

Implant Fracture : Rising Concern for Implantoholics

Dr. Charushila S. Sardar
Professor & P.G. Guide

Dr. Omkar Shetty
Dean, HOD & P.G. Guide

Dr. Asha Rathod
Professor

Dr. Aashish Jain
P.G. Student

Department of Prosthodontics
Dr. D.Y. Patil Dental College & Hospital
Nerul, Navi Mumbai

Address for Correspondence :
Dr. Charushila S. Sardar, Professor & P.G. Guide
Department of Prosthodontics
Dr. D.Y. Patil Dental College & Hospital
Nerul, Navi-Mumbai
Charusbs@yahoo.co.in

Introduction

Dental implants are a functional and esthetic solution to partial and complete edentulism. The initial success rate of this treatment modality is 90-95%, but the treatment modality is not free of complications. One of the rare yet severe complication is implant fracture. Implant failures may be sorted into groups by the timing of their appearance or by the origin of failure. Fractures belong to the group of late complications caused by a mechanical overload. Overload may be caused by inappropriate seat of the superstructure, in line arrangement of the implants heavy occlusal load, location of the implant and the size of implant or metal fatigue. In this article various factors that may lead to fractures are discussed.

The fracture of a dental implant is an uncommon occurrence with most studies reporting an incidence of between 0-1% in Branemark fixtures - An early study reported an incidence of 3.5% but this may have been due to the inclusion of implants inserted Whilst the technique was being developed and the longer maximum follow up period of 15 years. Implant fracture occurs at all levels of the fixture, usually at around five years after insertion, and with the majority in the maxilla.

Classification of Implant Fracture

Vertically Fracture

Fig. 1 : Noble Replace Showing Implant Fracture

Horizontal Fracture

Fig. 2 : Horizontal Fracture of Implant

Etiology of Fracture

Potential causes of implant factors are as follows-

- Bending overload³
- Manufacturing imperfections⁴
- Restoration design⁵
- Accuracy of fit of restoration⁶

- Implant numbers, dimensions and positioning^{7,8}
- Marginal bone loss⁹
- Occlusion and parafunctional habits¹⁰
- Chemical factors¹¹

Bending Overload

Bending overload is defined as the load on an implant-supported prosthesis that exerts a bending moment on the fixture cross-section at the crestal bone level, leading to marginal bone loss and/or implant fatigue fracture. Prosthetic load conditions for dental implants may be significantly different in posterior partially edentulous or single-tooth restorations than in full-arch prostheses in completely edentulous patients. Support for full-arch restorations is based upon the use of multiple implants positioned on a curved line dictated by the residual alveolar process. When posterior partially edentulous spaces are restored, the implants are placed in a more linear configuration. The straighter the alignment, the greater the potential bending of the implants.¹⁵ Posterior implant-supported prostheses are subjected to bending moments functional and parafunctional linear configuration. The straighter the alignment, the greater the potential bending of the implants. Posterior implant-supported prostheses are subjected to bending moments generated by functional and parafunctional movement patterns of the mandibulars.^{16,17}

According to theoretical studies, bending moments lead to higher stress levels in the implant components and the supporting bone than compressive or tensile forces. Excessive bending moments may lead to various types of failures, including implant fracture.

Manufacturing Imperfections

There are no reports of implant fractures due to manufacturing imperfections. 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.^{18,19}

This can be one of the factors of implant fracture as there can be some imperfections while manufacturing due to mass productions of V implants so as to meet the global needs of the dental consumer market which may also include titanium impurities or grade of the titanium used.

Restoration Design

Cantilever design bridges increase the stress upon an implant, and have been found to be associated with fractured implants. Implant fractures associated with a combined dento implant supported restoration have also been reported.

Fig. 3 : Fracture due to cantilever

Cantilevers act as crowbars, generating tension in the fixtures and making them susceptible to fracture, especially in the posterior regions of the mouth.²¹ In this situation, whenever possible, the number of implants must be increased, and their placement in a straight-line configuration must be avoided.^{18,20} Frequent loosening or fracture of the retaining screws and bone loss around the implant are characteristic signs that precede the fracture of implants.

Accuracy of Fit of Restoration

Previous studies have shown implant fracture in partially edentulous fixed prostheses occurs with older, less passively fitting prostheses. A non-passive fit can also lead to screw loosening. It is anticipated that the new bridge, which is constructed from a milled titanium framework, provides a more accurately fitting prosthesis by eliminating errors that may arise in the casting process.



Implant Numbers, Dimensions and Positioning

Theoretical models suggest the effects of loading on implant supported restorations can be significantly reduced by the placement of additional implants, the use of wider platform fixtures and the avoidance of implants being positioned in a straight line. Implant diameter also has a direct influence on the occurrence of fracture, in that dental implants with small diameters have reduced resistance to fatigue. In several of the cases analyzed, fracture took place in implants with reduced (3.5 mm) or standard (3.75 mm) diameters.¹⁸ Therefore, Eckert²³ Rangert al all, Krogh²⁴ Graves and beaty describe the advantages of dental implants with large diameters and advise their use whenever possible, especially in the mandibular and maxillary posterior regions, where most fractures take place.

Marginal Bone Loss

Recently, lignres for acceptable bone loss associated with fixtures of various designs and loading protocols have been proposed. However, in edentulous arches, the mean acceptable maximum value for marginal bone loss around Branennark I/lark II implants restored following the original two stage. protocol is 1_2 mm during healing and the first year after bridge connection, and 0.1 mm annually thereafter. Lekholm and coworkers reported a mean bone loss of 0.7 mm over a ten-year period in partially edentulous jaws.

In the 15-year study by Adell et al in 1981, fixtures that ghadg rapid bone loss of approximately 3 mm a year all presented with eventual mechanical complications such as screw, fixture and bridge fractures. This would suggest that any rapid mar- ginal bone loss should be investigated for possible mechanical complications, including fixture fracture.

In the analyses carried out by Green²² it was observed that bone loss may be intensified by the release of cytotoxic ions from non-precious metal alloys used in the prosthetic superstructure in direct contact with the implant, which, in the presence of oral fluids, produce galvanic currents, leading to corrosion of non-noble metals and contributing to bone loss around the implant.

Occlusion & Parafunctional Habits

Implant fracture has also been associated with parafunction forces on teeth by repeated or sustained occlusion and have long been recognized as harmful to stomatognathic system.

Nadle has classifies the causes of parafunction or nonöfunctional tooth contact into following six categories-

- Local
- Systemic
- Psychological
- Occupational
- Involuntary
- Voluntary

Fatigue Fractures

The increase in duration of the force is a

considerable problem. Materials follow a fatigue curve, which is affected by the number of cycles and the intensity of the force. A force can be so great that once cycle causes a fracture. However a lower force magnitude repeatedly hits an object the object will still fracture. Biomechanical and physiologic overload seems to be the most common cause of dental implant fracture: overload may be caused primarily by two

of replacing missing teeth. When complications occur, consideration should be given to potential causes and how they can be overcome.

Implant fracture is a rare cause of failure but when it does occur it can present significant treatment planning and technical challenges.

References

References are available on request at editor@healtalkht.com

Incidence of Dental Fracture^{12,13,14}

Study	Fixture Sample	Restoration	Followup	Fractured Implants
Adell et al 1981	1997	Fixed, Complete	1-15 Yrs.	3-5%
Zarb & Semitt, 1990	274	Fixed, Complete	4-9 Yrs	0-0%
Naert et al, 1992	564	Fixed Complete	0.4-6.9%	0.5%
Henry et al, 1996	107	Single Tooth	Upto 5 Yrs	0-0%
Lekholm et al, 1999	461	Fixed Partial	5-10 Yrs	0.4%
Eckert et al, 2000	4937	Complete Partial	Upto 15 Yrs	0.6%

factors- parafunctional habits and prosthesis design. Parafunctional habits such as bruxism or clenching may increase overload on the implantprosthesis system through the magnitude, duration, frequency, and direction of forces applied. According to Rangert²⁰ around 56% of patients with fractured dental implants presented with bruxism and marked occlusal forces. Parafunctional habits have been identified as the major causative factor associated with fixture fractures.

Chemical Factors

Titanium implant components adsorb hydrogen in the biological environment and it has been suggested that this makes them more brittle and prone to fatigue.

Planning Considerations

Salvaging a fractured dental implant is not always feasible. In this case the fracture level was favourable, with sufficient screw threads available in the retained portion to locate the Endmillbur's guide pin and to secure an abutment screw. If this had not been the case then retaining the fractured fixture as a viable functioning unit would not have been possible.

Methods for treating the Implant Fracture

Balshi¹⁸ 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.

Guidelione for Key Implant Positions

- No cantilevers
- No three adjacent pontics
- Canine-molar rule
- Arch dynamics

(Table)

Conclusion

Dental implants are a predictable method

Event Alert

11-14 Sep. 2014

FDI

World Dental Congress 2014

NCR New Delhi, India

Greater Noida (U.P.)

18-19 Oct. 2014

Expodent Bengaluru 2014

Bangalore International

Exhibition Centre

Tumkur Road, Bengaluru

7-8 Nov. 2014

Roots Summit 2014

Confluence Convention Centre

Mahabalipuram

Chennai, India

22-23 Nov. 2014

Dentophoria 2014

32nd Tamiladu State

Dental Conference 2014

Nala Hotels

Namakkal (Tamilnadu)

26-27-28 Dec. 2014

Expodent International 2014

Pragati Maidan

New Delhi

