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CASE REPORT

Implant fixture fracture related to angulation path compounded by implant width – A case report.

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ABSTRACT

Accurate implant placement is vital for proper function and prognosis of implant fixture followed by implant-restoration structural unit. Less than 1% of implant failures occur primarily due to fracture of the implant fixture. Though the principle of implant placement is prosthetic-driven, proper implant fixture placement is fundamental to the life of the implant-prosthesis unit. This includes key factors such as clinical expertise placing the implant fixture, length, and diameter, angulation or path of insertion, length of implant fixture. Research indicates that diameter and angulation or proposed path of insertion of the implant fixture play an important role in the long-term stability of the implant fixture.

This case report discussed about a patient who underwent bilateral implants in mandible. Implant fixtures were placed in the region of missing tooth #19 and #30 which were extracted due to pulpal disease of carious origin. In both cases, a 5.0 mm diameter implant fixture was selected to replace the missing #19 and 30. The implant in the #19 region was placed with an ideal angulation and subsequently restored, while the implant fixture in the missing #30 location was inserted at an off-angle, then subsequently restored. Three years following restoration, the patient presented with a fractured implant replacing #30. This case report emphasizes the importance of selection of appropriate implant fixture features such as diameter and angulation for the long-term survival of the entire implant-prosthesis unit. As the report would further indicate, in the region of tooth #30, it was difficult to ascertain the cause of implant therapy failure. The case report also underpins the need to pay attention to all factors on an individual basis that essentially compound to improve the survivability of the implant-prosthesis unit.

Keywords: Implant fracture, Implant-prosthesis, Implant failure.

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INTRODUCTION

Dental Implant therapy has become the most effective treatment to replace missing teeth to restore esthetics and function in a patient. Implant-restorative units are being increasingly utilized in the anterior and posterior aspects of the maxilla and mandible. Though success of implant therapy is essential in both the anterior and posterior aspect of the jaws, the need for a balanced occlusion in the posterior teeth is vital for function, if implants are used to replace teeth in these areas. In particular, the success rate of implant therapy in the posterior regions of the jaw is 95%. Therefore, the skills of the implantologist is extremely crucial to avoid implant failures, which includes, but is not limited to, implant fractures.

A dental implant is considered to be a failure if the implant is lost, mobile or shows peri-implant bone loss of greater than 1.0 mm in the first year and 0.2 mm a year after. Dental implant fracture also leads to loss of the implant along with the super-structure. The imminent cause of a dental implant fracture is difficult to ascertain due to the multivarious factors responsible for the failure. Among prominent factors responsible for a dental implant fracture are inadequate implant fixture length, inadequate implant fixture width, improper angulation of the fixture in the bone and poor osseointegration. The expertise of the implantologist also plays a role in compounding the aforementioned factors. These factors, either alone or in combination, can lead to implant fracture that requires removal of the entire implant and replacement with a new implant-restorative unit.

Through this case report, we have described dental implant failure, as a result of dental implant fracture. Implant therapy in our patient included placement of

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implant fixtures in the region of missing tooth #19 and #30. A 5.0 mm diameter implant fixture was placed in the region of tooth #19 and #30. However, the implant fixture in tooth #30 region was placed at off-angle. Both the implant fixtures were then restored. After three years, patient returned with a fractured implant in the region of tooth #30. This case report elucidates the factors that are essential for the long-term survival of the implant-prosthesis unit. The report also underscores how several factors such as implant length, implant diameter and path of insertion of the implant combine to result in the failure of a dental implant due to implant fracture.

CASE DESCRIPTION

A fifty-five-year-old Caucasian male was seen by a general dentist in January 2015 for consultation regarding treatment options for edentulous areas in the mandibular left and right first molar region. After treatment options were discussed and a comprehensive treatment plan drafted which included replacing single-tooth edentulous areas (tooth #19 and #30) in the left and right side of the mandible with implants. Patient consented to have the edentulous spaces of tooth #19 and #30 replaced with implant-abutment-crown units and, therefore, was referred to a periodontist to initiate implant therapy.

Figure 1: Clinical photograph of fractured coronal portion of implant fixture with porcelain restoration

The periodontist evaluated the patient and obtained pertinent medical history which was significant for Shingles. Intra-oral examination revealed missing tooth #1, #16, #17, #19, #30 and #32. Treatment plan for implant therapy for replacing missing tooth in the region of tooth #19 and #30 was explained to the patient and informed consent obtained for implant fixture placement. All diagnostic work-up which included, but not limited to, full mouth radiographic series and clinical measurements to assess alveolar bone width in the region of tooth #19 and #30. During March 2015, tooth #30 region was planned for implant fixture placement. After profound anesthesia was obtained with one capsule of 2% lidocaine containing 1:100000 epinephrine administered through an Inferior Alveolar Nerve Block, a horizontal crestal incision was made in the region of tooth #30 and pilot drill used with different depth sequences to excavate bone to prepare for the placement of the implant fixture. At this time, the periodontist decided to use the Nobel Active Implant fixture with a diameter and length measuring 5.0 mm and 8.5 mm, respectively. The selected implant fixture was then secured in position in the alveolar bone and a post-operative radiograph was taken to confirm its position. A cover screw was then placed to adequately cover the implant fixture and an healing abutment was placed in July 2015. The patient was then referred back to the general dentist who restored the implant fixture in August 2015 after ascertaining that the implant fixture had osseo integrated adequately. Patient's occlusion was checked after implant fixture was restored with crown placement and patient was then informed by the general dentist that the implant crown was serviceable from that point forward.

Figure 2: Intra-oral periapical radiograph showing fractured residual fragment of implant fixture which was removed completely

In March 2018, patient returned to the periodontist with complaints of a "loose crown" in the area of previously placed implant fixture. The implant-restoration unit was tightened with an implant wrench to 35 Newton-centimeters, to address the problem. The implant-restoration unit was then deemed stable and patient was discharged with a serviceable implant-crown in the region of tooth #30. Patient, however, returned to the periodontist office on May 8, 2018 with the crown and portion of the implant fixture completely avulsed from tooth #30 region. On radiographic examination, it was confirmed that the implant fixture had fractures at the apical-third level and, therefore, had dislodged the implant fixture with the restoration portion. At this juncture, the periodontist, after discussing and obtaining appropriate consent from the patient, decided to opt for corrective treatment with

reference to the implant-restoration unit. The periodontist decided to remove the fracture segment of the implant fixture that was lodged in the alveolar bone in the region of tooth #30 and place a new NobelActive implant fixture with an appropriate width and height of 5.5 mm and 10.0 mm, respectively.

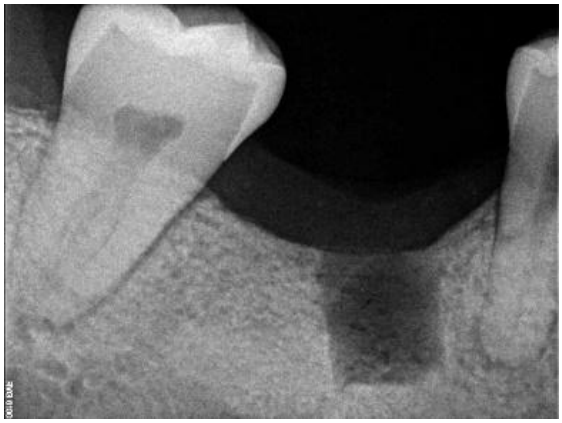

Figure 3: Intra-oral periapical radiograph showing site of explanted implant fixture

On May 22, 2018, the periodontist proceeded to surgically remove the fractured implant fragment by removing bone ("guttering") around the fractured implant with a Trephine bur. An implant fixture with modified dimensions was secured in place within bone and closed with a cover screw. A healing abutment was placed over the implant fixture in September 2018. The implant fixture was again restored by a general dentist in November 2018 and the implant-restoration unit has been in function and serviceable continuously since then, without interruption and any untoward incident. Patient was satisfied with the outcome of the treatment done the second time around and has not reported any symptoms from the implant-restorative until till date.

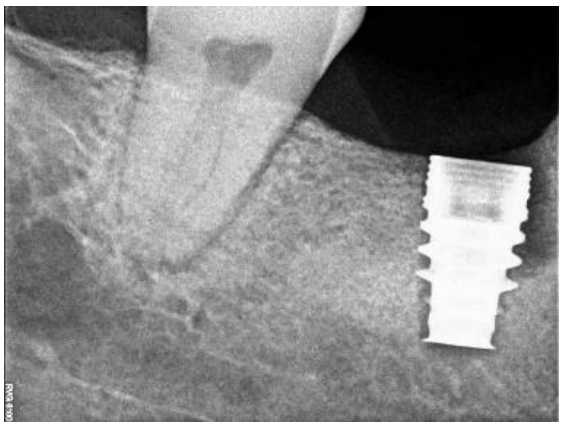

Figure 4: Intra-oral periapical radiograph replacement implant fixture with new dimensions after removal of fractured implant fixture

The edentulous site in the region of tooth #19 was treated by the same periodontist with a NobelActive implant fixture with 5.0 mm width and 8.5 mm height and an healing abutment with specific dimensions, 6.5 mm x 3.0 mm. The implant fixture was later restored by the general practitioner in 2017 and since been in function without incident.

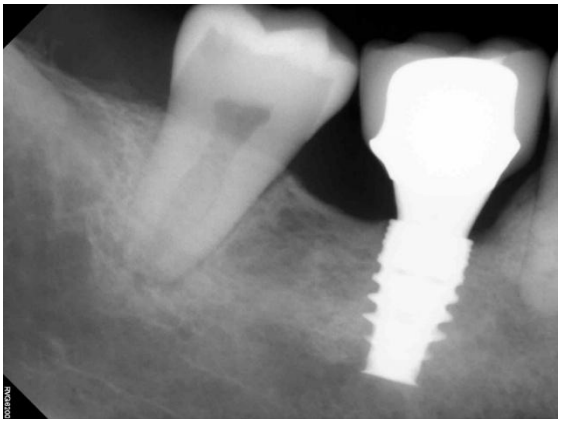

Figure 5: Intra-oral periapical radiograph showing implant fixture with restoration (6-month post-operative evaluation)

DISCUSSION

In contrast to implant failures which occur because of biologic reasons (such as peri-implantitis), implant fractures rarely occur. In fact, the incidence of implant fractures has been reported to be less than 1% in numerous review articles.[1,2,3,4,5] Nevertheless, similar to an implant failure associated with biologic failures, the eventual outcome of a fractured implant is equally undesirable. In most cases, fractured implants cannot be surgically repaired, and often demands immediate removal and replacement with a new implant.

Because the incidence of implant fracture is low, it is difficult to pinpoint the exact causes of implant fractures. Patterson et al. implicated metal fatigue as one of the more common cause of implant fracture.[6] Metal fatigue occurs as the metal parts are weakened due to repeated cyclic stress from loading forces. Once the loading stress exceed the metal fatigue limit, fracture of the metal will occur. Taking this into account, it is equally important to take note of the location of the implant within the oral cavity, which may be subjected to different loading forces. Higuchi et al. reported that most implant failures occur in the premolar and molar regions.[7] This is in agreement with Rangert et al. and Tabrizi et al. who reported that the majority of implant fractures occurred in posterior teeth where occlusal forces are generally known to act most strongly compared to the anterior region of the jaws.[8,9] To illustrate this, Rangert et. al. found that ninety percent of all implant fractures were in the molar and premolar regions of the mouth, where chewing forces and

lateral movements associated with cusp inclination generate undesirable forces. Thus, it is conceivable that implants replacing one or more missing posterior teeth are subjected to heavier masticatory loads, which puts them at higher risk of bending overload, greater fatigue, and eventual metal fracture.

Chrcanovic et al. identified several other factors which can potentially have significant effects on implant fracture: implant diameter, implant length, presence of a cantilever, and sleep bruxism.[10] Intuitively, the smaller the diameter of the implant, the greater the possibility that fracture occurs [10,11] since the stresses concentrated on the crestal portion of the implant increases. Additionally, the stress dispersion increases with the increase in the implant diameter. However, other studies demonstrate a little to no correlation between implant diameter and implant fracture.[9,12] One study showed that a significant effect could be seen in fatigue performance for 5 mm implants and 3.75 mm implants, however 3.3 mm implant did not exhibit the typical, predictable fatigue behavior.[13] Since the implant placed in this case report was 5.0 mm, it is difficult to implicate implant diameter as being the causative (or even a contributing) factor for the fracture observed in this case.

Similarly, there is conflicting data on the correlation between implant length and implant fixture fracture. Chrcanovic et al. reported that the probability of implant fixture fracture increases by 22.3% as the length of the implant increases by 1 mm.[10] Yet, Tabrizi et al. and Lee et al. reported no significant correlation between implant length and fixture fracture. Therefore, further research is necessary in this area.[9,11] However, as it pertains to this case, it is difficult to implicate implant length as being the causative (or even a contributing) factor for the implant fracture.

Another factor that needs to be addressed is the implant fixture loading angle which can be a risk factor for implant fracture, especially since the mis-angled placement of implant #30 area may have contributed to faulty stress distribution at the implant-to-bone interface. Load factors are related to the magnitude and direction of occlusal forces. An implant placed in an ideal angle and orientation will facilitate an occlusion that is well balanced and loading forces that are well distributed all along the implant-to-bone interface. On the other hand, an implant placed at an angle and/or orientation that is not harmonious with physiologic masticatory processes may be subjected to lateral forces which could introduce undesirable shear forces at the implant-to-bone level, thereby inducing metal fatigue which ultimately led to the implant fracture. This was seen in this case where the implant on #19 was placed in an ideal orientation which facilitated a well-balanced occlusion and well distributed loading forces. In contrast, the implant placed in the #30 region was not placed at an angle or orientation that would facilitate these favorable conditions.

CONCLUSION

The findings from this case report can be generalized only to this case and may not have external validity. In addition, it is possible that the patient had sleep bruxism and/or oral parafunctional habits because the patients who exhibited them were not well diagnosed.

CONFLICT OF INTEREST

There is no conflict of interest

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