EXTRAORAL IMPLANT IN MAXILLOFACIAL PROSTHESIS: A REVIEW

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ABSTRACT

Conventional methods for retention of maxillofacial prostheses are generally associated with patient’s distress however with the evolution of osseointegrated implants in maxillofacial prosthetic and rehabilitative procedures has greatly changed. Retention, stability and esthetics are greatly improved in osseo integrated implants and have overcome the problems causes by other mode of retention. Extra oral implants are currently used in oncology and trauma patients with intraoral soft and hard tissue defects resulting in more natural appearing and functioning prosthesis. This articles reviews the uses of extra oral implant in various maxillofacial prosthesis and also outlays the advantages of extraoral implants as a mode of retention than other means of retention. It provides stability of the prostheses in hygienic and aesthetically pleasing way.

INTRODUCTION

Maxillofacial prosthetics is defined as that branch of Prosthodontics where the facial structure is replaced by artificial substitutes that may or may not be removed (Glossary of Prosthodontic Terms). It encompasses prosthetic rehabilitation of patients with oral, para oral, or facial defects, which may be acquired or congenital. Syndromes like Treacher Collins, Crouzon’s, and Pierre robinos are associated with facial deformities, palatal cleft and significant malformation external ear congenital abnormalities (Ozlem Kara,2015). Neoplasms and traumatic events can result in the loss of facial structures. Branemark, in 1975 postulated that a skin-penetrating implant should be possible based on the principles of dental implants (Jacobsson M,1992). Branemark and his coworkers, the first clinical trial on skin-penetrating osseo integrated implants the mastoid region was conducted in 1977 at Sahlgren's Hospital in Goteborg, Sweden, to support a bone conduction hearing aid (Branemark PI, 1983). Restoration of facial defects can be accomplished either surgically, prosthetically, or by using a combination of both methods. Prostheses retained by extra oral implant retained increased life span of the prosthesis and it also improves retention and stability.

It provides accurate placement of prosthesis and improves skin hygiene and patient comfort and decreases the daily maintenance (Sumita YI, 2012). Allergic skin reactions between the prosthesis and skin are eliminated and it also minimized problems with marginal integrity, placement misalignment, and prosthesis camouflage. This article emphasises the importance of extraoral implants in maxillofacial prosthesis.

Extra oral implants system

The classic Branemark system as a solitary screw implant, classic titanium fixtures, “solitary implants”. “grouped implants”. 1) Extraoral system with solitary implants: Branemark System, ITI Systems and others systems with solitary implants . 2) Extraoral systems with grouped implants: Epitec system, epiplating system (Philipp A,2009)

Biomechanical considerations implant retained prosthesis

Surface area, force and stress distribution are of significant concern in an implant retained prosthesis. The limiting factor for maxillofacial implants is the decrease in the bone thickness in the oral and maxillofacial region (Seals RR, 1989) (Parel SM,1991). Extraoral implants are short, 3 to 5 mm in length, and possess a peripheral flange to increase the implant surface area in contact with the bone. Perforations in the flange provide additional surface area and provide mechanical stabilization. (Sreejith karunakaran,2015). Following factors should be consider while planning for extraoral implant.

- Design of the implant
- Micromotion at the interface.
- Stress transfer from implants
- Load distribution to several screws
- Impact of implant stiffness on stress distribution
- Implant of the implant shape on stress distribution
- Impact of implant surface on stress distribution
- Clinical measurement of implant stability and osseointegration

Diagnosis and treatment planning: Comprehensive analysis for each patient is necessary as specific the patient. Previous prosthetic interventions area good indicator of success of the

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prosthesis. Size, shape, and location of the defect, residual and osseous structures needs to considered to evaluate to determine the potential of endosseous implant placement. Implant angulation or implant body or subsequent bar splint placement does not interfere with normal contours of the facial prosthesis. Facial moulage impressions are made for diagnostic purposes. Fabrication of diagnostic casts, wax trial prostheses are made after evaluation of presurgical photographs, presurgical casts, contralateral anatomy, and estimation of normal anatomic forms to assess potential areas for prosthesis retention.

**Implant retained prosthesis:** Surface area, force and stress distribution are of significant concern in an implant retained prosthesis. The limiting factor for maxillofacial implants is the decrease in the bone thickness in the oral and maxillofacial region. Extraoral implants are short, 3 to 5 mm in length, and possess a peripheral flange to increase the implant surface area in contact with the bone. Perforations in the flange provide additional surface area and provide mechanical stabilization.

**Surgical and prosthetic procedures:** Skin around the implant may be excised if it is hair bearing, and replaced with a split-thickness skin graft. Lack of hair follicles around the implant enhances the patient’s ability to keep the implant clean. When considering prosthesis for patients with missing facial structures one must evaluate subjective as well as objective factors. Bar construction with retentive clips provides good retention for large defects which have implants in the upper orbital rim to support. Ball attachments is used when defects as they occupy little space behind the prosthesis. Three implants creating a tripod are imperative to provide satisfactory retention and stability. Console attachments is preferred in cases of small closed defects where 2 implants are inserted in the upper rim and 1 exists in the lower orbital rim and the direction of the implants are at different angles to each other.

**Maxillofacial Implants in Various prosthesis**

**Orbital defect:** Replacement of the orbit and its contents is a predictable procedure. It is only when the orbital contents as well as contiguous facial structures are lost that implant retention becomes more critical. The use of multiple acrylic resins custom trays and polyvinyl siloxane impression material allowed the proper reproduction of all soft and hard tissue detail and the position of the implants. The technique provided for a vertical path of removal for the implant transfer copings in the superior and inferior border of the orbit. Implants are ideally placed superior and lateral aspect of the rim. In extensive orbital defects, it can be placed in zygoma/maxilla. For an orbital defect, the superior, lateral and inferior orbital rims were considered as possible sites for 3 or 4 mm implants. 3 or 4 implants were needed with the long axes of the implants toward the center of the orbit, to accommodate a one-piece retentive bar (Sailaja Chelakara R, 2016)\(^4\). Potential placement sites for implants as the fixation source for ocular epistheses, the mean length of bone was 7.8 mm, and the mean width was 8.3 mm.(Matsuura M,2002)\(^5\)

**Nasal defect:** Movement of the muscles of facial expression may either dislodge a nasal prosthesis in the inferior half of the nasal area and its can be counteracted bar clip assemblies. The implants for nasal prosthesis requires two implants, with one implant placed to the left and one to the right of the maxillary mid-line. Implants can be placed in the maxillary & frontal bones. For nasal prosthesis, the anterior surface of the maxilla just inferior to the nasal cavity offered sufficient thickness of bone and an optimal position for 4 mm implants. Longer implants, 6 mm or greater can also be used (Sailaja Chelakara R, 2016).\(^6\)

**Auricular defects:** Diagnostic wax patterns of the ear may prove more valuable in determining implant position. Prosthetic replacement may produce anatomically correct and aesthetically pleasing prosthesis that is often difficult to position correctly and successfully retain in place. (Rubenstein JE,1995)\(^7\)(Guo G,2008)\(^8\). Ideally placement of implants should involve the use of a surgical guide. When positioned on patients it should indicate most optimal locations for implant placement and these are usually associated with the anti-helix of the external ear in this area the exposed implant and retention system have the best opportunity to be hidden from the view.2-3 implants are sufficient for satisfactory retention.

(Sailaja Chelakara R, 2016)\(^9\) Ideal position of implants should be 18-20 mm from the center of the external auditory meatus. The distance between the fixtures should be at least 15 mm if possible depending on the anatomic situation fabricated an auricular prosthesis were 3-4 mm implants were used in the temporal bone. The abutments were joined by a bar constructed in a C-shaped design to improve the stability and retention of the prosthesis. The retentive clips or, magnets and a bar did not appear to compromise the contours of the prosthesis (Gary,1993)\(^10\). BHA uses the principle of osseointegration where the sound conduction is made through the bone directly to the internal ear by the placement of Ti implant & abutment in mastoid cortex. Maintenance of hair free area around the abutment is required. Abutment is loaded with the mechanoelectric transducer system after osseointegration.

**Mid-Face Defects:** It result from ablative procedures that are used to control malignancies of nasal & maxillary structures. Complexity of prosthetic rehabilitation increases As the size of the defect expands to involve the intraoral structures. Intraoral and extraoral prosthesis retained defects can be done together by the help of magnetic retention and implants (Karayazgan, Banu, 2007)\(^11\). This can enhance the retention of the facial prosthesis however stability is affected. It can be grouped under three main categories:

**Maxillary facial defect opposing edentulous mandible:** In this type of defect the biting force is reduced and is beneficial. The use of implants in conjunction with a maxillary obturator prosthesis improves the retention and stability of the prosthesis. An attempt to rehabilitate mandible with implants is contraindicated.

**Maxillary facial defect opposing bilateral posterior edentulous mandible:** In this situation is combined with the defect of anterior maxilla, significant stress is applied to the implants. When implants are placed in the posterior midface structures (zygoma, infraorbital rim, pterygoid plates) sufficient bone stock is present and it establishes a lever with the location of the fulcrum at the oral retention bar. This leads to superoinferior rotational movement of the maxillary prosthesis, which will produce gaping in the facial prosthesis. This can annoy the patient but it will release the stress on the implants. When the rotational movement is restricted it is more acceptable to the patient however it increases the stress to the implants.
Maxillary facial defect with natural posterior vertical stops

Vertical stops on natural molars and premolars represents the most desirable occlusal condition. Use of residual maxillary dentition for stabilizing the obturator and development of an occlusion that inhibits anterior contacts provides the best opportunity for restricting obturator generated movement of the facial prosthesis. Craniofacial site classification for the osseointegrated implants identifies all potential locations for implant placement in the midfacial region. (Ole T. Jensen, 1992) 16

Alpha sites: 6 mm or more in axial bone volume available. E.g. anterior maxilla through the nasal fossa & the zygoma; zygomatic arch and later al periorbital region.

Beta sites: 4-5 mm of bone available. E.g superior, lateral & inferolateral orbital rims, temporal bone and zygoma.

Delta sites: marginal sites with 3 mm or less of bone available. E.g. locations in temporal bone, pyriform rim, infraorbital rim, zygomatic buttress. (Sailaja Chelakara R, 2016) 10

Oral-Facial Defects: Many facial defects are associated directly or indirectly with maxillary defects of various configurations. Nasal and orbital defects often communicate directly with maxillary defects. Facial defects are rehabilitated for cosmetic and psychosocial reasons, oral defects require rehabilitation for physiologic reasons. Patient’s inability to speak, swallow, and chew dictates the need to restore a separation between the mouth and the nasal and paranasal structures. This can be done with an obturator prosthesis. (Sreejith karunakaran, 2015) 9

Osseointegration in the irradiated patient

Cancer patients are irradiated as part of cancer treatment and rehabilitated. Placement of implant in irradiated includes side effects like healing of soft tissue over the implants, rupture of major vessel, flap necrosis, fistulation, skin or mucosa infections, loss of implants denuded bones around implants and even osteoradionecrosis. 3 Hyperbaric oxygen increases angiogenesis and metabolism, this act as a growth factor and bone tissue renovation. HBO enables a better implant osseointegration in irradiated bones; protection against osteoradionecrosis; surgical complication reduction and healing increase in irradiated tissues. Jacobson et al had showed that osseointegration could function in previously irradiated patients even after high radiation doses. 3 Endosseous titanium implants could be successfully placed in previously irradiated bone to secure maxillofacial prostheses. Resulting the restorations more acceptable to function and appearance

Recent advancement

A new CAD system optimized preoperative surgical planning for orbital implant placement. The software may be applied in other craniofacial areas for Implant placement in the future. (Zhang X, 2007) 17 A new porous surfaced modifications in the extraoral implant enhanced bone to implant contact and greater long term stability. (Luciano Lauria Dib, 2004) 18

Survival Rate

Implant retained nasal prostheses implants success rates was 71.4% whereas the success rate in the anterior nasal floor was 88.15 % however the percentage of variation significant by anatomic site (Flood tr, 1998) 19. Patients who had not received radiation for elimination of malignant disease could be treated with reasonably good expectations for long term success. 8 John F. Wolfaardt (Wolfaardt JF, 1993) 20 considered that the mastoid region in non-irradiated patients to provide a high degree of predictable implant success. The success rates in radiated patients yielded far lower success rates, which varied with anatomic location. (Alexandra Kolontai, 2013) 21 The total success for osseointegrated skin-penetrating implant titanium implants used for anchoring facial prosthesis survival was 95.6% in the auricular defects and 67.2% in the orbital defects. Approximately 10% of the patients had some skin problems, whereas the remaining 90% had no or minimal problems. The possibility of achieving osseointegration around an orbital defect was not as good as in the mastoid process (Williams BH, 2007). 22

Dos Reis HB et al evaluated the success and survival rates of extraoral implants for the fixation of facial prostheses in three anatomical regions. The success rates and survival times were 95.9% and 8.6 years for the orbital, 92.9% and 2.8 years for the nasal, and 92% and 9.0 years for the auricular region, respectively. The success rate of implants in previously irradiated regions was 90.3% for the orbital and 100% for the auricular region. None of the patients was irradiated in the nasal region. (Dos Reis HB et al 2017) 23

Balik evaluated 24 patients with 64 implants (30 in auricular region of 13 patients, 24 in nasal region of 8 patients, and 10 in orbital region of 3 patients). He found that one patient among 13 patients (1/13) has lost his implants in the auricular area, 1 patient among 8 patients (1/8) lost his implants, and 1 patient among 3 patients (1/3) has lost all of her implants. Peri-implant soft tissue response was evaluated for a 60-month period and a total of 654 visits/sites recorded. Grade 0 (no irritation) was present in 72.8% of the visits/sites. Grade 1 (slight redness) was observed for 18.8%. Grade 2 (red and slightly moist tissue) was scored in 6.9%. Grade 3 (red and slightly moist tissue with granulation) was noted in 1.5% and grade 4 (infection) could not be found. He concluded that osseointegrated implants provide reasonable support and show successful results when used with maxillofacial prostheses (Balik, 2016) 24

Maintenance: Implant retained prostheses requires additional hygiene procedures to maintain them in good condition and to keep the implants and retentive elements free of debris and the surrounding skin healthy. 25 Hygiene procedure should be performed at least once daily and preferably at night before the patient goes to bed.

DISCUSSION

Conventional methods for retention of maxillofacial prostheses are generally associated with patient’s distress because such tools can easily result in prostheses debonding or detachment away from the skin depending on the intensity of their daily activities or involuntary movements. Implant retained prostheses has better retention and stability, easy, accuracy of prosthesis placement improved skin hygiene and patient comfort than adhesive retained. Elimination of allergic skin reactions and. Increased life span of the prosthesis 1Implant retained prostheses requires additional hygiene procedures to maintain them in good condition and to keep the implants and retentive elements free of debris and the surrounding skin healthy. 26 Prostheses should be removed for sleeping to allow soft tissue. Area should be wetted with a 50:50 mixture of hydrogen peroxide and water, carried with a cotton swab, to loosen any dried debris. A soft, nylons bristled brush and facial
soap may then be used to clean the area. A dental floss wrapped around the abutment and moved back and forth “shoe shining” motion was also considered effective measure of cleaning. Thus this articles discusses the importances of extra oral osseointegrated implants in maxillofacial prosthesis and however it overcomes the problems usually encountered by other means of retention. For instances with the use of tissue undercuts or attachment to the prosthesis by the patient's eyeglasses or dentures or medical-grade adhesives or tapes, dirt are collected resulting in unhygienic maintenance.

CONCLUSION

Bone anchored implant retention offers patients who wear facial prostheses increased security, especially with large defects or where the prosthesis rests on highly mobile tissues. Prosthesis failure due to lack of retention, the benefits obtained through the use of end osseous implants for prosthesis support and retention. Retention is a main concerns with maxillofacial prostheses increased security, especially with large dentures or medical aids for retention.

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