Annals of R.S.C.B., ISSN:1583-6258, Vol. 26, Issue 1, 2022, Pages. 1451- 1458
Received 08 November 2021; Accepted 15 December 2021.

Orofacial Rehabilitation with Implants: A Boon for Retention

1. Dr. Roma Goswami, Head of Department, Dept of Prosthodontics and Crown & Bridge, Subharti Dental College and Hospital, Meerut.
2. Dr. AviPahwa, Postgraduate student, Dept of Prosthodontics and Crown & Bridge, Subharti Dental College and Hospital, Meerut.
3. Dr. Deepesh Saxena, Professor, Dept of Prosthodontics and Crown & Bridge, Subharti Dental College and Hospital, Meerut.
4. Dr. Arushi Chopra, Postgraduate student, Dept of Prosthodontics and Crown & Bridge, Subharti Dental College and Hospital, Meerut

Abstract: Maxillofacial prosthesis are useful in the rehabilitation of patients who have had ablative surgery, have a congenital abnormality, or have been injured. These patients' physical and mental health necessitates good organisation and coordination among the health professionals who are involved in their care. Osseointegrated implant rehabilitation is the first true hope for individuals with such malformations to enhance their quality of life. Using the introduction of current silicones and bone anchorage, the rehabilitation of extra oral defects with implantmaintained prosthesis became more essential. Following Branemark's development of the osseointegration idea of retention, intraoral endosseous implants have become the gold standard, with several studies proving its effectiveness, safety, and predictability. Implants have proven to increase retention, stability, and aesthetics while also lowering the issues associated with other retentive treatments. The key elements of extra-oral implantology in maxillofacial prosthesis are discussed in this article.

Keywords: Extraoral deformities, Osseointegration, implant, Maxillofacial prosthesis

Introduction: The area in and around the mouth is intimately linked to one's self-esteem. Individuals with missing eyes, nose, ears, or facial tissues may find it difficult to be socially acceptable and face psychological difficulties[1]. Surgery is a popular therapeutic option for facial deformities. Prosthetic care of face abnormalities is carried out using maxillofacial prostheses when surgical treatment is not indicated or evaluated as an option. Due to the lack of teeth, adequate mucosal undercuts, and the presence of movablevestibular and nasal mucosa, maintaining a prosthesis in patients with complete palatal abnormalities without alveolar support can be difficult. The existence of a means of securely attaching the artificial alternative to its right place without causing irritation to the tissues with which it comes into touch is critical to the success in rehabilitation of a prosthesis. When a prosthetic device, because of its anatomic placement, may be surrounding or fitted into some part of the normal structure close to the prosthesis, the problem of retention can be readily controlled. Implants have decreased the need for adhesives, overcoming the drawbacks of adhesive use while also simplifying cleaning processes and prolonging the life of prostheses[2]. The influence of the implants on the patients has resulted in their capacity to participate in society with confidence because their flaws are less obvious[3].

Discussion: In prosthodontics, retention has always been an issue. Prosthodontists have traditionally struggled with maxillofacial prosthesis retention. When utilising a facial prosthesis at workplace or in social environments, increased retention improves the patient's comfort and confidence.In the last several years, there have been significant advancements in the techniques and materials used for maxillofacial prosthesis retention. The various techniques of maxillofacial prosthesis retention are determined by the case requirements in terms of defect location and size, resilience, possible neighbouring tissue undercut, weight of

Annals of R.S.C.B., ISSN:1583-6258, Vol. 26, Issue 1, 2022, Pages. 1451- 1458
Received 08 November 2021; Accepted 15 December 2021.

the constructed maxillofacial prosthesis, and anatomical features such as undercuts and concavities.

Modes of retention[4]:

1. Adhesives: Skin tissue adhesives for facial prostheses include acrylic resin, latex, silicone, pressure sensitive tapes, spirit gum, and water-based adhesives. They are conveniently accessible, manipulateable, and applyable. However, routine removal can harm the external pigmentation, cause the margins to rip, and cause allergic or irritative reactions in some people.

2.

Eyeglasses, retentive clips, magnets, and acrylic buttons are all examples of mechanical retention. By using newly developed eyeglass frames for the patients, eyeglasses can be used as a feasible technique of keeping a nasal prosthesis. However, attaching a nasal prosthesis to eyeglass frames as a permanent fixation should be avoided because removing the glasses for whatever reason allows the prosthesis to be removed as well, which can be quite embarrassing. Magnet corrosion, their weight, and the necessity to repair them frequently are only a few of the difficulties encountered. In terms of breakaway retentive force, retentive clips have a higher retentive ability than magnets.

Implants: Implants have been used for the retention of dentures and other prosthetic substitutes for missing teeth, are now being used to retain extraoral structures. The implants' retention allows for the fabrication of massive maxillofacial prosthesis that rest on a moveable tissue bed. Osseointegration is a process that occurs with implants. Branemark defines osseointegration as "a direct bone attachment to an implant body that can offer a foundation for a prosthesis and has the ability to transmit occlusal forces directly to bone." Craniofacial implants help to keep the prosthesis in place and give great retention. Because of the reduced marginal degradation caused by daily application and removal of the prosthesis, the functional life of implant-retained prostheses is extended. Transcutaneous abutments are used to attach implant-retained craniofacial prosthesis to the implants. Despite the fact that these connections provide adequate retention, debris accumulation around the abutments is always a possibility. This condition can result in skin irritation around the abutments, microbial infection, patient pain, and eventual implant loss. In addition, the patient must make a major long-term commitment to attend frequent maintenance visits. Implant insertion necessitates a significant change in lifestyle and reduces the likelihood of eventual autogenous repair.

Multiple professions are involved in cranial osseointegration care, which is a step-by-step, protocol-driven process. For the sake of everyone, the osseointegration care process must be planned and effectively managed. Implant treatment and planning is a collaborative endeavour involving the work of a reconstructive surgeon, a prosthodontist, a dental technologist, an anaplastologist, and a dental assistant[6].

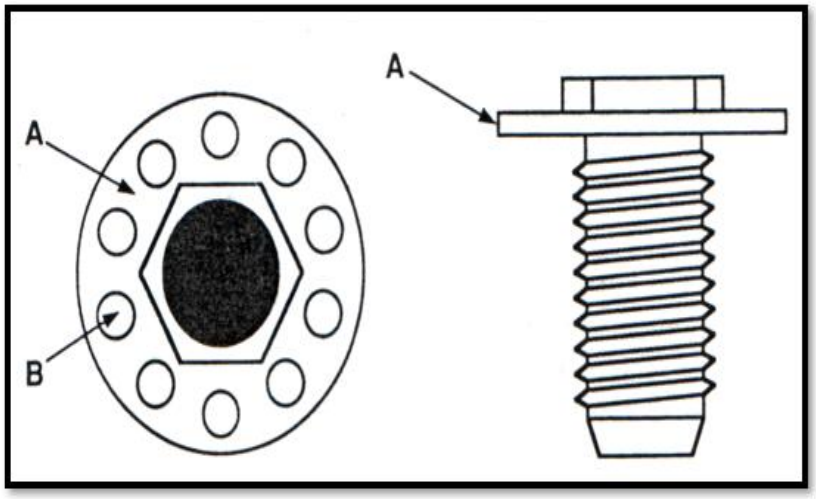
Implants in Maxillofacial Prosthesis: Biomechanical Considerations[7]:

Extraoral implants are short and feature a flange on the outside, ranging in length from 3mm to 5 mm. The flange increases the surface area of the implant that comes into contact with the bone. The flange's perforations give more surface area and mechanical stability.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 26, Issue 1, 2022, Pages. 1451- 1458
Received 08 November 2021; Accepted 15 December 2021.

Biomechanical Considerations in Maxillofacial Prosthesis[7]:

1. Design of craniofacial implant- Extraoral implants are 3mm to 5 mm long and feature a flange on the peripheral. The implant surface area in contact with the bone is increased by this flange. Perforations in the flange give greater surface area as well as mechanical stability[8] (Fig 1).



2. Implant to Bone Stress Transfer[9]- It is critical that neither the implant nor the bone be stressed beyond their long-term fatigue capability. Due to the close apposition of the bone to the implant at the Angstrom level, Osseo integrated implants meet these standards. An implant's surface roughness can also have a beneficial interlocking effect on a microscale, similar to screw threads.

3. Load distribution to multiple screws- When a prosthesis is supported by many screws, the combined structure becomes a unit in which the relative stiffness of the individual pieces, as well as the geometry of their arrangement, govern the distribution of any applied load.

4.Impact of implant stiffness on stress distribution- From a biomechanical aspect, the implant should be as rigid as possible. Choosing a larger diameter implant increased the rigidity. If the diameter of the implant is increased by 30%, the stiffness will increase fivefold, reducing stresses around the implant neck.

5. Impact of implant form on stress distribution- Implant Osseo integration in the entire bone region is important regardless of implant shape., will lead to stress concentrations in the cortical area during vertical and horizontal loading. Implants showing rational symmetry can be considered more favourable as it will lead to uniform stress distribution.

6. Impact of the implant surface on stress distribution- Threading, plasma flame spray coating, or surface roughening, as well as acid etching, should be used to increase the implant surface and lower compressive pressures.

Implants as a retentive aid have been used both for the extraoral and intraoral prosthesis.

Restoration of extraoral defects:
Surgical rehabilitation

Maxillofacial prosthesis surgical implant procedure There are two types of implant implantation procedures. They really are:

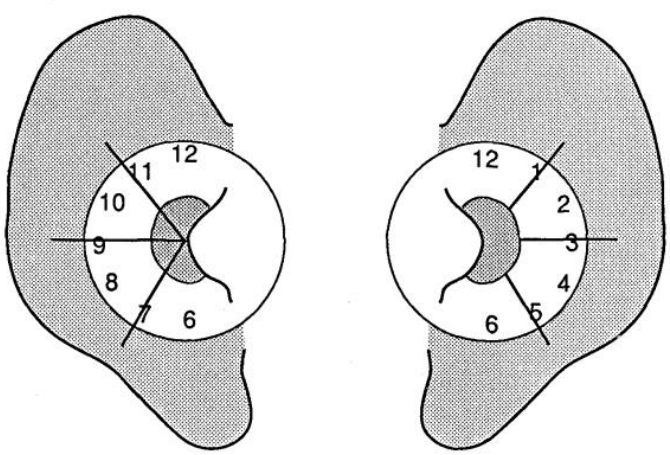
Annals of R.S.C.B., ISSN:1583-6258, Vol. 26, Issue 1, 2022, Pages. 1451- 1458
Received 08 November 2021; Accepted 15 December 2021.

1) Procedure with a single stage and

2) A two-stage technique is used.

In a single-stage procedure, recovery screws are implanted, and the incision is closed with wire sutures, then the skin is dressed with ointment-soaked gauze[10]. A two-stage surgery involves two surgical procedures.The initial step is to place the implant in the desired craniofacial defect area.The second stage operation is performed after a sufficient healing interval and osseo-integration has occurred[11].

Implant retained auricular prosthesis- Since the introduction of endosseous implants for use with bone conduction hearing aids in the 1970s, the use of osseointegrated implants to keep face prosthesis has gained in relevance. Acceptance, contribution to quality of life, and utilisation of bone-anchored auricular prostheses as replacement prostheses for developmental or acquired impairments could all play a role in their success. By boosting the retention and stability of the prosthesis, auricular implants boost the patient's confidence and sense of security. Furthermore, attachment mechanisms aid in the proper positioning of prostheses, making them easier to use for those with auricular abnormalities.The external ear canal can be used as a guide for implant placement in the auricle. The most cranial implant on the left side is between 1 and 2 o'clock, and the caudal implant is between 3:30 and 4:30, whereas the most cranial implant on the right side is between 1 and 2 o'clock. The right ear's most cranial implant is between 10 and 11 o'clock, whereas the caudal implant is between 7 and 8 o'clock[12] (Fig 2).



Implant placement: If a one-stage surgery is employed, a hole is produced immediately over the implant with a 4-mm disposable skin punch. If a two-stage operation is considered, the abutment connection is completed after the implants have osseointegrated, which takes 3 to 6 months.

Prosthetic rehabilitation: Compared to magnets, a bar retention using clips has a stronger retention and does not contain any ferrous components, making it MRI compatible. The space between the implants should be 15 to 20 mm in most cases. The bar design should be center-to-center, and the bar should be as close to the contours of the prosthesis as possible. The cantilever parts should be about 10 mm long.

Other retentive mechanisms: Commonly utilised systems include bar and clip, ball clips,

Annals of R.S.C.B., ISSN:1583-6258, Vol. 26, Issue 1, 2022, Pages. 1451- 1458
Received 08 November 2021; Accepted 15 December 2021.

and magnetic retentive cap systems. Recovery takes 3-4 months on average[13].

Implant retained orbital prosthesis: The rehabilitation of a patient who has endured psychological trauma as a result of the loss of an eye necessitates the use of a prosthesis that is both aesthetic and functional.
By filling the orbital volume and limiting the likelihood of socket constriction owing to scar tissue formation, orbital implants enable stable retention and enhanced postoperative cosmetic results. Adhesive retained prosthesis, on the other hand, is the recommended alternative in cases when bone density is low and bone development is incomplete. Magnetic attachment is chosen for implant-supported orbital prostheses because it takes up the least amount of space.

Implant implantation is possible on the superior, lateral, and inferior rims[14]. Implants can be put in the outer or inner canthus, as well as the superior orbital rim[15].

Implant placement: The implant should not be angled facially. The implant's length is normally 3-4 mm, and there should be a 10 - 12 mm gap between them to allow for cleanliness. Magnets are the most widely employed retentive mechanisms with implants. Adhesive, Straps, Spectacle frames, and Implants are some of the other retentive mechanisms[16]. In the deficient space, anatomic undercuts must be used in conjunction with a flexible conformer. The conformer will fit into the socket and retain the prosthesis in place while keeping the socket's size. Maintains eyelid competency and residual muscular activity while preventing scar tissue contractures from altering the socket bed[17].

Prosthetic rehabilitation: Magnetic retention or, alternatively, bar and clip retention are regularly used. Given the difficulties of insertion path, the most typical solution in the orbit is to use freestanding cantilevered abutments with magnet retention.

Implant retained nasal prosthesis: Despite recent developments in surgical reconstruction techniques, restoration of massive, full-thickness nose lesions following ablative oncological surgery remains a problem. The need to reconstruct the nose's complicated three-dimensional structure with a sufficient cover, lining, and support frequently necessitates tiered treatments and the availability of healthy local tissue. Contact dermatitis and allergic reactions have been linked to the use of tissue adhesives to keep implants in place, as well as loss of adhesion and dislodgement and ugly bulky prosthetic edges. A prosthesis that is implant-retained overcomes these restrictions and provides the patient with the security of a stable prosthetic. Implants are placed in the glabella, the floor of the nose, the piriform ridge, and the inferior orbital foramen. In his case study, McHutchion discussed how digital technology was integrated into the treatment of a patient with an osseointegrated implant-retained nasal prosthesis, and how it improved treatment efficiency[18].

Implant placement: Fixtures of 4 mm or longer are typically used. When supporting both intraoral and extraoral prostheses, a thickness of 7-10 mm is employed. These implants are known as bifunctional implants because they can support oral prosthesis on both the intraoral and extraoral ends.

Prosthetic rehabilitation: Mini magnets (primarily) and bar and clip retentive devices are used.

Intraoral defect restoration:Many issues such as lack of retention due to dislodging forces exerted by scarred postsurgical soft tissues, lack of bony base, lost structures of the posterior

Annals of R.S.C.B., ISSN:1583-6258, Vol. 26, Issue 1, 2022, Pages. 1451- 1458
Received 08 November 2021; Accepted 15 December 2021.

palatal seal area, multiple defect sites, and compromised medical status are encountered[19] in the rehabilitation of such large maxillofacial defects. The surgical site must be kept free of oral contamination, and all lines of contact must be shut down. A typical prosthesis places too much strain on auxiliary teeth in certain situations, producing periodontal disease. Cross arch stabilisation and resistance to vertical movement of the prosthesis are lost, especially for big and one-sided abnormalities. As a result, it's possible that important teeth for handling will be lost. A few implants placed at or around the problem site can help to reduce the defect's size.

Maxillary tumours are frequently treated with resection to slow disease development. The hard palate is frequently involved, and if the procedure is extensive, the infraorbital rim and orbital contents may also be included. Mandibular resections have been performed to treat both benign and malignant illness of the tongue, floor of mouth, and mandible[20]. Implant-supported obturators have presented to be a good alternative to surgical reconstruction of defects in cases of intact orbital floor and with no significant loss of soft tissuesowing to their shorter treatment period, lower costs and rather, extensive reconstructive surgery could be dispensed off**.** Buurman et al compared masticatory performance and patient reported eating ability in maxillectomy patients with implant-supported obturators and patients with surgically reconstructed maxillae, concluding that masticatory efficiency increased in patients with class ii maxillary defects when compared to surgical reconstruction[21.]

Implant site:The nature of the deficiency and the available bone sites define the number of implants and their location. For most edentulous total maxillectomy patients, the remnant anterior maxillary segment is the best place to put implants. If at least 10 mm of bone is available underneath the maxillary sinus, the edentulous posterior alveolar process may serve as an alternative to surgical reconstruction[22].

Obturators restoring defects of the soft palate and pharyngeal wall should be accurately positioned in the nasopharynx and effectively retained if speech and swallowing are to be restored[22]. Dental implants have a low success rate due to poor bone quality in the posterior maxilla. Various methods of bone augmentation have been documented, however the majority of them require two-step surgical procedures with high rates of resorption and failure. Zygomatic implants are an option for these people. Pterygoid implants have primarily been used in the rehabilitation of patients with atrophic maxilla or to avoid maxillary sinus augmentation procedures. Zygomatic implants use the basal craniofacial bone, whereas pterygoid implants have primarily been used in the rehabilitation of patients with atrophic maxilla[23.]

Recent advancements: Different recent directions for reconstruction patients include

- **Rapid prototyping[24]**-Traditional procedures for constructing maxillofacial prostheses include obtaining impressions, creating master casts, wax model sculpting, dewaxing, silicone packing, and colouring. It takes time and requires artistic skills. Converting 3-dimensional image data to a CAD/CAM system for mathematical processing, design simulation, and model production could potentially reduce the time and skill required for sculpting these prostheses for patients with defects, potentially opening up new possibilities for maxillofacial prosthodontics in the future. It is worth noting that this process would eliminate any flaws caused by human abilities, and it would save time when compared to previous methods. Gayatri Shankaran in her case report described the fabrication of a cranial prosthesis combined with an ocular prosthesis with rapid prototyping and stereolithography and concluded that the patient was highly satisfied with the prosthesis[26]
- **3D visual imaging[27]**-A multispectral data visualisation system's purpose is to give

medical practitioners with improved diagnosis capabilities. Using Virtual Reality imaging, planning, and control methodologies, several pioneering research groups have already demonstrated better clinical performance.CT scans and, more recently, cone-beam computed tomography (CBCT) scans produce volumetric images of a patient's facial anatomic structure. Using a series of computerised mathematical procedures, these data can be translated into 3D images of a patient's craniofacial bone and the soft tissue that covers it. The process of 3d modelling and personalised implants is fast evolving, thanks to advances in research and technology, and has created new channels for rehabilitation. The utilisation of 3D modelling and current breakthroughs in bespoke implants in cranial, skull base, zygomatic orbital, midface, mandible reconstruction, and orthognathic surgery has paved the way.Parthasarathy described a method for the fabrication of custom titanium mesh cranioplasty plates for large defects using rapid prototyped models. It was observed that the implants were well fitted. the surgical time was reduced by 60 percent. after eighteen months of post-operative follow-up, it was revealed that the mesh did not shrink or resorb. this method treated three patients with a 20 months of uneventful follow up[28].

Conclusion: Patients who are candidates for implant-supported face prosthesis must undergo a comprehensive evaluation. Their treatment options should not be limited to whether or not there is sufficient bone for implant implantation. Today's Osseointegrated craniofacial extraoral implant applications in maxillofacial reconstructive patients are fairly diverse. It will be much broader and more diverse in the future, limited only by practitioners' imagination, reconstructive surgeons' skills, reconstruction biology, and cost-cutting measures. The basic goal of implant-supported facial prostheses should be simplicity of design, long-term function, and low maintenance.

References

1. Pisulkar S, Pakhan AJ, Godbole SR. Psychological considerations in patients with maxillofacial defects: a literature review. Journal of School of Advanced Studies. 2018;1(2):57-60.
2. Beumer III JB, Curtis TA, Marunick MT. Maxillofacial Rehabilitation: Prosthodontic and Surgical Considerations. 2nd ed. St. Louis: IshiyakuEuromerica 1996: 377–449.
3. Funk GF, Arcuri MR, Frodel Jr JL. Functional dental rehabilitation of massive palatomaxillary defects: cases requiring free tissue transfer and osseointegrated implants. Head & Neck: Journal for the Sciences and Specialties of the Head and Neck. 1998 Jan;20(1):38-51.
4. Parel SM. Diminishing dependence on adhesives for retention of facial prostheses. The Journal of prosthetic dentistry. 1980 May 1;43(5):552-60
5. Branemark PI, Hansson BO, Adell R, Breine U, Lindstrom J, Hallen O et al. Osseo integrated implants in the treatment of edentulous jaw. Experience from a 10- year period. Scand J PlastReconstr Surg. 1977; 11:1-175
6. Branemark PI (1983). Osseointegration and its experimental background. J Prosthet Dent, 50(3), 399-40.
7. Nobrega AS, Santiago Jr JF, de Faria Almeida DA, Dos Santos DM, Pellizzer EP, Goiato MC. Irradiated patients and survival rate of dental implants: a systematic review and meta-analysis. The Journal of prosthetic dentistry. 2016 Dec 1;116(6):858-66.
8. Albrektsson T, Brånemark PI, Hansson HA, Lindström J. Osseointegrated titanium implants. Requirements for ensuring a long lasting, direct bone-to-implant anchorage in man. Acta Orthop Scand. 1981; 52:155-170.
9. R. P. Verma, Materials Today: Proceedings, 2020, 26, 3148– 3151.
10. Albrektsson T, Wennerberg. Oral implant surfaces: Part 1 - review focusing on topographic and chemical properties of different surfaces and in vivo responses to them. Int J Prosthodont, 2004, 544-

564
11. Drinias V, Granstrom G, Tjellstrom A. High age at the time of implant installation is correlated to increased loss of Osseo integrated implants in the temporal bone. Clin Oral Implants Rel Res, 2007\
12. Tjellstrom A, Rosenhall U, Lindstro¨m J, Halle´n O, Albrektsson A, Branemark PI et al. Five-year experience with skin penetrating bone-anchored implants in the temporal bone. Acta Otolaryngol (Stockh). 1983; 95:568- 575.
13. dos Santos DM, Goiato MC, Pesqueira AA, Bannwart LC, Rezende MC, Magro-Filho O, Moreno A. Prosthesis auricular with osseointegrated implants and quality of life. Journal of Craniofacial Surgery. 2010 Jan 1;21(1):94-6.
14. Wolfaardt J, Gehl G, Farmand M, Wilkes G. Indications and methods of care for aspects of extraoral osseointegration. International journal of oral and maxillofacial surgery. 2003 Apr 1;32(2):124-31.
15. Chen YY, Kuan CL, Wang YB. Implant occlusion: biomechanical considerations for implant-supported prostheses. J Dent Sci. 2008 Jun 1;3(2):65-74.
16. Rajani A, Mistry G, Sardar C, Kini A. Rekindle maxillofacial prosthesis with extra oral implants as retention system.
17. MentinSencimen, Aydin Gulses. Current Concepts in Plastic Surgery, Chapter 3, implant retained auricular prosthesis P49-68
18. McHutchion L, Kincade C, Wolfaardt J. A clinical study on the use of digital technology in the workflow for an osseointegrated implant-retained nasal prosthesis. The Journal of Prosthetic Dentistry, Vol. 121, No. 5, 858-862, May 1, 2019.
19. Nishimura RD, Roumanas E, Sugai T, Moy PK. Auricular prostheses and osseointegrated implants: UCLA experience. The Journal of prosthetic dentistry. 1995 Jun 1;73(6):553-8.
20. MentinSencimen, Aydin Gulses. Current Concepts in Plastic Surgery, Chapter 3, implant retained auricular prosthesis P49-68.
21. Buurman DJ, Speksnijder CM, de Groot RJ, Kessler P, Rieger JM. Mastication in maxillectomy patients: A comparison between reconstructed maxillae and implant supported obturators: A cross-sectional study. Journal of oral rehabilitation. 2020 Sep;47(9):1171-7
22. Visser A, Raghoebar GM, Van Oort RP, Vissink A. Fate of Implant-Retained Craniofacial Prostheses: Life Span and Aftercare. International Journal of Oral & Maxillofacial Implants 2008;23(1).
23. Dholam KP, Pusalkar HA, Yadav P, Bhirangi PP. Implant-retained orbital prosthesis. The Journal of Indian Prosthodontic Society. 2008 Jan 1;8(1):55.
24. Sabarigirinathan C. Implants in Maxillofacial Prosthesis; Journal of Science 2015;5(12):1131-1136.
25. Tania Saia, Mohit Kheur. Maxillofacial Prosthesis: All Insight into Their Retention and Support; International Journal of Dental Practice and Medical Sciences 2013;1(2).
26. Shankaran G, Deogade SC, Dhirawani R. Fabrication of a cranial prosthesis combined with an ocular prosthesis using rapid prototyping: a case report. Journal of Dentistry (Tehran, Iran). 2016 Jan;13(1):68
27. Boyes-Varley JG, Howes DG, Davidge-Pitts KD, Branemark I, McAlpine JA. A protocol for maxillary reconstruction following oncology resection using zygomatic implants. Int JProsthodont. 2007;20:521-531
28. Parthasarathy J, Parthiban JK. Rapid prototyping in custom fabrication of titanium mesh implants for large cranial defects. RAPID, May. 2008 May 20;20:22.