

REVIEW ARTICLE

Fracture of Dental Implants - An Overview

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ABSTRACT

The use of dental implants for rehabilitating partial and total edentulous patients has promoted the functional recovery of the stomatognathic system, in addition to preserving the dental structures and providing longevity of the treatment. Due to the high success rates, the insertion of dental implants has become a knowable treatment solution for several patients. Implant fractures constitute clear implant failures, and in most of the cases, they require implant removal. The objective behind doing the present literature review was to analyze the causes of dental implant fractures and to describe the treatment options for these failures, aiming to help the clinicians to properly plan the implant-supported prosthesis treatment by considering important biomechanical aspects of this type of rehabilitation.

Keywords: Bone reabsorption, Dental Implantation, Dental Implants, Treatment failure.

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INTRODUCTION

The use of implants for rehabilitating partial and total edentulous patients has promoted the functional recovery of the stomatognathic system, in addition to preserving the dental structures and providing longevity of the treatment. Due to the high success rates, the insertion of dental implants has become a knowable treatment solution for several patients.^[1] Dental implants

have been a preferred treatment option for rehabilitation of completely and partially edentulous patients. One of the most important complications is the fracture of a dental implant that has undergone osseointegration by which the prosthesis is adversely affected by the loss of the supporting tissue.^[2-4] In some situations, one of the most serious complications to be faced is the fracture of implants. It is a frustrating problem not only for the patient but also for the clinician because it usually involves loss of both the implant and the prosthesis. Thus, the objective of this work was to investigate possible causes that may lead to fracture of dental implants, as well as options available for treatment.

REASONS FOR FRACTURE OF DENTAL IMPLANTS

Causes of implant fracture may be divided into three categories: (1) Defects in the design of the material, (2) non-passive fit of the prosthetic structure, and (3) biomechanical or physiologic overload.^[3] Possible causes of fracture include failure in the production and design of dental implants, bruxism or large occlusal forces, superstructure design, implant localization, implant diameter, metal fatigue, and bone resorption around the implant.^[5] In addition, the galvanic activity of metals used in prosthetic restorations can be cited as a cause.^[6] Defects in the production and design of dental implants are very unlikely reasons for fracture. Microscopic analysis of fractured fixtures revealed no porosity or any other defects in the titanium structure, a finding that eliminated failure in the manufacturing process as causative.^[3,7] Load factors are related to the magnitude and direction of occlusal forces. 90% of dental implant fractures are located in the molar and premolar regions of the mouth, where chewing forces and lateral movements associated with cusp inclination generate undesirable forces.^[8] Chewing occlusal forces when in function are 3 times more intense in the posterior region than in the anterior region.^[9] Chewing involves vertical forces mainly; however, horizontal movement of the mandible and the inclination of the dental cusps creates lateral forces that are transferred to the implant and to the bone.^[7,8,10] Biomechanical and physiologic overload seems to be the most common cause of dental implant fracture; overload may be caused primarily by two factors: Parafunctional habits

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and prosthesis design.^[3] Parafunctional habits such as bruxism or clenching may increase overload on the implant/prosthesis system through the magnitude, duration, frequency, and direction of forces applied. It has been suggested that posterior cantilevers should be avoided or minimized, especially in partially edentulous patients.^[3] The localization position of dental implants also has a direct influence on the biomechanical distribution of forces. If the implant axis is placed at a certain distance from the center of the prosthetic crown, forces created by this distance from the occlusal contact point to the implant axle may cause screw loosening or component fracture. Nevertheless, in cases of fixed prostheses, if this compensation is part of a tripod organization, conditions may become favorable.^[11] The installation plan for implants must, whenever possible, avoid configuration in a straight line.^[3,12] The addition of a third implant in a free end region, to prevent the use of cantilevers, reduces stress forces in approximately two-thirds of cases. Yet, when these implants are placed in a non-linear geometric configuration, overload on the implant/prosthesis system is reduced 6-fold, compared with prostheses with cantilevers.^[12] Implants with small diameters tend to fracture more easily than those with large diameters, especially when placed in the posterior region.^[5] Biomechanical unbalance is caused by loads that are dissipated around the implant and go beyond the bone functional adaptation capacity. On the other hand, host/parasite unbalance corresponds to superficial (peri-implant mucositis) and deep (peri-implantitis) inflammatory alterations that lead to marginal bone loss. In a significant number of patients who present with dental implant fracture, a characteristic bone loss pattern is evident, with a radiolucent image around the coronal portion of the implant in a "V" shape.^[12] This bone resorption submits the implant to high stress forces caused by supporting tissue loss, normally located at the end of the abutment screw level, where resistance to tension forces is reduced.^[12-17]

TREATING FRACTURES OF DENTAL IMPLANTS

Tonetti MS and Schmid J.^[3] suggests three methods for treating fractures of dental implants:

1. Removal of the fractured implant (replace the implant and manufacture a new prosthesis),
2. Alteration of the existing prosthesis and maintenance of the osseointegrated fractured part, and
3. Alteration of the fractured implant and remanufacturing of the prosthetic portion.

Treatment of fractured implants represents a clinical challenge. First, the fractured fragment must be atraumatically removed with minimum bone removal.

A new fixture is placed and the time to osseointegration must pass; only after that, the prosthetic phase begins.^[6] It is suggested that, for removal of the intraosseous portion of a dental implant, a trephine bur should be used, and, if possible, another implant with a larger diameter should be installed immediately.^[6,14]

DISCUSSION

Adequate prosthetic planning is fundamental to reduce dental implant fracture rates even further. Biomechanical factor, besides achieving a passive fit of the prosthetic superstructure, must be taken into consideration from the moment implants are placed until prostheses are installed.^[3,8,12] Cantilevers act as crowbars, generating tension in the fixtures and making them susceptible to fracture, especially in the posterior regions of the mouth.^[13] In this situation, whenever possible, the number of implants must be increased, and their placement in a straight-line configuration must be avoided.^[3,5,12] Frequent loosening or fracture of the retaining screws and bone loss around the implant are characteristic signs that precede the fracture of implants.^[3,7,8,12] It is understood that bone resorption is a consequence of several adverse factors to which the implant/prosthesis system is exposed. Bone loss will increase the cantilever effect with the consequent increase in tension forces, generating stress in the thread portion of the implant, where a hollow cylinder is normally found along with greater fragility, resulting in metal fatigue.^[3,5,7,8,12] Among the treatment options mentioned by Balshi,^[3] removal of the fractured implant followed by the placement of a new one is the choice of most authors.^[6,7,14]

To reduce the possibility of bone resorption, regular monitoring is essential. Clinical assessment can confirm whether the occlusion is well balanced and the load is well distributed on the dental implants. It is fundamental to include routine radiographic examinations to observe bone loss related to stress caused by overload.^[17] Schwarz MS^[8] suggested the following sequence: If the prosthesis retaining screw fractures or loosens frequently (even though it had been adequately tightened), precision in prosthetic structure fit may be insufficient.

CONCLUSION

After this review of the literature, it is possible to conclude that fracture of osseointegrated dental implants is a late complication that, despite its low incidence, is highly frustrating. Causes attributed to the fracture of dental implants are multifactorial. Treatment of implant fractures usually consists of removal of the fractured fragment, installation of another implant, and the manufacture of another prosthesis.

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