Risk factors and prevention of implant fracture: A literature review and case report

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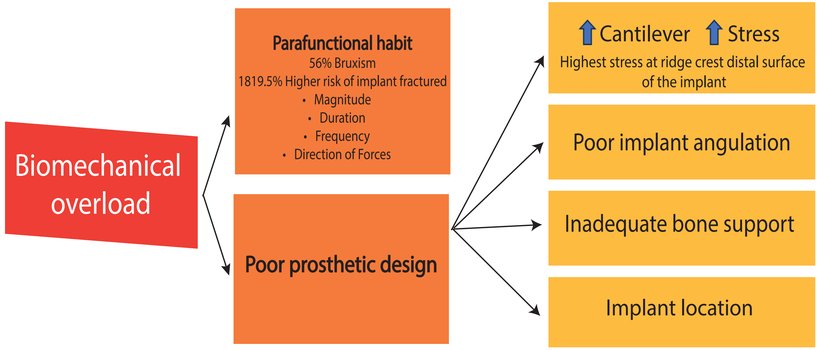
Introduction

Implant fracture is uncommon with a reported prevalence between 0.2-2.3%, but poses a complex, challenging clinical situation for the clinician. Abutment screw loosening, prosthetic mobility, and spontaneous bleeding often preceded implant fracture.[3] The pain of implant fracture stems from the inflammed mucosa surrounding the fractured implant. Its functional, restorative, surgical, and psychological implications significantly impact both the clinician and the patient because the failure involves the loss of both the implant and the prosthetics rendering it exceptionally severe.[1,2] The goals of our poster are to review risk factors, present a rare multi-implant fracture case, and propose strategies for reducing fracture risk.

Risk factors of implant fracture

Various factors influence implant fracture risk, including titanium grade, abutment connection, implant dimension, location and design of the implant, occlusal force, crown-to-implant ratio, passivity of the prosthesis, presence of cantilever, parafunctional habits, and service time. Implant fracture is a late complication and risk factors can be categorized into three main categories.[3] Failure in implant design or material, non-passive fitting of the prosthetic crown, and overloading.[3] Each factor's impact on fracture susceptibility is examined, providing valuable insights into clinical decision-making.

Biomechanical Overload



Implant Dimension (Diameter and Length)

The highest implant fracture rate occurs at a narrow-diameter implant (3-3.5mm). Small-diameter implants tend to fracture more easily than wide diameters [1,4], particularly when placed posteriorly. In a study by Eckert et al., the incident of body implant fracture was observed in all 3.75 mm diameter threaded implants.[3] Every 1 mm increase in implant diameter decreases the fracture risk by 96.9%, and every 1 mm increase in implant length increases fracture risk by 22.3%.

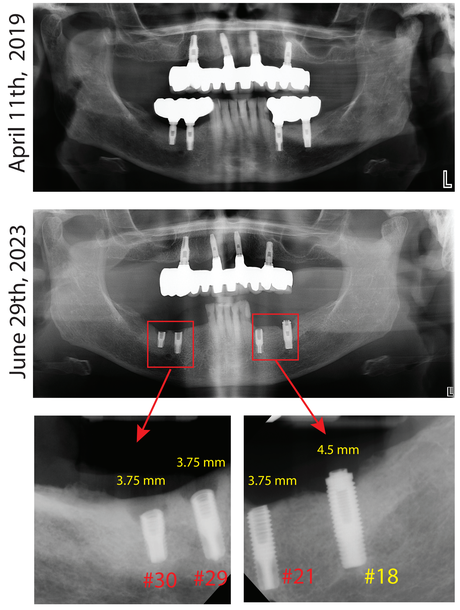
Case Report

A distinctive case involves a 72-year-old Caucasian female presenting pain and mobility in her lower right implant-supported prosthesis. Four implants with external – hexagon connections were placed 14 years prior. #21, 29, 30 with implant diameter 3.75 mm and #18 with implant diameter 4.5 mm. Sequential fractures occurred in the crown third of implants #21, #29, and #30, revealing contributory factors like slender long molar implants, cantilever, implant position too lingual, opposing zirconia prosthesis, loss of posterior support, and lack of occlusal guard. This presentation delves into strategies for minimizing such risks, emphasizing the need for meticulous surgical, and prosthetic planning and execution.

Radiographic findings

All implant fractures are highly associated with marginal bone loss.[3] The bone resorption decrease implant support and place excessive stress on implant itself.[5] Interestingly, a distinctive pattern of bone loss is found in most implant fracture cases with a V radiolucent shape. This pattern of bone loss reduces tissue support and transmits high-stress forces to the end of the abutment screw level, where resistance to tension forces is reduced.[1]

In this case, we can clearly observed that the implants were placed with decent angulation. However, the fractured implant #21, #29, and #30 are all narrow diameter implants. Additionally, there was obvious changes of bone pattern from flat to the implant platform in April 2019 to V shaped pattern of bone loss encircling implant platform in June 2023.



Clinical Findings

- Dull pain was her major chief concern that brought her to seek treatment, also reported in the literature.
- During oral examination, prosthesis was mobile and there was inflammed mucosa surrounding implants.
- Narrow implants (3.75 mm #21, 29, 30) and the only implant that did not fracture was #18 with diameter 4.5 mm.
- Mesial and Distal cantilever
- Lingually placed implants (#29, 30)

Strategies that prosthodontists can employ to reduce the risk of implant fracture.

- **Fabrication of acrylic resin occlusal guard:** If patient has a history of bruxism, they will need to be encouraged to be used at all time aside during eating
- **Wider implant diameter in the mandible and maxilla posterior regions or at the most distal cantilever.**[1] Therefore, as for this case, all implant #21, 29, 30 in the posterior, the clinician should place wide diameter implants.
- **Avoid extreme length of implants**
- **Reduction of occlusal table and cusp inclination; occlusal contact centralization.** As for this case we see that the screw access hole are not centralized, but located on the lingual of the prosthetic.
- **Prosthodontically driven implant planning and placement (avoid mesial - distal and buccal-lingual cantilever)**
- **In cantilever situations and patients with parafunctional habits, increase the number of implants, and avoid straight-line configuration.**[1,3] In this case, the clinican can deliver implant position on #28 and #30, reduce the length of prosthetic and make no cantilever as the opposing teeth are full fixed zirconia which indicates heavy occlusal load during function.
- Finally, **early identification of changes radiographically and clinically should raise awareness for the provider to intercept implant failure which is a late complication.**
- **Identify the early signs of implant fracture:** loosening or fracture of the screws, bone loss around implants, and take measures at the early stage.

Conclusion

Our presentation underscores the multifaceted nature of implant fracture. The most essential concern is fracture prevention, and prosthodontists must be aware of factors that prevent implant fracture and be able to recognize early signs preceding implant fracture. Integrating the multi-pronged strategies with meticulous treatment planning empowers clinicians to effectively mitigate the risk of this challenging complication and safeguarding the longevity of implant treatments.

Reference

1. Gealh WC, Mazzo V, Barbi F, et al: Osseointegrated implant fracture: causes and treatment. Journal of Oral Implantology 2011;37:499-503
2. Chrcanovic BR, Kisch J, Albrektsson T, et al: Factors influencing the fracture of dental implants. Clin Implant Dent Relat Res 2018;20:58-67
3. Goiato MC, Haddad MF, Gennari Filho H, et al: Dental implant fractures–aetiology, treatment and case report. Journal of Clinical and Diagnostic Research: JCDR 2014;8:300
4. Sanivarapu S, Moogla S, Kuntcham RS, et al: Implant fractures: Rare but not exceptional. J Indian Soc Periodontol 2016;20:6-11
5. Liaw K, Delfini RH, Abrahams JJ: Dental implant complications. Seminars in Ultrasound, CT and MRI. Elsevier, 2015.