

Review Article

Dental Implants- Success Criteria, Classification and Management of Failing Implants-An Overview

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ABSTRACT:

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. 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. It is the inadequacy of the host tissue to establish or to maintain osseointegration. Treatment strategies are broadly divided in to nonsurgical & surgical treatment strategies.

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INTRODUCTION

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.¹ Since the introduction of the concept of osseointegration, the success of implants has increased dramatically because of better understanding of bone response and improvement in bone loading concept.²

An implant supported restoration offers a predictable treatment for tooth replacement.³ Every attempt must be made to keep implant failures to be minimum. All failures should be carefully analyzed and evaluated to identify their causes in order to prevent future reoccurrence.⁴ Endosseous dental implants have been a successful treatment alternative for restoring missing teeth.⁵

Implant failure⁶

- 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.
- Implant failure is defined as the total failure of the implant to fulfill its purpose because of mechanical or biological reasons.
- Implant failure is the inadequacy of the host tissue to establish or to maintain osseointegration.

Iatrogenic failure and biologic failure

Iatrogenic failure is one characterized by a stable and osseointegrated implant, but due to malpositioning it is prevented from being used as part of the anchorage unit. Biological failure can be defined as the inadequacy of the host tissue to establish or to maintain osseointegration.

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.

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.

Failed implants

- An implant that demonstrates clinical mobility peri-implant radiolucency, and a dull sound when

percussed. A failed implant is non-functional and must be removed.

Surviving implants

Surviving is a term described by Alberktson that applies to implants that are still in function but have not been tested against success criteria.⁶

Warning signs of implant failure¹-

- 1.Connecting screw loosening.
- 2.Connecting screw fracture.
- 3.Gingival bleeding and enlargement.
- 4.Purulent exudates from large pockets.
- 5.Pain.
- 6.Fracture prosthetic component.
- 7.Angular bone loss noted radiographically.
- 8.Long standing infection and soft tissue sloughing during the healing period of first stage surgery³.

WHEN TO SAY AN IMPLANT HAS FAILED?⁶

The individual practitioner and certifying agencies are presented with a bewildering series of choices in determining which implant systems provide an adequate prognosis to warrant their acceptance for clinical use. To make these critical selections, a set of criteria for success based on scientific investigations is essential.

Success Criteria For Dental Implants⁷

Smith and Zarb have reviewed the success criteria given by different authors.

A - Schnitman And Schulman :

1. Mobility less than 1 mm in any direction.
2. Radiologically observed radiolucency graded but no success criterion defined.
3. Bone loss not greater than one third of the vertical height of the bone.
4. Gingival inflammation amenable to treatment.
5. Functional service for 5 years in 75% of patients.

B - Chainin, Silver Branch, Sher, And Salter :

1. In place for 60 months or more.
2. Lack of significant evidence of cervical saucerization on radiographs.
3. Freedom from hemorrhage according to Muhelman's index.
4. Lack of mobility.
5. Absence of pain and tenderness.
6. No pericervical granulomatosis or gingival hyperplasia.
7. No evidence of a widening peri-implant space on radiograph.

C - Mckinney, Koth, And Steflik: Subjective Criteria -

- i. Adequate function.
- ii. Absence of discomfort.
- iii. Patient belief that esthetics, emotional, and psychological attitude are improved.

Objective Criteria -

- i. Good occlusal balance and vertical dimension.
 - ii. Bone loss no greater than one third of the vertical height of the implant, absence of symptoms and functionally stable after 5 years.
 - iii. Gingival inflammation vulnerable to treatment.
 - iv. Mobility of less than 1 mm buccolingually, mesiodistally, and vertically.
 - v. Absence of symptoms and infection associated with the dental implant.
 - vi. Absence of damage to adjacent tooth or teeth and their supporting structures.
 - vii. Absence of parasthesia or violation of mandibular canal, maxillary sinus, or floor of nasal passage.
 - viii. Healthy collagenous tissue without polymorphonuclear infiltration.
- Success Criteria Provides functional service for 5 years in 75% of implant patients.

II. Revised Criteria For Implant Success

Alberktson, Zarb, Washington, And Erickson -

- i. Individual unattached implant that is immobile when tested clinically.
- ii. Radiograph that does not demonstrate evidence of peri-implant radiolucency.
- iii. Bone loss that is less than 0.2 mm annually after the implant's first year of service.
- iv. Individual implant performance that is characterized by an absence of persistent and/or irreversible signs and symptoms of pain, infections, necropathies, paraesthesia, or violation of the mandibular canal.

In content of criteria mentioned, a success rate of 85% at the end of a 5-year observation period and 80% at the end of 10-year observation as a minimum criterion for success⁷. Further, in 1998 Esposito et al.^{7,9} have listed out the various criteria for success which were agreed upon at the 1st European Workshop on Periodontology. According to them following were to be considered success criteria for osseointegrated implants –

- Absence of mobility
- An average radiographic marginal bone loss of less than 1.5 mm during the first year of function
- Less than 0.2 mm annually thereafter,
- Absence of pain/parasthesia

CLASSIFICATIONS⁷

Various authors have classified implant failures depending on several criteria.

-**Rosenberg et al.** classified implant failures as

- 1.Infectious failure
2. Traumatic failure

-**Esposito et al.** have classified oral implant failures according to the osseointegration concept.

Biological

Early or primary (before loading): failure to establish osseointegration.

Late and secondary (after loading): failure to maintain the achieved osseointegration.

Mechanical

Fracture of implants, connecting screws, bridge frameworks, coating etc.

Iatrogenic

Nerve damages, wrong alignment of implants, etc.

Inadequate patient adaptation

Phonetical, esthetical, psychological problems, etc.

-**Truhlar** classified failures as

Early failures

- That occur within weeks to few months after placement.
- Caused by factors that can interfere with normal healing processes or by an altered healing response.

Late failure

- Failure that arises from pathologic processes that involve a previously osseointegrated implant.

-**El Askary et al.** have divided the failures into seven categories.

1. According to etiology

Failures because of host factors

- Medical status – Osteoporosis and other bone diseases; uncontrolled diabetes.
- Habits – smoking, para-functional habits.
- Oral status – poor home care, juvenile, and rapidly progressive periodontitis, irradiation therapy.

Restorative problems

Excessive cantilever, pier abutments, no passive fit, improper fit of the abutment, improper prosthetic design, improper occlusal scheme, bending moments, connecting implant to natural dentition, premature loading, excessive torquing.

Surgical placement

- Off axis placement (severe angulation).
- Lack of initial stabilization.
- Impaired healing and infection because of improper flap design or others.
- Overheating the bone and exerting too much pressure.

-WORKING CLASSIFICATION⁸

Early failures (intraoperative or within 3 months)

- Minimal space between implants.
- Placing the implant in immature bone grafted sites.
- Placement of the implant in an infected socket or a pathologic lesion.
- Contamination of the implant body before insertion.

Implant selection

- Improper implant type in improper bone type.
- Length of the implant (too short, crown-implant ratio unfavorable).
- Diameter of the implant.

2. According to origin of infection

- Peri-implantitis (infective process, bacterial origin).
- Retrograde peri-implantitis (traumatic occlusion origin, non-infective, forces off the long axis, premature, or excessive loading).

3. According to timing of failure

- Before stage II (after surgery).
- At stage II (With healing head and or abutment insertion).
- After restoration.

4. According to condition of failure: (clinical and radiographic status)

- Ailing implants.
- Failing implants.
- Failed implants.
- Surviving implants.

5. According to responsible personnel

- Dentist (oral surgeon, prosthodontist, periodontist).
- Dental hygienist.
- Laboratory technician.
- Patient.

6. According to failure mode

- Lack of osseointegration (usually mobility).
- Unacceptable esthetics.
- Functional problems.
- Psychological problems.

7. According to supporting tissue type

- Soft tissue problems (lack of keratinized tissues, inflammation, etc.).
- Bone loss (Radiographic changes, etc.).
- Both soft tissue and bone loss.

<p>1. According to etiology- -Implant selection-Improper implant type, diameter of implant, surface impurities, roughness. -Surgical placement: off axis placement stabilization, overheating of bone, minimal space between implants, contamination of implants during placement</p>	<p>1. According to etiology- -Host factors-systemic factor diabetes habits, alcoholism implants -Tissue abuse, smoking, parafunctional, habits, alcoholism -Radiotherapy</p>
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- Restorative problems: Improper design, occlusal scheme, improper fit, excessive loading	
2. Due to Personnel Responsible - -Dental expertise: oral surgeon, prosthodontist, periodontist -Laboratory technician:improper design of prosthesis	2.Due to Personnel Responsible- - Patient: inadequate post• operative maintenance
3. According to failure mode - Lack of osseointegration	3. According to failure mode – functional and psychological problems
4. Due to biological causes- Peri-implantitis	4. . Due to biological causes- Infections: retrograde perimplantitis, due to traumatic occlusion.

Treatment strategies ⁹

Treatment option varies according to aetiology. Treatment strategies are broadly divided in to nonsurgical & surgical treatment strategies.

1. Nonsurgical treatment:

When biochemical forces of occlusion are considered as aetiological factor then, occlusal is first evaluated any occlusal interference if present, should be corrected. Fit of prosthesis & abutment should also be evaluated & corrected if required. When plaque & microorganisms are suspected as aetiological factors, thorough debridement is treatment of choice. It was based on hypothesis that bacterial biofilms on implant surfaces cause peri-implantitis, and that the removal of these bacteria is the cure described by using the experimental gingivitis model originally described by Loe et al. It was observed that mechanical non-surgical therapy could be effective in the treatment of peri-implant mucositis lesions. The local debridement of hyperplastic peri-implant tissues using hand or ultrasonic plastic instruments has been suggested. Metallic instruments are avoided to minimize surface damages and roughening, which can favour plaque adhesion. Furthermore, the adjunctive use of antimicrobial mouth rinses enhanced the outcome of mechanical therapy of such mucositis lesions. Chemical disinfectants such as, hydrogen peroxide & chlorhexidine digluconate were used adjunct to mechanical debridement to improve clinical outcome. However, their results show variable findings. Local & systemically administered antibiotics were used along with local debridement found to be effective in several cases. Local application of minocycline or doxycycline as an adjunct to mechanical debridement and irrigation with an antimicrobial agent may be effective in moderately deep lesions. The current available scientific information on the use of locally or systemically administered antibiotics is insufficient to allow any firm specific recommendations for the use of these drugs.

2. Surgical treatment:

In the instances, when condition is unstable after proper nonsurgical treatment, clinician should reevaluate the case & may approach to surgical treatment if required. Surgical treatment includes the

elevation of a mucoperiosteal flap and the removal of the peri-implant inflammatory granulation tissue. Following surgical exposure of the contaminated implant surface mechanical, chemical, or photodynamic measures and combinations of all three can be used to attempt to eliminate infection, resolve inflammation and render the surface conducive to bone regeneration and re-osseointegration. Multiple procedures have been tried to decontaminate and condition the implant surface. Surfaces have been subjected to cleaning with carbon or plastic curettes, ultrasonic scalers, air-polishing devices using sodium bicarbonate or glycine powder, saline wash, peroxide, irradiation with hard or soft laser light, implantoplasty and/or the application of acids or various antimicrobial agents. However, there is no definitive gold standard method still proven. Various regenerative approaches including use of bone grafts & use of barrier membrane had been documented. Goal of regenerative approach is to fill osseous defect around implant as well as to improve soft tissue condition. Autogenous bone, allogenic decalcified freeze-dried bone, xenogenic bone mineral, phyto-genic calcium carbonate, hydroxyapatite or tricalcium phosphate have been used in an attempt to fill peri-implant defects and regenerate bone. ePTFE, collagen, and resorbable synthetic membranes have been placed to cover the area. All of above documented method show various degree of success. Lack of properly conducted clinical trial does not allow for any firm specific recommendation of surgical therapy.

3. Peri-implant maintenance

According to the 2003 American Academy of Periodontology position paper, “patients should be evaluated at regular intervals to monitor their peri-implant status, the condition of the implant supported prostheses, and plaque control.” Maintenance principles should include regular evaluation of implants and their surrounding tissues and prostheses; occlusal examination; review and reinforcement of oral hygiene; removal of plaque and calculus; treatment of disease or repair of prostheses, as required; and institution of customized preventive measures. Recent study showed the absence of preventive maintenance in individuals with pre-

existing peri-implant mucositis was associated with a high incidence of peri-implantitis. Clinical parameters, such as bleeding on peri-implant probing, periodontal probing depth and the presence of periodontitis were associated with a higher risk of developing peri-implantitis.

Identifying Failing Implant ³-Treatment options include identifying a failing implant to avoid continuous alveolar bone loss which might complicate the option of replacing the failed implant .

Implant Replacement -An implant that replaces a previously failed one could serve as a predictable procedure with reasonable survival rates. However, these survival rates are lower than the rates reported for first attempt single implant placement. Clinicians should remember that once an implant has failed, replacement of that implant is subjected to at least all the initial factors that led to the failure Treatment options for ailing and failing implants are varied from conservative to more aggressive therapy depending upon the situation. The overall goal of therapy is to arrest further loss of bone support, re-establish a healthy peri-implant mucosal seal& to regenerate hard & soft tissue to implant & abutment.

CONCLUSION

With any biomechanical entity, difficulties can arise in the area of biologic function as well as mechanical or engineering stability. Implant prosthodontics has been fraught with compromises and complications, which are frustrating to the patients and prosthodontists alike. Predicting the adverse implant events and knowledge of treating the failing implants becomes mandatory for every clinician.

Avoiding those conditions that contribute to poor results, choosing cases that offer ideal surgical and prosthetic circumstances and scrupulously evading

complex clinical challenges can improve favorable outcome data substantially.

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