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Review Article

Implants and Magnets as Retentive Aids in Maxillofacial Region- A Review of Literature

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ABSTRACT

Patients with facial or intraoral defects will seek treatment to address the loss of comfort, function or natural appearance. It is maxillofacial prosthodontist's responsibility to provide prostheses that do not injure the remaining structures. As anatomy is altered, demands on residual structures increase. The field of maxillofacial prosthetics is embracing the rapid explosion of technology. The use of ossoeointegrated implants has broadened the treatment options. New technologies offer standardized quality, excellent precision of fit and outstanding biocompatibility, combined with adequate mechanical strength and provision for aesthetic design. Magnets in contact with saliva, magnets corrode and experience subsequent loss of magnetism. Encapsulating materials such as stainless steel is effective but susceptible to wear. Magnets therefore have a relatively short life, although more research is required to help the clinician determine their potential lifespan within the mouth. The development of samarium-iron-nitride may offer better resistance to corrosion, and its introduction into prosthodontics will be viewed with much enthusiasm.

Key words: Dental Implants, magnets, retentive, prosthesis.

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INTRODUCTION

Surgical reconstruction of head and neck structures may not be possible owing to size or location of the defect. The patient's medical condition or personal desires may also preclude reconstructive surgery. In such cases, prosthetic rehabilitation is indicated. Facial disfigurement can be the result of a congenital anomaly, trauma or tumor surgery. A Facial prosthesis restores normal anatomy and appearance, protects the tissues of a defect and provides great psychological benefits to the patient. The introduction of first facial prosthesis was by Ambrose Pare in the year 1501-1601.[1] The Dentist generally and Prosthodontist in particular has a major role in maxillofacial prosthetics because of his knowledge of anatomy, physiology and pathology as well as his skill and experience in using materials that are compatible with the patients remaining tissues. Only esthetics is the logical expectation in most extraoral defects and only function may be expected in most intraoral defects. Retention, Stability and support are the basic qualities that a prosthesis should poses. In maxillofacial rehabilitation, there is no definitive configuration of the defect anatomy, so without using any retentive aids, achieving retention is quite difficult and many times the prosthesis also requires auxillary retentive features. **Chalian VA. & Philips RW[2]** classified the maxillofacial prosthesis into two main groups extra-oral and intraoral prosthetic materials. The criteria for ideal materials maxillofacial prosthetics are as follows: extra-oral prosthesis **should** not irritate the surrounding tissues, yet it should be strong enough about the periphery to endure. **Seals RR, Cortes AL and Parel SM[3]** in their study described fabrication and support of the facial prosthesis retained by osseointegrated implants. **Cheng AC et al[4] used** resin-bonded retentive element as an option for restoration

of the labial defect. Surgical resection of the lips is a relatively rare procedure.When there is a combination of extra-oral and intraoral defects, another method of retention relies on connecting the extra-oral prosthesis with the intraoral prosthesis. In the present study we aim to describe the usefulness of implants and magnets as retentive aids for maxillofacial and oral reconstruction.

DIFFERENT TYPES OF RETENTIVE AIDS

Magnets

Magnets have been effectively used for retention, maintenance and stabilization of combined maxillofacial prosthesis, and they are effective for this purposes.[5]The main magnetic material used is the rare-earth material neodymium iron boron (Nd-Fe-B) which is the most powerful commercially available magnet material. Samarium iron nitride is a promising new candidate for permanent magnet applications because of its high resistance to demagnetization, high magnetization, and better resistance than Nd-Fe-B-type magnets to temperature and corrosion. But this material is still under development.[6] Magnetic materials are either "soft" or "hard", which depends on the material to retain its magnetic property even after removing the applied magnetic field. "Domain" is a small region in the magnetic material in which large portions of unpaired electrons creating tiny magnetic fields align together. On the application of a magnetic field, the domains align and thereby produce an overall magnetization in the specimen, which will reach a saturation point. Magnetically soft materials require only small fields to reach saturation, whereas magnetically hard materials require large fields to reach saturation. When the applied field is removed, a permanent magnet or hard material retains much of the magnetization or remanence.

Classification of magnets

BASED ON ALLOYS:

- Cobalt containing: Alnico, Alnico V, CO-Pt, Co5Sm
- Non-Cobalt containing:Nd-Fe-B, samarium iron nitride.

BASED ON ABILITY TO RETAIN MAGNETIC PROPERTIES:

- Soft (easy to magnetize or demagnetize): Pb-CoNi alloy, Pb-Co alloy, Pb-Co-Cr alloy
- Hard (retain magnetism permanently): Alnico alloy, Co-PT alloy, Co5Sm

BASED ON ARRANGEMENT OF THE POLES:

- Reversed pole
- Non-reversed pole

BASED ON TYPE OF MAGNETIC FIELD:

- Open Field
- Closed Field

Some advantages of using magnetic retention are lateral stresses on the anchored teeth would be minimized as magnets slide freely over the abutting surfaces, technical procedure involved is are simple and quick, materials required are relatively inexpensive and a constant retention force.[7] A fixed reference point is obtained and hence re orientation becomes easier. In case of fabrication of replacement prosthesis, repositioning is not required and no additional clinical time is required. In case of new moulage-ocular component is easily removed from silicone and reused.[8] Magnets in the coin form have more advantages in the maxillofacial prosthesis than the other forms. The size of the magnets depends on the size of the defect.[9]Retention by mini magnets is preferred for cases of orbital exenteration and nasal prostheses. Retention by ring and maxi magnet retention systems are preferred for ear prostheses. Magna caps have the advantage of improved hygiene due to easy access, easier patient placement, less direct stresses and elimination of requirement of parallel implant and abutment placement.[10]

Robinson used horseshoe magnets for the retention of an upper denture and obturator for a patient with a complete maxillectomy. In such a situation, it is very difficult to find any other means for retention than that provided by magnets.[11] Magnet technology is constantly improving and the problems faced in the past like size and corrosion have substantially been overcome. Magnets provide a useful method for attaching dental prosthesis to osseointegrated implants. A case report suggests a dramatic improvement in the quality of life of the patient by incorporating magnetic retention in the conventional implant supported obturator.[12] Creating facial prostheses to restore midfacial defects involves many challenges, including the achievement of proper retention and marginal fit. A case report presents a 65‐year‐old woman who was referred for restoration of her lost lip. A quick and simple method of positioning magnets with lip prosthesis attached to maxillary denture and thus esthetics and speech of the patient is restored. Use of retention magnets simplify the clinical and laboratory phase retains the denture and makes it stable and comfortable for the patient. The advent of magnets has enhanced the dental practitioner's capabilities with a remarkably improved potential for increasing prosthesis stability and preserving tissue.[13]Zeno et al. described combination lower lip prosthesis retained by two Micro‐ERA attachments as an intraoral component. Retentive elements beyond what conventional adhesives offer often are required. For this reason the prosthesis given to patient describe in this case report was retained with mechanical retention through magnet. [14] Birnbach and Herman described the use of intraoral and extraoral devices to rehabilitate orofacial cancer patients.[15] This prove to be successful as the prostheses could be easily inserted and removed, there was good retention, which gives a psychological advantage and confidence to patient to wear the prosthesis.

IMPLANTS

Alterations in maxillofacial anatomy result in diverse physical and emotional responses from the patient. Residual anatomy, in the form of teeth, residual ridges, or the contours of the defect, may provide retention, support, and stability of maxillofacial prostheses. Endosseous implants may be used as an alternative anchorage system for the diminished retention, stability and support. Efficacy of implant support has been established in the restoration of edentulous and partially edentulous jaws, and it appears that similar responses are possible in congenital, developmental and acquired maxillofacial defects. Prosthetic designs and strategic implant placement must anticipate the functional demands of the prosthesis while also recognizing the dislodging forces applied to it. With limited area of implant placement, there is a risk of lateral force application. Such forces may be implicated in bone and implant loss, and are clearly damaging to prosthetic retaining screws and components.

Conventional implants have been used in the residual elements of the of the zygoma on the defect side of total maxillectomy defects. However, there are important disadvantages to this technique. First, it is very difficult surgically to create a zone of immobile tissues around the implants. Second, the implants will exit the tissues high in the defect, making oral hygiene very difficult for the patient. Third, because the implants are generally positioned parallel to the plane of occlusion, they cannot be engaged aggressively. To minimise lateral torquing forces delivered to the implants, magnets may be used.

Implants in maxillary defects:

When considering the maxillary defects, implants are of great benefit in providing retention, but their use for support and stability may be risky. Endosseous implants in the grafted bone will allow the placement of a dental prosthesis that does not create deleterious compressive forces on the graft. If mandibular continuity is not re-established, the functional capacity of the patient is diminished. As patient's experience tooth loss, management of removable prostheses in conjunction with manipulation of the residual mandible may prove difficult. In this situation, endosseous implants is quite effective, since dental prostheses will gain retention, support and stability from the implants.

Surgical resection of tumor in the maxilla often results in the communication between the oral and the nasal cavity. These communication is to be closed if the patient must experience near-normal functions of phonation, deglutition and mastication. Obturator a prosthesis used since long, for such defects supported and retained by natural teeth. Loss of supporting natural teeth would lead to compromised support and retention. Relatively large obturator prosthesis, place substantial forces on the residual ridges. When Implants are used to retain the prosthesis, it is essential to consider the different forces. These prosthesestend to rotate in the defect area when occlusal load is exerted. Tissue bar designs must be implant assisted and must accommodate the multiple axes of rotation of the obturator prosthesis during function; otherwise the risk of implant overload, bone loss and subsequent loss of implants is significant. Endosseous implants should be of sufficient number, length and distribution to resist the anticipated complex forces of mastication and dislodgement.Implants can be placed at the time of tumor resection or at some appropriate time thereafter. The most common location for implant placement is anterior maxilla and maxillary tuberosity.[16]

In large defects or where only tuberosity remained single implants with O-ring attachments are used. The solitary O-ring permits multiple axes of rotation and so the implants were used almost entirely for retention rather than to provide support and stability.

Implants in mandibular discontinuity:

The major advantage of the bony reconstruction is that it re-establishes the facial forms and allows a framework for intraoral and extraoral structures to achieve adequate speech and swallowing. This is particularly critical for discontinuity defects that include anterior mandible.The patients with bone graft and are edentulous, generally require implants to retain their prosthesis. First step in preparing the graft for implants, is to remove the reconstruction plates and the tissues over the graft should be debunked and is replaced with a skin graft. The osteotomy sites in the grafts must heal before the plate can be removed and before the implants can be placed.[17]Fixed implant prostheses can be used in this population, but many patients have moderate to severe decrease in the oral opening due to accompanying scarring and fibrosis of soft tissues and muscles of mastication. These prostheses often require considerable vertical height, replacing teeth and alveolar process. In these instances, it is difficult for gaining access for the screw drivers that must pass through the occlusal surface to an implant 2 cm inferior to the occlusal surfaces.[17] A removable prosthesis allows control of the contours of the alveolar process needed to achieve adequate facial support and airflow during speech. A long lever arm is created on the short implants to replace the alveolus and dentition. Implant-retained prosthesis can gain support from the contra-lateral natural dentition and the remaining mandible. Due to limited mouth opening, patients may have hygiene problems that are accentuated with a fixed prosthesis. Given these difficulties, few patient situations have been acceptable for fixed-implant prosthesis.

CONCLUSION

Use of retention magnets simplify the clinical and laboratory phase retains the denture and makes it stable and comfortable for the patients. Magnets provide a useful method for attaching dental prostheses to either retained roots or osseointegrated implants. Magnetic technology is constantly improving: currently available magnets based on Nd-Fe-B are small (which allows them to be incorporated

into dentures) and have attractive forces that enable them to provide retention.Implant supported prosthesis are most sensitive to this factor though implants are one of the best possible means to achieve retention, stability and support particularly for extra oral prosthesis and in many situations. Patients with facial or intraoral defects will seek treatment to address the loss of comfort, function or natural appearance. Success of implants is based on precise preoperative planning of the implant placement and the restoration. Modern three-dimensional (3D) imaging techniques such as digital volume tomography allow the acquisition of radiologic data with very low levels of radiation and excellent image accuracy and allow the processing of these data with various types of soft -ware application.

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