

**IMPLANT FAILURE: - KNOW AND PREVENT**

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Abstract

Failures are stepping stones to success. Implant failures are now increasingly becoming common, hence a better understanding of the factors associated with implant failures will help prevent and facilitate clinical decision making and may enhance implant success. This review article summarizes and classifies implant failures into early and late failures, surgical and prosthetic failures, hence simplifying the protocol to help prevent and manage the same.

Key words: Dental implants, prosthetic failures, surgical failures, early failure, late failure

## **Introduction**

Dental implants have long been a successful treatment alternative for restoring missing teeth. Nevertheless, it has like with, as every surgical procedure, several potential complications which can occur and must be known in order to prevent or solve them.

Nowadays, implants are considered as the first line of treatment in almost all cases of complete or partial edentulous patients.

The majority of problems that can arise in implantology treatment are accidental, complications or iatrogenic errors, and could be a consequence of an inadequate indication such as<sup>1</sup>:

- Poor quality or quantity of bone
- An erroneous surgical technique
- Infections
- Lack of oral hygiene
- Smoking habit
- Systemic diseases that were poorly controlled

## **DEFINITIONS**

### **Implant failure**

- 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.<sup>1</sup>

**Iatrogenic failure and biologic failure**

Iatrogenic failure is one which is characterized by a stable and osseointegrated implant, but due to malpositioning it is prevented from being used as part of the anchorage unit.<sup>1</sup>

Biological failure can be defined as the inadequacy of the host tissue to establish or to maintain osseointegration.<sup>1</sup>

**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.<sup>2</sup>
- Ailing implants are those that are showing radiographic bone loss without inflammatory signs or mobility.<sup>3</sup>

**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, a peri-implant radiolucency, and a dull sound when percussed. A failed implant is non-functional and must be removed.<sup>3</sup>

Failed implants are those with progressive bone loss, with clinical mobility and that which are not functioning in the intended sense.<sup>1</sup>

### **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.<sup>1</sup>

### **PROBABLE FACTORS AFFECTING IMPLANT FAILURES;**

1. Older Age.
2. Osteoporosis.
3. Hypohydrotic ectodermal dysplasia.
4. Hypertension.
5. Oral Lesions such as oral lichen planus.
6. Myocardial infarction.
7. Congestive heart failure.
8. Sub acute endocarditis.
9. Uncontrolled Diabetes mellitus.
10. Smoking.
11. Oral cancer.
12. Cytotoxic chemotherapy.
13. Irradiation.
14. Sjogren syndrome.
15. Scleroderma.

16. Multiple myeloma.

17. Parkinson disease.

18. HIV.

## **IMPLANT SUCCESS CRITERIA**

Consideration must be given to evaluating the following criteria<sup>4</sup>:

- Success of the implant depends upon the case selection, type of bone quality, type of implant active or passive, surface treated or non-treated.
- The amount of bone loss following implant placement should be evaluated and should be not more than 0.2mm after 1 year of implant placement.
- Gingival health should be optimum i.e. absence of inflammation or recession.
- As the resistance of the periodontal fibers to the insertion of probe in the pocket around is less as compared to that around the natural tooth. The pocket depth around the implant should not be more than 2-4mm.
- After the functional loading of the implant it should not have any untoward affect on the adjacent or the opposing teeth.
- The implant should be in harmony to the adjacent soft and hard tissue structures for optimal form and function.
- Care must be taken after placing the implant in the aesthetic zone as less than sufficient bone support in the buccal aspect of the implant may lead to bone resorption and hence recession affecting gingival aesthetics.

- Adequate pre-operative planning should be done to avoid any surgical complications intra and post operatively such as infection, paresthesia or anesthesia.
- The operator must have a thorough knowledge, and assessment of the anatomical landmarks helps to avoid encroachment in the anatomical areas such as mandibular canal, maxillary sinus, mental nerve and nasal floor.
- Emotional and psychological attitude and satisfaction of the patient.

Smith and Zarb<sup>5</sup> have reviewed the success criteria given by different authors.

#### **According to Schnitman and Schulman<sup>2</sup>**

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

#### **According to Chainin, Silver Branch, Sher, and Salter<sup>1</sup>**

- In place for 60 months or more.
- Lack of significant evidence of cervical saucerization on radiographs.
- Freedom from hemorrhage according to Muhelman's index.
- Lack of mobility.

- Absence of pain and tenderness.
- No pericervical granulomatosis or gingival hyperplasia.
- No evidence of a widening peri-implant space on radiograph

### **According to Mckinney, Koth, and Steflik**

#### Subjective criteria

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

#### Objective criteria

- Good occlusal balance and vertical dimension.
- Bone loss no greater than one third of the vertical height of the implant, absence of symptoms and functionally stable after 5 years.
- Gingival inflammation vulnerable to treatment. •
- 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 success.<sup>2</sup>

In 1998 Esposito et al.<sup>4</sup> have listed out the various criteria for success which were agreed upon at the 1st European Workshop on Periodontology which is listed below-

- Absence of mobility

- An average radiographic marginal bone loss of less than 1.5 mm during the first year of function and less than 0.2 mm annually
- Absence of pain/paresthesia were to be considered success criteria for osseointegrated implants.
- It was also suggested that probing depths related to a fixed reference point and bleeding on probing should be measured.<sup>1</sup>

### **REVISED CRITERIA FOR IMPLANT SUCCESS**

According to Alberktson, Zarb, Washington, and Erickson there should be;

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

### **PARAMETERS USED FOR EVALUATING FAILING IMPLANTS**

The clinical signs previously discussed emerge only when the failure process reaches an irreversible state. However, the ideal parameter for monitoring implant conditions should be sensitive enough to distinguish early signs of implant failure. The following parameters have, therefore, been proposed.



### **Radiographically observed progressive marginal bone loss**

There seems to be unanimous consensus that progressive marginal bone loss is a pathological sign, which can lead to implant failure.

Alberktson et al. have suggested using less than 1.5 mm of marginal bone loss during the 1st year

- Mobility of less than 1 mm buccolingually, mesiodistally, and vertically.
- Absence of symptoms and infection associated with the dental implant.
- Absence of damage to adjacent tooth or teeth and their supporting structures.
- Absence of parasthesia or violation of mandibular canal, maxillary sinus, or floor of nasal passage.
- Healthy collagenous tissue without polymorphonuclear infiltration.

Adell et al. determined that the mean bone loss for Branemark osseointegrated implants is 1.5 mm for the first year, followed by a mean bone loss of 0.1 mm per year. This value was confirmed by Cox and Zarb with their 3-year report showing a mean bone loss of 1.6 mm for the first year and a mean of 0.13 mm in subsequent years. Because documentation demonstrates that a mean bone loss of not more than 0.2 mm per year after the first year is attainable, this figure should serve as a valid criterion for success.

### **Clinical signs of late infection**

A progressive marginal infection can lead to implant failure. However, clinical signs of infection such as hyperplastic soft tissues, suppuration (spontaneous, on probing or under pressure),

swelling, fistulation, color changes of the marginal peri-implant tissues are signs, which call for intervention to prevent failure of the dental implant.

In the absence of mobility and radiographic changes, these signs indicate more of a complication (amenable to treatment) than a failure.<sup>1</sup> Mombelli et al. compared clinical and microbiological findings related to healthy and failing dental implants. Unsuccessful implant sites were characterized by probing depths 6 mm or greater, suppuration, bone loss, and micro biota consisting primarily of gram negative anaerobic rods.<sup>6</sup>

William Becker et al. reported that failing implants showed evidence of increased mobility and a high incidence of periimplant radiolucency.<sup>5</sup>

### **Bleeding on probing**

Bleeding on probing has been employed to measure periimplant tissue conditions. However, recent findings suggest that it cannot be used to discriminate between a healthy or a diseased peri-implant state and it does not have a scientific support.<sup>4</sup>

### **Absence of keratinized mucosa**

A relationship and correlation between implant failure and absence of an adequate band of keratinized mucosa surrounding the abutment has been suggested. Esposito et al.<sup>7</sup> states that there seems to be a consensus that clinical data, acquired via an evidence based format have failed to show any correlation between the width of keratinized mucosa and implant failures. However, there might be some situations where the patient can benefit from the presence of attached keratinized tissue specifically to facilitate plaque removal.<sup>6</sup>

An implant was noted to have failed from infection if one or more of the following criteria were seen.

- Clinical signs of infection with classic symptoms of inflammation.
- High plaque and gingival indices.
- Pocketing.
- Bleeding.
- Suppuration.
- Attachment loss.
- Radiographic peri-implant radiolucency.
- Presence of glaucomatous tissue upon removal.

Implant was suspected to fail from traumatic conditions if the following conditions usually in combination existed -

- Radiographic peri-implant radiolucency.
- Mobility.
- Lack of glaucomatous tissue upon removal.
- Lack of increased probing depths.
- Low plaque and gingival indices.

## **CLASSIFICATIONS OF IMPLANT FAILURES**

Many factors are attributed to failure of the dental implant, either directly or indirectly.<sup>8</sup>

Various authors have classified implant failures depending on several criteria.

Rosenberg et al.<sup>9</sup> classified implant failures as

- Infectious failure
- Traumatic failure

Esposito et al. have classified oral implant failures according to the osseointegration concept.<sup>4</sup>

### **[1] Biological**

- Early or primary (before loading): failure to establish osseointegration.
- Late and secondary (after loading): failure to maintain the achieved osseointegration.

### **[2] Mechanical**

Fracture of implants, connecting screws, bridge frameworks, coating etc. Iatrogenic Nerve damages, wrong alignment of implants. Inadequate patient adaptation, Phonetical, esthetical, psychological problems.

Truhlar<sup>3</sup> 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 failures:**

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

Heydenrifik<sup>2</sup> further classified the late failure into.-

A) Soon late failures: Those occurring during the first year of loading.

B) Delayed late failures: Implants failing in subsequent years over a period of 5 years.

El Askary et al.<sup>4</sup> have divided the failures into 7 categories.

**1. According to etiology****i) 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.

**ii) Restorative problems**

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

**iii) 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.
- 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.

#### iv) **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)
- Bone loss (Radiographic changes)
- Both soft tissue and bone loss.

**Heydenrijik et al.<sup>2</sup> The authors classified implant failures referring to occurrence in time as;**

**Early failures**

Osseointegration has never been established, thus representing an interference with healing process.

**Late failures**

Osseointegration not maintained implying processes involving loss of osseointegration.

**Soon late failures**

Implants failing during the first year of loading.

**Delayed late failures**

Implants failing in subsequent years.

The authors suggest that early failures can occur prior to prosthetic rehabilitation due to-

- Surgical trauma
- Insufficient quantity of bone or quality
- Premature loading of the implant failures
- Bacterial infection.

**A Check list of Common predisposing surgical factors leading to failure of implant;**

1. Lack of primary stability due to a wider than indicated osteotomy site or very high torque application leading to failure of osteointegration.
2. Lack of primary closure of the wound in augmentation procedures.



3. Malpositioned implant or incorrectly placed angulated implant.
4. Implant surgery encroaching on the anatomic areas e.g. maxillary sinus, inferior alveolar nerve, mental nerve, nasal floor.
5. Presence of peri apical infections in immediately placed implant placement.
6. Less than adequate bone support for implant placed leading to dehiscence or gingival recession.
7. Intra operative infection or Post – operative infection.

**A check list of Common predisposing prosthetic considerations;**

1. Implant fracture
2. Implant screw fracture.
3. Fracture of tooth prosthesis or chipping of crown and bridge restoration.
4. Prosthetic offset from implant centre.
5. Improper height and width of restoration. (over-contoured/ under-contoured prosthesis).
6. Prosthesis over extension.
7. Improper fit of the restoration.

Other factors;

Bruxism,

TMJ problems,

Clenching.

## **CONCLUSION**

With many varying factors playing a role in implant failure, difficulties can arise in the area of biologic function as well as mechanical or engineering stability. Diagnosing the exact etiology for failure and knowledge of treating these failing implants becomes mandatory for every clinician. Case selection that offer ideal surgical and prosthetic circumstances and scrupulously evading complex clinical challenges can improve favorable outcome data substantially. Anticipating and diligently observing for implant fixture and restoration fracture is the first step in managing and detecting a declining clinical circumstance. It is not how well clinicians place implants, but how best they tackle complex situations and failures is what determines the skill of a clinician. Failures are stepping-stones to success only if the cause and the confounding factors are eradicated, managed and their occurrence is prevented. Hence, it is mandatory for every clinician to know, how and why failures occur and how best we can prevent them in order to give the upcoming branch of implant dentistry a new and successful horizon.

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