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REVIEW AND SUCCESS RATE OF ENDOSSEOUS IMPLANTS IN MAXILLOFACIAL PROSTHESIS

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Abstract:

Aim: Endosseous osseointegrated implants have enormously increased the potential for reconstruction of the patients with varied soft and hard tissue maxillofacial defects. This review focuses on the survival rate of endosseous implants in maxillofacial prosthesis.

Background: In recent years, the endosseous implants for prosthetic rehabilitation of maxillofacial defects with acquired and congenital conditions have become more common practice with higher percentage of long-term success. Endosseous implants have been used for retention in the maxillofacial defects can offer excellent support and retention thereby eliminating the usage of adhesives.

Review results: Maximum number of systematic reviews has been compiled by different authors on the success rate of endosseous implants. However, endosseous osseointegrated implants can remain in service for a long term, and many techniques are reliable and predictable.

Conclusion: This article highlights the long-term outcomes of endosseous implants used to retain the various types of maxillofacial prosthesis.

Keywords: *Craniofacial defects, endosseous implants, maxillofacial prosthesis, osseointegration, maxillofacial defects.*

Introduction:

Alterations in maxillofacial morphology and anatomy may result in diverse physical and emotional responses of the patient.[1,2] The esthetic changes, loss of function and discomfort are usually the major sources of concern for the diverse responses of the patient. The human body is remarkably complex in nature. Each tissue in the human body is dependent upon another tissue. Without a proper controlling nervous system, the muscles cannot be able to perform the functional activities. Due to the complex nature of the maxillofacial region, any disruption in the components of this region can affect the remaining components. If the patients were treated with oral and maxillofacial defects, then the clinician can anticipate altered sensations which may be difficult to overcome with conventional prosthetic treatment methods. Retention of the maxillofacial prosthesis is depend upon the frictional contact which can result in irritation and alteration in the residual anatomy. Patients should be provided with prosthesis which avoids tissue irritation and makes more comfortable.

The maxillofacial prosthodontist must have the responsibility for fabrication of the prosthesis that provide function, esthetics and comfort. As the number of involved structures and the size of the defect increases, the task of the maxillofacial prosthodontist would be difficult.[3,4] Esthetically, there must be shade matching in relation to hue, chroma and value of the lost tissue which includes tissue texture, size, shape and contour. Placement of a maxillofacial prosthesis in an area where the focal point for most human contact, the face, serves to intervene the matching process even more. When the societal emphasis on physical appearance is considered, it is prudent that maxillofacial defect patients may be emotionally affected.

Factors that affect the success of prosthesis:

The success of prosthesis depends upon the remaining anatomic structures which provides support, retention and stability of a prosthesis. To achieve a favorable level of retention, remaining teeth, soft and hard tissues must be used to an optimal degree. It is very much important to extend impressions as much as possible without interfering with mobile tissue. Border molding is advocated whenever a prosthesis depends on tissue support either that the tissue is located within the defect or part of the remaining structures. In addition, close adaptation to the underlying tissue results in a thin fluid film between the prosthesis and the tissue. According to the Stanitz equation,[5] thinner the intervening fluid, more the prosthetic retention.

Support is the ability to resist displacement of the prosthesis towards the supporting structures. Remaining teeth, edentulous areas and the postsurgical maxillofacial defect are the supporting tissues for prosthesis and prosthetic loads are exerted through these tissues to the underlying supporting bone. As the tissue has minimal

capacity for displacement, more the surface area of tissue contact, lesser the displacement of the prosthesis towards the tissue. In such an instance, maximum peripheral extension combined with an exact adaptation to the remaining structures will provide the most favorable support for prosthesis.

Stability is the resistance to forces that are neither directed towards the tissue nor directed away from the tissue is provided by the remaining teeth, the residual ridges and the maxillofacial surgical site itself. It is the physical force that is called as most frequently in maxillofacial prosthetics because changes in the normal structures results in decreased potential for support and retention. As the majority of forces are not directed towards or away from the tissue, but are exerted at an angle to the tissue, so the stability was considered to be the most important factor with respect to function.

Atwood [6] described the chronic, progressive and persistent deterioration of the underlying structures relative to the use of complete dentures but this structural loss may be even more prudent when maxillofacial prosthesis are needed. Compensation for unfavorable anatomical support generally requires surgical alteration of the maxillofacial defect, alternative methods of external fixation, mechanical encroachment of tissue undercuts or the use of denture or skin adhesives. Although these methods have been very much beneficial when alternatives do not exist, none of them have been obviously predictable.[7-9]

Endosseous implants may be used to depict the concerns of decreased support, retention and stability. Implants are placed into the residual bone used for retention and stability of the prosthesis. Efficacy of implant support has been achieved in the restoration of the completely and partially edentulous jaws and it is also evident that similar responses are possible in congenital, developmental and acquired maxillofacial defects.[10 ,11] Use of endosseous implants in extraoral maxillofacial region has gained popularity, especially for the retention of maxillofacial auricular prosthesis and for bone anchored hearing aids.[12-14] Unfortunately, the responses of endosseous implants in maxillofacial defects can be variable. As seen in most maxillofacial prosthetic patients, changes in normal anatomy decreases the opportunities for the clinician to restore with endosseous implants. This situation occurs when supporting bone is lost due to surgical resection or when tissue is changed due to radiation therapy.

Since endosseous implants lacking clinical mobility, equalization of force and compensation for prosthesis displacement, use of these implants clinically may be difficult. Prosthetic designs and strategic implant placement must fulfill the functional demands of the prosthesis along with the dislodging forces applied to the prosthesis. With localized implant placement, there is a risk of lateral force application. Such forces have been compromised in bone loss, implant loss, and prosthetic retaining screw complications.[15-18]

When considering maxillary defects, implants are of great benefit in providing retention but their use for support and stability may be unpredictable. As the dislodging forces can be anticipated, the design of the prosthesis requires modification to resist these forces. The clinician should be aware of fracture strength of the implant components in order to design the prosthesis to provide retention which is below the level of component breakage and to disengage before breakage occurs. Unfortunately it is extremely difficult to anticipate the masticatory forces of the patients, especially when these forces may not be exerted in the long axis of the implant.[19,20] With extraoral maxillofacial defects, the support and stability of the prosthesis is incredible to overstress the implants. Similarly, retention of the extraoral maxillofacial prosthesis is limited to the resistance of gravitational forces.[21,22] Movement of the head, jaws and facial musculature must also be considered but none of these forces approach the levels of force encountered with the intraoral maxillofacial prosthesis. Therefore, extraoral maxillofacial prosthesis supported by endosseous implants should require minimum number of implants relative to prosthesis size when compared to intraoral maxillofacial prosthesis.

Auricular Prosthesis:

Prosthetic replacement of the missing or deformed auricle can provide extraordinary cosmetic results. Unfortunately, the presence of hair and the absence of anatomic undercuts often results in unfavorable adhesive retention of an auricular prosthesis. Endosseous implants specifically designed to be placed in the temporal bone permits adequate retention of auricular prosthesis. Patients also benefitted from the excellent seating of the prosthesis over the implants. The main complication of this prosthesis is difficult to maintain adequate hygiene around the skin penetrating the implants. Holgers [23] reported that the adverse tissue reactions in approximately 11% of the patients receiving these implants. Although soft tissue reactions rarely injure the long-term survival of the implants, it can create an uncomfortable situation which may require surgical intervention and also increased hygiene is essential.[24] Endosseous implants can also be used to secure bone conduction hearing aids. The bone anchored hearing aid has reported its efficacy in patients with intact middle ear components but with damaged external ear structures.[25,26]

Nasal Prosthesis:

Nasal resection is a highly complicated and needs variable treatment modalities. Extension of surgical margin of the nasal defect is different for every patient with respect to endosseous implants. Actually the total or near total resection of the nose creates difficulties for the maxillofacial prosthodontist. Prosthesis must be extended to surrounding areas to provide skin adhesive retention in order to avoid dislodgment of the prosthesis depends upon the level of physical activity of the patient. Rectification of the maxillofacial defect may be possible only when highly resilient materials are used. Success of the placement of the endosseous implant is very high on the superior surface of the maxilla and are used to retain the inferior aspect of the nasal prosthesis.[27] Whereas the bone quantity and quality in the glabellar region of the frontal bone is very low, implants at the superior aspect of a nasal defect usually cannot be placed. Because implant retention is possible at the inferior aspect of the prosthesis only, it is very crucial that the design of the retentive elements of the prosthesis must incorporate two planes of retention. Generally a "U" shaped retentive bar, connected to the implants at the base of the "U" will provide three points of retention, the two vertical struts and the horizontal crossbar.[27] Retentive clips are most often used to secure the nasal prosthesis.

Orbital prosthesis:

In smaller orbital defects, skin adhesive retention of the prosthesis may be satisfactory and the limited size of the orbital defect does not require implant placement without interference with the prosthesis margins.[28-30] As orbital defects increase in size, the need for implant support becomes higher. This need is very important when orbital defects are confluent with maxillofacial and nasal defects. In those situations the implants are generally located in the supraorbital rim or in the lateral rim of the residual orbit. Medial placement of the implants is not advisable due to decreased bone quantity and quality in this region and because of diminshed bone quality, the survival rates of the implant is compromised. [31,32]

Mandibular defects:

Mandibular discontinuity subsequent to tumor ablative surgery is effectively treated by immediate or delayed surgical reconstruction. The reconstructed mandible will be edentulous in the graft site. Endosseous implants in the grafted bone site will allow the placement of a dental prosthesis that does not create compressive forces on the graft.[33]

If mandibular continuity is not re-established the functional capacity of the patient is decreased. The mandible will be deviated towards the side of the resection because of adverse changes in the surgical site as well as absence of musculature on that side. This treatment group also shows a high level of functional variability but patients with good musculature control of the residual mandible generally perform better than patients who lack such control. As patient experiences tooth loss, management of removable prosthesis in conjunction with manipulation of the residual mandible may become difficult. In these situations, the use of endosseous implants is quite effective since dental prostheses will gain retention, support and stability from the implants. Force application to the implants must however be considered carefully.

The resected mandible which has not been reconstructed will have a deviated mouth opening and closing arc. The angle of mandibular closure will create forces on the implants which will not be in line with the long axis of the implants. Clinical experience with implant supported mandibular resection prosthesis has been shown promising results despite the concerns over the angular force application.

Hard and soft palate defects:

Surgical resection of tumor in the maxilla often results in oronasal communication. These communications must be closed if the patient has to experience normal functions of phonation, deglutition and mastication. Obturator supported and retained by the residual natural dentition should have a long history of successful clinical application. Loss of supporting teeth however results in compromise in prosthetic retention and support. Relatively large obturator prosthesis place substantial forces on the residual structures. When implants are used to retain such prosthesis it is essential that the different forces must be considered. These prosthesis will have a tendency to rotate into the defect area when occlusal loads are placed on the defect side as well as have the tendency to rotate out of the defect area as gravity exerts its pull on the prosthesis.[34] Although it is possible to gain support and retention within the defect, it may be less satisfactory.

Endosseous implants in residual maxilla must have sufficient number, length and distribution to resist the anticipated complex forces from mastication and dislodgment. The use of four implants in the intact maxilla has been suggested as the minimum number for the support of overdenture prosthesis.[35] The force distribution in the hard palate defect patient is likely to be less favorable than in the edentulous maxilla, consequently it is essential to place four or more implants when an obturator prosthesis is to be retained and supported by endosseous implants. If the implants are placed bilaterally, more acceptable forces will be exerted to the implants and there will be better retention and stability of the prosthesis.

Soft palate defects are normally associated with bilateral maxillary support. Occlusion is not an important criteria in soft palate defects, the primary function of implants is to retain the prosthesis and to support the occlusion. Before placement of an implant, direct and indirect retention of the prosthesis should be considered with broad distribution of implants providing more favorable long-term prognosis.

Discussion:

Unfavorable anatomical areas are generally compensated by surgical alteration of the defect, alternative technique for external fixation, mechanical engagement of undercut areas and other use of skin adhesives. Endosseous osseointegrated implants are used for restoration of function and esthetics in immunocompromised patients, where the conventional maxillofacial prosthesis cannot be implemented for many reasons.[36] Endosseous implants for oral and maxillofacial prosthesis serves the purpose for debilitated patient which requires careful patient selection, pre surgical evaluation of bone quality at the implant site provides a great success on long term basis. Appropriate treatment planning helps the maxillofacial prosthodontist to satisfy patients expectations based on the diagnosis and proper evaluation of the patients.

In developmental or acquired defect patients, the success of endosseous implants depends on the quality of bone, patient's acceptance and the use of replacement prosthesis.[37] In such above conditions, endosseous implants can be placed in close proximity to the pre-operatively planned positions. These positions must be satisfactory in relation to surgical and prosthetic point of view in order to maintain optimal implant retained prosthesis.[38,39]

Craniofacial endosseous implants offer patients with the maxillofacial defects a significantly improved quality of life. The favorable anatomic site into which the implant is placed has greater effect on the success rate which gives the surgeon to predict the survival of the prosthetic rehabilitation. Most of the endosseous implants to retain auricular prosthesis were placed in the temporal region, and congenital defects were the most common reason for maxillofacial prosthetic rehabilitation. Actually, auricular fixtures have a better prognosis than any other because of thin and immobile soft tissues facilitate hygiene procedures and has less inflammation.[27]

Some study reported that the implant treatment to restore orbital defects was not as reliable as in the mastoid region. Nishimura et al[31] depicted that the success rate of only 35% for orbital fixtures. Some authors also have suggested that survival of endosseous implant in the orbital region might be zone dependent, implants in the lateral orbital rim and buttress areas being more successful than in the superior orbital rim.[40] The greater rate of implant failure in the supra-orbital rim was mainly because of poor vascular supply in this region.[41] Nishimura et al[27] also suggested that adequate implant hygiene is very difficult to maintain in patients with mono ocular vision. Hence, the orbital rim may not possess adequate remodeling potential to support long term success rate of osseointegration. In general, fixtures in the temporal region are much more reliable than the fixtures placed in the orbital region.

A scientific study was conducted by Roos et al[42] in which some authors have stated the protocol for criteria to evaluate the success rate of an intraoral implants. Therefore the mentioned protocol could be modified and adopted to evaluate the quality of an extraoral implant rehabilitation.

One of the advantage of an osseointegrated endosseous implants is that it can be inserted in the grafted alveolar bone clefts. The quality and quantity of the grafted bone in the clefts may be suboptimal for the endosseous implants of sufficient dimensions. It is more advisable to place implants when the growth of maxilla is complete, once the permanent teeth is erupted. Implants placed in growing site of the bone is more apically anchored which will hinder the periodontal as well as prosthetic problems due to unfavorable crown root relationship.

The survival rate of intraoral and extraoral endosseous maxillofacial implants are "zone dependent" and less reliable. It is important to know about basic bone biology and development of new methods for reliable determination of bone quality.

Conclusion:

Patients with facial or oral defects will seek treatment to gain the loss of comfort, function or natural appearance. It is maxillofacial prosthodontist's responsibility to provide prosthesis that do not injure and disturb the remaining structures. As anatomy is altered in maxillofacial defects, demands for the anchorage is mainly depends on the residual structures. Endosseous implants may be used to provide retention, support and stability for maxillofacial prosthesis when the residual anatomy is no longer capable of fulfilling these functions. Osseointegrated implants are considered as the first choice of treatment because they provide the best retention for extraoral maxillofacial prosthesis.|

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