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FAILURES IN IMPLANT THERAPY- A REVIEW

Dental Science

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ABSTRACT

Since, the introduction of the concept of osseointegration, the success of dental implants has increased dramatically because of better understanding of bone response and the improvement in bone loading concept. Improper patient selection, accumulation of bacterial plaque because of poor oral hygiene, traumatic occlusion, debris retention resulting from improper prosthetic restoration, and bone preparation without the use of internally cooled, high torque, slow speed hand pieces have been the factors contributing to the breakdown of otherwise successful implants.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.

KEYWORDS

Classification of implants, Criteria for implant success, Implant failures, Osseointegration.

INTRODUCTION:

Dental implants are inert, alloplastic materials embedded in the maxilla and/or mandible for the management of tooth loss and to aid replacement of lost orofacial structures as a result of trauma, neoplasia and congenital defects. The goal of implant therapy is to provide long-term replacement for missing dentition on ideally positioned osseointegrated implants. Advances in radiographic imaging, splint construction, bone regeneration capabilities, and soft-tissue reconstruction permit placing implants predictably in acceptable positions.

Surgery for dental implants is a procedure with a high rate of patient success defined as providing a viable implant-supported prosthesis that satisfies the patient. However, as with any medical procedure, failures occur. In a few cases, acceptable surgical and prosthetic outcomes do not meet with satisfaction from the patient. Such failures probably often have little to do with the implant team's technical competence. As with most complex reconstruction procedures that involve a degree of collaboration between an imlantologist and a patient, patient factors that influence the imlantologist - patient relationship and the patient's compliance with imlantologist requests may play a key role in this procedure's ultimate success.

Classification of Implants :

Dental implants may be classified under four categories:
A - Depending on the placement within the tissues
B - Depending on the materials used
C - Depending on their reaction with bone
D - Depending on the treatment options

A)Depending On The Placement Within The Tissues:

Depending on the placement within the tissues, implants can be classified into

a)Endosseous – Root form
Blade (plate) form
Ramus frame

b)Sub-periosteal – Unilateral
Complete
Circumferential

c)Transosteal – Staple
Singlepin
Multiple pin

B)Depending On The Materials Used:

Based on the marerials used, the implants can be classified into-

a) **Metallic implants –** Titanium, Titanium alloy, Cobalt Chromium Molybednum alloy.
b) Non- metallic implants – Ceramics, Carbon etc.

C)Depending On Their Reaction With Bone:

Based on the ability of the implant to stimulate bone formation, implants can be classified into:
a) Bioactive implants – Hydroxyapatite
b) Bio-inert implants – Metals

D)Depending On The Treatment Options:

Misch in 1989 reported **five** prosthetic options of implants, of the five the first three are fixed prosthesis that may be partial or complete replacements, which in turn may be cemented or screw retained. The fixed prosthesis are classified based on the amount of hard and soft tissue structures that are to be replaced. The remaining two are removable prosthesis that are classified based on the support derived.

a) **FP- 1:** Fixed prosthesis; replaces only the crown; looks like a natural tooth.
b) **FP- 2:** Fixed prosthesis; replaces the crown and a portion of the root; crown contour appears normal in the occlusal half but is elongated or hypercontoured in the gingival half.
c) **FP- 3:** Fixed prosthesis; replaces missing crowns and gingival color and portion of the edentulous site; prosthesis most often uses denture teeth and acrylic gingival, but may be made of porcelain, or metal.
d) **RP-4:** Removable prosthesis; overdenture supported completely by implant.
e) **RP-5:** Removable prosthesis; overdenture supported by both soft tissue and implant.

Success and failure:

Albrektsson (1986) proposed the criteria for successful integration of dental implants have been. Of these, a lack of mobility is of prime importance as 'loosening' isthe most often cited reason for implant fixture removal. Adell (1981) reported the success rate of 895 implant fixtures over an observational period of 5 years after placement. Eighty-one per cent of maxillary and 91% of mandibular implants remained stable.

Despite high success rates, implant fixture failure may occur and is defined as 'the inadequacy of the host tissue to establish or maintain osseointegration. One review (Adell, 1990) suggested that 2% of implants failed to achieve osseointegration following placement. Using a meta-analysis, failure rates for Branemark dental implants were 7.7% (excluding bone grafts) over five years. Interestingly,

failure rates within edentulous patients were almost double those for partially dentate patients (7.6% versus 3.8%).

Signs and symptoms of failure for an implant are :

1) Horizontal mobility beyond 0.5mm or any clinically observed vertical movement under less than 500 g force,
2) Rapid progressive bone loss regardless of the stress reduction and periimplant therapy,
3) Pain during percussion or function,
4) Continued uncontrolled exudate in spite of surgical attempts at correction,
5) Generalized radiolucency around an implant,
6) More than one half of the surrounding bone is lost around an implant, and
7) Implants inserted in poor position , making them useless for prosthetic support.

Success Criteria For Dental Implants:

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 pericervicalgranulomatosis or gingival hyperplasia
7. No evidence of a widening peri-implant space on radiograph.

C - Mckinney, Koth, AndSteflik: 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.

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 success. Further, in 1998 **Esposito et al.** 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

It was also suggested that probing depths related to a fixed reference point and bleeding on probing should be measured. Several authors have expressed many criteria to assess the success of a functional implant. The success criteria, which were initially targeted for evaluation as 5 years survival has changed. With the improved technology and understanding of the tissue behaviour the criteria are set with a target of 10-year survival rate.

Diagnostic criteria employed for the evaluation of established implant failures (failed implants):

a)Clinical signs of early infection

During the healing period (3−9 months) complications such as swelling, fistulas, suppuration, early/late mucosal dehiscences, and oseteomyelitis, can occasionally be present and may indicate implant failure.

b)Pain or sensitivity

Pain or discomfort is often associated with mobility and could be one of the first signs which indicate an implant failure.

c)Clinical discernible mobility

Mobility is always a clear sign of failure. Once the clinician has distinguished between the mobility of a poorly connected abutment and the mobility of the underlying implant, the implant must be suspected to be surroundedby a fibrous tissue capsule.

Several different types of mobility have been recognized as follows:

- Rotation mobility
- Lateral or horizontal mobility
- Axial or vertical mobility.
- Occasionally, clinically discernible mobility can be present without distinct radiographic bone changes. Therefore, mobility is the cardinal sign of implant failure.

Radiographic signs of failure:

- There can be two well-distinct radiographic pictures: a thin peri-fixtural radiolucency surrounding the entire implant, suggesting the absence of a direct bone-implant contact and possibly a loss of stability, and an increased marginal bone loss.
- Since the distinction between the two radiographic pictures is not always clear, when a suspected peri-fixtural radiolucency or excessive marginal bone loss is observed, it is recommended to remove the prosthetic construction and cheek the implants for stability.
- Clinically discernible mobility after bridge removal can confirm the presumptive radiographic diagnosis of implant failure.

Dull sound at percussion

It has been suggested that a subdued sound upon percussion is indicative of soft tissue encapsulation, whereas a clear crystallization sound indicates successful osseointegration.

Parameters Used For Evaluating Failing Implants:

a)Radiographically observed progressive marginal bone loss

Alberktson et al. have suggested using less than 1.5 mm of marginal bone loss during the 1st year of loading and thereafter less than 0.2 mm yearly as success criteria.

- **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:
- 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, etc., are signs, which call for intervention.
- 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.

- **William Becker et al**:reported that failing implants showed evidence of increased mobility and a high incidence of periimplant radiolucencies.

- **Bleeding on probing:**Bleeding on probing has been employed to measure periimplant tissue conditions.

- **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.

Clasification of Implant Failures :
1)Rosenberg et al. classified implant failures as -
a) Infectious failureand
b) Traumatic failure

An implant was determined 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.
- Pocket.
- 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 existed.
- Radiographic peri-implant radiolucency.
- Mobility.
- Lack of glaucomatous tissue upon removal.
- Lack of increased probing depths.

Low plaque and gingival indices.

2) Esposito et al. have classified oral implant failures according to the osseointegration concept:

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.
3.Iatrogenic:
Nerve damages, wrong alignment of implants, etc.
4.Inadequate patient adaptation:
Phonetical, esthetical, psychological problems, etc.

3) Truhlar classified failures as
a) Early failures
That occur with in weeks to few months after placement.
Caused by factors that can interfere with normal healing processes or by an altered healing response.
b)Late failure
Failure that arise from pathologic processes that involve a previously osseointegrated implant.

4) Hobo et al. listed out the various complications occurring in implants as follows

1) Complications in Stage I surgery :
a) Inability to achieve LA
b) Surgical trauma- Penetration into a sinus, nasal cavity, or through inferior border of the mandible, Mental nerve damage Mucoperiosteal perforation,overheating
c) Excess countersink
d) Thread exposure
e) Eccentric drills, taps
f) Stripping of threads
g) Jaw fracture
h) Ecchymosis, more common in older patients.
i) Wound dehiscence
j) Facial space abscess submental, submandibular, Ludwig's angina
k) Suture abscess
l) Loose cover screw
m) Contamination

2) **Complications in Stage II surgery:**
a) Poor selection of fixture height
b) Incorrect fixture placement more than 35° cannot be used prosthetically
c) Damaged hex nut on top of fixture.
d) Loose abutment
e) Fractured abutment screw
f) Early loading by prostheses
g) Aspiration of instruments
h) Thread exposure
i) Fixture fractures
j) Excess bone resorption
k) Plaque/calculus formation, periodontal problems
l) Poor selection of abutment height.

3) Prosthetic complications:
a) Fracture of prostheses, gold screws, abutment screws
b) Insufficient space beneath the fully bone anchored prosthesis
c) Abutments penetrate through alveolar mucosa (unattached tissue).
d) Screw fractures: gold or abutment screws.
e) Acrylic or porcelain fracture
f) Posterior fixture failures in the maxilla.

4) El Askary et al have divided the failures into **seven** categories
1) According to etiology
a)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.

b)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.

c)Surgical placement
- Off axis placement (severe angulation)
- Lack of initial stabilization
- Impaired healing and infection because of improper flap design.
- 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.

d)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

3)According to timing of failure
- Before stage II (after surgery)
- At stage II (With healing head and or abutment insertion)
- After restoration.

There are **three etiologic factors** that lead to **Retrograde Peri-**

Implantitis. The first, implant factors, include contamination of the implant, and poor biocompatibility with the implant surface. e second factor, patient factors, include residual bacteria at the implant site, an adjacent endodontic lesion, residual root particles or foreign bodies, or poor bone quality. The third, the dentist factor, includes bone overheating, bone compression, and premature loading.

DISCUSSION:

Osseointegration, a term coined by **Branemark** and co-workers in early **1960**s, represents a direct connection between bone and implant without interposed soft tissue layers. The factors contributing to failure of osseointegration have been identified as medical status of the patient, smoking, bone quality, bone grafting, irradiation, bacterial contamination, lack of preoperative antibiotics, degree of surgical trauma, and operator experience. Furthermore, it appears that implant surface properties, roughness and premature loading influence the failure pattern.

The failure of the implant has a multifactorial dimension. Often many factors come together to cause the ultimate failure of the implant. One needs to identify the causemnot just to treat the present condition but also as a learning experience for future treatments. Proper data collection, patient feedback, and accurate diagnostic tool will help point out the reason for failure. An early intervention is always possible if regular check-ups are undertaken.

With significant achievements accomplished in the field of comp uterized implant-dentistry implant placement has become highly predictable, even in patients where implant surgery was contra-indicated formerly. As a result, attempts are now been made toward complete automation of implant-dentistry. Yet, keeping the limitation of high radiation dose, computerized implant-dentistry must be limited to anatomically complicated cases. Future tasks include advanced intraoperative imaging techniques for navigated surgeries along with sophisticated mechanized surgical tools and new robotic develop ments, which will revolutionize the field of implantology.

Although most of these studies have shown that the administration of vitamin D can improve the healing of the peri-implant bone tissue, it is not yet clear whether vitamin D supplements can promote the osseointegration of dental implants. Although the incidence of early implant failures was higher in patients with low serum levels of vitamin D, this study failed in proving an effective link between low levels of vitamin D in the blood and an increased risk of early implant failure. Further higher level studies (prospective controlled trials or, even better, randomized controlled clinical trials) with a more rigorous statistical analysis are therefore needed to investigate this issue. If an association between low serum levels of vitamin D and higher risk of early implant failure could be demonstrated, the clinician could give a set dose of vitamin D in the weeks before surgery, in order to normalize serum levels and obtain a positive effect on the healing process.

Despite the high success rates and stability of dental implants, failures do occur. While surgical trauma together with bone volume and quality are generally believed to be the most important etiological factors for early implant failures, the etiology of late failures is more controversial. Early detection and treatment of early progressive bone loss around dental implants by mechanical debridement, antimicrobial therapy, and regenerative therapy are the keys for saving early failing implants. A lost dental implant constitutes an ever-growing problem in clinical practice, one which is likely to intensify in the coming years since, the number of implants placed annually is still growing. The decision-making tree should be aimed at assisting and simplifying the process of selecting the appropriate alternative once a failure has occurred. Failure of dental implants should be perceived as part of the overall risk and consequences of modern dentistry.

With the success of dental implant treatment, new treatment protocols have been proposed. Immediate implant loading protocols provide patients with satisfactory results by reducing the time interval between implant surgery and prosthesis delivery. However, it is important that the practitioner carefully select the patients before suggesting dental implant treatment. Although the aforementioned factors may influence implant failure, prosthetic design also can play an important role in affecting the implant outcome; this topic is not covered in this review. The following is a list of some guidelines that can help practitioners prevent implant failure.

a. Clinicians should critically evaluate the patient's oral hygiene, compliance, motivation,and risk factors before suggesting dental implant treatment.
b. Achieving primary stability is important for successful implant placement.
c. Host-related factors, operative-related factors, and implant-related factors may influence the outcome of implant treatment and should be thoroughly evaluated during treatment planning.
d. Practitioners treating patients with systemic metabolic disorders, such as diabetes or osteoporosis, those undergoing radiation therapy, and those who smoke, should follow a 2-staged approach for optimal implant outcome. Further studies are needed for evaluating the response of these patients to immediate implant loading.

Additional clinical and histologic studies are needed for the evaluation of other etiologic factors that may influence implant failure.

Dental implants require constant maintenance and monitoring, which further involves assessment of the patient's general and oral health, professional implant maintenance, and diligent patient home care as critical factors that will ensure the long-term success of implants and a predictable replacement for natural teeth. Atypical maintenance visit for patients with dental implants should last 1 hour and should be scheduled every 3 months to evaluate any changes in their oral and general history. It is essential to have a proper instrument selection to prevent damage to the implant surface and trauma to the peri-implant tissues. As the number of patients opting for dental implants is increasing, it becomes increasingly essential to know the differences between natural teeth and implant care and accept the challenges of maintaining these restorations.

Significant difference in the failure rates of dental implants between smokers and non-smokers and smokersare at twice risk of implant failure compared to that in non-smokers and effect maxillary implant more compared to mandibular implants. Smoking have a significant effect on dental implants placed in patient having bone height less than 4 mm. Effect of smoking get worse with increased amount and duration of smoking per day. Effect of smoking on the dental implant can be reversed if patient follow smoking cessation protocols. Implant failures can be majorly categorised into 4 categories: biologic, mechanical, positional and esthetic. The most common failures i.e. the one associated with greater than 15% incidence rate are the mechanical failures which majorly includes: screw loosening, screw fracture, abutment fracture. Along with these a few uncommon complications may also occur during implant placement. Clinicians should be aware of the various failures and complications associated with dental implants, as they can be prevented by proper patient selection and treatment planning. While dealing with an implant failure, treatment plan should be made according to each patient taking into account all relevant variables. Patients should be well informed regarding all possible treatment modalities after implant failure and written consent taken for the chosen treatment option.

Thus several studies on implant failure showed that most of these failures can be prevented with proper patient selection and treatment planning.

CONCLUSION:

Since, the introduction of the concept of osseointegration, the success of dental implants has increased dramatically because of better understanding of bone response and the improvement in bone loading concept. Improper patient selection, accumulation of bacterial plaque because of poor oral hygiene, traumatic occlusion, debris retention resulting from improper prosthetic restoration, and bone preparation without the use of internally cooled, high torque, slow speed hand pieces have been the factors contributing to the breakdown of otherwise successful implants. Implant prosthodontics can be straightforward when fixture position and angulation are ideal. Component and framework breakage, inadequate tissue support, poor fixture position and angulation and fixture loss complicate prosthetic treatment and may compromise the final prosthetic result. Failure of the implant has a multifactorial dimension. Often many factors come together to cause the ultimate failure of the implant. One needs to identify the cause not just to treat the present condition but also as a learning experience for future treatments. Proper data collection, patient feedback, and accurate diagnostic tool will help point out the reason for failure. An early intervention is always possible if regular

check-ups are undertaken.

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