Review Article

Mechanical Failure and its Management in Dental Implants: A Review

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ABSTRACT

Dental implant is one of the most accepted treatment modalities for the replacement of missing teeth. Although the overall success is high, dental implants occasionally fail due to biologic, technical and esthetic reasons. Technical or mechanical complications occur when the strength of materials is not able to resist the forces that are being applied. This may occur due to poor framework design, undue force factors, sub-optimal implant position, and wrong choice of the prosthetic materials. Mechanical complications inclue fracture of veneers, loss of the screw access hole restoration, abutment screw loosening, abutment screw fracture, fracture of implants, and overdenture clip/attachment fracture. Prompt management of such complications is the key to implant success.

Key words: *Dental implant, failure, complication, mechanical.*

Replacement of missing teeth with implants requires proper planning, experience and skills. The overall success rate of implant dentistry is very high, but we may occasionally encounter implant failures in our clinical practice.[1,2] Absence of mobility, no radiographic evidence of peri-implant translucency, 1 mm bone loss during first year following implant loading and 0.2 mm per annum afterwards, and absence of radiolucency around the implant and associated pain have been proposed as criteria for implant success.[3] According to the International Congress of Oral Implantologists Pisa Consensus Conference report, implant failure refers to implants that were lost or removed.[4]

Implant failures can be classified as early and late implant failures depending upon the time of occurrence. [5,6] Early implant failure occurs before the implant is osseointegrated in the bone and commonly occurs due to surgical and postoperative complications. Late implant failures occur after the implant has osseointegrated and primarily results because of restorative complications. The term "implant complication", on the other hand, is applied when there is an unexpected deviation from the standard treatment outcome, and further treatment is required after delivery of the prosthesis.[7] A complication is considered as a secondary ailment that develops during or after surgical implants procedure or prosthetic phase.[8] Esposito et al [9] defined implant failures as biological failures and mechanical failures. Mechanical failures are related to fractures of components or implant prostheses. Koutsonikos [10] listed additional categories of implant failures which included iatrogenic failure and failure owing to patient factors.

MECHANICAL FAILURES

Technical or mechanical complications occur when the strength of materials cannot withstand the masticatory load. [11,12] Various mechanical failures such as fracture of veneering ceramics (13.2% after 5 years), dislodgement of the screw access hole restoration (8.2% after 5 years), loosening of abutment/occlusal screw(5.8% after 5 years),

abutment/occlusal screw fracture (1.5% after 5 years; 2.5% after 10 years), implant fracture (0.4% after 5 years; 1.8% after 10 years) have been reported.[13] Besides, loosening of the overdenture retentive mechanism (33%), resin veneer fracture with FPDs (22%), overdentures needing to be relined (19%), and overdenture bar or clip fracture (16%) have also been mentioned in literature.[8]

Framework fractures

The size of frame work plays vital role for its strength. A minimum dimension of 4 mm x 6 mm in cross section is recommended. The solder joints located distal to the distal most implant are common weak spots where fracture occurs. Zarbet al [14] reported extensions exceeding 20 mm in the mandibular arch is prone to framework breakage. The fractured solder joint is re-assembled intraorally, indexed, and then soldered during the repair. The heat generated during soldering burns the acrylic veneer in the prosthesis, which needs to be changed after verification of the fit of the repaired framework. Factors that need to be considered for prevention of framework fracture include minimal flexure even under functional loading, maximum support with no unsupported areas of the veneer material and wide distribution of the occlusal force. In case of fracture of framework, the framework needs to be refabricated.

Fracture of fixed restoration veneers

Without the periodontal ligament (PDL) to provide shock absorption and proprioceptive reflex, dental implants are essentially ankylosed to the surrounding bone. Patients tend to generate higher masticatory forces on implant-supported restorations relative to the natural dentition, which may lead to fracture of fixed restoration veneers. In a study done by Angelis et al. it was found that when risk factors such as smoking, bruxism, bone augmentation procedures and the presence of load risk were considered, bruxism with load risk had the most dangerous association (success rate 69.23%) and could be included among the absolute contraindications for implant treatment. [15] In cases of fractured fixed restoration veneers, repair or refabrication needs to be done.

Occlusal wear:

Occlusal wear is more evident in implant supported restorations when there is a mismatch of opposing restorative materials. Porcelain can be abrasive when opposed with enamel, metal, resin, or even porcelain, especially when it lacks a highly polished surface.[16] Exposed opaque layer and use of external characterizations with metal oxides all add to the abrasiveness of porcelain and should be used with care.

Screw and cement restorations

Because of the required screw access hole of the implant, the esthetics and occlusion of the patient are compromised. It also has the potential to undermine the strength of the restoration due to the lack of material. The presence of the prosthetic screw also bears the potential of screw complications. Additionally, this type of restoration is more sensitive to the passive fit of the restoration to the supporting implants. The literature indicates that screw retained restorations may present more postoperative complications compared to cement-retained restorations. Duncan et al. [17] reported that patients restored with screw-retained restorations had problems with prosthetic screws and screw access hole filling material while no complications were encountered with patients restored with cement retained restorations after 3 years. Karl et al. [18] found that cement-retained FPDs may result in lower strain levels compared to conventional screw-retained. Higher strain level at the time of delivery may increase potential future complications

Screw loosening and fracture

The causes of screw loosening and fracture are inadequate torque application, inaccurate framework abutment interface and cantilever extension. It is recommended that the prosthetic gold screws should be torqued till 10 N cm and abutment screw till 20 N cm. The necessary torqueing can be obtained with the aid of a torque driver and a manual torque converter. Prosthesis loosening is evaluated during the prosthetic delivery and during hygiene follow up appointments. The prosthesis is removed and the movement of the components is evaluated by checking percolation of saliva at the interface. The screws which are loose need to be replaced.

Cantilever extension

The extent of the cantilever beyond the distal implant governs the length of the lever arm. Greater the cantilever extension, greater is the amount of force exerted to the implants, framework and prosthetic components. Longer cantilever may result in loosening of prosthetic and

abutment screw and implant fracture. The recommended cantilever extension is 15 mm or less for mandible and 10 mm or less for maxillary arch.

Inaccurate framework abutment interface

The circumferential contact without any opening at the framework abutment interface is the ideal connection that is desired. The chances of screw loosening are escalated with a non-passive fit of the framework, which may create stresses in the screws and lead to lack of osseointegration. The screws should be torqued one at a time. The gap at framework abutment interface should be checked and lift of the framework should be evaluated. Tightening all screw before evaluating the fit of the framework may bend the framework and provide false impression of accuracy of the fit. Such frames, if allowed to seat, will result in constant undue stresses on the implant as well as the components.

Implant fracture

Implant fractures occur due to fatigue and trauma. The fracture usually occurs just below the abutment level. The fractured fragments need to be removed. However, the apical portion should be left behind, if it is not to be replaced. The apical portion is generally osseointegrated, retrieval of which may require trimming of ample of the alveolar bone. Balshi et al [19] listed three categories of causes that may explain implant fractures: design and material, non-passive fit of the prosthetic framework, and physiologic or biomechanical overload. A rare but possible complication related to prosthesis fracture is the fracture of mandibular implant supported fixed complete denture at the midline. [20] It is speculated that the flexure of the mandible during function can cause this type of complication. To avoid this problem, fabricating a two-piece fixed restoration has been advocated by some. The cause of such fracture is flexure of the mandible during function, which can be prevented by fabricating a two-piece fixed restoration.

CONCLUSION

The overall success of dental implant therapy is high, but implants occasionally fail due to biologic, mechanical and esthetic complications. Mechanical failures occur when the strength of the implant and the prosthetic components is not able to resist the masticatory load being applied. Proper planning, proper framework design, accurate implant position, selection of optimal prosthetic materials, with due consideration of patient's force factors are keys to minimizing mechanical complications in dental implants.

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