FAILURE IN ENDOSSEOUS IMPLANTS: AN OVERVIEW

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ABSTRACT

In present world endosseous dental implants have been a successful treatment alternative for restoring missing teeth. Dental implants have almost replaced old school fixed and removable prosthesis and with 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 concepts. As every treatment has its own pros and cons ,implants are also not successful in every case, as evidenced by reports reviewing the reasons for implant failures. The focus of implant research is shifting from descriptions of clinical success to the identification of factors associated with failure.

Keywords: Endosseous, Failure, Implant,Peri-implantitis,Tooth.

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INTRODUCTION

Implants helps a lot in replacing missing tooth. Although it is most successful procedure for replacing missing teeth but every good thing is associated with failures.[1] Some authors have related failures to biological or microbiological reasons, and others have attributed dental implant failures to biomechanical or biomaterial factors or implants surface treatment and characteristics.[2] 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 coolants, high torque, slow speed hand pieces, have been the factors contributing to the breakdown of otherwise successful implants.[3]

Definition of Implant Failure

The total failure of the implant to fulfill its purpose (functional, aesthetic or phonetic) because of mechanical or biological reasons.[4] Dental implants may fail for different reasons, with a range that differentiates between a failure and a complication. Esposito et al stated that this definition includes biological failures related to biological processes and mechanical failure of the component including fractures of implants, coatings, connecting screws and prosthesis.[5]

Tonetti and Schmidt classified dental implant failures chronologically as early and late failures. They presented the different elements in the understanding of the biomechanical equilibrium, where osseo-integrated implants and the surrounding bone represent a single functional unit that withstands repeated loading cycles.[2]

The concept of failure beyond the loss of integration has included esthetic, functional and phonetic reasons. Successful implant integration does not necessarily result in satisfaction in patient with high expectations.[6] Furthermore to avoid or decrease the percentage of failure caused by loading, a loading concept has been introduced by Misch so as to permit the physiology of bone to respond to the additional load; this concept is called progressive bone loading.[7]

Warning signs of implant failure[8]

- Connecting screw loosening
- Gingival bleeding and enlargement
- Connecting screw fracture
- Angular bone loss noted radiographically
- Fracture prosthetic component
- If there is long-standing infection and soft tissue sloughing during the healing period of first-stage surgery.

Classification[2]

According to condition

- Ailing Implant
- Failing Implant
- Failed Implant

According to Etiology

- Host factor
- Surgical factor
- Implant selection factor
- Restorative factor

According to timing of failure

- Before stage II
- After stage II
- After restoration

According to failure mode

- Lack of osseointegration
- Unacceptable aesthetics
- Functional problems
- Psychological problems

According to supporting tissue type

- Soft tissue loss
- Bone loss
- Combination

Host factor

- Medical status
- Habits
- Oral status

Medical Status

• Osteoporosis and other bone diseases[9,10]

Postmenopausal osteoporosis is a skeletal disorder in which there is a decrease in bone density and bone mass. It is considered to be a relative contraindication for osseointegrated implants, caused by decreased bone density, which negatively and substantially affects the

'implant-bone contact. Longer healing period, hyperbaric oxygen therapy, and therapeutic treatment for osteoporosis. The use of hydroxy apatite (HA) coated implants would help increase the implant-bone contact surface area with a biochemical bonding to the bone instead of mechanical bonding. The increased number of implants to support the prosthesis also is considered contributing factor for better load distribution.

• Uncontrolled diabetes[11]

Diabetes mellitus does not affect directly the failure of implants. Diabetes experience more infection in clean wounds than patients without diabetes. The liability of infection is probably caused by thinning and fragility of the blood vessels so as to alter blood supply.

Habits[12]

• **Smoking:** Studies have shown that 'One of the primary factors that leads to implant failure is smoking.

• Para functional habits

Habits such as bruxing and Clenching create mechanical and biologic complications related to prosthetic components, materials and Bone-anchored hardware or the state of osseointegration.

This is the most common cause of implant bone loss or lack of rigid fixation during first year after implant insertion

Oral Status[13,14]

Dental plaque is one of the main factors that leads to implant failure. Because the suprabony connective tissue fibres are oriented parallel to to the implant surface, it is susceptible to plaque accumulation and bacterial ingress.

Management

- Recall patient frequently, preferably at a minimum of 3-month intervals.
- Periodontal indices, bleeding on probing and radiographic evaluation should performed, using plastic tipped probes for checking pocket depths.
- Soft tissue debndement should be performed by means of plastic curettes and plastic tips.

Juvenile and rapidly progressive periodontitis

It seems that there is a strong link between periodontally involved patient and dental implant failure. Gram-negative anaerobic flora with high level of spirochetes associated with failing implants.

Irradiation Therapy

The relationship between dental implant failure and the irradiated patient is not clear. The main problem with irradiated patients is decreased salivary flow xerostomia, the liability for infection because of the decrease in blood supply and the possibility of osteoradionecrosis.

Surgical Factors[2]

- Off axis placement
- Lack of initial stabilization
- Impaired healing and infection
- Over heating of the bone and exerting too much of the pressure :
- Minimal space between the implants
- Placing the implants in immature bone grafted sites
- Placement of the implant in an infected socket or pathologic lesion

Dental implants may fail because of[15]

- placement of the fixture into either an infected socket
- an existing pathological lesion (e.g., 'cyst); or
- migration of infection from a neighboring tooth via marrow space

Implant Selection[16,17]

Improper Implant Type in Improper Bone Type: Qualitative and quantitative considerations of bone must be evaluated before placing implant. The quality of bone supporting the implant is important for long-term success. The amount

of bone available 'and the position of anatomic structures ultimately define the design of implant to be used and its location in the arch.

Length of the Implant (Too Short, Crown Root Ratio Unfavorable): The long-term success of the implant is dependent on the amount of bone-implant contact. Therefore, the placement of a short implant where bone permits a longer length (i.e., an 8-mm implant in a 12-mm ridge) would result in higher stress concentration leading to subsequent failure of the implant. The crown-implant body ratio affects the appearance of the final prosthesis along with the amount of moment of force on the implant and the crestal surrounding bone. Greater the crown-Implant ratio, the greater the amount of force with any lateral force .

Width of the implant: Misch Stated that the primarv criterion affecting the long-term survival of endosteal implants is the width of a available bone. It has been recommended that not less than 1 mm of bone surrounding the fixture labially and lingually, is mandatory for the long term predictability of dental implants because it maintains enough bone thickness and blood supply.

Number of the implants: Misch stated that the use of more implants decreases the number of pontics and the associated mechanics and strains on the prosthesis and dissipates stresses more effectively to the bone structure (specially at the crest). It also increases the implant bone inter-face and improves the ability of the fixed restoration to withstand forces.

Improper implant design[2,15]

Hollow implants (i.e., the hollow basket) affect the success rate negatively) more than the solid cylinders because of the dead space that is susceptible to infection. It is suggested that solid implants are better than hollow implants for long-term success .

Restorative Problems

Excessive cantilever: For partially edentulous patients, it places offset loads to the implant abutments and results in greater tensile and shear forces on cement or screw fixation. Fracture of the prosthesis, loss of osseointegration and bone fracture.

Pier Abutments:

Because of the difference in mean axial displacement between natural teeth and implants the breakdown of supporting tissues is extremely rapid because the dental implant will take most of the load as a result of difference in mean of axial displacement.

No passive fit:

To reduce stresses in the superstructure, implant components and bone adjacent to the implant, a passive fit is essential. Achieving a proper abutment fixture interface fit is critical. Improper locking between the two parts of the antirotational implant device leads to increased microbial population and increased strain on the implant components with subsequent bone loss and rapid screw joint fracture.

Misch prosthetic consideration for final treatment plan[18]

- Interarch space
- Implant permucosal
- Existing occlusal plane
- Arch relationship
- Arch form
- Existing occlusion
- Existing prostheses
- Number and location of missing teeth
- Lip line
- Mandibular flexure

Improper occlusal scheme[19,20]

The occlusal pattern of dental implants was derived from the basic occlusal concepts of natural teeth. Occlusal trauma on dental implants is more offensive than on natural teeth because of the force dissipation difrerence and because of differences in proprioception.

Bending moments: Bending overload can be

defined as a situation in which occlusal forces on an implant supported prosthesis exert a bending moment on the Implant cross section at the crestal bone, leading to marginal bone loss and/or eventual Implant fatigue.

Connecting implants to natural dentition: Because of the difference between natural tooth and dental implant movements in vertical and lateral directions, because of the potential differences in the way-natural teeth and implants would react to static and dynamic loading. Because of the difference in Proprioception, rigid connections between Implants and teeth are questionable

Premature loading: Too rapid loading of the implant support system is considered to be one of the most common causes of prosthetic related failure. Branemark stated that strict protocol requires a stress¬free healing period of 3 to 6 months for osseoingration to occur.

Excessive torquing: Preloading of the implant components was first accomplished by hand. Then, a torque wrench was introduced to apply a fixed amount of torque. Acid-etched surfaces resisted counter torque more successfully than blasted or machined surfaces .

According to timing of failure[2]

? Before stage II (after surgery)

? At stage II (with healing head and/or abutment insertion)

? After restoration

Before stage Ii[21]

It usually occurs as a result of

? Implant misplacement i.e. placement of the implant in an infected socket, pathological lesion, or immature bone previously augmented or placement of a contaminated implant in the osteotomy

? Infection or soft tissue complications

? Lack of biocompatibility

? Excessive surgical trauma

? Lack of primary stabilization of the implant

? The failed dental implant may appear to be an exfoliating fixture accompanied by a purulent exudates.

At Stage II (With Healing Head and/or Abutment Insertion)[22].

Dental implants may fail at a certain stage of treatment that does not fall in either of the two categories of early and late failure. It can fail at the second stage of surgery, during healing or head placement, at abutment connection and before prosthetic placement. A contaminated implant may stay in a dormant condition until torque is applied to the cover screw. Then it comes out because of lack of integration, which can result from the implant being placed in a wide osteotomy, the implant being loaded before the recommended time, or traumatic placement of the implant.The implant can stay in place asymptomatically because of its biocompatibility and may not manifest signs of infection, or it may remain in a sub-acute condition, with failure being obvious at the time of uncovering. It cannot be considered an early failure because it is not early enough, and it is not a late failure because it happened before prosthetic placement.

After restoration[1]

This particular timing of failure is most common and it occurs due to occlusal trauma which starts after an integrated implant is loaded and leads up to the point of discovery of the failure. It has its own clinical manifestations, known as peri implantitis.

Peri-implantitis[23]

Bacterial invasion of the peri-implant tissues results in soft tissue inflammatory changes and rapid bone loss. The clinical signs of inflammation, bleeding, and purulence, in addition to increased mobility, peri implant radiolucency, and probing depths greater than 6 mm, are associated with failing implants.

One of the main cause of implant failure

? It begins as peri-implant mucositis

? Completely edentulous mouth are at lesser risk than Partially edentulous mouth Higher chance of cross infection from periodontitis sites to implant site

Prevention

? Selection of implant candidate

? Complete periodontal therapy before implant placement

? Maintenance of good oral hygiene

? Regular recall appointments

? Early intervention , treatment at the stage of mucositis

Retrograde peri-implantitis[24,25]

Retrograde implant failure can be due to bone micro fractures caused by premature implant loading or overloading, trauma or occlusal factors. These are characterized by periapical radiographic bone loss without gingival inflammation. The microflora is consistent with periodontal health. The mechanism by which retrograde peri implantitis induces implant failure could be explained by the fact that once the biomechanical demand has exceeded the load bearing ability of the bone, microfractures may occur. They may also occur if micro damages accumulate faster than they can be repaired, a fatigue fracture at the bone implant interface may result.

Meffert stated that implants move minimally in bone compared with their natural counterparts because the periodontal ligament hypertrophies with increased function, allowing greater movement in bone. Another fact is that with overload, microfracturing of the bone occurs. In contrast, mineralized bone volume may be reduced around natural teeth, but in the absence of inflammation or periodontal disease, the situation is reversible once the overload is eliminated or reduced. Finally, a reduced areas of support exists in the root form implant compared with the natural teeth because the periodontal ligament is attached to a natural tooth with greater surface area and allows off axis loading.

Prevention

? Careful analysis of occlusal forces

? Increased no of implants

? Precise placement and distribution of implants

? Proper follow up

According to failure mode[2]

? Lack of osseointegration

? Unacceptable aesthetics

? Functional problems

? Psychological problems

Lack of Osseointegration[26,27]

? Osseointegration is defined as a direct contact established between normal remodeled bone and an implant surface without the interposition of connective tissue.

Adell et al proposed that lack of osseointegration can be due to

? Surgical trauma

? Perforation through covering mucoperiosteum during healing

? Repeated overloading with microfractures of the bone at early stages

Lack of osseointegration can occur during the early stages of treatment because of the inability to mineralize, which can result from surgical trauma, premature loading, infection, and surface contamination.

Signs of a failed implant

? Mobile

? Easy to remove with a counter torque

? Thin radiolucent zone around fixture radiographically

? Thin layer of soft tissue seen upon fixture removal

Unacceptable esthetics[28,29,30]

The esthetic outcome is affected by 4 factors :

- Improper placement
- Soft tissue management
- Bone grafting considerations
- Prosthetic considerations

The dimensional difference between the implant head and cervical cross section of the implant will hinder the optimal esthetics in the anterior region. Improper placement of the implant and improper soft tissue management around the implant will result in a dramatic failure. Another factor is the contour of the ridge in which the implant placed. Failure of the prosthodontist to replicate the patient's natural dentition in the final prosthesis may result in unnatural appearance.

Positional failure

Implant placement must be controlled and precise in order to support tooth like restorations, the restoration should guide implant placement and planning for implant placement must take into account the form and position of the restoration. Malposition of the implant can lead to biomechanical problems to the screw joint or in severe situations to the implant itself due to overload. The implant should be placed with at least 1mm of bone circumferentially; this will allow for the crestal bone loss which can occur around the implant. When implants are not placed in relation to teeth in aesthetic areas, poor aesthetics will ensue.

Differing depths of implant placement will result in uneven exit of the implant restorations from the soft tissue, again yielding less than ideal results. In these multiple implant situations the most apically placed implant should dictate the positions of the other implants placed. If the most apically planned implant causes the other implants to be too apical, the area should be grafted prior to implant placement of the implant site not used.

Biomechanical failures

These faliures include :

a) loosening of screws

b) breakage of implant components and implants.

But these failures can be avoided with proper treatment planning, a good understanding of screw joint mechanics and knowledge of the implant system used. In implant-restoration connections the screw acts much like a spring, the torque applied to the screw causes the threads to engage and continued torque after the components are seated causes the screw to elongate. The rebound of the stretched screw clamps the implant components together; this is known as the preload.

Functional problems[31]

The masticatory efficiency of an implant supported restoration can be affected by several factors. If the implant supported prosthesis does not fulfill such a function, it is considered to have failed because of failure of function Proper function of the implants is dependent on two main types of factors, anchorage related and prosthesis related.

? Anchorage related factors: Osseo integration and Marginal bone height.

? Prosthesis related factor: Prosthesis design and Occlusal scheme .

Psychological problems[32]

Failure to fulfill the patient expectations and failure to gain the patient acceptance and satisfaction with such treatment will definitely be considered part of the failure. Educational tools (eg, slides, radiographs, models, pictures, real cases, and computer imaging) should be used before surgery to give the patient an image of what he or she will look like after treatment.

According to supporting tissue type2

? Soft tissue problems

? Bone loss

? Both soft tissue and bone loss

Soft tissue problems[33,34]

Tonetti and Schmid stated that the late failures that occur as a result of peri¬implantitis (infectious etiology) occur because of defective function of the soft tissues. Soft tissue proliferation may occur under supporting bars

of over dentures. It may require simple excision if there is adequate attached keratinised tissue apical to it, or an inverse bevel resection as used in periodontal surgery to thin out the excess tissue but preserve the keratinised tissue to produce a zone of attached tissue around the abutment.

The marginal peri-abutment tissues should constitute a functional barrier between the oral environment and the host bone sealing off the osseous fixture site from noxious agents and thermal and mechanical trauma. Continous recession around implant followed by bone loss leads to failure of implant due to soft tissue problems .

Bone loss[35]

Loss of marginal bone occurs both during the healing period and after abutment connection. The amount of bone loss differs between the two periods and between both jaws. Bone loss in mandible is higher during the healing period. In maxilla, bone loss is higher after abutment connection. These differences could be due to the higher vascularity of the maxilla, which allows faster remodeling during the healing period and the compact nature of the mandible, which withstands applied functional forces much better after abutment connection.

Factors that contribute to marginal bone loss

? Surgical trauma such as detachment of the periosteum and damage cased during drilling

? Improper stress distribution caused by defective prosthetic design and occlusal trauma

? Physiological ridge resorption

? Gingivitis, which if allowed to progress will lead to ingression of bacteria and their toxins to the underlying osseous structures.

Both soft tissue and bone loss[36]

Although they are independent, soft tissue and bone around dental implants are two separate entities. Each alone could affect the survival of the implant, and each has its own mechanism for protecting the implant. Soft tissue around the dental implant forms a biological seal that protects the supporting structure. The ultimate function of the soft tissue as a barrier is reflected in the long term changes of the marginal bone height, where as marginal bone height affects the peri implant soft tissue directly. If failure starts from soft tissue, then it usually is considered to be due to a bacterial factor. However, if failure starts at the bone level, then it is considered to be due to a mechanical factor. Both bone and soft tissue may be involved together.

According to condition of the failure[2]

Meffert proposed a classification of failure including ailing, failing, and failed implants. He described ailing implants those showing radiographic bone loss without inflammatory signs or mobility. Such implants do not pose any indication of failure but with the progression of bone loss they could be greater risk of failure. Failing implants are characterized by progressive bone loss, signs of inflammation, and no mobility. These implants are usually in a reversible state (condition can be treated). Failed implants are those with progressive bone loss swith clinical mobility and that are not functioning in the intended-sense. Failed implant are usually encapsulated in a fibrous capsule. Radiographically, failed implants are characterized by diffuse radiolucency around them.

CONCLUSION

Regular review and maintenance of patients are essential to maintain the health of implant supporting tissues, to prevent minor complications and measure one's own long-term success at providing this treatment. With proper patient selection and treatment planning, using dental implants to support restorations replacing missing teeth can provide long lasting functional and aesthetic restorations.

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