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Review Article

FAILURES IN DENTAL IMPLANTS: A REVIEW.

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ABSTRACT

The use of oral implants in the rehabilitation of partially and fully edentulous patients is widely accepted. Despite high success rates, implant failures do occur. All failures should be carefully analyzed and evaluated to identify their causes in order to prevent future reoccurrence. Most of these failures can be prevented with proper patient selection and treatment planning. Every attempt must be made to keep implant failures to a minimum. The purpose of this review is to highlight the implant failures and discuss major etiologic factors as well as the parameters used for evaluating such failures.

Keywords: Dental Implants, Implant Failures, Implant Complications, Implant Mobility, Peri-Implantitis

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[1]. Implantology is continually developing, as new research results provide a better understanding of the biologic principles that direct the development of a dynamic interface between the living tissue and an artificial structure[2]. In recent years, oral implants are considered the treatment of choice in an increasing number of carefully selected cases[3].Success criteria for implants have been proposed previously by several authors and the report by Albrektsson et al[4] is widely used today. The conference on osseointegration in clinical dentistry in Toronto in 1982 developed more restricted criteria for implantation success rates which state that for an implant to be successful, it must have a survival rate of 95% in a 5-year follow-up and 80% in a10-year follow-up. A number of clinical follow-up studies since that conference have reported success rates higher than 90% for mandibular implants and slightly below 90% for maxillary implants. Thus it is generally acknowledged that if patients are selected carefully, implantation prognosis can approximate 100%[5]. Despite of these high success rates, implant fixture failure may occur and is defined as the inadequacy of the host tissue to establish or maintain osseointegration[1].

The purpose of this article was to review different types of complications that have been reported in conjunction with implants and implant prostheses.

I) PARAMETERS USED FOR EVALUATING IMPLANT FAILURE

The most common diagnostic criteria used for the assessment of implant failures are:

1) Pain:

Pain from the implant body does not occur unless the implant is mobile and surrounded by inflamed tissue or has rigid fixation but impinges on a nerve. Pain during function from an implant body is a subjective criterion that places the implant in the failure category[6].

2) Infection:

Infection is the most common explanation for complications that might occur during the healing period. These complications may include swelling; fistulas, suppuration and early/late mucosal dehiscence can occur and may point to implant failure. The signs of infection either early or late should not be used alone to determine the fate of an implant, but should be evaluated in relation to other parameters such as radiographic changes and mobility[2].

3) Probing depth:

Probing depths around teeth are an excellent proven means to assess the past and present health of natural teeth, but probing depths around implants may be of little diagnostic value, unless accompanied by signs (e.g., radiographic radiolucencies, purulent exudate, bleeding) and/or symptoms (e.g., discomfort, pain)[6].

4) Mobility:

Mobility of implants is the key sign of their failure. This clinically noticeable situation can, occasionally, be present without distinct radiographic signs of bone changes. Several

different kinds of mobility: horizontal, vertical and rotation mobility have been recognized. The reverse-torque test was proposed to discover mobile implants and the periotest device can be used for a better evaluation of horizontal mobility. While rotational mobility may reflect an immature bone/implant interface, horizontal and vertical mobility on the other hand, may be associated with bone loss and the presence of soft tissue capsule[2].

5) Radiographic bone loss:

The radiographic examination remains one of the main tools for recognition of failed implants in clinical practice. Standardized periapical radiographs should be taken at regular follow-up intervals to detect peri-implant radiolucency and/or progressive marginal bone loss. The peri-implant radiolucency suggests the absence of direct bone-implant contact and possibly a loss of stability, whereas in the case of increased marginal bone loss, the implant can be stable[2].

II) CLASSIFICATION OF FAILURES

Implants can be described as failing or failed. A failing implant demonstrates a progressive loss of supporting bone but is clinically immobile, whereas a failed implant is clinically mobile[7]. Various authors have proposed different classifications for implant failures. They are:

A) According to E S Rosenberg, J P Torosian and J Slots[8].

1) Infectious failure which included: High plaque indices and gingival indices, pocketing, bleeding, suppuration, attachment loss, radiographic peri-implant radiolucency, presence of granulomatous tissue upon removal.

2) Traumatic failure which included: Radiographic peri-implant radiolucency, mobility, lack of granlomatous tissue upon removal, lack of increasing probing depth, low plaque and gingival indices.

B) According to Abdel Salem El Askary, Ronald Meffert[9].

1) According to etiology: Host factor, surgical factor, implant selection factor, restorative factor.

2) According to timing of failure: Before stage II, after stage II, after restoration.

3) According to origin of infection: Peri-implantitis, retrograde peri-implantitis.

4) According to failure mode: Lack of osseointegration, unacceptable aesthetics, functional problems, psychological problems.

5) According to condition of failure: Ailing implant, failing implant, failed implant, Surviving implant.

6) According to supporting tissue type: Soft tissue loss, bone loss, combination.

C) According to Kees Heydenrijik, Henny JA Meijer: Early failures, late failures[10].

D) According to Marco Esposito, Jan Michael Hirsh: Biological, mechanical, iatrogenic failures[11].

E) According to Charles Goodacre[12].

I) Surgical complications.

II) Implant loss.

III) Bone loss.

IV) Peri-implant soft tissue complications.

V) Mechanical complications.

VI) Esthetic/phonetic complications.

III) IMPLANT FAILURES

I) Surgical complications

Surgical complications during implant placement are not uncommon. Kelly Misch[13] stated that implant complications can be outlined in four categories i.e. treatment plan-related, anatomy related, procedure-related, and other.

1) Treatment plan-related complications :

i) Wrong Angulation

Implant angulation is yet another determinant for implant success. Proper angulation should be determined according to the future prosthesis with the consideration of bucco-lingual, apico-coronal, and mesio-distal positions. The surgery should be planned for suitable angulation at the onset. Surgical guides can help to control the implant placement angle if they are made and used correctly. Mandibular teeth in the natural dentition are lingually inclined in relation to both the mandibular base, specifically as 109 degrees, as well as the maxillary opposing arch dentition (eg, lingual cusp buccal inclination) and therefore implants should be placed at a similar inclination. Failure to do so may result in perforation of the lingual concavity, constriction of the lingual space or damage of the lingual artery. Restorations may be difficult to restore due to tongue impingement or incorrect opposing positions. In the posterior mandible, limited mouth opening prevents the drill and implant carrier from fitting correctly in the vertical direction. Teeth adjacent to implant sites and surgical guides with long drill channels often require the use of drill extensions and maximum opening by the patient which may be strenuous. Short breaks to relieve muscle tension, using a bite block and having the patient shift their jaw to the opposite side can help ensure the correct angulation of the drill.

ii)Improper Implant Location

Adjacent teeth should be at least 1.5 mm from the implant body and more than 3 to 4 mm between adjacent implants to prevent horizontal bone loss as well as to preserve esthetics.Preoperative measurements and planning are essential to achieve an ideal implant placement that facilitates future implant prosthesis. Placing an implant in the wrong location is a frustrating, embarrassing and avoidable complication. Measurements (eg, interocclusal, interdental, ridge height, and ridge width) confirm whether implants are indicated in the first place. The spatial orientation should be in line with the occlusal plane and centered according to the opposing occlusion to prevent cross bites or additional stresses on the prosthesis. Many times fixtures are ideally intended for one specific position to be in the proper occlusion. If more than one implant is to be placed, a diagnostic wax-up should be used to determine the correct implant locations. At the very least, drawing and measuring on the stone casts will allow for calculations and treatment planning.

2) Anatomy-related complications

i)Nerve Injury

When placing implants in the mandible, proper radiographs and pretreatment planning must be done to ensure complete aversion of the inferior alveolar, mental, incisive or lingual nerves. If the mandibular canal cannot be seen on a panoramic radiograph, a computer tomography (CT) scan should be taken to verify the location. The potential risks and complications of injury or damage to these vital structures should be included on the informed consent to avoid liability in cases of lawsuits.

Possible causes of nerve injury include poor flap design, traumatic flap reflection, accidental intraneural injection, traction on the mental nerve in an elevated flap, penetration of the osteotomy preparation and compression of the implant body into the canal. If the situation is the latter, the implant needs to be removed, or a shorter body implant should be placed instead. Within days or months, minor trauma injuries usually heal but permanent damage from neuritis can occur. Treatment options include neuronal anti-inflammatory drugs such as clonazepam, carbamazepine or vitamin B-complex, although marginal effects have been shown. Referral and treatment for IAN injuries should be done immediately before distal nerve degeneration develops.

ii) Bleeding

Life-threatening events associated with dental implants are rare but major complications such as severe hemorrhage are more common and Goodacre et al,[12] found hemorrhage-related implant complications had an incidence of 24%. Potential causes include incision of arteries in soft tissue, osteotomy preparation, and lateral wall sinus lift procedures. Risk sites as described above in the posterior mandible include the sublingual fossa and lingual cortex. A ruptured artery in the area within 30 minutes, can cause a blood loss rate of 14 ml/min and if %500 ml of blood loss occurs, hypotension can result. Life-threatening airway obstruction is a serious threat and early treatment is essential. Treatment involves having the patient stick out their tongue to compress the blood vessels against the body of the mandible. Extraoral pressure to the submental or submandibular arteries for 20 minutes against the body of the mandible helps. The posterior superior alveolar and infraorbital arteries are located approximately 19 mm above the maxillary alveolar ridge, and the anastomoses of these arteries can pose a risk during sinus lift procedures by lateral window preparation. Bone wax, pressure, crushing, and electrocautery can alleviate hemorrhage. Hemorrhage treatments at implant osteotomy sites include compression, finger pressure, vasoconstriction, cautery, bone graft, bone cement, and ligation of arteries.

iii)Cortical Plate Perforation

The buccal cortical plate varies in thickness throughout the mouth and traumatic dental extractions can cause markedly thin plates or concavities, as well as overall ridge width deficiency.When preparing osteotomy sites or placing implant fixtures in areas with minimal labial plate thickness, or if the implant is placed too buccally, a fenestration or dehiscence implant defect is a common finding. A fenestration leaves intact bone coronally with the exposed threads at the apical portion of the crest, whereas a dehiscence defect has the coronal portion of the implant exposed. Immediate correction with particulate bone grafting with or without a membrane during the time of implant placement, can be done as long as primary stability has been achieved. “Flapless” implant surgeries should be avoided in areas of potential perforation of the buccal or lingual bone.

iv) Sinus Membrane Complications

In the maxillary posterior, the proximity of the sinuses can create a problem for dental implants if there is minimal residual crestal bone for stability. Tatum[14] stated maxillary sinus lift technique is an accepted procedure.

v) Devitalization of Adjacent Teeth

Adjacent teeth at implant recipient sites should be evaluated before implant placement. Pulpal and periradicular conditions such as small periapical radiolucencies, root resorption and large restorations in/near the vital pulp are often misdiagnosed. If endodontic pathosis is identified, root canal treatment or extraction should be initiated before implant placement to prevent microbial contamination of the implant during healing and possible failure. Dilacerated roots and excessive tilting in the mesiodistal direction that invade the implant space often prevent ideal placement. If a drill and/or implant fixture invades the PDL, hard tooth structure and/or vital pulp, this will lead to endodontic lesions. Devitalization of an adjacent tooth next to an implant delays treatment and adds additional financial burden for both the patient and surgeon. A proper surgical guide and a careful radiograph analysis are necessary to avoid improper angulation and hidden dilacerated roots.

3) Procedure related complications

i) Mechanical Complications

Situations deeming an implant as “hopeless” are usually associated with surgical trauma during osteotomy preparation with the drill. Ericsson and Albrektsson[15] showed bone resorption occurred at 47°C when drilling was applied for more than 1 minute in rabbits. The result obtained from this study leads to the conclusion that if temperature or duration increases while drilling in bone, necrosis can occur causing detrimental effects for osseointegration. To reduce frictional heat, high speed handpieces, an up-down motion technique of the bone preparation, and copious irrigation can be used. Misch[16] recommends using external and/or internal irrigation, as well as cool saline irrigation, intermittent pressure on the drills, pausing every 3 to 5 seconds, using new drills, and an incremental drill sequence. Generating less heat by preparing implant sites at 2500 rpm may decrease osseous damage. According to Quirynen et al[17],over preparation or over heating osteotomies can result in inactive and active retrograde peri-implantitis lesions that can be detected on radiographs as periapical radiolucencies up to a month after insertion. Clinically, these lesions are asymptomatic and radiographically, they present as periapical radiolucencies. As long as the radiolucency stays stable in size and the implant is integrated, no treatment is necessary. In contrast, problems with microbial invasion during surgery, such as implant contamination during insertion or placing the implant into an area with previous inflammation (eg, endodontic lesion) can lead to active lesions. A risk of successful treatment can be considered in extraction sites with a history of failed endodontic treatment or adjacent teeth with endodontic pathology.

ii) Lack of Primary Stability

Lack of primary stability is a surgical complication that should be dealt with at the time of implant surgery. An unstable implant should be removed or an attempt to place a larger diameter should be completed. To leave an unstable implant without action can often lead to fibrous encapsulation that causes implant failure. Nonetheless, bone fill will occur in immediate implants placed into extraction sockets with a

marginal defect lateral to the implant wider than 1 mm but primary stability is still a requirement.

iii) Mandibular Fracture

Attempts to place implants in patients with severely atrophic mandibles increases the risk of fracture, especially when monocortical grafts and ridge-splitting surgeries are completed. In patients who present with osteomalacia or osteoporosis, implant placement may subject the brittle bone to splintering because of the loading or frictional forces. Other reasons for mandibular fracture may include using the wrong implant (eg, 10 mm site preparation with intent of placing a 12 or 14 mm implant).

iv) Ingestion and Aspiration

Extreme caution should be emphasized when handling small implant components in the oral cavity. Components winding up on the floor or down a patient's throat can be embarrassing and expensive mishaps, not to mention serious implications could occur if aspiration takes place. Most instruments have a special tip to help ensure screws and abutments transfer directly from the surgical tray into the patient's mouth, but nevertheless, accidents happen unfortunately. For these reasons, preventative measures such as gauze throat screens and floss ligatures on implant pieces are encouraged.

II) Implant loss

Implant loss was evaluated by Charles J. Goodacre[12], in relationship to the factors like prosthesis/arch, time of loss, implant length, bone quality, and systemic conditions. Because the success of the implants and the number/ severity of the complications vary with the type of prosthesis that is used, categorization by type of prosthesis was used as a convenient means of reporting complications. Studies indicate that with both implant fixed complete dentures and implant overdentures, the implant loss in the maxilla was much greater than the mandibular implant loss .With implant fixed partial dentures, the maxillary and mandibular implant loss rates were the same. With fixed complete dentures, implant overdentures and implant fixed partial dentures preprosthetic implant loss was more than postprosthetic implant loss. More implant loss was observed during first year of prosthesis placement. Implant loss was more in implant less than 10 mm in length compared to that of length greater than 10mm. Implant loss was less in type I, type II, type III than in type IV.Several factors produce systemic changes that have been evaluated for their effect on implant success/failure. These items include smoking, radiation therapy, diabetes, chemotherapy, osteoporosis, hormone replacement therapy, scleroderma, Sjogren's syndrome, Parkinson's disease, multiple myeloma, and an HIV-seropositivestatus.

Implant failures related to overload include those situations in which the functional load applied to the implants exceeds the capacity of the bone to withstand it. Failures that happen between abutment connection and delivery of the prosthesis, probably caused by unfavorable loading conditions or induced by the prosthetic procedure, considered to have an overload etiology[1].

III) Bone loss

The patient's oral hygiene has a significant impact on the stability of the marginal bone around osseointegrated implants. Even in fully edentulous patients, poor oral hygiene is related to increased peri-implant bone loss, especially in smokers[2].Stress concentrations in the marginal bone resulting from occlusal''overload'' may cause marginal boneloss[18].

IV) Peri-implant soft tissue complications

Peri-implant complications that have been reported include fenestration/dehiscence, gingival inflammation/proliferation, and fistula[11]. Marginal tissue breakdown around implants, induced by subgingival ligature placement, seems to have microbial similarities with periodontitis. This can suggest that peri-implantitis is induced and promoted by the same mechanisms as in periodontitis.It is however also possible that the deepened pockets, easily created with ligatures around implants, have favored this microbial shift. The lack of cementum with inserting collagen fibres around implants could indeed enable a more rapid down-growth of plaque and epithelium than around teeth. Moreover, the firm contact between ligatures and tissues (especially around implants) could also induce foreign body reaction[13]. Implants with peri-implantitis thus reveal a complex microbiota encompassing conventional periodontal pathogens. Species such as A.actinomycetemcomitans, Peptostreptococcusmicros, and Campylobacter rectus, Fusobacterium and Capnocytophagaare often isolated from failing sites, but can also be detected around healthy peri-implant sites have induced a foreign body reaction. Implants with peri-implantitis thus reveal a complex microbiota encompassing conventional periodontal pathogens. They confirm the bacterial shifts detected in animal studies after the induction of experimental periimplantitis[2]. Rough surfaces (crowns, implant abutments and denture bases) accumulate and retain more plaque (thickness, area and colony forming units). After several days of undisturbed plaque formation, rough surfaces harbor a more mature plaque characterized by an increased proportion of motile organisms and spirochetes. As a consequence of the former, crowns with rough surfaces are more frequently surrounded by an inflamed periodontium, characterized by a higher bleeding index, an increased crevicular fluid production and/or an increased inflammatory infiltrate[19].

V) Mechanical complications

These types of failures range from loosening of screws to breakage of implant components and implants. These types of failures can be avoided with proper treatment planning, a good understanding of screw joint mechanics and knowledge of the implant system used. Screw loosening is an often reported problem with implant supported restorations, especially with single tooth restorations. This is largely due to clinicians not having a good understanding of the mechanics of a screw joint and the implant manufacturers not providing components and instrumentation that would allow clinicians to maximize the retentive properties of the screw. Other types of biomechanical failure involve fracture and breakage of prostheses. Many of the materials used to restore implants are derived from conventional restorative dentistry, for example denture base resins. Complete denture wearers develop relatively little bite force compared to force generated with implant supported restorations. Breakage is a common failure of overdenture restorations. Metal fatigue of restorative materials can also lead to breakage the rigid connection of implants to the bone demands that attention is paid to the size of

connectors.Breakage of implants and implant components can also occur; often this is due to poor treatment planning and exposing implants to excessive forces[19].

VI) Esthetic complications

Mucosal dehiscence is a soft tissue complication that can develop infections in the surgical area and implant and/or graft failures that can lead to unfortunate esthetic results. As a rule, surgical wound dehiscence are associated with patients that have scarring problems due to a poor-quality mucosa (thin biotype, traumatized or cicatricial type), heavy smokers, patients treated with corticosteroids, diabetics, or irradiated patients. Another factor leading to surgical wound dehiscence is flap closure under tension, for it has been established that a higher tension causes a more frequent onset of these complications. M Angeles Sánchez et al[20], suggested that the use of free connective tissue grafts may be highly useful for both guaranteeing the closure of the wound and the enlargement of the mucosa thickness around implants, all of which allows better esthetical results.

CONCLUSION

Implant treatment is regarded as a safe technique with high success rate. Despite high success rates, implant fixture failure may occur.Complications and loss of implants can be costly, both in terms of time and financial resources. Loss of integration can be troublesome, resulting in an edentulous space more difficult to restore than prior to implant placement. The ability to reliably identify patients and conditions with greater potential for success would be valuable.

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