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## **Retention in maxillofacial prostheses: A literature review**

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**Abstract**---Facial disfigurement affects the functional, social and psychological well-being of an individual. It reduces an individual's self esteem and acceptance in the society. It can be congenital or acquired. Prosthetic rehabilitation and surgical reconstruction techniques are the ways to lessen or diminish the problems associated with facial disfigurement. Prosthetic rehabilitation is favored as it is less invasive and affordable. The success of a prosthetic rehabilitation of any part relies on the availability of a method of attaching the artificial substitute securely to its place. Various means of retention have been developed over the years from metal bands to implants. With the advancing technology, in cases where anatomic undercuts are futile, craniofacial implants prove to be a boon for rehabilitation.

In this literature review, the various modes of retention available for maxillofacial prostheses were assessed and appraised.

**Keywords**---retention, maxillofacial prostheses, psychological, surgical reconstruction.

## Introduction

Body deformities or malformations compromises the appearance, function of a person and leave the sufferer incapable of leading a normal life. Not just abnormalities but, extensive surgical procedures performed to treat the patients with malignancies or trauma also sometimes results in cosmetic, functional and psychological deterioration. This leads them to disintegrate themselves from the society. Amongst all defects, maxillofacial defects worst hits the confidence and quality of life of an individual. This is aptly summed in a quote by Dieffenbach, a German surgeon, "at the sight of whom all men turn in disgust and abhorrence and at whose presence children cry and dogs bark".(1)

Prosthetic rehabilitation, surgical reconstruction techniques, or a combination of both the techniques are the options one has for correction of these facial disfigurements. Literature suggests that the result in regard with esthetics is better with maxillofacial prosthesis when compared to surgical reconstruction. (2-4) Prosthetic rehabilitation is much more simpler and less expensive for congenital defects. Also, surgical reconstruction may be limited due to age, general medical condition of the patient, insufficient residual tissue, need to monitor tumor recurrence, vascular compromise following radiation, inadequacy of the donor sites, or patient choice.

Maxillofacial prosthesis is the branch of Prosthodontics concerned with the restoration and replacement of the stomatognathic and craniofacial structures with the prostheses that may not be removed on a regular or elective basis. (5) Retention is a key factor for successful outcome of maxillofacial prosthesis. According to GPT-9 (The Glossary of Prosthodontic Terms), retention is that quality inherent in the dental prosthesis acting to resist the forces of dislodgement along the path of placement. (5) Prosthesis will serve its motive only when it is properly retained. Properly retained prosthesis not only improves patient comfort but also imparts confidence to the patient at work and in social gatherings.

With time, the retentive aids in Maxillofacial Prostheses used have also advanced from metal bands to implants. According to the clinical situation, any prosthesis can be retained by means of *Anatomical, Mechanical, Chemical and Surgical anchorage*. To decide the best retentive aid for each case, the prosthodontist should be familiar to all the options for retention, as the responsibility for planning prosthetic rehabilitation that is acceptable and sustainable lies with them. This article reviews various options for retention in Maxillofacial Prostheses.

## **Anatomical Anchorage**

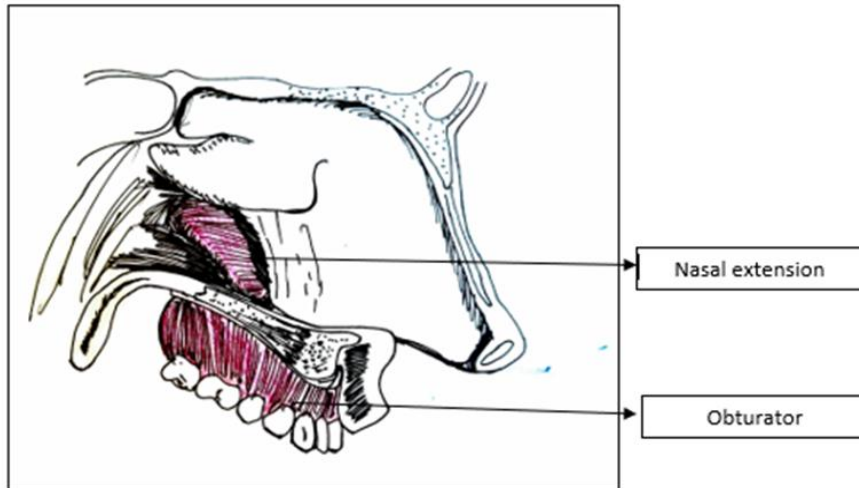
Anatomic retention requires the use of both hard and soft tissues of head and neck region. It can be acquired by already existing anatomical structures or by creating an area for retention it by planning before surgery. The retention acquired depends on several factors like location and size of defect, tissue mobility, undercuts and weight of prosthetic material.(6)  
Anatomic Anchorage can be intraoral or extraoral.

### **Intraoral Anatomical Anchorage**

It is achieved from teeth, mucosa and bony tissue. Teeth are major assets in providing retention to the prosthesis particularly an obturator prosthesis. The number, position and periodontal status of remaining natural teeth are crucial factors as they determine the amount of stress that the remaining teeth may be able to absorb. The remaining teeth should be examined and any pre- prosthetic treatment required should be done. While designing the prosthesis intra-coronal or extra-coronal direct retainers can be used. Relatively weak teeth should only be clasped if they can be splinted permanently to other stable teeth.

Anatomic undercuts found in palate, retromolar area, anterior nasal spine, posterior nasal spine, large alveolar ridge and high arched palate provide good retention(Fig.1). Intraoral retentive aids are well-tolerated by the patient and easy to remove for examination of surgical site. Engagement of the skin graft and scar band formed at the junction of skin graft mucosal junction can also be used for retention. As this scar organizes, it contracts longitudinally in the manner of a purse- string, thus creating an undercut superiorly and a concavity inferiorly. Retention may be enhanced by extending the prosthesis along the nasal surface of the soft palate and / or anteriorly onto the nasal aperture.

Dr. Kenneth E. Brown, discussed the peripheral considerations in improving obturator retention in cases of maxillary resection. He suggested extending the lateral border of the obturator high in the defect to create longer radii of the arch of the obturator around a retentive fulcrum in the framework. So, establishment of such high lateral extension would be resisted by a greater surface area of defect wall in a more efficient manner. The stresses would also be distributed to a greater surface area and cause lesser impingement of already vulnerable tissues.



**Fig.1: OBTURATOR WITH POSTERIOR EXTENSION OF OBTURATOR BULB IN THE NASAL CAVITY**

### **Extraoral Anatomical Anchorage**

Anatomic retention for an Extraoral prosthesis is difficult to obtain due to lack of available undercuts. The only favorable factor in this type of anchorage is that, the extraoral prosthesis usually restore a structure around an anatomical aperture like the nasal cavity, orbital cavity or the external auditory meatus which can be engaged for retention.

### **Mechanical Anchorage**

This type of anchorage includes magnets, eye glasses and frames, extension from denture, precision attachments and elastic and non-elastic straps.

### **Magnets**

Magnets have various applications in Removable Prosthodontics. Due to their small size and strong attractive forces, they can be placed within prostheses without being conspicuous. Other advantages include ease of cleaning, automatic reseating, ease of positioning for both dentist and patient, and sustained retention with number of cycles. In prosthodontics they can be used as retentive aids for sectional dentures, obturators for maxillectomy defects, complete dentures for extensively atrophied ridges(Fig.2).(7) In 1960, Behrman SJ presented a technique for the implantation of magnets in the jaw to aid retention of the prosthesis. Eight years of follow showed the complete safety of implanting magnets in the jaw.

In 1963, Robinson JE suggested a possible resolve for rehabilitating patients who have undergone surgical removal of both maxillae. He described a method of

constructing a two section intra oral prosthesis with the use of attracting magnets as positive locking device. In 1976, Federick DR demonstrated a technique for fabrication of a sectional interim maxillary obturator with retention augmented by a magnet. The positive locking and retentive quality of the prosthesis provided by the magnet permitted normal speech and mastication as well as an improved psychologic state during an unpleasant rehabilitation period. In 1979, Tsutsui H, Kinouchi Y, Sasaki H, Shiota M, Ushita T examined the magnetic properties of the Sm – Co magnet as compared with other conventional magnets. In 1986, Highton R, Caputo AA, Pezzoli M, Matyas J investigated six magnet – keeper systems to determine the relationship between an air gap and the resulting breakaway force. The maximum retention was obtained when the magnet and keeper were in apposition.

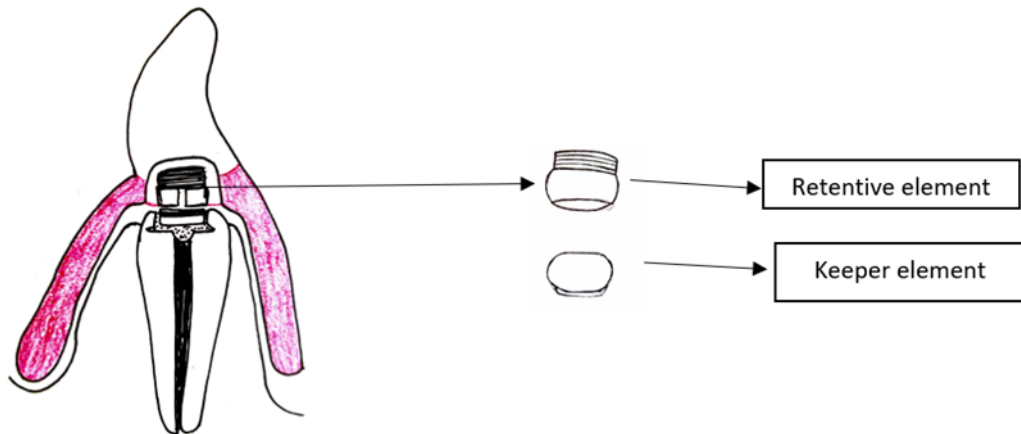
Mainly two types of alloys are used to manufacture dental magnets:

1. Neodymium iron boron (Nd-Fe-B) which is found to be the most powerful commercially available magnet material.
2. Other materials used include the RE alloy samarium cobalt (Sm-Co).

Samarium iron nitride is a newer material which is showing promising results due to higher magnetization, better resistance to temperature and corrosion when compared to Nd-Fe-B type magnets. Iron- Platinum alloys also have magnetic properties, and they have been investigated for possible application to dentistry.(6)

There are many sizes of magnets and keepers available in prefabricated, commercial dental magnetic attachment systems. Spherical magnets come in two different sizes and are cylinder- shaped with a flat top. These magnets provide no resistance to lateral forces which is why they are usually combined with telescopic or conical magnets. Telescopic magnets provide guidance when the prosthesis is being inserted and also resist lateral stress, but due to a gap of 100 mm between telescope/conus and abutment, there is no friction. Along with the retention force generated by each magnet, the combination and alignment of the magnets and their geometric properties are important for retention of the facial prosthesis. Spherical magnets are easier to insert but they provide little resistance to shear stress. Telescopic magnets are more resistant to shear stress due to their geometric properties, but these make them more difficult to handle. If two or more telescopic magnets are used, a parallel arrangement of the posts is mandatory. This may be achieved by navigational techniques.

Magnets are simple to use, rapid and also cost effective. They provide superior esthetics and easy maintenance. The only disadvantages are low corrosion resistance and cytotoxic effects of the leachant. Magnets have poor corrosive resistance within oral fluids due to which they require encapsulation within a relatively inert alloy such as stainless steel or titanium. When such casings are ruptured, contact with saliva rapidly brings about corrosion and loss of magnetism.



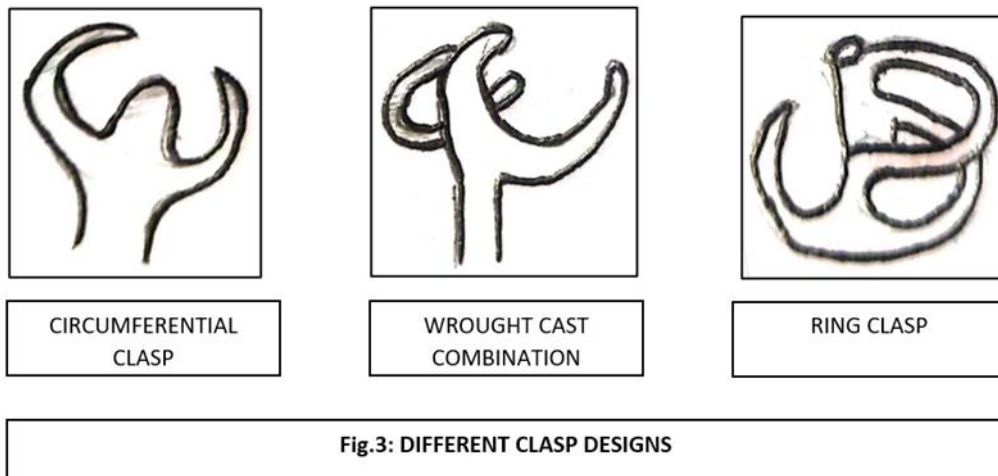
**Fig.2: MAGNETIC ATTACHMENT ENHANCING THE RETENTION OF PROSTHESIS**

### **Eye Glasses and Frames**

These are generally used in retaining ocular, nasal and auricular prosthesis. The prosthesis could be retained by attaching the prosthesis to the frame of the eye glass patient is using. Karacoka et al, in a patient with midfacial defect, attached the prosthesis permanently to the eye glass frame. However, in this scenario the biggest disadvantage was that the prosthesis gets removed when the patient removed the eye glasses.(8) If attached temporarily, eye glass frame as a means of retentive aid is easy to use, economic and practical.(6) It also masks the borders of the prosthesis when the frame is kept thick and opaque material is used.

### **Extension from Denture**

This includes the most primitive and economical type of retentive aids- retentive clasps and acrylic buttons. The most common and easiest option for retaining an intraoral prosthesis is the use of a retentive clasp made of metal which engages an undercut. The clasp should be designed in such a manner that it provides retention, stability, splinting, bilateral bracing as well as reciprocation(Fig.3). Success of the obturator prosthesis depends upon its retentive components, retentive clasps being the most important.. Properly designed clasps not only retain the obturator in its place but also reduce the stresses transmitted to the abutment teeth. Retention by means of acrylic button has 2 units- an acrylic substructure which fits to the defect and an acrylic projection which attaches to the substructure. The final prosthesis should be fabricated such that it snap fits over the acrylic buttons and aid in retention.



### Attachments

The use of multiple attachments provides increased retention and stability to the prosthesis, as well as improved water and air tightness in case of obturators. Attachments are used as supplement to maxillary obturators to-(a) improve retention in comparison to conventional clasping on incisors as terminal abutments adjacent to a large defect and (b) enhance aesthetics. The use of precision attachments can yield significant functional improvement in a dentate maxillectomy patient.

Attachments like bar-clip also maintain an accurate contact between the prosthesis and the adjacent soft tissues. According to some authors and the design of the bar, the vertical retention forces of bar-clip attachments differ from 16Æ8 to 29Æ8 N. Various designs have been proposed for bar attachment, from round to square section. Square section bars are friction retentive whereas round bars are interlocked with clips. When splinted into a fixed partial denture, round section should be preferred as it acts as a real precision attachment for the removable partial denture.(9)

Retentive clips are metallic or plastic clips that snap over the bar used as a superstructure connected to the implants. When compared to magnets, they have better retention in terms of breakaway retentive force than magnets. However, they tend to wear at a faster rate than the magnets. Retentive clips have an advantage over magnets in that they are not subject to the effects of bodily fluids as magnets are. Retentive clips are useful in retaining facial prosthesis in patients with good dexterity and where retention is to be maximized in areas with little muscle force, e.g., for retention of an auricular prosthesis.

A combination of magnets and retentive clips can be used at discretion of the clinician, depending on factors such as retention, thickness of the bone, proximity of adjacent muscle activity and dexterity of the patient. Extracoronary ball

attachments and telescopic crowns can be used to increase retentive ability of maxillofacial prosthesis.

### **Elastic and Non Elastic Straps**

They are generally used to retain extraoral prosthesis. Head bands with elastic straps are mostly used in cases of auricular prosthesis. Some headbands have buckles incorporated in the non- elastic straps that make it adjustable to use. It should be accompanied with a head cap to gain anchorage. Some authors have suggested use of orthodontic headgear assemblies like head cap and adjustable non-elastic strap extension in cases with extensive defects.(10)

### **Chemical Anchorage**

Chemical anchorage is reinforced by means of adhesives. Maxillofacial Prosthetic Adhesive is defined as “a material used to adhere external prosthesis to the skin and associated structures around the periphery of an external anatomic defect.”(5) Medical products that contain adhesives that attach human skin to the prosthesis are termed as pressure sensitive adhesives (PSA). These are basically visco-elastic materials, which at room temperature binds strongly to various substrates under slight pressure for a limited period of time. Adhesives used for facial prosthesis occur in different forms according to their use. They can be double sided pressure sensitive tape, glue, sprays, pastes and liquid systems. According to the composition they can be broadly classified as acrylic resin, latex, silicone, spirit gum and water based adhesives. (11)

Adhesives composed of acrylic resin are soluble in water and provide adhesiveness when water evaporates. These adhesives are easy to remove from most of the materials used for fabrication of prosthesis except polyurethane. It is readily available in the market as Hydrobond (Epithane 3). Silicone adhesives are another option. Similar to acrylic resin based adhesive, this adhesive is dissolved in the solvent, which when evaporates develops into a tacky adhesive. The advantage of silicone adhesives is that they are extremely resistant to moisture hence absorb very little water and are unaffected by other chemicals or sunlight. Secure medical adhesive is a type of RTV (room temperature vulcanizing) silicone adhesives which is a low molecular weight polymer ending with hydroxy.

Latex based paints and surgical PMMA (polymethylmethacrylate) cements are other means of chemical anchorage but not preferred because some residue is left on the contacting surface of the skin and prosthesis, they are arduous to remove and release odor, which is irritating to the patient. On the contrary, pressure sensitive tape is widely used because of its ease of application, easy removal, and renewability. However, it should be renewed timely as the tape loses its stickiness over time.(12)

Adhesives may interfere and modify the physical and optical properties of the materials used in fabrication of the maxillofacial prosthesis. Hence, the adhesive as well as the agent which is used to clean the adhesive residue on the skin and prosthesis should be selected meticulously. The factors to be considered include the type and composition of adhesive, adhesive bonding to the skin and facial

prosthetic material, biocompatibility of the adhesive, material used for fabrication of the prosthesis, host skin condition & quality, handling and shelf life of the adhesive.(13)

Adhesive is a cost effective option and is easy to manipulate and apply, hence is generally preferred in situations where the patient is not willing for surgical anchorage. But there are various shortcomings of this option as well, such as, some adhesives require solvents to clean once the prosthesis is removed by the patient, provides an unreliable retention especially against gravity, during sweating and tissue movement. According to a study conducted by Kiat-Amnuay et al, bond strength of the adhesive decreased during the course of the day which could be attributed to the increase in perspiration and body motion.(14) Apart from these, allergic reaction (contact dermatitis) is another disadvantage one encounters while using adhesive. Some adhesives may modify the optical properties of the maxillofacial prosthetic material and may alter the color of the prosthesis. Also, continuous use of adhesive leads to abrasion of the prosthesis edges. While it is easy to apply, but patients with poor dexterity may feel it challenging.(4,13–15)

The use of tissue protector in conjunct with adhesive is recommended to avoid the side effects and to increase the effectiveness of the adhesive. One such tissue protector is Skin-Prep protective dressing (Smith & Nephew, Inc, Largo, Fla.). It protects the skin from adhesive, trauma, abrasion, chafing and irritation by creating a physical, waterproof barrier that is nonirritating. Wilborn studied the effect of adhesive tape removal on skin protected by Skin-Prep protective dressing. The punch biopsies revealed reduced trauma in cases where the tissue protector was used.(16) Kiat-Amnuay et al also studied the reapplication effects of adhesive on the retention of maxillofacial prostheses. They concluded that applying a second coat of adhesive after an interval of 4 to 8 hours improves the retention of the silicone elastomeric strips.(15)

### **Surgical Anchorage**

The prognosis and patient satisfaction in cases with denture and other prosthesis for replacing missing teeth retained using intraoral implants, have resulted in their use in extra-oral regions to retain the maxillofacial prosthesis. Implants have been in use in dentistry since 1965 but in the year 1977 the first clinical trial on skin penetrating osseointegrated implants was conducted at Sahlgren's Hospital in Goteborg, Sweden. Specifically designed implants were placed in the mastoid region to support a bone conduction hearing aid. Later in January 13, 1995 the food and drug administration gave clearance to Nobel Biocare USA to market the Branemark. Maxillofacial implant system.

Extra oral implants differ from intra oral implants in their size and form. Unlike intra oral implants, extra oral implants are of shorter dimension (3–4 mm long and 5 mm in diameter) which is in accordance with the bone thickness on which these implants are to be placed. Some of them have wing extensions or are porous to enhance the mechanical stability and retentive efficiency.(4,17) Care must be taken while using these as they may cause bacterial growth, debris accumulation, and infection.[17,18]

Extra oral implants used in cases with facial deformities are orbital, auricular, zygomatic and nasal implants(Fig.4). Endosseous implant is an alternative anchorage system when there is limited retention, stability and support. These implants are used with other attachments such as bar & clip, magnets etc. to facilitate retention of the prosthesis.

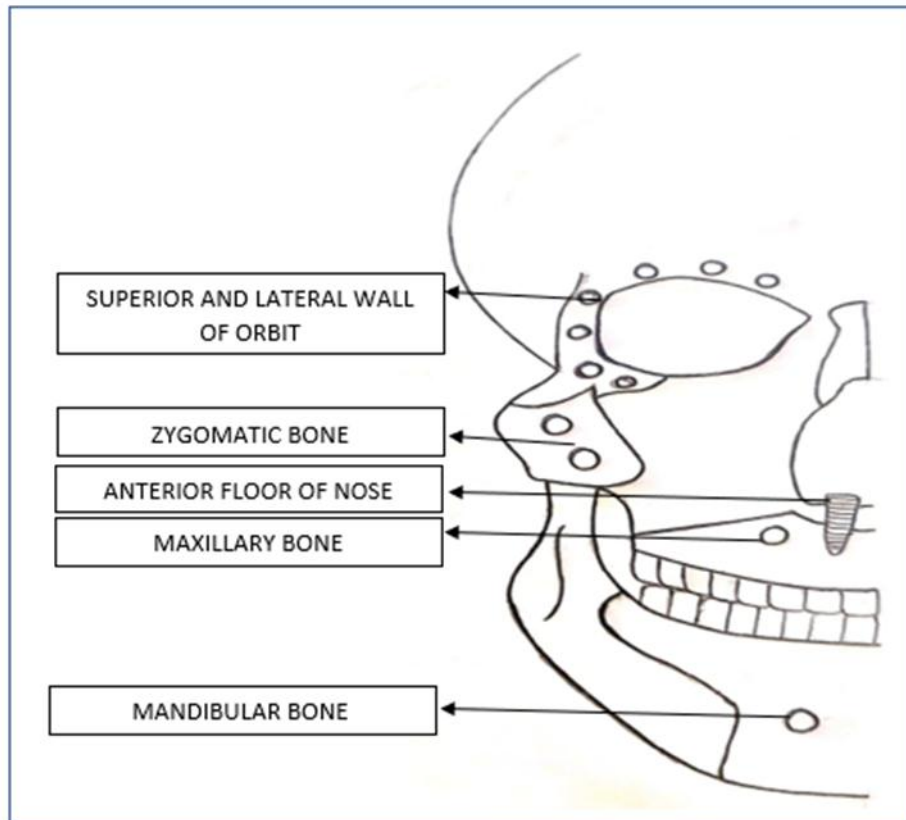
Zygomatic implants are mostly used in the rehabilitation of maxillary defects. Another possible option is to use pterygoid implants. Pterygoid implants are viable in cases where rehabilitation of the mid face defect is to be done post bilateral maxillectomy.(18) Nasal prosthesis is generally retained by tissue bar and clip over implants placed in maxillary region and anterior floor of nose. Zygomatic implant is another available option for the prosthetic reconstruction of the nose following rhinectomy.(19)

Aydin C et al in their study found 100% success rate of implants for retaining silicone auricular prosthesis.(20)The results may be attributed to the adequacy of the auricular bone for implant placement and stability. If inadequate, bone transplantation from iliac crest region is another way of improving the quality of bone for placement of extra-oral implants to support the auricular prosthesis.(21) Implants in conjunct with magnets may also be used to retain auricular prosthesis. A screw retained magnetic alloy casting is placed over the implant, which is inserted mostly in the temporal bone, to retain the acrylic resin magnet keeper which is further attached to the auricular prosthesis.(11)

The anatomy of the orbit dictates the inclination of the implants to be placed in that region. The orbital implants are implanted radially into the orbital boundary to provide adequate bone thickness for retention. The lateral walls are the choice of site for placement of implants as the bone is usually thick in that region, while placement of implants in the medial border is not recommended as the bone is inadequate and there is presence of lacrimal fossa. Hence axial loading of implants in orbital region is not possible. The implants used to retain ocular prosthesis can be divided into 2 groups:1) Integrated porous implants contain hydroxyapatite and encourage formation of fibrous tissue because of its porous structures. 2) Non Integrated implants - Not in direct mechanical contact to the eye prosthesis instead covered with a mesh like material that causes the muscles to bind. To retain the prosthesis 3-4 implants should be placed in the lateral wall or the upper side of the orbital wall so that the implant connection is hidden by the prosthesis.(22)

An implant is considered successful only if it is well osseointegrated. Radiation therapy for treating malignancies not only affects the soft tissues but also affects the quality of bone. Irradiation of 5000Gy or more obstructs the osseointegration of the implant. To compensate for the loss, patients should undergo hyperbaric oxygen therapy before going for implant placement to enhance the quality of the bone. (23) Another way of improving the quality and quantity of bone is the use of bone grafts. Autogenous bone grafts are generally transplanted from iliac crest, calvarium or anterior surface of the tibial plateau. Synthetic bone substitutes such as calcium sulfate hemihydrates in combination with porous ceramic hydroxyapatite granules and bone augmenting factors such as bone morphogenic protein BMP 2 and BMP 7 may also be incorporated.(24) Apart from the radiation

dose and the site, the time interval between the radiation therapy and implant placement is a crucial factor for the success of osteointegration of implant. A time interval of 6 months is considered beneficial as the tissues start to heal and regress to its original form.(23)



**FIG.4 – IMPLANT PLACEMENT REGION FOR RETENTION IN MAXILLOFACIAL PROSTHESES**

The longevity of an osseointegrated implant depends upon its stability and its capacity to withstand the stresses associated with supporting, retaining, and stabilizing prosthetic restorations. This is best offered by porous-surfaced implants and should be used in facial rehabilitation because it not only increases the implant stability and load bearing capacity but also shortens the healing time, thereby, requires a shorter period comparatively, between fixture installation and abutment connection.(21)

Patient satisfaction and compliance is found to be highest in cases with implant retained prosthesis. This is because comparatively larger prosthesis that rests on a movable tissue bed can be fabricated with promising retention. Also once the implants are osseointegrated, no tissue or skin reactions are encountered. Unlike adhesives, there is no change in the optical properties of the properties when

using implants as retentive aid. The superstructure placed over the implants is also not considered as foreign object by the patient. The rehabilitation of defect using implants not only results in successful reconstruction and acceptable aesthetic but also improves the quality of life of the patient.(25) However, an acceptable prognosis may only be achieved by comprehensive planning of the number, position, and orientation of the implants and an optimum integration between the prosthesis and implant.

### **Conclusion**

A maxillofacial prosthesis may be retained by various techniques. The prosthodontist should have knowledge about all the options so as to arrive at the best possible treatment plan. The quality and type of the adjacent tissues, the patient's expectations and socio-economic status of the patient give the dentist the idea of which retention system should be used. Thorough evaluation of the situation and careful judgment and treatment planning can give acceptable quality and longevity of maxillofacial prosthesis, thus improving the patient's quality of life.

### **References**

1. Dable R, Balaji P, Athavale S. Prosthetic rehabilitation of hemi-mandibulectomy patient. *J Indian Prosthodont Soc.* 2006;6:47-50.
2. Wilkes GH, Wolfaardt JF, Dent M. Osseointegrated alloplastic versus autogenous ear reconstruction: Criteria for treatment selection. *Plast Reconstr Surg.* 1994;(5):967-79.
3. Miles BA, Sinn DP, Gion GG. Experience with cranial implant-based prosthetic reconstruction. *J Craniofac Surg.* 2006 Sep;17(5):889-97.
4. Cobain M V., Coto NP, Crivello JO, Lemos JB, Vieira LM, Pimentel ML, et al. Retention systems for extraoral maxillofacial prosthetic implants: a critical review. *Br J Oral Maxillofac Surg.* 2017 Oct;55(8):763-769.
5. Ferro KJ, Morgano SM, Carl CF, Freilich MA, Guckes AD, Knoernschild KL, et al. THE GLOSSARY OF PROSTHODONTIC TERMS Ninth Edition Editorial Staff Glossary of Prosthodontic Terms Committee of the Academy of Prosthodontics. *J Prosthet Dent.* 2017 May;117(5S):e1-e105.
6. Kanathila H, Pangi A. THE CHANGING CONCEPTS IN THE RETENTION OF MAXILLOFACIAL PROSTHESIS FROM PAST TO PRESENT- A REVIEW. *J Evol Med Dent Sci.* 2017;6(84):5879-5883
7. Warner R, Pittard S. Magnets. In: *New Developments in NMR.* 2016.
8. Karakoca S, Ersu B. Attaching a midfacial prosthesis to eyeglass frames using a precision attachment. *J Prosthet Dent.* 2009 Oct;102(4):264-5.
9. Etienne OM, Taddei CA. Use of bar-clip attachments to enhance the retention of a maxillofacial prosthetic obturator: A clinical report. *J Oral Rehabil.* 2004 Jun;31(6):618-21.
10. Yeshwante B, Patil SJ, Baig N. Retentive aids used in maxillofacial prosthesis. *Int J Comput.* 2014;5(2):12-20.
11. Gurjar R, Kumar SM, Rao H, et al. Retentive aids in maxillofacial prosthodontics - a review. *J Contemp Dent.* 2011;2(3):84-8.
12. Diken AA, Saglam SA, Bulut AC. Retention systems used in maxillofacial prostheses: A review. *Niger J Clin Pract.* 2019 Dec;22(12):1629-1634.

13. Karatas MÖ, Özdemir D, Azak AN, Evlioğlu G. Adhesives in maxillofacial prosthesis. *İÜ Diş Hek Fak Derg* 2005;39:1-2.
14. Kiat-Amnuay S, Gettleman L, Khan Z, Goldsmith LJ. Effect of adhesive retention on maxillofacial prostheses. Part I: Skin dressings and solvent removers. *J Prosthet Dent*. 2000; 84(3):335-340.
15. Kiat-Amnuay S, Gettleman L, Goldsmith LJ. Effect of multi-adhesive layering on retention of extraoral maxillofacial silicone prostheses in vivo. *J Prosthet Dent*. 2004 Sep;92(3):294-8  
Wilborn W. The effects of removing adhesive tape from unprotected skin and from skin protected by Skin-Prep protective dressing [product literature]. Largo, Fla.: Smith & Nephew United, Inc; 1992.
16. Bidra AS, May GW, Tharp GE, Chambers MS. Pterygoid implants for maxillofacial rehabilitation of a patient with a bilateral maxillectomy defect. *J Oral Implantol*. 2013; 39(1):91-97.
17. Bowden JR, Flood TR, Downie IP. Zygomaticus implants for retention of nasal prostheses after rhinectomy. *Br J Oral Maxillofac Surg*. 2006 Feb;44(1):54-6.
18. Aydin C, Karakoca S, Yilmaz H, et al. Implant- retained auricular prostheses: an assessment of implant success and prosthetic complications. *Int J Prosthodont* 2008;21(3)241-4.
19. Dib LL, Oliveira JA, Neves RI, et al. Auricular rehabilitation by means of bone grafting from the iliac crest in combination with porous extraoral implants: a case report. *Clin Implant Dent Relat Res* 2007;9:228-232.
20. Yeshwante B, Choudhary N, Baig N. Ocular Prosthesis-A Review. *IOSR J Dent Med Sci Ver III*. 2015;14(4):63-7
21. Leonardi A, Buonaccorsi S, Pellacchia V, et al. Maxillofacial prosthetic rehabilitation using extraoral implants. *J Craniofac Surg* 2008; 19:398-405.
22. Elsalanty ME, Genecov DG. Bone grafts in Craniofacial Surgery. *Craniofacial Trauma Reconstr*. 2009; 2(3):125-134.
23. Cariati P, Solis JF, Perceval MP, et al. Reconstruction of mid-facial defects using facial prostheses supported by dental implants. *J Aesthet & Reconstr Surg* 2016;2(2):14.