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Implant Complications and Failures – A Review

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ABSTRACT

Background: The goal of modern dentistry is to restore the patient's dentition to normal contour, function, comfort, esthetics, speech, health and implant dentistry has the ability to achieve this goal. Although implant is considered to be a safe technique to replace tooth or teeth, certain complications are bound to occur with implants like any other surgical procedures. Implant surgery complications are frequent occurrences in dental practice and knowledge in the management of these cases is essential. The article highlights the complications in implant surgery, which helps to prevent them by proper patient selection, devising proper treatment plan and treating the implant cases in a way to avoid complications and failures associated with implants.

Keywords: Dental implants, Peri-mucositis, Peri-implantitis.

INTRODUCTION

Implant treatment is regarded as a safe technique with high rates of success. Nevertheless, it has, as every surgical procedure, several complications that can occur and that must be known in order to prevent or solve them. Implant related complications and failures can be grouped under four heads: (1) surgical complications, (2) biologic complications, (3) technical or mechanical complications and (4) esthetic and phonetic complications[1].

Proper precautions must be taken to prevent the risk of injury resulting from surgical procedures, including thorough medical history, a comprehensive clinical and radiographic examination and good surgical techniques. Surgical complications include perilous bleeding, damage to adjacent teeth, injury to nerves, and iatrogenic jaw fracture. Additionally, post-operative complications may arise such as hematoma or infection[1].

Biologic complications involve pathology of surrounding periimplant hard and soft tissues. Mechanical complications occur when strength of materials is no longer able to resist the forces that are being applied, leading to fracture.[1]Esthetic complications arise when patient expectations are not met. They generally result from poor implant placement and deficiencies in existing anatomy of the edentulous sites that were reconstructed with implants[1]. The vast majority of complications in implant surgery can be prevented by correctly selecting patients and treating difficult cases in the most adequate way, while knowing the risks, trying to avoid them with the necessary information and having carefully devised a specific plan for every patient.

CLASSIFICATION OF IMPLANT FAILURE

(I) El Askary et al.[2] have divided the failures into seven categories.

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1. Failures 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 oral hygiene, juvenile, and rapidly progressive periodontitis, irradiation therapy.

Medical Status

A. Osteoporosis and other bone diseases: Osteoporosis is considered to be a relative contraindication for osseointegrated implants, caused by decreased bone density, which negatively and substantially affects the implant-bone contact. Other bone diseases like Paget's disease and fibrous dysplasias are totally contradicted for implant therapy because of poor osseous architecture in these diseases.

B. Uncontrolled Diabetes: Implants are avoided in patients with uncontrolled diabetes because of increased liability of infection, impaired wound healing and surgical stress which can release endogenous norepinephrine causing significant increase in plasma glucose level thus worsening the condition.

Habits

A. Smoking: It is likely that long term smoking predisposes people to poor bone quality, which directly affects the lifespan of dental implants. It is also likely that reduced vascularity of bone is the predominant mechanism for failure in smokers. Also, impaired wound healing due to compromised polymorphonuclear leucocytes function is directly associated with the implant failures.

B. Parafunctional habits: Parafunctional habits such as bruxism and clenching create mechanical and biologic complications related to prosthetic components, materials, and bone-anchored hardware or for the state of osseointegration.

Oral Status

A. Poor oral hygiene: Poor oral hygiene is the main factor for implant failure. Plaque accumulation leads to loss of permucosal seal and ingress of bacteria. Subsequently, dental plaque is one of the main factors that lead to implant failure.

B. Juvenile and rapidly progressive periodontitis: Transmission of periodontopathic organisms from periodontitis sites to implant sites in the same mouth is a likely event. It calls the attention of the clinician to the potential cross infection from periodontitis sites to implant sites. It seems that there is a strong link between a periodontally involved patient and dental implant failure.

C. Irradiation therapy: The relationship between dental implant failure and irradiated patients is not clear. Irradiation for the treatment of oral cancer does not seem to reduce the survival rate of implants as compared with those placed in the non-irradiated jaw. The main problem with irradiated patients is decreased salivary flow, the liability for infection because of decreased blood flow and the possibility of osteoradionecrosis. The complication of radiation starts when the dose exceeds 64 Gy.

D. Systemic chemotherapy in cancer patient: With increasing use of systemic chemotherapy in the treatment of cancer, adverse oral effects such as infection, hemorrhage, mucositis and pain are commonly seen. Infectious complications can occur like painful localized peri-implant infections to numerous episodes of fever and septicemia. Also in some patients, complications like painfully abraded and lacerated atrophic oral mucosa may occur. All of the infectious, hemorrhagic, and mucosal complications follow the cytotoxic and myelosuppressive cycle induced by chemotherapy. Proper management of a dental patient about to undergo chemotherapy requires removal of implants either before therapy or retained with protective care provided[4].

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 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.

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. Failures according to origin of infection

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

3. Failures according to timing of failure

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

4. Failures according to condition of failure (clinical and radiographic status)

a. Ailing implants
b. Failing implants
c. Failed implants
d. Surviving implants.

5. Failures according to responsible personnel

a.Dentist (oral surgeon, prosthodontist, periodontist)
b. Dental hygienist
c. Laboratory technician
d. Patient.

6. Failures according to failure mode

a. Lack of osseointegration (usually mobility): Osseointegration is defined as "a direct functional and structural connection between living bone and the surface of a load-bearing implant"[3]. Adell et al[4] 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

b. Unacceptable esthetics: An implant with successful osseointegration and biointegration can still be a failure if the final prosthesis does not provide the optimal required esthetics. Failure to achieve proper esthetics could be due to several reasons, some of which are untreatable.
Aesthetic outcome is affected by four factors
- Implant placement
- Soft tissue management
- Bone grafting consideration
- Prosthetic consideration

c. Functional problems: 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 factor

A. Osseo integration
B. Marginal bone height
- Prosthesis related factor

A. Prosthesis design
B. Occlusal scheme

d. Psychological problems: Because of the possibly high expectations of the patient regarding esthetics, some patients believe that dental implants are a replica of natural teeth. If these expectations are not fulfilled, the patient may become depressed. Failure to fulfil the patient's expectations and failure to gain acceptance and satisfaction with such treatment will definitely be considered part of the failure.

7. Failures according to supporting tissue type

a. Soft tissue problems (lack of keratinized tissues, inflammation, etc.): 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. Gingival loss leads to continuous recession around the implant with subsequent bone loss. This will lead to a soft tissue type of failure.

b. Bone loss (Radiographic changes, etc.): Loss of marginal bone occurs both during the healing period and after abutment connection. The loss is accounted for as the remodeling process of the bone. The amount of bone loss differs between the two periods and between both jaws. Factors that contribute to marginal bone loss are:-

- 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.

c. Both soft tissue and bone loss: 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, whereas marginal bone height affects the periimplant 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.

(II)Failures according to Heydenrijiket al.[5]

The authors classified implant failures referring to occurrence in time as

1. Early failures: Osseointegration has never been established, thus representing an interference with healing process. Occur prior to prosthetic rehabilitation. Causes attributed to early implant failures

a. Surgical trauma
b. Insufficient quantity of bone or quality
c. Premature loading of the implant failures
d. Bacterial infection.

2. Late failures: Osseointegration not maintained implying processes involving loss of osseointegration. Late failures, which occur following prosthetic rehabilitation have been divided into:

a. Soon late failures- Implants failing during the first year of loading. Overloading in relation to poor bone quality and insufficient bone volume.
b. Delayed late failures- Implants failing in subsequent years. Progressive changes of the loading conditions in relation to bone quality and volume and peri-implantitis.

BIOLOGIC COMPLICATIONS OF IMPLANTS

Osseointegration is defined as "direct functional and structural connection between living bone and the surface of a load-bearing implant". Biological failure can be defined as the inadequacy of the host tissue to establish or to maintain osseointegration. Peri-implant diseases, i.e. periimplant mucositis and peri-implantitis, were subsequently defined in consensus reports from the 1st and the 6th European Workshop on Periodontology. Accordingly the term 'periimplant mucositis' was defined as "reversible inflammatory reactions in the soft tissues surrounding a functioning implant" and peri-implantitis was "inflammatory reactions with loss of supporting bone in the tissues surrounding a functioning implant".

Periimplant mucositis

The clinical features of peri-implant mucositis are in many respects similar to those of in gingivitis at teeth and include classical symptoms of inflammation, such as swelling and redness and bleeding on probing.

Periimplantitis

Peri-implantitis represents a clinical condition that includes the presence of (1) an inflammatory lesion in the peri-implant mucosa and (2) loss of periimplant bone. The assessment of the diagnosis periimplantitis must consequently require detection of both bleeding on probing (BoP) as well as bone loss in radiographs.

Peri-implantitis has been defined by Meffert as the progressive loss of peri-implant bone as well as soft tissue inflammatory changes[6].

Richard Truchlar[7] defined Peri-implant disease as a general category of pathological changes of the peri-implant tissues.

Etiology And Pathogenesis Of Peri-Implantitis

Richard S. Truhlar studied the various factors that lead to peri-implantitis. The author divided the failures into early and late fixture failure[7].

Multiple studies have demonstrated that maintenance of optimal soft tissue health around functioning implants results in a peri-implant microflora predominated by streptococci and non-motile rods. This is essentially identical to the microflora around healthy teeth.

The microbiota around the failing implants exhibited an increase proportion of gram negative anaerobic rods and spirochetes. Rosenberg et al have divided the implant failure as infectious and traumatic and found that the implants failing due to infection demonstrated spirochetes and motile rods

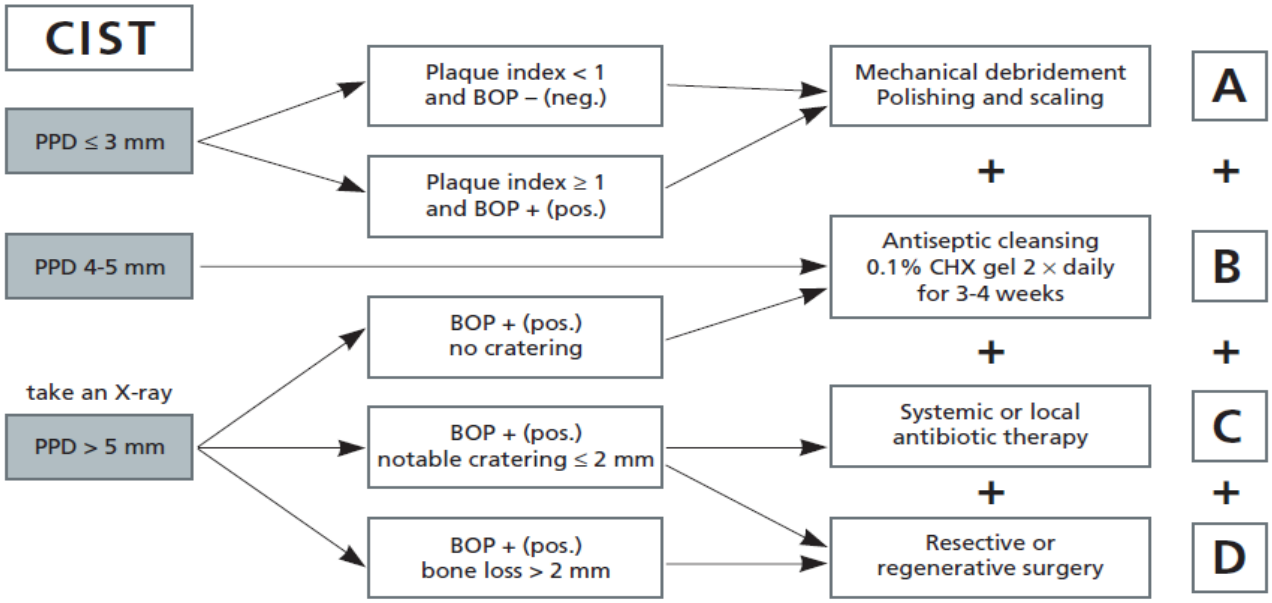

Fig 1: Schematic representation of CIST.

(42%)[8]. In contrast implants failing from suspected traumatic etiology were predominated by streptococci.

The percentage of pathogens in fully edentulous patients were comparatively less than those with partially edentulous condition. The microbiota in the edentulous conditions predominated with gram positive facultative cocci and non- motile rods, whereas the proportion of motile rods, spirochetes and cocci increased in partially edentulous conditions.

Periimplantitis Classification

It is also possible to classify the various stages of periimplantitis with regard to the required therapy. The basis for this classification was the clinical status of periimplant bone during the various stages of periimplantitis, although no sharp demarcations exist between those stages[9].

Class I- slight horizontal bone loss with minimal peri implant defects.

Class II- moderate horizontal bone loss with isolated vertical defects.

Class III- moderate to advanced horizontal bone loss with broad circular bony defects.

Class IV- advanced horizontal bone loss with broad, circumferential defects, as well as loss of the oral and/or vestibular bony wall.

TREATMENT OF PERIIMPLANTITIS

The principal objectives of the treatment of peri-implantitis are to reduce bacterial colonization of the surface of the implant, mechanically eliminate the bacterial microbiota, and introduce an ecology capable of suppressing the subgingival anaerobic flora. Both surgical and nonsurgical techniques have been developed to this effect.

Cumulative interceptive supportive therapy (CIST):

Depending on the clinical and eventually the radiographic diagnosis, a protocol of therapeutic

measures has been designed to head off the development of peri-implant lesions. This system is cumulative in nature and includes four steps. (Figure 1)

SURGICAL COMPLICATIONS OF IMPLANTS

Surgical complications are divided into two i.e. soft tissue complications and hard tissue complications.

1. Soft tissue complications include:

a. Haemorrhage in the form of petechiae, purpura, ecchymosis or hematoma.
b. Injury to inferior alveolar nerve or lingual nerve when placing implants in themandible
c. Tissue emphysema by inadvertent introduction of air into tissues under the skin or mucous membranes.
d. Wound Dehiscence and exposure of graft material or barrier membrane
e. Aspiration or ingestion of foreign objects
f. Pain control

2. Hard tissue complications include:

a. Periapical Implant Pathosis and retrograde periimplantitis
b. Mandibular Jaw Fracture
c. Lack of Primary Implant Stability
d. Inadvertent Penetration Into Maxillary Sinus or Nasal Fossa
e. Complication associated with maxillary sinus lift like membrane perforation and post-operative sinusitis

MECHANICAL COMPLICATIONS OF IMPLANTS

1. Overdenture complications include loss of attachment retention or fracture of the attachment system, fracture of components of the denture, prosthesis-related adjustments, etc.
2. Fracture of fixed restoration veneers/fixed restorations
3. Fracture of implant supported complete denture
4. Implant screw-related complications like screw loosening
5. Abutment-related complications like incomplete seating of the abutment to the implant body
6. Improper implant angulation

AESTHETIC COMPLICATIONS OF IMPLANTS

Aesthetic complications of implants can arise at the stage of:

1. Presurgical planning,
2. Surgical phase, and
3. Prosthetic phase.

1. Pre-surgical planning:

a. Presence of sufficient bone: Lack of available bone in any of the three dimensions may lead to buccal recession, lack of interdental papilla, and poor implant positioning.

b. Soft tissue analysis should be done in terms of amount of keratinized gingiva, examining the interdental papilla and recession

c. Gingival biotype: The patient's biotype determines how the periodontium will respond to implant placement and will affect the ideal implant type and size to maximize esthetics in that patient.

d. Implant Selection: Selecting the correct implant diameter or platform size contributes significantly to achieving an acceptable emergence profile for the final prosthesis.

e. Number of Teeth to be Replaced: In cases of multiple implants, it has been suggested that reducing the number of implants and placing pontics in between implants will improve the esthetic outcome[10].

2. Surgical phase

a. Flapless Surgery Versus Flap: Using a flapless surgical approach like the "tissue punch"[11] may provide a more esthetic outcome for patients, although it prevents full visualization of bony defects in the area (which could potentially result in unesthetic recession if undetected).

b. Surgical Guides: Properly positioned implants are necessary for esthetics and the use of surgical templates are a valuable way to ensure their accurate placement.

c. Malpositioning of Implant: malpositioning of implant can occur in any of the directions: mesiodistal, labiolingual or apicocoronal. Any of the malpositioning leads to poor implant appearance.

d. Provisionalization: Immediate provisionalization of the soft tissue overlying the implant can help to optimize esthetics by shaping the soft-tissue emergence profile[12]. Utilizing these restorations can also maintain interdental papillae until the final restoration is placed.

3. Prosthetic phase

Potential esthetic complications should be identified in the presurgical planning phase and appropriate modifications in treatment planning and surgery should be made to optimize esthetics. In the event that an unesthetic situation arises, there are some prosthetic adjustments that can be made to disguise and minimize the unesthetic result.

Angled abutments to correct slight inaccuracies in placement, fabricating restorations with a wider contact area, soft-tissue grafting, using pink porcelain, and ceramic abutments may all benefit implant esthetics[13,14].

CONCLUSION

Failure of 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-up are undertaken.

Fortunately, serious complications associated with dental implant placement are uncommon, and less severe situations can often be avoided. Preplanning using diagnostic radiographs, wax-ups, and attention to detail before and during implant procedures can help to avoid problems. Other methods that can be used to enhance success include the following: create a checklist of things that might be overlooked, confirm equipment is working before it is needed, carry out routine tasks with care and attention, follow procedures as planned and modify as required, check and recheck procedures for possible errors, and assess completed work with respect to what was planned. Recognition of a developing problem and prompt management reduce postoperative complications. Finally, proper training should be obtained before advanced surgical or prosthodontic procedures are undertaken.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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