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Review Article

Implant Failure: A Growing Concern for Implant Dentistry

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***ABSTRACT*:**
An implant-supported restoration offers a predictable treatment for tooth replacement. There is high success rate regarding the implant placement except in medically compromised patients. Nevertheless, there are pros and cons related to everything and similar are the case with the implants and the burning problem that all the implantologists are confronted today is the complications and failures occurring with the treatment of osseo-integrated implants. The surgical trauma with bone volume and quality are generally believed to be most important etiological factors for early implant failures and the etiology of late failure is more controversial and thus when an implant fails a tailor may treatment plan should be provided to each patient according to all relevant variables and patients should be informed of regarding all possible treatment modalities following implant failure and give their consent to the most appropriate treatment option for them. Thus the aim of this paper is to explain different methods and treatment modalities to affect implant failure.
Keywords: Classification, implant failure, osseointegration, periimplantitis, prosthesis, fracture, overloading, smoking.

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INTRODUCTION:

Implant dentistry is the second oldest discipline in dentistry followed by exodontias. Intense research over the past 50 years has culminated in the introduction of dental implants as an effective and predictable way of replacing lost teeth and currently dental implantology has become one of the major specialties of dentistry in terms of restoring function, esthetic and patient acceptance. Now a day dental implants are the best permanent and secure solution in the replacement of one or more missing teeth giving a natural appearance.[1] Though the success rates reported with this form of therapy are relatively high, failures do occur. It is commonly difficult to assess the proper reason for implant failure. For instance, some of the failures are due to that implant that never osseointegrate, and some other are due the overheating/poor surgery.[2] Osseointegration is currently considered to be a firm, stable, and long lasting connection between the implant and periimplant bone tissue and is essential for implant survival. If osseointegration does not take place, the result is biological failure and consequent implant loss.[3] Reported predictors for implant success and failure are generally divided into patient-related factors (*e.g.*, general patient health status, smoking habits, quantity and quality of bone, oral hygiene maintenance, etc), implant characteristics (*e.g.*, dimensions, coating, loading, etc), implant location, and clinician experience.[4] Still the ultimate success of any implant supported prosthesis is directly related to the clinicians understanding of the biology of the human host and the mechanical aspects of the implant system.[5] Numerous multi centre studies and several meta-analyses have indicated 93% survival rates of dental implants but the incidence of implant loss due to failure to osseointegrate or to loss of integration after loading has

also been well-documented in numerous prospective and retrospective reports.[6] According to **Se-Lim Oh et al**, found an overall implant survival rate to be around 86.3% and suggested that the survival rate of retreated implants is lower than that generally reported after initial implant placement. Higher survival rates were reported with rough-surfaced implants than with smooth-surfaced implants in retreatment. The most initial implant failures are likely attributable to modifiable risk factors, such as implant architecture, anatomic site, infection, and occlusal overload.[7]
Another study conducted by **Olmedo-Gaya MV**, found that early dental implant failure was more frequent in men and in individuals with severe periodontal disease, short implants, pain/inflammation at 1 week postsurgery, or bone expansion treatment.[8] Hence, it is mandatory for every clinician to know, how and why the failures occur and how best we can prevent them in order to give the upcoming branch of dentistry a new horizon.

Classification of Implant Failure: [9]

Iatrogenic failure and biologic failure:
1. Ailing implants
2. Failing implants
3. Failed implants
4. Surviving implants

Rosenberg: classified implant failures as:
1. Traumatic failure
2. Infectious failure

Esposito 1998: classified implants according to the Osseointegration Concept:
1. Biological:
a. Early: failure to establish osseointegration.
b. Late: failure to maintain the achieved osseointegration.
2. Mechanical: fracture of implants, connecting screws, bridge framework, and coating.
3. Iatrogenic: nerve damage, wrong alignment of implant.
4. Inadequate patient education: phonetical, esthetical, pshycological problems.

Truhlar in 1998, classified failures as:
Early failure:
That occurs within weeks to few months after placement. It is caused by factors that can interfere with normal healing processes or by an altered healing response.

Late failures:
Failure that arise from pathologic processes that involve a previously osseointegrated implant.

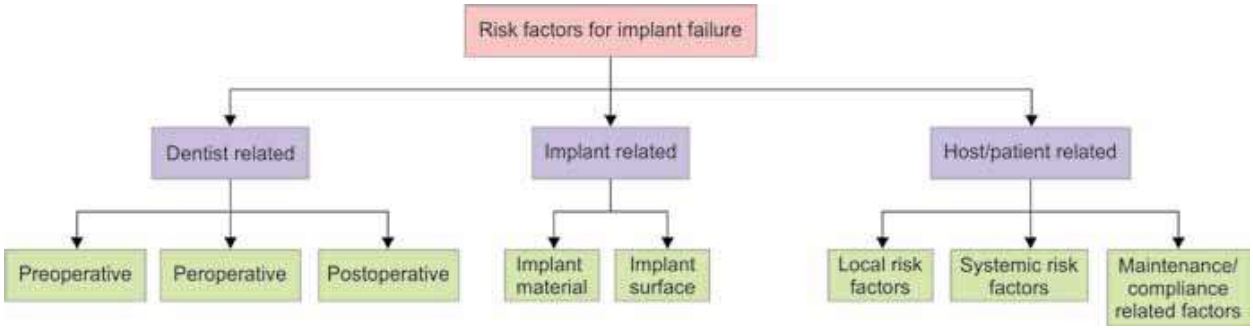
Kees Heydenrijik: classified failure to occurrence of time:

Early failure:
1. Surgical trauma
2. Insufficient quantity or quality of bone
3. Premature loading of implant
4. Bacterial infection

Late failure:
1. Soon late failure: during first year of loading.
2. Delayed late bone: implant failure in subsequent years.

According to Cranin:
1. Intraoperative complication
2. Short term complication (first six post operative months)
3. Long term complication
According to Bragger et al 1997, (Periimplantitis):
1. Level of mucosal margin
2. Peri-implant probing depth
3. Level of the tissue in the peri-implant zone providing resistance to probing.
4. Effects of probing regarding breeding exudation and suppuration.

RISK FACTORS FOR DENTAL IMPLANT FAILURES[10]



DENTIST RELATED RISK FACTORS:

- Pre-operative: X-ray magnifications incase of conventional and panoramic radiography may lead to mistakes in planning and in performance of dental implantations, making special methods necessary to correct for eventual magnification which will enable recording of exact anatomical measurements.
- Per-operative factors: Overheat and thermal induced necrosis produced by friction from high torque equipment, damages the implant bone bed. Non-ideal position for the dental implant may subject it to non-axial loading during mastication. This increases risk for implant fractures and peri-implant bone fractures, which usually occurs in the posterior region that is subjected to a high load. Selection of too-short implants may also increase the failure rate and thus making proper selection an important step.
- Post-operative: Improper design and guidance of the crown contribute to Failure and Occlusal forces contribute to implant fractures and peri-implant bone fractures. Crown width, cusp height, guidance, and occlusal alignment can all be used to control occlusal forces.

Figure 1: representing the incorrect placement of implant

IMPLANT RELATED:

Implant material: Use of bioincompatible implant materials leads to implant failure initiated by adverse host tissue responses Dental implant materials have been remarkably improved in the past half century to meet all kinds of demands. But more biocompatible and functional materials are needed to prevent implant failures and to prolong implant life in service.

Implant surface: The implant surface coatings comprise titanium oxide (TiO2) coating, ceramic coating, or diamond coating. Biodegradable ceramic coating may have the best future prospects.

HOST/PATIENT RELATED:

Local risk factors

Bone quality and quantity, irradiated bone, biomechanical occlusal loading respectively leads to implant failure. Patients with low quantity and low density of bone are at highest risk for implant loss. Thus, it is important to have the good quality and quantity for successful implant treatment. Since, radiation therapy is not an absolute contraindication to implant treatment; the reported success rate is only about 70%. Long-term studies are limited, but Jacobsson et al showed increasing implant loss over time. It has also been concluded that occlusal loading, strains the hard peri-implant bone because implants lack the protective periodontal ligament system. Thus, high mechanical loading leads to increased bone resorption. The occlusal overload may also result in progressive bone loss around the implant, leading to the failure of the implant.

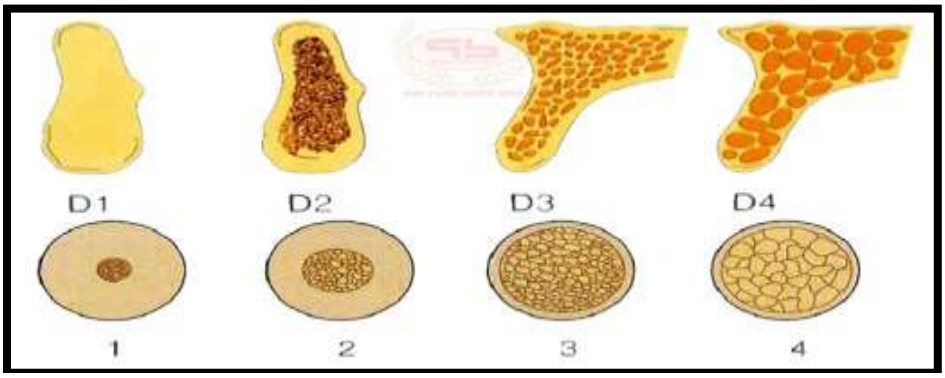


Figure 2: representing bone quality

Systemic factors

Diabetes mellitus, osteoporosis, medication and irradiation therapy: diabetic lesions have been focused on periodontitis, and diabetes mellitus has also been considered a risk factor, occasionally even a contraindication for performing dental implantations. But, it has been reported that dental implants in diabetes are successful, for the short-terms. The local bone quality of the implantation bed is a more sensitive prognostic factor in this respect than that of peripheral bone, in general, in osteoporosis patients. Implants in osteoporosis have been successful in the short-term, but long-term results have not been reported. glucocorticosteroids cause iatrogenic osteoporosis by increasing bone resorption via stimulation of osteoclastogenesis doxorubicin and methotrexate, which inhibit osteoblasts and diminish bone formation.

MAINTENANCE AND COMPLIANCE RELATED FACTORS:

Implants are susceptible to plaque-related diseases in a very similar manner to teeth. Therefore, various periodontal indices must be low. Before starting any implant therapy, the clinician needs to ensure that the patient has the oral hygiene skills to minimize the risk of developing peri-implant diseases. The patients who are compliant in the first few years of scheduled maintenance care tend to continue in long term supportive periodontal therapy in implant treatment. This is ensured by improvements in patient communications and motivations at the end of active therapy. Hence, before implant treatment supportive periodontal therapy should be presented as an essential and necessary part of implant therapy and the benefits should be highlighted.[11]

SMOKING: MAJOR RISK FACTORS

There are several studies associating implant failures with smoking. Bain and Moy suggested that smoking caused both systemic and local injury to the tissues and is a common contributor to decrease tissue oxygenation, which negatively affects wound healing. Nicotine, presenting the main element of cigarette, reduces proliferation of red blood cells (RBCs), macrophages, and fibroblast, which are the main element of healing. It also increases platelet adhesiveness which can lead to poor perfusion due to microclots. It also acts as sympathomimetics by increasing the release of epinephrine and nor epinephrine, and causes increased vasoconstriction which limits over all tissue perfusion. These all studies hypothesized that smoking compromises wound healing.[12,13]

AGE

Theoretically, patients with increased age will have more systemic health problems, but there is no scientific evidence correlating old age with implant failure.

PARA-FUNCTIONAL HABITS AND BRUXISM

Para-functional habits and bruxism are very common occlusal diseases. Heavy occlusal forces constitute a risk factor for loosening of dental implants. Metal fatigue and implant fractures occur more frequently in these patients than in controls. More than 77% of all implant fractures have been reported to occur in patients who have signs and a history of chronic bruxism. Para-functional habits are also related to increased peri-implant bone loss.[14, 15]

Figure 3: representing attrition and dental implants

PERIIMPLANTITIS

Peri-implantitis has been primarily described as a simple infectious pathologic condition of peri-implant tissues. Local factors, which include, topology, implant surface, and bacterial contamination at the implant/abutment junction, including patient factors, such as smoking habit, presence or history of periodontitis, poor oral hygiene, genetics, and excessive alcohol consumption, have also been associated with an increased risk of developing peri-implant diseases.[11]

Spiekermann[16] classification of Peri-implantitis

Class-1 Slight bone loss with minimal peri-implant defect

Class-2 Moderate bone loss with isolated vertical defect

Class-3 Moderate bone loss with circular bony defect

Class-4 Advanced bone loss with broad, circumferential vertical defect, involving loss of oral and vestibular bony wall.

Staurt J. Froum and Paul S. Rosen[17] classification of Peri-implantitis

Early PD ≥ 4 mm with 25% bone loss of the implant length

Moderate PD ≥ 6 mm with 25-50% bone loss of the implant length

Advanced PD ≥ 8 mm with >50% bone loss of the implant length

DIAGNOSIS

Peri-implant diagnostic procedures can cause several functions:

(i) Screening of peri-implant disease and factors which increase the risk to develop an undesirable condition,
(ii) Differential diagnosis of peri-implantitis and peri-implant mucositis,
(iii) Treatment planning followed by
(iv) Evaluation of therapy and monitoring.

Figure 4: Representing Periimplantitis

Table-4: main diagnostic differences between peri-implant mucositis and peri-implantitis**(*Chen &Derby*)**[18]

Clinical parameters	Peri-implant mucositis	Peri-implantitis
Increased probing depth	+/-	+
BOP	+	+
Suppuration	+/-	+
Mobility	-	+/-
Radiographic bone loss	-	+

MANAGEMENT

The board treatment approaches for peri-implantitis has been separated into two sections:

- Nonsurgical treatment of peri-implantitis; and
- Surgical treatment of peri-implantitis.

Peri-Implantitis Nonsurgical Therapy: Mechanical Or Automatic Debridement[19, 20, 21]

Targets and innovations for the mechanical debridement of implant surfaces (curettes, air-abrasive devices, ultrasonic devices and lasers) have been assessed for the treatment of peri-implantitis. Various sorts of curettes have been considered, primarily those made of carbon fiber or titanium, and a large portion of the conventions incorporated an adjunctive clean with an rubber cup and polishing paste.[19]

As of recent, a fueled air-abrasive structure, framework with a low-grinding amino-destructive glycine powder, has been shown as an effective methodology for biofilm expulsion from the root surface, without hurting hard and sensitive tissues and has been recommended for debriding implant surfaces.[20] Different tip adjustments have been proposed, for example, carbon fiber, silicone or plastic to eliminate calculus and biofilms without modifying the implant surface.[16]

Another modification to the regular ultrasonic device is the Vector-framework, in which the horizontal vibration is converted by a reverberating ring into a vertical vibration, bringing about a parallel development of the working tip to the surface. The utilization of lasers has additionally been proposed in the treatment of peri-implantitis because of their antiinfective, physical and ablation properties. The erbium-doped yttrium aluminum garnet laser has demonstrated the most elevated potential for use in the treatment of periimplantitis because of its capacity to eliminate subgingival plaque and calculus effectively without essentially harming the implant surface.[21]

Peri-Implantitis Nonsurgical Therapy: Adjunctive Use Of Antimicrobial Products[17,22]

Adjunctive treatments, for example, cleaning agents and anti-microbials, have been proposed to improve the aftereffects of nonsurgical debridement as decrease of bacterial burdens to levels viable with tissue health is hard to achieve utilizing mechanical methods as it were. Chlorhexidine-based items, as gels, water system and additionally flushes, and in various definitions and systems, have been accounted for examples include:

1) Frequent regular irrigation of the peri-implant pocket with 0.2% chlorhexidine in one first session.
2) Single use of 1% chlorhexidine gel with a disposable syringe.

3) Repeated application of 1% chlorhexidine gel at treatment and at 30 and 90 days after treatment;
4) The combination of pocket water system with 0.2% chlorhexidine + 0.2% chlorhexidine gel, applied subgingivally in each implant at the day of intervention and the use of 0.2% chlorhexidine mouth wash, twice every day for about fourteen days; and
5) Pocket water system with 0.12% chlorhexidine + 1% chlorhexidine gel.

Peri-implantitis surgical treatment

The treatment of peri-implantitis should focus on bone recovery and the fulfillment of re-osseointegration. This wonder of direct tissue that stays to be worked out contact on a once in the past contaminated implant surface has been accounted for in preclinical models anyway has never been appeared in humans.[23] In this way the two overlap reason of the cautious treatment of peri-implantitis involve:
1) To improve implant surface clean-limit; and
2) To modify the existence frameworks of delicate and hard peri-implant tissues in order to get re osseointegration.

Peri-implantitis Surgical Therapy: Surgical Techniques[24]

Different and careful strategies have been suggested, depending upon the final objective of the surgical intervention:
1) Access for cleaning and decontamination of the implant surface (Access flaps)
2) Access for cleaning and disinfecting in addition to introduction of the affected surfaces for cleaning (apically repositioned folds); and
3) Access for cleaning in addition to focusing on bone recovery and re-osseointegration (regenerative methods).

a) Access Flap Surgery: The goal of this flap surgical intervention is to preserve and to keep up all the delicate tissues around the influenced implant and to focus basically on the purification of the implant surface. As a rule, intra-crevicular entry points are made around the influenced implants and mucoperiostal folds are raised both buccally and palatally/lingually. Degranulation of the peri-implant aggravated tissues is best accomplished with titanium curettes and implant surface sterilization is performed. At last, the flaps are repositioned and satisfactorily stitched.

b) Apically Positioned Flaps: This surgical methodology has been pushed to improve self-performed oral hygiene and decrease the pockets around the influenced implants. Actually, a reverse beveled incision is planned subjected on probing pocket and the width and the thickness of the peri-implant mucosa. Vertical releasing incisions might be required to situate the flap apically. Mucoperiostal flaps are raised both buccally and palatally/lingually. The collar of the influenced tissue is then taken out and the implant surfaces are completely decontaminated. Deliberately performed osteoplasty utilizing bone chisels, is regularly required. At last, the flaps are sutured to leave the previously affected part of the implant presented to the oral cavity. Implantoplasty to smoothen the presented part and to diminish the postsurgical contamination of the implant surfaces have additionally been proposed. The procedure is demonstrated for peri-implantitis cases with suprabony defects or a one-way intrabony defect.

c) Regenerative Surgical Techniques[24]

Regenerative methodologies have two primary goals:
I) To help the tissue measurement during the mending procedures, keeping an essential separation from downturn of the mucosa.
ii) To improve the opportunity of getting re-osseointegration, utilizing reconstructive and regenerative strategies/materials.

Intracrevicular incisions are normally performed to maintain up the aggregate sum of delicate tissues. After rise of buccal and lingual periosteal flaps, degranulation of the imperfection is performed utilizing titanium instruments. After cleaning of the implant surface, a graft is set around the implant, filling the intrabony part of the distortion. Grafting may be performed with either autologous bone or bone substitutes. The graft may be made sure about with a resorbable or a nonresorbable layer. Finally, the flaps are coronally arranged and sewed to choose patching, with either a nonsubmerged or a brought down technique.

CONCLUSION:

In spite of the high achievement rates and stability of dental implants, failures do occur, the failures have multifactorial event and combination of event leads to ultimate failure of implants. As someone well said, it isn't how much achievement we get but how best we tackle the intricate circumstances and failure of the skill of a clinician. Consequently, every dental specialist needs to recognize the reason to deal with the current condition like appropriate data collection, understanding patients criticism and precise diagnostic tools which inturn will assist with calling attention to the explanation behind failures. Almost certainly failures are stepping stones to progress yet not until their etiology are set up and their event is forestalled. Maintaining a strategic distance from those conditions that contribute to poor outcomes, choosing cases that offer ideal careful and prosthetic conditions and

circumspectly avoiding complex clinical challenges can improve favorable result significantly.

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