design.
4. Type and quality of patient's skin.
5. Composition and viscosity.
6. Handling, storage and shelf life.

There are two types of adhesives, water and solvent based adhesives. Water based adhesives are easy to apply and clean than solvent base adhesives. Whereas, solvent based adhesives provide better retention than water based adhesives. Water and solvent based adhesives can be used together, in order to maintain the fine edge of prosthesis. A thin layer of water based adhesive is applied to the fitting surface of prosthesis and is allowed to cure. Then a thin layer of solvent based adhesive is applied on to cured part and left to dry for 1-2 minutes. After that, the prosthesis is attached to the skin. This method facilitates removing solvent and water based adhesives from the prosthesis easily¹.

Medical adhesives includes double side tape, pastes, liquids and sprayers. Acrylic resin adhesives are acrylic resin dispersed in a water solvent. It leaves a rubber-like substance which when evaporated provides the adhesiveness. Silicone adhesives are a room-temperature vulcanising silicones, that are dissolved in a solvent. This solvent evaporates and provides adhesiveness which helps in retention. Pressure sensitive tapes consists of a backing strip composed of cloth, paper, foil or a laminate strip coated with a pressure sensitive adhesive which provides retention⁵. Double sided tape is the most preferred type of adhesives due to its ease of application, easy removal and renewability. However they possess certain disadvantages such as low flexibility and the need for frequent reassembly due to loss of stickiness⁶. Examples of adhesives are Pros-Aide adhesive, Epithane-3 adhesive, 3M bifaceis, Hollister Medical Adhesive, 3M double sided tape⁷. Adhesives and solvents may advently affect the physical and optical properties of the maxillofacial elastomers. Furthermore, it is recommended to use tissue conditioners when applying the adhesives to avoid soft tissue reactions and to provide good bonding between adhesive and skin. The success of extra-oral prosthesis retained by adhesives relies on selection of the correct adhesives and patient's dexterity (Figure 1).

A study by Kiat et al, evaluated time and reapplication effects of adhesive retention of maxillofacial prostheses. According to this study, perspiration and normal body motion decreases the bond strength of the adhesive and it was

noted that the application of a second coat of adhesive after an interval of 4 to 8 hours enhanced the retention of the silicone elastomeric strips⁵.



Figure 1:- Medical grade adhesives.

Advantages:

Adhesives are cost effective, non- invasive, easy to manipulate and apply and has less aggressive side effects. Adhesives as a retentive aid are considered for maxillofacial defect patients who are not willing for implant surgical procedures¹

Disadvantages

1. Certain adhesives require solvents to clean after removal of prosthesis⁷.
2. Adhesives can damage both the prosthesis surface and the skin during insertion and removal. Maintenance of the skin and prosthesis required considerable daily effort and dexterity by the patient.
3. If adhesive systems are used for a long time, they may cause contact dermatitis. Patients should be advised to remove the prosthesis once a day to clear the surrounding tissue and to decrease the risk of skin contact disorders and to allow the tissues to restore the strength.
4. The use of adhesives may cause a change in the colour of the prosthesis.
5. Adhesives can abrade the edges of the prosthesis.
6. They do not provide sufficient adhesion against gravity, sweating, and tissue movement.
7. All adhesive systems are inadequate to ensure the rigid fixation of facial prosthesis.
8. It provides an unreliable retention^{1,5}.

ANATOMICAL

Anatomical undercuts can be used for the retention of extra-oral prostheses. These areas can be created by planning before and after surgery as a mode of retention for maxillofacial prosthesis. They are also obtained by already existing anatomical structures just as the undercut area in ocular defects². Anatomic retention can be either intraoral or extraoral¹.

Intraoral Retention

Intraoral retention is achieved from hard and soft tissues. It can be from teeth, mucosal and bony tissues. Anatomic undercuts are found in the palatal area, cheek, retro molar area, remaining teeth, alveolar ridge, septum and anterior nasal aperture⁴. Intraoral retentive aids are usually considered comfortable for the patient for easy removal and for the examination of the surgical site by the dentist in order to check for recurrence of tumour.

Extraoral Retention

The movement of the prosthesis create stress on the abutment teeth, leading to the loss of the tooth. Therefore, in such cases an additional retention can be used. Extra oral retention can be achieved from hard and soft tissues of maxillofacial and neck region. Deep undercuts and soft tissue undercuts like in the maxillary sinus, nasal cavity and orbital regions are usually used for extra oral retention⁴.

In partial rhinectomy, there are enough spaces in the nasal cavity and maxillary sinus that can assist in the retention of nasal prosthesis. Patients with lateral nasal defects have natural undercuts to retain the prosthesis without using adhesives. In total rhinectomy, natural undercuts offer less chance for retention of nasal prosthesis but if the maxillary sinuses are not exposed they can assist for retention of nasal prosthesis. Intranasal anatomical retention

provides good retention and aesthetic in the beginning but movement of adjacent tissue during eating, smiling and speaking affects the stability of prosthesis. Therefore, this method is preferred when there is a little movement and is recommended in partial defects².

In case of partial removal of ear, tissue remnants can provide retention of auricular prosthesis with using adhesive. However, this method is not highly recommended because of mobility of the remnant tissue. In case of total missing ear, open external auditory canal can assist in retention of auricular prosthesis but this will affect the hearing. Hence, this method is contraindicated^{2,4}.

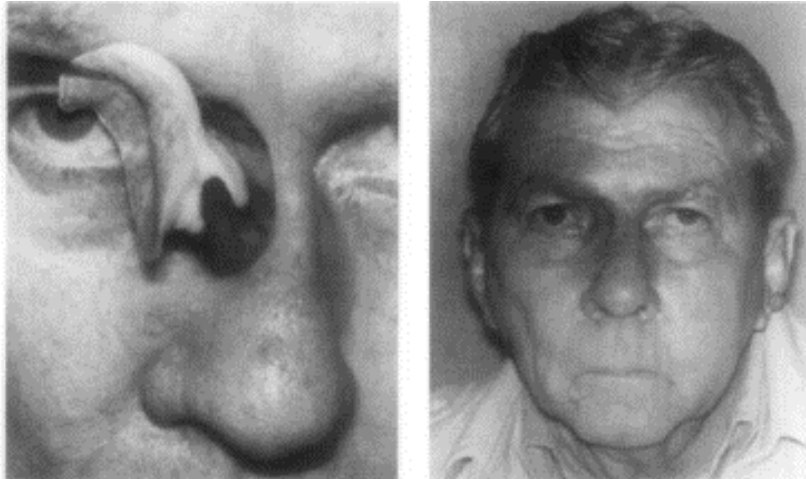


Figure 2:- A Lateral nasal-canthal prosthesis with projections providing vertical and lateral resistance to displacement. B Prosthesis retained without adhesives³.

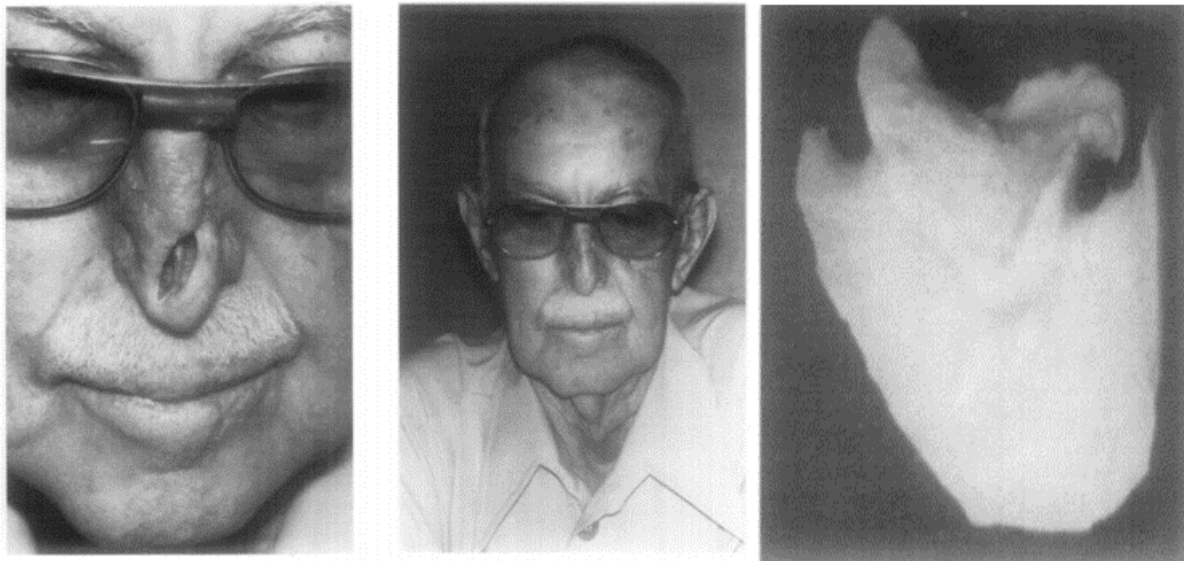


Figure 3:- Midline defect of the nose, well-supported by surrounding tissue without adhesives³.



Figure 4:- Extensive nasal defect with retentive skin remaining on the bridge of the nose³.

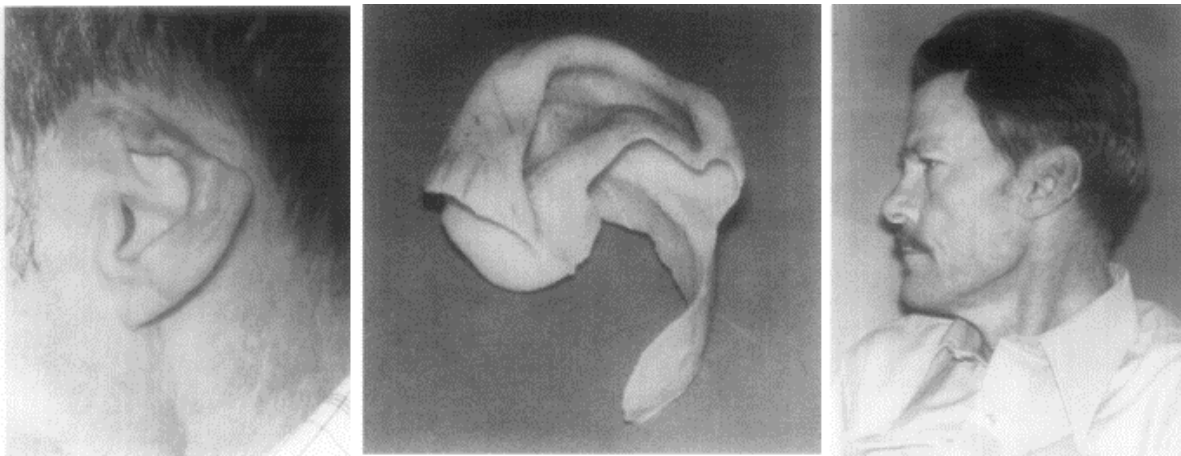


Figure 5:- Superior ear resection with supported residual tissue.³

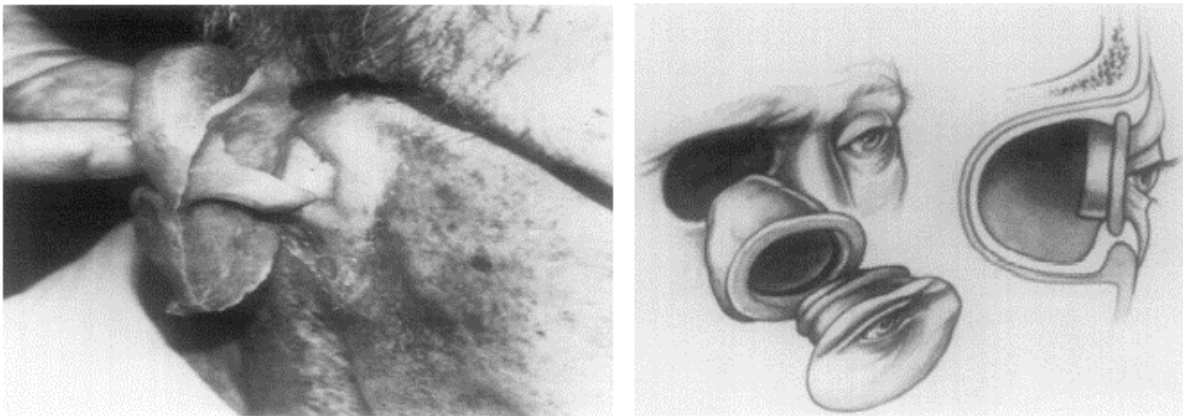


Figure 6,7:- anatomic retention gained from undercuts.³

Mechanical Retention

Mechanical anchorage includes-

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

Magnets

Due to their small size and strong attractive forces magnets are used widely in the retention of maxillofacial prosthesis. They are available in different sizes and can be chosen according to the size of the defect. They are said to provide the best retention and stabilisation for maxillofacial prosthesis. Magnets are used as retentive aid for sectional dentures, hemi-maxillectomy, obturators, complete dentures or extensively atrophied ridges. They also aid in the attachment of implant to the prosthesis. Magnetic attachments on the teeth and on implants are used to improve stability, support and retention of prostheses^{8,9}.

Advantages of using magnets are ease of placement, automatic reseating, easy replacement, small size with strong attractive forces can be placed within the prostheses and ease of cleaning.

Two types of alloys are commonly used for the manufacture of small dental magnets. They are cobalt-samarium and iron neodymium and boron. They have high attractive forces in very small sizes, but have low corrosion resistance¹⁰. Tsutsui H et al found Samarium-Cobalt magnet to be superior in magnetic properties to other magnets¹¹. Grant GT et al (2001) described a procedure for the fabrication of an extraoral prosthesis with an acrylic resin substructure that retains a magnet sealed from the environment by a polyurethane liner.¹² Fe-Pt dental magnetic attachments are clinically useful for retention of maxillofacial prostheses due to their excellent attractive force. Fe-Pt magnetic attachment system (magnet and keeper) can be cast in a dental casting machine. Hence, any size or shape of castable magnetic attachment can be fabricated for maxillofacial prostheses.¹⁰

Magnets are used in both mandibular and maxillary sectional intraoral maxillofacial prostheses. Retentive forces by these magnetic attachments are limited against lateral masticatory forces¹⁰. In such cases, additional retention should be considered and this can be obtained by adhesives, resilient attachments, implants or it can be united to an obturator by magnets. Magnetically retained overdentures require less maintenance and relatively inexpensive. Seema Pattanaik et al described rehabilitation of a patient with subtotal maxillectomy and enucleated eye by intraoral prosthesis and extraoral orbital prosthesis retained with magnets¹⁴.



Figure 8:- Orbital defects with magnets⁶.

Eyeglasses

Spectacles can be used to retain extra-oral prosthesis for ocular, nasal and auricular defects. This is considered as the basic and user friendly method especially for elderly patients with limited dexterity. The most common problem that is associated with eyeglass is the movement of the frame along with the tissue, and the transfer of pressure which ultimately affects the stability of the prosthesis. To overcome this problem, ear locks can be used to prevent displacement of eyeglass frame and provide stability of prosthesis⁶. Advantages of using eye glass as retentive aid can be mentioned as easy, economic and practical. It also helps in masking the borders of the prosthesis¹.

Extension from Denture

Retentive aids like cast clasps, retentive clips and acrylic buttons are still being used as they are the most economical amongst the others.

Precision Attachments

Bar clips are widely used precision attachment that connects the prostheses and implant and between different parts of prosthesis. Telescopic crowns and extracoronal ball attachments are used to increase and improve retentive force in maxillofacial prosthesis cases¹⁵.

Elastic and Non-Elastic Straps

They are used with extraoral prosthesis. Head bands are used in cases of auricular prosthesis. Non-elastic straps along with buckles are used to make it adjustable. It requires a head cap for anchorage. Orthodontic headgear assemblies like head cap and adjustable strap extension are very useful for extensive maxillofacial prosthesis.^{1,3}

Surgical

Implants to retain extra-oral prosthesis is considered as the best method compared to other traditional methods of retention. Titanium implants can be used for anchoring prosthetic ears, nose and eyes. They provide most reliable form of retention for maxillofacial prosthesis. It also enhances the function of prosthesis and good marginal fit making the margins less obvious. Placement of osseointegrated implants have shown great effect on the function of facial prosthesis in a matter of retention, stability and support. Most commonly used are cylindrical or tapered root form titanium implants which are mechanically anchored to bone.^{16,17} Osseointegrated implants bring many benefits. Firstly, it provides more stability and retention than other methods of retention. The use of adhesives and removers are not required and this prevents tear of the edge of prosthesis and skin irritation which are results of application and removal of adhesives when cleaning the prosthesis. The life of silicone prosthesis will be increased. On the other hand, the patient should be aware of all the problems which may result with this type of retention including soft tissue complications which result from insufficient care of prosthesis and the tissues around the abutments, regular clinical appointments will become mandatory. In case of implant failure, an additional surgery is indicated to place farther implant in order to support the prosthesis.¹⁸ The most ideal location for implants in edentulous total maxillectomy patients is residual premaxilla. Zygomatic implants also used in the treatment of maxillary defects secondary to trauma, tumour resection or any congenital defects. For nasal prosthesis, ideal site is maxillary region and anterior floor of nose with tissue bar and clip design. Nilgun A et al fabricated an auricular prosthesis with extraoral implants and bar and clip retention.^{1,19}

There are various types of implant retention.

1. Bar construction and retentive clips: It is preferred to use with auricular and large orbital prostheses as they provide even force distribution on the implants.¹⁹
2. Magnetic retention: This method of retention is preferred when there is not enough space for a bar – clips construction. This method allows the patient to insert and remove the prosthesis easily and the patient is able to clean around the abutments properly.
3. Bar splint / magnet retention: This method is used to retain large prosthesis such as hemi-facial prosthesis, where a number of implants are placed in the upper part of defects. They provide satisfactory retention.
4. Ball attachments: This method is recommended to use in case of shallow defects. Three implants can produce optimum retention and stability for prosthesis.
5. Combined direct adhesive / magnetic retention: This technique involves use of adhesive and magnets to retain extra-oral prosthesis. The advantage of this technique is to prevent using the adhesive on the fitting surface of silicone prosthesis. This method involves the construction of acrylic base which contains a number of magna-caps. This base is placed on the tissue of the defect area and fixed with adhesive to obtain retention. The prosthesis is then attached to the magna-acrylic base by using magnets that are also incorporated into acrylic base which is attached on the fitting surface of prosthesis using primer. The most important thing with this method is that the location of acrylic plate should be in accurate position so that the location of prosthesis will be in exist position. This method of retention can be used to retain extra-oral prostheses such as orbital, auricular, nasal and hemi facial cases. As well as it can be used in partial cases such as partial nasal and partial auricular defects.²⁰



Figure 9:- Retentive bar and ear prosthesis.¹⁹

Conclusion:-

Retention of maxillofacial prosthesis is one of the key factors that determines the success of prosthesis. The aesthetics achieved after complete treatment depends on the amount of tissue removed, marginal adaptability and minimal sagging due to the weight of the prosthesis. The final prosthesis should restore the aesthetics and function in a near natural appearance. The choice of retention method relies on many factors such as the size of the defect, soft tissue movement, age and ability of the patient, position and number of implants. The need for professional evaluation on a periodic basis should be encouraged to determine the adaptability of prosthesis to soft tissues, stability, retention, function and aesthetics.

Financial support and sponsorship

Nil.

Conflict of interest

There are no conflict of interest.

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