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Implant Failures – A Review

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Abstract: ***A dental implant is a prosthetic device made of an alloplastic material implanted into the oral tissues beneath the mucosal and periosteal layer and within the bone to provide retention and support for a fixed or removable dental prosthesis. Implant is the best way to prevent bone loss and edentulism with better replacement options. From the view of prosthodontist it is important to identify the factors that consociate with the failure of the implant. Various studies reveal that only 2mm of bone loss occur per year in case of replacement of the tooth by implants. Hence this review is intended to focus on reducing the failure of implants by entailing occlusal load, crown height and abutment retention loss.***

Keywords: Dental Implant, review, edentulism, replacement, implant failures

1. Introduction

An implant is "a graft or insert set firmly or deeply into or onto alveolar process that may be prepared for its insertion."[1] Implants are used for single tooth replacements, partially edentulous arches and for completely edentulous arches. They are inert, alloplastic materials most commonly made of titanium or titanium alloy or vitalinium. Alternatively, ceramics such as hydroxyapatite, bioglass, or aluminum oxides can be used. Depending on their placement within the bone, they are classified into epiosteal, endosteal, and transosteal [2]. The most common one is endosteal (screw shaped or cylindrical). An implant consists of an implant body which is placed within the bone, implant screw placed on the superior surface of the body to which is attached the healing cap. Abutments are placed over the implant body which provides retention to the prosthesis. Implants are placed into the bone either in 1 stage or 2 stage surgery [3]. In spite of taking many precautions and surgical precision, implant failures do occur attributing to certain factors. Despite many advances in materials, techniques, and implant design, implant failure is a significant concern for the dentist and patient [4].

Implant failure is the first instance at which the performance of the implant, measured in some quantitative way falls below a specified and acceptable level [5].

The aim of this article is to study the various causes of implant failure by focusing on the various classifications given from time to time. Implant failure is caused by a number of factors which include peri-implantitis, absence of Osseo integration, and implant fracture[6].It may also be caused due to surgical trauma, micro motion, and overloading. Over the years, differed classifications of Implant failures have been proposed by various authors [7].

2. Definitions

- Implant failure is defined as the total failure of the implant to fulfill its purpose (functional, esthetic or phonetic) because of mechanical or biological reasons [8].
- Implant failure is the inadequacy of the host tissue to establish or to maintain Osseo integration.

Ailing Implants:
- An implant that may demonstrate bone loss with deeper clinical probing depths but appears to be stable when evaluated at 3−4 months interval.
- Ailing implants are those showing radiographic bone loss without inflammatory signs or mobility [8].

Failing Implants:
- An implant that may demonstrate bone loss, increasing clinical probing depths, bleeding on probing, and suppuration. Bone loss may be progressive.
- Failing implants are characterized by progressive bone loss, signs of inflammation and no mobility [8].

Failed Implants:
- An implant that demonstrates clinical mobility, a peri-implant radiolucency, and a dull sound when percussed. A failed implant is non-functional and must be removed.
- Failed implants are those with progressive bone loss, with clinical mobility and that which are not functioning in the intended sense [8].

3. Classifications

Many factors are attributed to failure of the dental implant, either directly or indirectly. Various authors have classified implant failures depending on several criteria.

Rosenberg et al. classified implant failures as Infectious failure Traumatic failure an implant was determined to have failed from infection if one or more of the following criteria were seen.

Table 1.1: Infectious Failure

1. Clinical signs of infection with classic symptoms of inflammation
2. High plaque and gingival indices
3. Pocket depth
4. Bleeding, suppuration
5. Attachment loss
6. Radiographic peri implant radiolucency
Presence of granulomatous

Table 1.2: Traumatic Failure

1. Radiographic peri-implant radiolucency
2. Mobility
3. Lack of granulomatous tissue upon removal
4. Lack of increased probing depths
5. Low plaque and gingival indices

Classification of Implant Failure according to Esposito et al [9]:

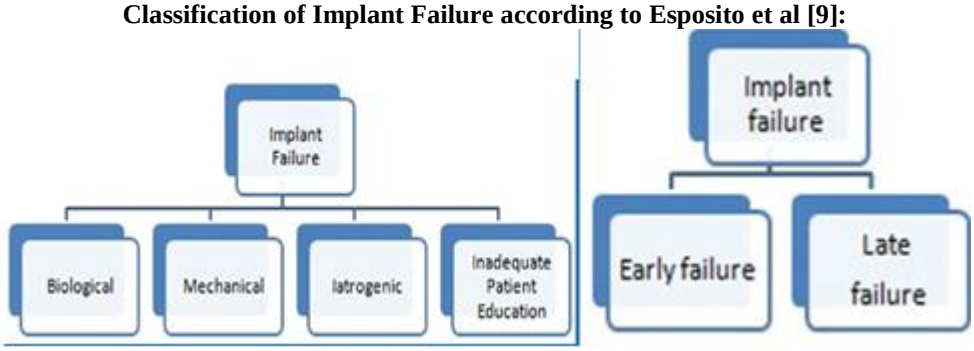

Figure 1: Classifications of Implant Failure

1) Biological
   - Early or primary (before loading)
   - Late or secondary (after failure)
2) Mechanical
   - Fracture of implants
   - Connecting screws
   - Bridge framework
   - Coatings etc.
3) Inadequate patient education
   - Phonetics
   - Aesthetics
   - Psychological problems
4) Iatrogenic
   - Improper implant angulation and alignment
   - Nerve damage

Classification of Implant Failures as Stated by Truhlar and Tonetti [9]:

Prosthetic complications:

1) Insufficient space beneath the fully bone anchored prosthesis
2) Abutments penetrate through alveolar mucosa (unattached tissue).
3) Screw fractures: gold or abutment screws.
4) Acrylic or porcelain fracture
5) Posterior fixture failures in the maxilla

EL Askary et al Divided Into 7 Categories:

1) According to Etiology
   - Host factors
   - Restorative problems
   - Surgical placement
   - Implant selection
2) According to origin of infection
   - Peri – implantitis
   - Retrograde periimplanitis
3) According to timing of failure
   - Before stage II
   - At stage II
   - After restoration
4) According to condition of failure(clinical or radiographic status)
   - Ailing implants
   - Failing implants
   - Failed implants
   - Surviving implants
5) According to responsible personnel
   - Dentist
   - Dental hygienist
   - Laboratory technician
6) According to failure mode
   - Lack of Osseo integration(mobility)
   - Unacceptable aesthetics
   - Functional problems
   - Psychological problems
7) According to supporting tissue type
   - Soft tissue problems(lack of keratinized tissue,inflamation etc.,)
   - Bone loss(radiographic changes etc.,)
   - Both soft tissue and bone loss.

According to the procedure it is classified as:

1. Surgical failure
2. Prosthetic failure.

1. Surgical Failures:

Patient Selection

A detailed patient history should be included not only dental disease but also the individual's potential medical problems and related medications as multiple factors can affect ones suitability for an implant restoration. Patient's use of nicotine, alcohol, or drugs however can have a negative effect on vascularity of the site and must be confidently evaluated discussed and documented [10].All extra oral examinations has to be performed for the potential implant patient. The status of the soft tissue in the edentulous arch must be checked [11].The thickness and width of the attached gingiva must be evaluated for its suitability of

implant site. Systemic disease may have an adverse effect on the prognosis of oral implants especially autoimmune disease and chronic oral diseases such as erosive lichen planus, sjorgrens syndrome, stomatitis, apthous ulceration and diabetes mellitus [12]. Secondarily includes patient financial consideration. Specifically whether the patient can afford surgery and subsequent restoration of implant. Evaluating patient`s periodontal health is mandatory because periodontal status also provides important information regarding patients potential for compliance during treatment [13].

Table 1.3: Difference between Absolute and Relative Contraindication

Absolute Contra -Indication	Relative Contraindication
Recent myocardial infarction	Smoking
Recent cardiac valve prosthesis placement	Uncontrolled diabetes
Hemolytic diathesis	Uncontrolled hypothyroidism
Immunosuppression	Osteoporosis
Severe, uncontrolled psychiatric disorder	Poor oral hygiene
Intravenous bisphosphonate treatment	Oral bisphosphonates
Cancer radiation and chemotherapy	History of radiation therapy to the jaws

Type of Bone

Alveolar bone of sufficient dimension and quality is classified as TYPE 1 to TYPE 4.Type 1 is highly dense cortical bone and it is most desired for implant placement.Type2 bone is the best bone for Osseo integration of dental implants, it has good cortical anchorage for primary stability. Type3 and type4 are soft bone textures with least success in type4 .The condition of the bony ridge, any pattern of previous resorption and angulation of this bone particularly in the anterior maxilla should be considered during preoperative treatment planning [14]. The thickness of buccal plate should be assessed well as using the appropriate calipers or a specialized implant probe. Implant should be surrounded by 2mm of bone to prevent undesired bone resorption and to enable correct faciolingual implant placement and the development of proper peri implant soft tissues .Quantitatively the available bone at the site should have three dimensional configuration permits placement of restoration driven implant, be of optimal length and diameter and have an optimal position and angulation [15].

Surgical Factors

Surgical complications leading to implant failure is multifactorial. They are of two stages [16]. Stage one includes the overheating of the bone causes necrosis and also result in osteomyelitis [17]·Heating of bone to a temperature in excess of 47 degree Celsius during implant surgery can result in cell death and denaturation of collagen, as a result Osseo integration may not occur,instead the implant gets surrounded by a fibrous capsule and the shear strength of the implant–host interface is significantly reduced [18]. When there is lack of primary stability, evident bone loss can also be seen. Infections, signs of infection are swelling, fistula,and pain during the healing period. The most reported cases are residual suture, poorly seated cover screw or trauma from inadequately relieved denture and a protruding implant. Maintaining the sterile condition is of utmost importance during surgical procedure[19].The agents,which interfere in surgical procedure are saliva, unsterileinstruments,contaminated gloves,perioral skin, air expired by the patient will leads in contamination of the implant site which results of causing infection in the implant site thus leading to failure of surgical procedure[20].

Loss of Osseo integration

Osseo integration is defined as 'A process in which clinically asymptomatic rigid fixation of alloplastic material is achieved and maintained in bone during functional loading this is in contrast to implants surrounded by fibrous connective tissue[13].Successful implant can be considered as "When an Osseo integrated dental implant has to meet certain standard in terms of functional ability chew, tissue physiology (presences and maintenance of Osseo integration, absence of pain and other pathology process, patient satisfaction which includes aesthetics and absence of discomfort [19]. A Failure of implant can be includes a great deal of arbitraries and encloses large variety of clinical situation , ranging from all symptomatic mobile implants to implants showing more than 0.2mm of peri implant bone loss after the first year of loading or bleeding pocket exceeding 5mm of probing depth[21].

Peri Implant Disease

Peri implant mucositis is characterized by inflammation of the soft tissues surrounding the implant without any signs of bone loss. The clinical feature includes bleeding on probing, probing depth of at least 4mm with no evidence of radiographic loss of bone loss. Peri-implantitis is multifactorial etiology includes 1. Implant related factors (material, surface prosthesis, design), 2.clinician factors (surgical and prosthodontics experience, skills) and 3.patient factors (systemic disease,medication, oral disease, smoking, bone quality).Treatment protocols have been proposed for the management of peri-implantitis is 1. Nonsurgical management 2. Surgical management. Nonsurgical management includes mechanical removal of plaque and calculus from the implant site and antibiotic therapy. Surgical management includes resection and regenerative therapy [17].

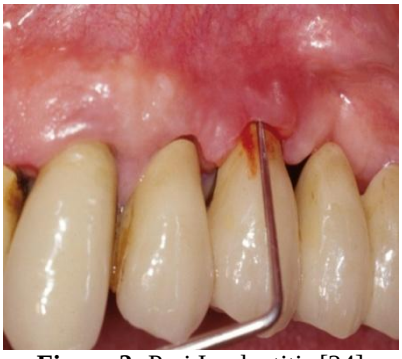

Figure 2: Peri Implantitis [24]

Prosthetic Failures:

Based on Loading

1) Early failure
2) Delayed failure

Early Failures
Early loading is the prosthesis is attached during a second procedure, earlier than the conventional healing period of 3 to 6 months.Time of loading should be stated in days to 8 weeks. This failures occur before Osseo integration and prosthetic rehabilitation [22].Factors influencing the early failures of dental implants are conditions of implant, patient and surgical technique.In implants the factors related to failure is surface roughness of implant that has to be loaded, surface purity and sterility plays important role in affecting the success of implant. Premature loading of implant will also lead to early failure. Bacterial contamination and extensive inflammation of the wound that may delay healing of soft and hard tissue [23].

Delayed Failures
Delayed loading is the prosthesis is attached at the second procedure after conventional healing period of 3 to 6 months. Delayed failures is of two types, 1.earlylate failure 2. Delayed late failure [23].In early late failure the implants tends to fail during first year of loading, where as in delayed late failure is implants failing in subsequent years ,progressive changes of the loading condition in relation to bone quality ,volume and peri-implantitis [24].

Component Fracture
Fracture of implant or breakage of implant components like abutment screws, occlusal screws, and fracture of prosthesis framework leads to exposure of implants surface due to excessive force which eventually results in implant failure, this often happens due to poor treatmentplanning [25].

Occlusal Fracture
Excessive occlusal loading cause's loss of Osseo integration [19]. This loss of Osseo integration causes plaque induced peri-implantitis where there is inflammation in gingival tissue accompanied by the marginal bone loss which further leads in the apical direction.

Implant and tooth movement is not similar. A tooth will move twenty eight µm in an apical direction with an axial load. An implant beneath an identical load moves approximately 5 µm. hence an implant-supported teeth must be adjusted. To achieve this, the following protocol is recommended:

Biting in centric occlusion with lightweight force utilizing a thin articulating paper (less than twenty five µm) is employed first to assess the occlusal contacts.

A stronger bite force is then applied to the articulating paper creating contact regions on both the implant restoration and the adjacent teeth. "The greater bite force on the region can be similar between implants and teeth, because it depresses the natural teeth, positioning them close to the depressed implant sites and equally sharing the occlusal load".

Along the long axis of the implant body, an occlusal force must be directed. There is an increase in compressive force at the crest on the opposite side while increasing tension along the same side when an angle load is applied to implant axis.

Poor Design
Poor designing of implant leads to failure of the implant. Poorly designed implant is that doesn't not communicate with the environment [23].There are three types of implants small diameter implants, short implants, and large cantilevers. Few implants may end up failing if they used in wrong situation, to avoid this proper planning and communication with the team which comprises surgical dentist, restorative dentist, laboratory and patient. Cantilevers are force magnifiers to the implants, abutment screws, and cement or prosthesis screws and implant bone interface.The length of cantilever is directly related to the amount of the additional force placed on the abutments [23].

Loosening of Screw
The loosening of implant-abutment connecting screw causes problem for both the clinician and patient [25].It is often necessary to sacrifice the overlying restoration to give access to the screw. The cement-retained implant restorations may be damaged or destroyed in the process, resulting in additional cost and further delay of treatment. Screws have been studied extensively in the engineering literature and dental implant screws have improved as a result.Together with proper design of the occlusion and stable Osseo integration, a reliable connection between implant and abutment is an important precondition for the appropriate functioning and stability of implant restoration [26].

Several clinical studies report widely varying incidences of abutment loosening in different types of abutment connections. In particular, external hex configurations seem to be prone to abutment screw loosening. Limited engagement of the external member and the presence of a short fulcrum point when tipping forces act, are the main reason for abutment screw loosening in external hex connections. In the external hex configuration, the axial preload of the abutment screw is a determining factor for stability of the connection. There is no lock form or positive locking by the external hex [27].The external hex determines the rotational position but does not absorb any lateral loading and the tensile force. So the stress is concentrated on the abutment screw [28].

Different methods have been tried effectively to reduce the screw loosening. The two important methods used to counteract screw loosening include the incorporation of an anti-rotational element and attaining optimum screw joint preload [29]. There are three methods for managing abutment screw loosening. The most conservative method is removal of the crown along with the abutment as described in the case report.The second method is to identify the access to the connecting screw head. The access may be labial, occlusal or lingual. This should be recorded during the cementation of the prosthesis. The abutment connecting screw is then removed or retightened through the perforation created at the access within the crown. Depending on the location of the access the crown can be reused or discarded [28].

4. Conclusion

Failure of implant is multifactorial occurrence. All cases are evaluated for bone width, boneheight, and implant diameter

preoperatively, along with crown height space and occlusal load but it is often only looked at pre-restorative phase after the implants have integrated.This sometimes becomes too late. Usually, the problems can be overcome with additional procedures, but the costs to the patient and the clinician are both monetary and emotional. Dental treatments have enough Complications even when things are done right. By paying attention to these parameters for implant dentistry preoperatively, we can minimize the complications.

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