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Failures in Dental Implants: A Literature Review.

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ABSTRACT

Oral implantology is the science and discipline concerned with the diagnosis, design, insertion, restoration, and/or management of alloplastic or autogenous oral structure to restore the loss of contour, comfort, function, esthetic, speech, and/or health of the partially or completely edentulous patient. This article describes many failures that can occur when using implants to support restorations. Most of these failures can be prevented with proper patient selection and treatment planning.
Keywords: Alloplastic, osseointegration, cortical, restoration.

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INTRODUCTION

The introduction of implants in dentistry has reduced the limitations of conventional prosthetic modalities. The field of implantology has been transformed from an unpredictable art to a well grounded clinical science as a hyper specialized treatment modality. The predictability of this modality of treatment has transformed restorative options of the edentulous patients. As a result of continued research in treatment planning, implant designs, materials and techniques predictable success is now a reality for many challenging clinical situations.

Knowledge regarding the types of complications that can occur with the dental procedures is an important aspect of treatment planning, dentist patient communication and post treatment care. Because the design of clinical implant studies has not been standardized the reporting of clinical complications tends to vary. Implant success and failure are dynamic time-linked conditions, and require periodic reevaluation and, if needed, a salvation treatment. Implant failure is a static end-result condition that requires removal of a failed implant.

According to British dental journal [1] Implant failures are classified in to 4 groups,

1. Failure due to loss of integration 2.Positional failures 3.Soft tissue failures 4.Biomechanical failures.

Failure due to loss of integration

Adell et al [2,3] proposed that osseointegration could be lost because of surgical trauma, performation through the covering mucoperiosteum during healing, or repeated overloading with microfractures of the perifixtural bone at early stages. carter and Giori proposed a correlation between implant stability and oxygen tension. This concept states that with decreased oxygen tension, a shift in the osteogenic potential of bone-to cartilage or bone-to-fibrocartilage formation occurs, whereas loss of osseointegration occurring later during the course of treatment may be the result of either overloading or infection.

Local endogenous factors, which have previously been identified, are the quality of the jaw bone [4,5] and smoking. Several studies document the influence of the bone quality on implant success. Bone quality has been classified into four categories, depending on the degree of corticalization. High percentages of implant failures occur mainly in type four bone (little cortical bone combined with less mineralised cancellous bone and larger trabecular spaces).

Another point concerning “where to place what?” is that self-tapping implant placement is recommended in the anterior mandible (i.e., D1 bone) to avoid the increased trauma and heat generation that is produced by the bone tap, i.e. by using a self-tapped fixture, one step of drilling is reduced. However, Tanaka et al stated that self-tapping placement of the implant is indicated for soft bone, such as in the maxilla, based on the assumption that self-tapping implants could inflict surgical trauma in denser bone.

Positional failure

Meffert [6,7,9,10] (personal communication, 1998) proposed that the minimum space between an implant and a neighboring natural tooth should not be less than 3mm to avoid impairment of the blood supply of the periodontal ligament, whereas the minimum space between two adjacent implants should range from 3 mm to 7mm space should not be less than 5mm to avoid overheating with subsequent death of the bone cells. However, in cancellous bone (type III and IV), this movement may be as small as 3mm because of the nature of cancellous bone which will not be subjected to the danger of overheating as much as type I bone (R. Meffert, personal communication, 1998).

Placing the Implant in Immature Bone-Grafted Sites: Woven bone is the fastest, and first, type of bone to form around the implant interface. Conversely, lamellar bone is ideal for implant prosthetic support. The waiting period is mandatory for implant survival in cases of grafted bone sites (from 6-9 months).Keller et al reported an 85% survival of implants placed in grafted bone, whereas others reported 77% survival.

Length of the Implant: A great variety of implant lengths exist in a range between 7mm and 20mm, with the most widely used falling in the range between 10mm to 16mm as proposed by Misch[[8]. The long-term success of the implant is dependent on the amount of bone-implant contact. Therefore, the placement of a short implant where bone permits a longer length (i.e, an 8mm implant in a 12mm ridge), would result in higher stress concentration leading to subsequent failure of the implant. This is supported by the findings of Block et al, which suggested that shorter implants that have less bone contact and provide less mechanical support are lost more frequently when compared with longer implants.

Width of the Implant [11]: Misch stated that the primary criterion affecting the long-term survival of endosteal implants is the width of the available bone. It has been recommended that not less than 1mm of bone surrounding the fixture labially and lingually is mandatory for the long-term predictability of dental implant because it maintains enough bone thickness and blood supply. Rangert et al stated that a 4mm implant has a fatigue resistance that is approximately 30% higher than that of the 3.75mm implant.

Number of Implants: Misch [8] stated that the use of more implants decreases the number of pontics and the associated mechanics and strains on the prosthesis, and dissipates stresses more effectively to the bone structure (specially at the crest). It also increases the implant bone interface and improves the ability of the fixed restoration to withstand forces. Contrary to this, Smith et al correlated between the increased number of implants and the high failure rate caused by wound contamination that might occur because of the long operating time. Davidoff suggested the number of implants that should be used to support a given restoration and concluded a checklist that can help one to decide on the number of implants necessary to support a fixed restoration for partially edentulous patients. He based his selection on bone volume and density, occlusion and the opposing dentition, the available proprioception, and the implant surface area and distribution.

Soft tissue failures [12-14]:

Esposito et al [15,16] stated that the clinical signs of infection observed during the postoperative submerged period may lead to an increased risk of implant failure. Also, systemic conditions like diabetes mellitus, anemia, uremia, and jaundice play a role in wound healing impairment.

Hunt studied the effect of flap design on healing and osseointegration of dental implants. He found that there is no single flap design that seems optimal for implant surgery.Bacterial invasion of the peri-implant tissues results in soft tissue inflammatory changes and rapid bone loss. This condition was termed peri-implantitis and was defined by Meffert as the progressive loss of peri-implant bone as well as soft tissue inflammatory changes. Mombelli et al [17,18] have shown that Gram-negative rods, including bacteroides and fusobacterium ssp., are consistent with failing implants. Rosenberg et al later suggested the association between the presence of spirochetes and motile rods (which, on average, made up 42% of the total morphotypes in the subgingival microflora, with a predominance of peptostreptoccus micros, fusobacterium species, and enteric gram negative rods) around implants failing because infection. Beaker et al also suggested the association of actinobacillus actinomycetemcomitans. Prevotella intermedia, and porphyromonas gingivals (all periodontal pathogens) based on DNA analysis of sites of failing implants. papaioannou et al suggested that it is not evident that the presence of periodontitis associated bacteria will necessarily lead to a destructive process of the peri-implant tissues. Also, salcctti et al suggested that there is no significant difference between failing and stable implants within the same patient, thus excluding the concept of cross infection.

Breetz et al reported that the etiological factors causing periapical lesions around implants (referred to as retrograde peri-implantitis) include bacterial involvement resulting from extracted teeth (placement in an infected socket) or the remaining teeth (cross infection), excessive heat generation during placement, and premature loading (as was described in a report by Mcallister et al).

Bretz et al also demonstrated that implants affected by retrograde peri-implantitis are characterized by periapical radiographic bone loss without (at least initially) gingival inflammation. The microflora of such and implant was described by Rosenberg as consistent with periodontal health, consisting mostly of streptococci and nonmotile organisms. The subgingival mocroflora of an implant filing due to retrograde peri-implantitis is similar to that around healthy implants.

Krekeler et al suggested a relationship between implant failure and the absence of an adequate band of keratinized mucosa surrounding the abutment. This suggested relationship was based on the ability of the keratinized mucosa to withstand bacterial insult and ingression. Also, supporting this concept, Tonetti and Schmidt stated that the late failures that occur as a result of peri-implantitis (infectious etiology) occur because of defective function of the soft tissues. Therefore, the marginal peri abutment tissues should constitute a functional barrier between the oral environment and the host bone by sealing off the osseous fixture site from noxious agents and thermal and mechanical trauma.

Biomechanical failures [19,20]:

Rangeret stated that placement of implants is a crucial factor to consider in a three unit posterior prosthesis. If such prosthesis is supported by two implants and has a cantilevered tooth, the bending moment may be twice that of a prosthesis in which both ends are supported. With occlusal forces acting on the cantilever, the implant becomes a fulcrum and is subjected to axial rotational, torsional forces.

Scher recommended use of a nonrigid connector to the mesial of the implant between the first and second premolar pontics. Misch explained that when the implant serves as a pier abutment the natural tooth may become uncemented because the implant may act as a fulcrum. He recommended use of the stress-breaking elements as well. Changing the situations from a pier into a total implant supported prosthesis may present a lot of problems that would arise from a pier situation.

According to Rangert et al the passive fit should exist at the 10- um level and is required to achieve an optimum load distribution. Milllington and Leung found a positive correlation between the size of fit discrepancy and stress on the superstructure.

Misch stated that 10 prosthetic considerations should be evaluated before the final treatment plan is presented to the patient: 1.Interarch space 2.Implant premucosal position 3.Existing occlusal plane 4.Arch relationship 5.Arch form 6.Existing occlusion 7.Existing prosthesis 8.Number and location of missing teeth 9.Lip line 10.Mandible flexure.

Brunski [21,22] stated that micromotion of more than 100μm should be avoided. Motion greater than this level would cause the wound to undergo fibrous tissue repair rather than the desired osseous regeneration. But this is hard to apply practically. In fact, the precise level of micromotion that can be tolerated without being significantly inhibiting to bone formation is unknown. Some authors applied the immediate loading of implants with certain criteria with a high degree of success, whereas others reported an early failure rate for immediate loaded fixture seven times higher than that recorded for delayed cases.

Misch recommended at the initial delivery of coping fixation that the screw be tightened to approximately two-thirds to three-fourths of the final torque force and after 4 weeks may be tightened to the full 20 Ncm torque force. More than 20 Ncm of torque force could lead to implant failure depending on the implant surface used (i.e. machined, blasted, acid etched, etc.). that acid-etched surfaces resisted countertorque forces more successfully than blasted or machined surfaces.

CONCLUSION

Dental implants may fail for different reasons, with a range that differentiates between a complication and a failure. Implant complications can be due to improper patient selection, surgical and prosthetic complications which can be managed thus preventing failure of prosthesis. An unmanageable degree of complication is considered as a failure. Implant failure is a static end-result condition that requires removal of a failed implant. So with proper patient selection and treatment planning, using dental implants to support restorations replacing missing teeth can provide long lasting functional and aesthetic restorations.

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