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IP Annals of Prosthodontics and Restorative Dentistry

Journal homepage: https://www.aprd.in/

Review Article

Maxillofacial prosthetic rehabilitation using different retention systems: A review

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ARTICLE INFO

Article history:
Received 23-07-2022
Accepted 23-08-2022
Available online 30-09-2022

Keywords:
Maxillofacial prosthesis
Retention
Adhesives
Magnets
Implants
Osseointegration

ABSTRACT

Maxillofacial abnormalities are the most deleterious to a person's self-esteem and quality of life. Restoration of speech, deglutition, and masticatory functions as well as achieving a normal orofacial appearance are the main objectives of rehabilitation of maxillofacial defects. Any prosthesis can be held in place by anatomical, mechanical, chemical, or surgical anchorage, depending on the clinical scenario. Various methods of retention have evolved over a period of time. Osseointegrated implants have been employed to enhance the retention of facial prosthesis, in the last 20 years. The prosthodontist should be familiar with all the available options, to opt for the appropriate retentive method, while planning for the prosthetic rehabilitation for the patient. In all cases of maxillofacial deformities, optimal outcomes could be a challenging task to accomplish, but careful evaluation, clinical decision-making, and planning can result in prosthesis of acceptable quality that might enhance the patient's quality of life.

1. Introduction

Body abnormalities or deformities can affect a person's overall appearance and functionality, making it difficult for the sufferer to live a normal life. Moreover, extensive surgeries used to treat patients with trauma or malignancies can have a negative impact on the appearance, function and mental health of the patient. They eventually separate themselves from society as a result of this. Maxillofacial abnormalities are the most deleterious to a person's self-esteem and quality of life. Dieffenbach, a German surgeon, once said that "at the sight of whom all men turn in disgust and abhorrence and at whose presence children cry and dogs bark" perfectly encapsulates this.[1,2]

Restoration of speech, deglutition, and masticatory functions as well as achieving a normal orofacial appearance are the main objectives of rehabilitation of maxillofacial defects.The outcome and the type of prosthesis primarily depend on the size, site, and the extent of the defect, age and the expectations of the patient as well as the cost of the prosthesis. The quality of patient's life is improved with the rehabilitation of the lost or missing structure with a suitable prosthesis, thus creating an illusion.The current Glossary of Prosthodontic Terms defines maxillofacial prosthetics as "the branch of Prosthodontics concerned with the restoration and/or replacement of the stomatognathic (jaws) and craniofacial (facial) structures with prostheses that may or may not be removed on a regular or elective basis".[3]

Official records state that Ambroise Pare, a French surgeon, created the first facial prosthesis in history. Throughout World War I, advancements in facial prosthetics continued to rise. Plastic, methyl methacrylate, glass, and silica gradually replaced the most used vulcanite material up until the 1930s. Prosthetics have become aesthetically and functionally more successful, since the introduction of silicone for facial prostheses in 1946.[4]

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https://doi.org/10.18231/j.aprd.2022.029

Any prosthesis can be held in place by anatomical, mechanical, chemical, or surgical anchorage, depending on the clinical scenario. The prosthodontist should be familiar with all retention options in order to choose the best one for each case. After all, it is up to them to design an acceptable and long-lasting prosthetic rehabilitation.[2]

Over the past few years, there have been notable improvements in both the techniques and materials utilised to retain maxillofacial prostheses. Osseo integrated implants have been employed to enhance the grip and retention of facial prosthesis, in the last 20 years. The intraoral or extraoral craniofacial regions have both adopted the use of implants for retention. The following systems are offered with implants: 1) the bar and clip system, 2) magnets, and 3) the mushroom and ball retention system.[4]

2. Classification of Maxillofacial P rosthesis[1]

Maxillofacial Prosthesis can be classified as:

1. Intraoral
2. Extraoral
3. Combination

2.1. Intraoral includes

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 or Stents- Surgical Splints, Bite Splints, TMJ appliance.

2.2. Extraoral includes

1. Orbital
2. Nasal
3. Auricular
4. Mid-facial

2.3. Combination includes

1. Orbito-Maxillary
2. Naso-Maxillary

2.4. Intra oral prosthesis

2.4.1. Obturators

Obturators are a type of prosthesis that holds and closes an oral cavity defect or other type of body defect. Obturators are advised for both congenital and acquired defects. Congenital defects can be treated with simple plate-type prostheses to help with feeding or palatal lift prostheses. Surgical, interim or definitive obturators are recommended for acquired deformities.[1] Different intraoral prostheses include the following:

1. Obturators for defects that involve hard palate
   (a) Surgical obturator: A prosthesis that is made before the maxilla is resected.
   (b) Definitive obturator: definitive obturator is one that is fabricated, after the interim obturator has been worn for a period of 6-12weeks.
   (c) Obturators for defects that involve soft palate: Speech aid prosthesis/Pharyngeal obturator/Speech bulb prosthesis: When the soft palate is unable to effectively close against one or more pharyngeal walls during swallowing or speech sounds, the condition known as palatopharyngeal insufficiency results.These defects are best managed with the use of speech bulb prosthesis.
   (d) Meatus obturator: Schalit gave the first account of it in 1946. The nasal and oral structures are physiologically separated by it since it merely serves as a static obturation and is unrelated to surrounding muscular activity. Obturator only contributes to a minimal improvement in speech during cleft palate rehabilitation.
   (e) Palatal lift prosthesis: The palatal lift prosthesis (PLP) is often employed to manage soft palate dysfunction. While the palatal component of the PLP is firmly held in place by the teeth, the palatopharyngeal section physically lifts the soft palate in dentulous patients. Hence, it must incorporate a moveable palatopharyngeal portion in the edentulous patient.
2. Prostheses for mandibular continuity defects.
   (a) Mandibular resection prosthesis.
   (b) Guide flange prosthesis.
3. Prostheses for total/partial glossectomy.
   (a) Tongue prosthesis.
   (b) Palatal augmentation prosthesis.
4. Splints and Stents: often used for bite stabilization.
5. TMJ appliance: It also improves mouth opening while easing TMJ trismus. These are essentially referred to as "jaw exercisers."
6. Radiation stents: Apart from the operated site, they shield the areas from potentially hazardous gamma radiation.[1]

2.5. Modes of retention

Epithesis refers to prosthetic devices that replace soft tissues.[5]

Methods that are generally used for retaining maxillofacial prostheses can be categorized into four groups:

1. Anatomical, where the prosthesis is held in place by the retentive contours present at the site of deformity.
2. Chemical, where the prosthesis is attached with the help of adhesives.
3. Mechanical.
4. Implant, in which the facial prosthesis is held in place with the help of implant fixtures that are inserted into the bone.[6]

3. Anatomic Methods

Retention of maxillofacial prosthesis is possible by means of creating anatomic undercuts, which can be planned prior to or after surgical procedures. Similar to the undercut area in ocular defects, anatomical retention is established by making use of pre-existing anatomical structures. It can be intraoral or extraoral.[7]

3.1. Intraoral retention

It is achieved with the help of hard and soft tissues. It can be derived from teeth, bony tissues as well as mucosa. The palatal region, cheeks, retromolar area, remaining teeth, alveolar ridges, septum and anterior nasal aperture are few sites, where the anatomic undercuts can be usually seen.[8] Large alveolar ridge and high arched palate usually offer better retention, when compared to flat ridges and palate. The patient usually finds intraoral retentive aids to be very comfortable, making it easier for the patient to remove it. It is always advisable for the dentist to assess the surgical site to look for a tumour recurrence.

Retention can also be achieved by engaging the skin graft and scar band seen at the skin graft mucosal interface. This scar forms an undercut superiorly and a concavity inferiorly as it organises by contracting longitudinally like a purse-string. Extending the prosthesis anteriorly onto the nasal aperture and/or along the nasal surface of the soft palate can improve retention.[2]

3.2. Extraoral retention

Retention is usually derived from the hard as well as the soft tissues of maxillofacial and neck region. When there are severe undercuts, It can be more challenging when it comes to inserting and removing the prosthesis. Soft tissues are more mobile and less likely to resist displacement when a force is exerted, which further causes problems. The maxillary sinus, nasal cavity, and orbital regions are typically where soft tissue undercuts occur. These prostheses offer the benefits of being affordable, aesthetically pleasing, and easier to fabricate.[8]

Ocular prosthesis: Following its installation, the prosthesis usually takes few weeks for it to adapt to the socket. Sagging oflower eyelid is usually seen, as a result of the contraction of the upper eyelid and the weight of the ocular prosthesis. It is advised to use the anatomic undercuts along with the flexible conformer in the areas of defect. Conformer is a device that is fitted into the socket and holds The prosthesis is retained with the help of conformer, which is an appliance that is placed into the socket. In addition to this, it prevents the scar tissue contractors from distorting the socket bed, while maintaining the size of socket. Moreover, the competence of the eyelids and residual muscle movement is maintained.[5]

4. Chemical retention

Chemical retention is achieved with the use of adhesives, which are the most popular retentive aid in keeping the maxillofacial prosthesis in place. 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.”[1]

The adhesives used for maxillofacial prostheses should possess the following properties:

1. It should be non-toxic, non irritant and biocompatible.
2. It should be odourless and should dry quickly.
3. It should be able to retain the prosthesis in for atleast 12 hours daily.
4. It should enable easier removal without causing damage to the skin as well as the prosthesis.

An adhesive is selected based on certain criterias such as:

1. Biocompatibility.
2. Bond strength of the adhesive to the prosthesis as well as to the tissues, to which it is applied.
3. The design of the prosthesis.
4. Compositionandviscosity.
5. The type and the quality of the skin of the patient.
6. Handling, storage and shelf life.

These are usually available in the form of acrylic or silicone based adhesives, latex, spirit gum or water based adhesives

4.1. Acrylic resin adhesives

The main component of acrylic resin adhesives is acrylic resin, which is dispersed in an extremely watery solvent that, when it evaporates, leaves behind a rubber-like substance. The term ’Latex adhesives’ is currently used to describe the dispersion of synthetic resins and rubbers. The incorporation of the surfactant allows for more

controlled wetting and penetration of the adhesives. For these adhesives to work, the surface needs to be water permeable in order to dry the dispersion and form the bond.[6]

4.2. Silicone adhesive

These adhesives are room temperature vulcanizing (RTV) silicones which is dissolved in a solvent. They exhibit low water sorption and are resistant to moisture as well as weathering. They have the ability to endure the effects of sunshine, ozone, contact with several oils and chemicals, and bio-deterioration. Low adhesive strength is a drawback of this substance.

4.3. Pressure sensitive tapes

Facial prostheses are held in place with the help of these tapes, using only finger pressure without the need for warmth or solvents. They have a backing strip made of cloth, paper, film, foil or a laminate strip with a pressure–sensitive adhesive on both surfaces. When compared to acrylic resin adhesive, the adhesion of the Bi face tape to the skin is weaker, as a result of which, should be applied onto less flexible materials and for those defects that exhibit least movement.

4.4. Rubber based liquid adhesive

Natural rubber is produced from latex, which is harvested from the bark of rubber trees by a process called tapping. This instantly dissolves in an organic solvent like petroleum spirits or benzene, to form a natural rubber adhesive, which gels rapidly due to the atmospheric oxidation reaction. This sticky rubber becomes hard, vulcanized with sulphur. The rubber recovered from vulcanized scrap rubber, can be converted to a rubber cement, by dissolving it in naphtha, which is found to be more adhesive. Dry tack or the ability to create adhesion between two clean surfaces, is a distinguishing property of these natural rubber adhesives, which is advantageous to be used for contact adhesives or pressure sensitive adhesives. Bard Appliance Adhesive is an example.[6]

4.5. Combination of adhesives

The previously described adhesives can be used alone or together. In most clinical practices, only one adhesive system is used to simplify the instructions and procedures for the patient. However, the combination of one or more adhesives can serve to solve retention problems in various situations.

Some of the adhesives available are:

The adhesives that were mentioned above can be used either separately or in combination. For convenience, only one adhesive system is usually employed in clinical settings. But in some circumstances, combining one or more adhesives can help to address retention issues. The following are a few examples of adhesives:

1. Silastic MDX4-4210 medical grade elastomer.
2. Silastic adhesive silicone type A.
3. Secure 2 Medical Adhesive.
4. Epithane-3 Adhesive ES.
5. Skin-Prep protective dressing.
6. Uni-Solve adhesive remover.
7. Pros-Aide adhesive.
8. Epithane-3 adhesive.
9. Telesis Silicone Adhesive.
10. 3M bifaceis.
11. Hollister Medical Adhesive.[6]

Adhesives have the benefits of being economical, manageable, and simple to use. Adhesives are an option for people with maxillofacial defects who are unwilling to undergo implant surgery.[1]

This technique also has a number of drawbacks, including the need for solvents to clean some adhesives after the patient has removed the prosthesis and the unreliability of retention, particularly against gravity and during sweating and tissue movement. According to a study done by Kiat-Amnuay et al, the bond strength of the adhesive reduced over the day, which could be linked to the rise in perspiration and body movements. Other than these, another drawback of applying adhesive is allergic reaction (contact dermatitis). Some adhesives may affect the colour and optical qualities of the prosthesis. Moreover, prolonged use of adhesives can cause the edges of the prosthesis to abrade. Although it is simple to apply, patients with poor dexterity could find it difficult.

To reduce adverse effects and boost the adhesive's efficiency, tissue protector should be used in conjunction with adhesive. Skin-Prep protective dressing (Smith & Nephew, Inc, Largo, Fla.) is an example. By forming a physical, non-irritating barrier that is waterproof and impermeable, it shields the skin from trauma, abrasion, chafing, and irritation. The effect on skin with Skin-Prepprotectivedressing following the removal of adhesive tape was studied by Wilborn, in which the trauma was found to be minimal. Another study by Kiat-Amnuayetal was done to evaluate the retention of maxillofacial prosthesis after the reapplication of adhesive. They came to the conclusion that retention of the silicone elastomeric strips is enhanced when second coat of adhesive is applied after 4-8 hours of interval.[2]

5. Mechanical Retention

Mechanical means of retention was one of the earliest methods employed for the retention of facial prostheses. Ambrose Pare proposed the use of strings to retain a prosthetic nose on the face. Pare also claimed that a leather

or metal headband could be used to hold an artificial ear and an orbital prosthesis in place.

Different ways by which mechanical retention can be achieved are:[9]

1. Eye glasses and frames
2. Magnets
3. Cast clasps
4. Acrylic buttons
5. Retentive clips
6. Elastic and non elastic strap
7. Precision attachments

5.1. Eyeglass

Retention of nasal, ear or eye prosthesis is made possible with the use ofeyeglassframes that are specially designed. In order to prevent retention marks from being apparent, the use opaque eyeglass frame is advised.

5.2. Magnets

Retention of maxillofacial prosthesis is best achieved with the use of magnets. They are indicated in patients who have undergone maxillectomy as well as in patients with microstomia.[4]

Dental magnets are mostly made from two types of alloys:

1. Neodymium iron boron (Nd-Fe-B) reported to be the strongest magnet material available in the market.
2. RE alloy samarium cobalt (Sm-Co).

Samarium iron nitride is a more recent material that has shown impressive outcomes with higher degree of magnetization, and its ability to resist corrosion and temperature, in comparison to Nd-Fe-B type magnets.[2]

5.3. Cast clasps

A cast metal clasp that enters an undercut is the most typical way to hold an intraoral prosthesis in place. A clasp that has been carefully designed and made will offer retention as well as stability, splinting, bilateral bracing, and reciprocation. The successful outcome of the obturator prosthesis is most likely attributed to retainers, which are the crucial components. It not only aids in prosthesis retention, but also helps in facilitating favourable load distribution.

5.4. Acrylic buttons

These acrylic substructures, which fit into the area of defect, are a part of acrylic buttons retained facial prosthesis, and typically comprises of one or more acrylic projections in the form of mushrooms (buttons), over which the prosthesis will snap, in order to retain the prosthesis.

5.5. Retentive clips

Retention of the prosthesis has shown to be more with the use of these metallic or plastic clips that snap over the bar connecting to the implants in terms of breakaway retentive force.[4]

5.6. Elastic and non-elastic straps

Extraoral prostheses are retained with the help of these straps. Head bands are in use of Auricular prosthesis is held in place with headbands and buckles are used with non-elastic straps, to allow for adjustments. For retaining extensive maxillofacial prosthesis, a head cap is essential to gain support from orthodontic headgear assemblies including head cap and adjustable strap extensions.[2]

5.7. Precision attachment

Includes bar clips, telescopic crown and extra-coronal ball attachments[1]

6. Implants

Orbital, auricular, zygomatic and nasal implants are some of the extra oral implants commonly employed as a means of retention in patients with maxillofacial deformities. In cases with least retention, stability and support, an alternative would be to use endosseous implants.[2] In addition to this, they can be also employed in cases with developmental, congenital and traumatic deformities as well as in patients with complete or partial endentulism.[1]

The prosthesis is held in place with the conjunctive use of these implants with attachments like bar & clip, magnets etc. The use of zygomatic implants are advocated for rehabilitating maxillary defects.

An alternative option would be to use pterygoid implants. Pterygoid implants are an option when a bilateral maxillectomy is followed by mid face rehabilitation. Normally, tissue bars and clips are used over implants in the maxillary region and the anterior floor of the nose to hold the nasal prosthesis in place. Zygomatic implants are an additional alternative for prosthetically reconstructing the nose after rhinectomy.[2]

1. Anatomical: Anatomic undercuts can be used
2. Implants in maxillofacial prosthodontics
3. Computed tomography (CT) scans or other radiographic assessment of bone mass are essential. Planning of implant therapy is done with the help of CT scan. Bone volume and density are calculated using a software.
4. Classification of the areas of bone where the facial implants can be inserted, which was given by Jensen and his team and explained by Asaretal. are as follows:
   (a) ALFA sites: greater amount of bone is available in these areas (6mm or more) and the bone is able to

bear greater load. As a result, complex facial or dental prostheses can be retained. Common sites are the anterior maxillary regions, zygomatic arch, and zygoma.[10,11]

(b) Beta sites: These are found in the periorbital but also in the temporal, zygomatic, and anterior nasal fossa locations.4 mm of craniofacial implants can be inserted in 4-5 mm bone volumes. Common sites include periorbital, anteriornasalfossa, temporal and zygomatic areas

(c) Delta sites: As the margins are 3 mm or less in bone mass, it is suggested to use craniofacial implants of 3 mm or less. Common site include medial orbit, temporal and frontal bones, buttress, pyriform, zygomatic arch, and zygomaticofrontal process.[10,11]

Craniofacial and intraoral implant designs, implant screw designs, surface, shape and of the implant, the amount of stress transmitted from the implant to the bone, distribution of the load, integration at the interface of bone and implant, osseointegration and the implant stability are some the biomechanical factors to be considered while planning an implant for maxillofacial prostheses.[4]

6.1. Surgical approach for implant placement in maxillofacial prosthetics

They are of 2 types:

1. Single stage procedure.
2. Two stage procedure.

In single stage procedure, recovery screws are inserted followed by closure of incision made with wire sutures.The skin is then dressed with gauze soaked in ointment to protect it.

Two surgical procedures are carried out in two stage procedure involves two surgical procedures, in which the implant is inserted into the proposed area of craniofacial defect in the first surgery and the second stage surgery is performed following proper healing and osseo-integration.[4]

6.1.1. Implant retained auricular prosthesis

Keeping a distance of about 20 mm from the opening of auditory canal, implants are inserted 15mm apart in the mastoid region. Two implants are normally inserted. Ball clips, magnetic retentive cap systems, and bar and clip retentive mechanisms are employed.[1]

Auricular prostheses can also be held in place using implants along with magnets. For retention of acrylic resin magnet keeper, which is subsequently attached to the auricular prosthesis, a screw-retained magnetic alloy casting is installed over the implant, which is primarily inserted in the temporal bone.[2]

6.2. Implant retained eye prosthesis

6.2.1. Mode of retention

Retention methods include adhesive, straps, eyeglass frames, and implants. In the area of defect, anatomic undercuts and a flexible conformer must be used. Conformer will adapt to the socket and helps in retaining the prosthesis, while preserving the socket size. Moreover, it prevents the distortion of socket bed by the scar tissue contractures, simultaneously maintaining the competence of the eyelids and residual muscle movements.

6.2.2. Position of implants

Placement of implants can also be done in outer canthus or inner canthus as well as the superior orbital rim. Additional implant or two was frequently positioned in the inferior orbital rim or zygoma.[12]Care should be taken not to place the implant inclined facially.[1]

Usually the length of the implant used is 3-4 mm and for proper hygiene, a space of 10-12mm between the implants is important.

Healing takes about 6-8 months.

Implants employed in orbital prosthesis include:

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

Semi integrated (Allen implants)

Integrated (Cutler's implants) 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)[4]

6.3. Implant retained nasal prosthesis

Modes of retention: Adhesives, straps, eyeglass frames and implants

6.3.1. Implant position

Common sites include floor of the nose, piriform ridge or inferior orbital foramen and glabella. Implant fixtures of length 4mm or more are usually used and in cases where retention of both intraoral and extraoral prostheses are required, 7-10 mm is employed. These are known asbifunctional implants.

Healing takes about 6-8 months. Other forms of retentive aids include mini magnets and bar and clip.[4]

6.4. Implants in irradiated patients

Relative contraindications for implant surgery are those with osteoporosis, diabetes mellitus, and particularly irradiated patients. Implant osseointegration is disrupted when there is Irradiation of 5000Gy or more. Thus, the quality of the bone can be improved with hyperbaric oxygen therapy, prior to implant placement. Bone grafts can also be used to enhance the quality as well as the quantity of bone.[2] It is

recommended to wait for atleast 6 months to 1.5 year post radiation therapy, in order to limit the risk of harm to the irradiated tissue.

6.5. Rate of survival and complications associated with the placement of extraoral implants

According to various studies, the auricular prosthesis has the highest implant survival rate, followed by the nasal and orbital areas. Peri-implantitis is the most common complication that is seen associated with maintenance of hygiene surround the implant site.[12]

The stability and the ability of an implant that has been osseointegrated, to withstand the forces generated during retention, support and stabilization of prostheses, are the few factors that determine its durability. The use of porous-surfaced implants offer many of these advantages including faster healing and enhanced stability and load bearing capacity of the implant.

6.5.1. Advantages

1. In circumstances where an implant retained prosthesis is used, patient satisfaction and compliance are reported to be highest. This is due to the fact that relatively larger prostheses with promising retention can be made and placed on a moveable tissue bed.
2. There have been no skin or tissue reactions experienced, once the implants have osseointegrated.
3. With the use of implants as means of retention, unlike adhesives, the optical properties of the prostheses are not altered.
4. The superstructure on the implants is not regarded as a foreign object by the patient.
5. The reconstruction of defect is successful and aesthetic is enhanced, with the use of implants as retentive aids, thus improving patient's quality of life.
6. However, thenumber and position oftheimplants as well as adequate integration between the implant and the prosthesis has to be carefully planned for a successful outcome.[2]

7. Conclusion

Maxillofacial deformity leaves a psychological and physical scar on the patient. Although the entire process of designing a maxillofacial prosthesis, that is almost similar to the original tissues is complex and challenging, the patient becomes more confident with the resultant prosthesis. The level of comfort of prosthesis is determined by how well it is retained. Various methods of retention have evolved over a period of time. The prosthodontist should be familiar with all the available options, to opt for the appropriate retentive method, while planning for the prosthetic rehabilitation for the patient. In all cases of maxillofacial deformities, optimal outcomes could be a challenging task to accomplish, but careful evaluation, clinical decision-making, and planning can result in prosthesis of acceptable quality that might enhance the patient's quality of life.

8. Source of Funding

None.

9. Conflict of Interest

None.

References

1. Sarkar S, Saha S, Giri TK, Ghosh R, Mukherjee S. Retention in maxillofacial prostheses: The ultimate challenge. *J Orofacial Rehabil*. 2022;2(1):41–54.
2. Nichlani G, Mittal DA, Joshi M, Ghadage M, Kadam N, Kamble SS, et al. Retention in Maxillofacial Prostheses: A Literature Review. *Int J Health Sci*. 2022;6(S2):2151–63. doi:10.53730/ijhs.v6nS2.5442.
3. Santhi B, Rao BL, Satyanarayana TSV, Padmini D, Bhargavi B, Kumar CS, et al. Retention In Maxillofacial Prosthetics: A Literature Review. *Global J Res Anal*. 2022;11(2):124–6.
4. Nazar SA, Nair VV, Kumar H, Ravichandran R. Retention in maxillofacial prosthetics: A review. *Int J Appl Dent Sci*. 2021;7(2):568–73. doi:10.22271/oral.2021.v7.i2i.1265.
5. Saini R, Nagpal A, Thakur K, Saini R, Shrivastav R. Retentive aids in maxillofacial prosthesis: A review. *IP Ann Prosthodont Restor Dent*. 2019;5(1):1–4. doi:10.18231/j.aprd.2019.001.
6. Kotewar S, Dr N, Baig D, Jadhav DRV, Kasat. Method Of Retentive For Maxillofacial Prosthesis : A Review. *Int J Creative Res Thoughts (IJCRT)*. 2020;8(6):2893–915.
7. Karthikeyan I, Khatree M, Gaddale R. A review on prosthetic rehabilitation of maxillofacial region. *J Sci Dent*. 2016;6(1):6–12.
8. Gurjar R, Kumar MVS, Rao H, Sharma A, Bhansali S. Retentive Aids in Maxillofacial Prosthodontics - A Review. *IJCD*. 2011;2(3):84–8.
9. Kanathila H, Pangi A. The changing concepts in the retention of maxillofacial prosthesis from past to present- a review. *J Evolution Med Dent Sci*. 2017;6(84):5879–83.
10. Retenr S, Kumar S, Shankar R, Krishna H, Kumar S. Extra oral implants as retentive aids for maxillofacial prosthesis: A review. *J Appl Dent Med Sci*. 2016;2(2):135–42.
11. Türksayar AD, Saglam SA, Bulut AC. Retention systems used in maxillofacial prostheses: A review. *Niger J Clin Pract*. 2019;22(12):1629–34. doi:10.4103/njcp.njcp_92_19.
12. Visser A, Raghoebar GM, Van Oort RP, Vissink A. Fate of Implant-Retained Craniofacial Prostheses: Life Span and Aftercare. *Int J Oral Maxillofac Implants*. 2008;23(1):89–98.

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Cite this article: Raghavan R, Shajahan PA, Mathew RS. Maxillofacial prosthetic rehabilitation using different retention systems: A review. *IP Ann Prosthodont Restor Dent* 2022;8(3):143-149.