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Review Article

Complications in implant dentistry

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ABSTRACT

After tooth loss, an individual may seek tooth replacement so that his/her function and esthetics could be restored. Clinical prosthodontics, during the past decade, has significantly improved and developed according to the advancements in the science and patient's demands and needs. Conventional options in prosthodontics for substituting a missing single tooth include the removable partial denture, partial and full coverage bridgework, and resin-bonded bridgework. Dental implants have gained increasing popularity over the years as they are capable of restoring the function to near normal in both partial and completely edentulous arches. With substantial evidence available, fixed implant-supported prosthesis are fully acknowledged as a reliable treatment option for the replacement of single or multiple missing teeth nowadays. While dental implants are increasingly becoming the choice of replacement for missing teeth, the impediments associated with them are progressively emerging too.

Key words: Implant complications, implant failures, peri-implantitis

INTRODUCTION

Understanding the pattern of tooth loss in a population helps in determining the quality of dental health care being provided, which varies geographically and culturally between countries. Studies have demonstrated that dental caries and periodontal diseases are frequent reasons for tooth extraction.[1-4] In Pakistan, advanced dental caries (63.1%) followed by periodontitis (26.2%) are two major reasons for tooth loss.[5]

Once a tooth is lost, an individual may seek its replacement so that his/her function and esthetics could be restored. Clinical prosthodontics, during the past decade, has significantly improved and developed according to the advancements in the science and patient's demands and needs. Conventional options in prosthodontics for substituting a missing single tooth include the removable partial denture, partial and full coverage bridgework, and resin-bonded bridgework.[6]

An attractive alternative to conventional dentures and bridges became available with the introduction of implants into dental industry.[6,7] At present, both single crown implants and implant-supported fixed partial dentures (FPDs) are the available options. The basis for dental implants is osseointegration, where osteoblasts grow and directly integrate with the titanium surface of the implants surgically placed inside the alveolar bone.[7] Dental implants have gained wide popularity over the years as they are capable of restoring the function to near normal in both partial and completely edentulous arches.

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Numerous systematic reviews have been conducted on the survival and complication rates of FPDs supported by implants. Good survival rates of up to 10 years have been reported for both single-unit[8,9] and multiple-unit[10-12] implant-supported FPDs. With substantial evidence available, fixed implant-supported prostheses are fully acknowledged as a reliable treatment option for the replacement of single or multiple missing teeth nowadays. However, the survival rates generally refer to the prosthesis that continued its clinical service during definite follow-up period and this does not necessarily render them free of complications.

While dental implants are increasingly becoming the choice of replacement for missing teeth, the impediments associated with them are progressively emerging too. The aim of the current review is to discuss specific complications associated with dental implants. Management protocols and possible means of avoiding certain complications are also briefly discussed.

COMPLICATIONS ASSOCIATED WITH DENTAL IMPLANTS

Implant-supported single crowns and multiple implant-supported bridges may suffer from various mechanical, biological, or technical complications [Table 1].[12,13] Poor patient selection is one of the important factors that adversely contribute toward failures in implant dentistry.[14]

Table 1: Complications associated with dental implants[12,13]

Mechanical complications	Technical complications	Biologic complications
Screw loosening	Fracture of veneering porcelain	Adverse soft-tissue reactions
Screw fracture	Fracture of the framework in implant-supported fixed partial dentures	Sensory disturbances
Cement failure		Progressive marginal bone loss, loss of integration

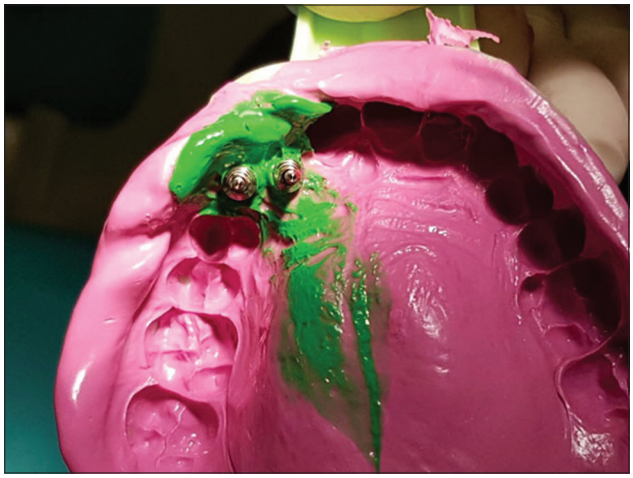

Figure 1: An open tray impression taken using addition cured silicone. Poor implant angulation can be judged which could lead to a mechanical failure

Mechanical complications

Mechanical complications are usually a sequel to biomechanical overloading.[15,16] Factors contributing to the biomechanical overloading are poor implant position/angulation [Figure 1] (cuspal inclination, implant inclination, horizontal offset of the implant, and apical offset of the implant),[17,18] insufficient posterior support (i.e., missing posterior teeth), and inadequate available bone or the presence of excessive forces due to the parafunctional habits, that is, bruxism.[18-20]

Screw loosening

Overloading of the implants usually causes loosening or fracture of the implant component.[21] Goodacre *et al*.[22] stated that screw loosening or fracture prevailed more with the prosthetic screws as opposed to the abutment screws. Implants restored with single crowns have shown more screw loosening as compared to multiple implants with multiple restored units,[23] and mandibular molar implant restorations are more affected by screw loosening as compared to the maxillary ones. In another study, the incidences of loosening of the abutment screw or the abutment were found to be 59.6% in a follow-up of 15 years.[24] In a systemic review by Pjetursson *et al*.,[25] the yearly rate of abutment or screw loosening ranged from 0.62% to 2.29% that converts into a 5-year complication rate ranging from 3.1% to 10.8%. In another follow-up study of Branemark single-tooth implants, screw loosening was reported to be the most frequent complication.[26]

To ease the incidence of screw loosening, it is advised to maximize the joint clamping forces while curtailing joint separating forces.[27] Joint separating forces include excursive contacts, cantilevered contacts, interproximal contacts, off-axis centric contacts, and nonpassive frameworks. In an article by Sadid-Zadeh *et al*.[28], it was suggested to torque the abutment or the screw retained crown, with twice the force recommended by the manufacturer at an interval of 5

min between each rotation. Over the course of years, many manufacturers have revised the conventional implant components to reduce the incidents of screw loosening.[29,30]

Screw/implant fracture

There are two major causes of implant fracture: biomechanical overloading and peri-implant vertical bone loss.[31] The risk of implant fracture increases multifold when the vertical bone loss is severe enough to concur with the apical limit of the screw.[32-34] Implant fractures are also attributable to flaws in the designs and manufacturing of implant itself.[35,36] Unnoticed and recurrent screw loosening is a risk factor for dental implant fracture, which indicates change in the prosthesis design.[37]

The most frequently encountered fracture is of the hexagonal head away from the main body of the screw.[38] When a screw is loose, it is more disposed to excessive sideward load. Fracture of the implant abutment screw can be a grim setback as the remaining fragment inside the implant jeopardizes the efficient functioning of the implant.[39,40] When patients wear an implant-supported prosthesis (fixed or removable), there is a decrease in the occlusal forces which ranges from 200 to 300 N.[41] The failure of implant abutments occurs when the lateral forces exceed 370 N for the abutments having the joint depth of at least 2.1 mm and 530 N with a joint depth of at least 5.5 mm.[42-44]

Implants with a smaller diameter of 4 and 3.75 mm are inclined to fractures more easily than those with the greater diameter.[35,36,45] It has been reported that an implant having a diameter of 5 mm is three times stronger than the one with the diameter of 3.75 mm, while an implant of 6 mm diameter is 6 times stronger than a 3.75 mm implant.[46] The risk factors associated with implant components are categorized into three groups and are enumerated in Table 2.[37,39] Abutment screw fracture and loosening can be reduced if certain strategies are followed. These include careful treatment planning, understanding of the occlusal scheme, tightening the implant to the recommended torque, and routine follow-up appointments.[47]

Table 2: Risk factors associated with dental implant fractures[37,39]

Periodontal factors	Implant factors	Prosthetic factors
Pocket depth >5 mm	Diameter <4 mm	Loosening/torsion
Bone loss	Crown/implant >1	Prosthesis screw
Occlusal overload (bruxism)	Implants design	Cantilevers Ceramic fracture

Cement failure

Cement failure is another consequence of biomechanical overload, typically affects the prosthesis attachment and may be treated by recementation procedure.[21] With the advancements in material science, particularly for luting agents, the incidence of decementation has reduced significantly.[28] However, careful treatment planning and clinical criteria must be followed to avoid such incidences.

Technical complications

The frequency of occurrences of technical complications is greater in implant-supported FPDs as compared to the implant-supported removable prosthesis.[48]

Fracture of the framework

Whenever there is a rigid connection between the osseointegrated implant and the fixed subsequent framework, the strains are inevitably induced in every component of the framework.[49] The additional functional load produces supplementary strains, which affect the bone-implant-prosthesis assembly.[50,51] Hence, the challenge remains for a prosthodontist to deliver a tolerable prosthesis that does not jeopardize the endurance of the treatment.[52,53] Therefore, passive fit of the framework has been advocated as a requirement for successful long-term osseointegration of the implant with the surrounding bone.[54-56]

The problem of fracture of framework is reportedly exaggerated in partially edentulous jaws, because the implant-abutment interface and abutment retention screw are exposed to higher lateral bending loads, tipping, and elongation as compared to bilaterally splinted implants in a completely edentulous jaw.[57-59] The length of the cast bar or framework span is directly proportional to the construction-related distortion,[60] which could get worsened by nonparallel placement of dental implants.

To correct the gross misfit of the abutment–superstructure relationship, cutting the framework or bar and then joining the sections by welding or soldering is recommended, but both techniques may further impair the original fit.[61] Since the corrective methods usually lead to a misfit, in order to avoid the need for such corrections, it is recommended that effort must be made to improve the original/initial fit of the cast frameworks.[62] Factors that influence the accuracy of the initial fit of the framework include the impression material,[63,64] impression technique,[62-64] and positional stability[64,65] of the transfer posts. Refined approaches and

detailed and accurate prosthodontic procedures are still a requisite to achieve a passive fit with an implant-supported superstructure.[66]

Fracture of veneering porcelain

Metal-ceramic restorations are the most common types of restorations in clinical dentistry.[67,68] With the passage of time, esthetic demands of the patients have risen and thus driven the clinicians to focus on all-ceramic restorations.[69] Zirconia restorations are promising, and the material is even being used to fabricate implant abutments for cement-retained restorations or for direct veneering for screw-retained prosthesis.[69]

Fracture of the veneering ceramic is another common complication associated with single-implant restorations.[28,70,71] Sadid-Zadeh *et al*.[28] concluded that of a total of 5052 ceramic and porcelain fused to metal restorations, 172 failed due to chipping off, which makes it 3.4% of the complications associated, at a mean follow-up of 5 years. The incidence of the fracture of the veneering ceramic can be reduced by following the clinical recommendations, that is, by reducing the occlusal table, preventing heavy occlusal contacts, keeping shallow cuspal heights, and by providing adequate thickness of the overlying ceramic.

Peri-implantitis

Biological failures include bacterial infections, microbial plaque buildup, progressive bone loss, and sensory disruptions.[72-74] Biological complications are subcategorized into early biological failures and late implant failures, where the early failures are attributed to the failure of placing the surgical implant under proper aseptic measures[74-76] and the late complications are typically peri-implantitis and infections bred by bacterial plaque.[77,78]

Peri-implant disease is defined as the inflammatory pathological change that takes place in the soft and hard tissues surrounding an osseointegrated implant [Figures 2 and 3].[79] When an implant is successfully osseointegrated, the peri-implant disease that occurs is the consequence of disparity between the host defense and increasing bacterial load.[80] It usually takes about 5 years for the peri-implant disease to progress and exhibit clinical signs and symptoms.[73,74,81] The incidence of peri-implantitis and implant loss could be greater if the studies with longer follow-up periods are evaluated.[82]

In a healthy environment around the implant, the tissues play a pivotal role in preventing the spread of agents that can be pathognomonic, and if the biological barrier is breached, it could lead to bacterial contamination around the bone resulting in hasty destruction of the tissues surrounding the implant.[83] The peri-implant disease is also related to unequal occlusal load distribution, which may lead to loosening of the superstructure, infection of the surrounding area, eventually culminating into the inflammatory process.[84] Predisposing systemic conditions include uncontrolled diabetes mellitus, osteoporosis, smoking, long-standing treatment with steroids, uncontrolled periodontitis, radiation therapy, and chemotherapeutics.[80,85,86] Table 3 enumerates clinical and radiographic symptoms that may be associated with peri-implant disease.

The peri-implant disease treatment strategies have been explored and employed to prevent failure of the implant treatment.[82] They include nonsurgical mechanical debridement, local antimicrobial delivery in periodontitis and peri-implantitis, and surgical debridement with bone grafting. Implant removal is warranted if there is more than 60% of bone loss following peri-implantitis, and there is an evidence of mobility.[87]

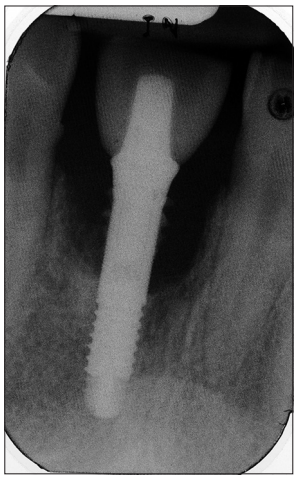

Figure 2: Radiographic picture showing significant bone loss around the implant

Table 3: Clinical and radiographic symptoms of peri-implantitis[86,87]

Probing depth <6 mm
Bleeding on probing/suppuration
Attachment loss/bone loss of 2.5 mm
Vertical destruction of crestal bone on radiographs
Possible swelling and hyperplasia of the peri-implant tissues
Pain (unusual) if present, depicts acute infection

Figure 3: Soft-tissue inflammation caused due to peri-implantitis

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Conflicts of interest
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