Case Report

An Alternative Approach for Removing a Fractured Implant Abutment Screw: A Case Report

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Abstract

An abutment screw fracture poses a particularly serious problem because removing the fractured abutment screw is time-consuming and difficult. Due to the lack of the screw head as part of the remaining fragment, the deep entrapment of the fragment in the implant fixture makes it difficult for clinical practitioners to locate it and engage it without damaging the interior wall of the fixture. In this case report, an alternative approach to the removal of such fragments involving the use of a customized guide cylinder modified from an "impression post" was applied. With the aid of the customized guide cylinder, a special removal instrument with sharp-edged tips can directly locate and reverse out the fragment without damaging the surface features or the internal threads of the implant. Overall this method was found to be safer and simpler than alternative methods, so if a removal kit for a specific implant system or a guide component is not available, this alternative approach may be the procedure of choice for clinical usage.

Key words: customized guide, implant abutment screw, screw fracture, screw retrieval

Introduction

The application of dental implants is an established treatment modality for oral rehabilitation. However, while the high success rate of implant osseointegration has been clearly demonstrated [1-3], the longevity of implant prostheses on implants is another concern [4-8]. Implant prosthesis failures primarily result from technical complications, including screw loosening, screw fractures, framework fractures, and veneer fractures. Among these complications, abutment screw fractures pose a particularly serious problem because of the excessive complications involved in the removal of a fractured abutment screw. Specifically, it is difficult to remove a fractured screw fragment remaining inside an implant fixture without damaging the implant body; if the fragment is not properly retrieved, the implant may lose its ability to retain the prosthesis despite remaining osseointegrated [8]. Abutment screw fractures have thus been a subject of long-term concern because, although such fractures rarely happen, addressing such situations can be difficult and time-consuming. The standard methods for removing fractured screw fragments are complicated; hence, this report presents a more simplified and straightforward approach.

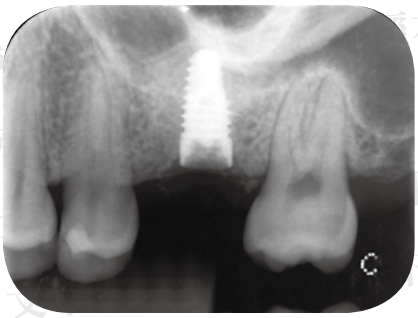

Fig. 1. Radiograph of the fractured abutment screw after crown removal. It demonstrated that the failed abutment screw remained within the implant body.

Fig. 2. Screw removal instrument (Lucky, SC-1713, ADL Bio, Seoul, Korea). The sharp-edged tips of the screw removal instrument can engage the irregular top surfaces of fractured screw fragments.

Over an observation period of 5 years, Kreissl et al. determined that the incidences of abutment screw fracture and abutment screw loosening were 3.9% and 6.7%, respectively [9]. Several contributing factors have been implicated in the etiology of screw failures, including bruxism, malfunction, improper placement techniques, non-passive fit of the superstructures, manufacturing errors, and the use of unfavorable superstructures [10]. These factors predispose screw joints to excessive bending forces and settling effects arising from micromovements at the implant–abutment connection, with these forces and effects leading in turn to abutment screw loosening [11,12]. In clinical practice, practitioners can detect this problem early through routine follow-up examinations. Screw loosening, meanwhile, is the main reason for screw fracture, and when such loosening goes undetected and untreated, over time even common chewing movements can lead to screw fatigue and fracture [13].

When an abutment screw fracture occurs, many methods exist for removing the fractured screw fragment remaining in the implant fixture. Generally, the most convenient way to remove the screw is to reverse it. Regardless of whether the fractured screw fragment is above or below the implant platform, one could thus first try using an explorer probe or an ultrasonic tip to unscrew the abutment screw fragment in a counterclockwise direction over the irregular fractured surface. However, this method sometimes does not work because the reverse torque cannot be effectively applied to the fragment using a freehand approach. Therefore, several retrieval kits have been made available on the market, such as the Certain® Screw Removal Tool Kit (Biomet 3iTM, FL, USA), Retrieval Instruments (Nobel Biocare, Zurich, Switzerland), the Neo Screw Remover Kit (Neobiotech, Seoul, Korea), and the ITI® Dental Implant System (Institut Straumann, Waldenburg, Switzerland). In substance, these retrieval kits consist of two components: first, instruments with different special tip designs to engage the fractured fragment and, second, guide components for the aforementioned instruments that aid in locating the fragment and help to prevent damage to the implant fixture during the retrieval process.

Due to the heterogeneity of implant systems, these removal kits cannot be applied to all systems. Therefore, in the event that a removal kit for a specific implant system is not available, this case report offers an alternative approach in which only a special screw removal instrument and a customized guide cylinder modified from its impression post are required. This method is safer and simpler than alternative methods for clinical practitioners.

Case Report

A 30-year-old male patient presented to our dental clinic with a loosened crown on the maxillary left first molar; the crown had been retained with an abutment screw over an implant (PrimaConnex® implant: Ø5.0 × 10 mm length; Keystone Dental, MA, USA) for 3 years. A dental radiograph indicated that the abutment screw of the maxillary left first molar had fractured at the junction of the screw shank and screw thread. The abutment screw fragment was 2 mm below the platform of the implant fixture (Fig. 1).

To retrieve a fractured screw, an alternative approach is introduced in the following procedure. This technique allows the abutment screw fragment to be removed without the risk of damaging the surface features or the internal threads of the implant. Additionally, it can be applied to most implant systems when a removal kit for a specific implant system is not available.

Fig. 3. To accommodate the slightly wider shank of the screw removal instrument, the channel of the implant impression post was enlarged. The impression post on the left is the enlarged one. The impression post on the right is the original one.

Fig. 4. A C-S2 tungsten carbide bur (Diaswiss SA, Nyon, Switzerland) in an electric straight handpiece was used to enlarge the impression post.

Fig. 5. The screw removal instrument could pass through the enlarged impression post.

Steps of the alternative method:

1. A screw removal instrument (Lucky, SC-1713, ADL Bio, Seoul, South Korea) was selected to remove the fractured fragment (Fig. 2). The sharp-edged tips of this instrument were designed to easily engage the irregular top surface of the fractured screw fragment, which helped the user to unscrew it.
2. A corresponding "impression post" (Ø5.0 mm), a component for implant-level impression to transfer the index position, angle, and depth of the implant, was employed. This component can serve as a specific guide to access the screw hole in the implant bore because the outer feature precisely fits the internal feature of the implant to make the component stable, while the inner channel provides a means of access by which to locate the fractured fragment in the screw hole. Unfortunately, the diameter of the shank of the screw removal instrument was slightly larger than that of the channel of the impression post. Therefore, a customized guide cylinder was modified from the original impression post by enlarging its diameter with a C-S2 tungsten carbide bur (Diaswiss SA, Nyon, Switzerland) in an electric straight handpiece (Fig. 3, Fig. 4, Fig. 5).
3. With the aid of the customized guide cylinder, the screw removal instrument could precisely locate the top surface of the fractured fragment without slippage. A light vertical force was applied parallel to the long axis of the implant so that the screw removal instrument could engage the fractured abutment screw with the sharp-tip end. Then, the screw removal instrument was manually rotated in a counterclockwise direction. Finally, the fractured fragment was retrieved efficiently without damaging the internal threads of the implant fixture (Fig. 6, Fig. 7).
4. A new abutment and screw were employed to fabricate a new implant-supported prosthesis (Fig. 8).

Discussion

In this case, the male patient had hyperactive masseter muscles and was in the habit of chewing betel nuts. The abutment screw fracture occurred in the posterior area, where the molar is subjected to greater masticatory forces than the anterior teeth. Additionally, the coarseness of the betel nut may have contributed to the unusually high incidence of mechanical overloading on the implant prosthesis. We assumed that the great overloading stress and accumulated fatigue loading led to the abutment screw fracture.

One common approach for retrieving a fractured abutment screw is to use the drilling method. This involves drilling a hole on the surface of the fractured screw and then using a special piece of

Fig. 6. Retrieved abutment screw fragment.

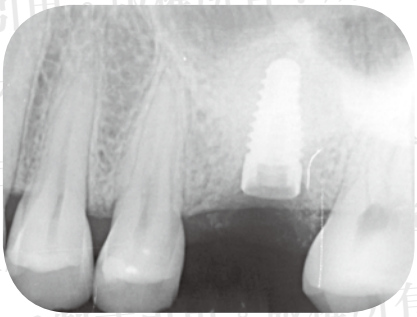

Fig. 7. After retrieval of the fractured abutment screw, a radiograph was taken to confirm its complete removal.

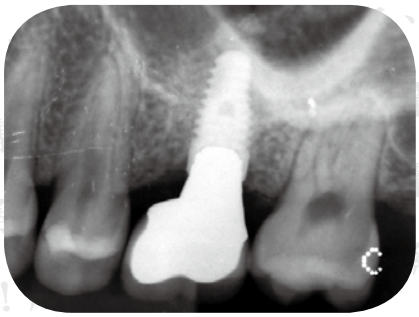

Fig. 8. Radiograph of the new implant-supported prosthesis.

equipment, such as a reverse-tapping rotary drill, to engage the hole in a counterclockwise direction and then rotate the screw out [14]. Compared to this drilling method, the alternative approach adopted in the present case study takes advantage of the uneven surface of the fractured abutment screw to foster rotation without drilling a hole. First of all, screw fractures commonly result in uneven surfaces. Several studies[15-17] have revealed that a crack was initiated on the tensile side of an abutment screw when the abutment screw exceeded the metal fatigue limit under the masticatory forces in the oral cavity. Such cracks typically continue to propagate over time. Fatigue striations running perpendicular to the direction of crack propagation have been observed under microscopes, with these striations being related to chewing cycles. In this study, a compression curl (a curved lip) was found at the end of the total fracture, indicating the existence of a strong bending component and that the fracture origin was on the opposite tensile side [18]. Through an investigation of the fracture process of the screw, the fractured surface of the abutment screw was confirmed to be uneven. By applying leverage on the uneven surface, the special screw removal instrument with sharp-edged tips could rotate and propel the screw fragment without drilling a hole. With this drill-free process, we reduced the risk of overheating the drilled components and generating metal debris. Additionally, using a guide cylinder modified from an impression post helped to prevent the screw removal instrument from slipping and damaging the internal wall of the implant fixture.

When a removal kit from the original manufacturer is unavailable, this alternative approach can serve as a safe and simple screw removal approach. Although there are removal kits with guide components on the market that claim to be universally or mostly compatible with all implant systems, in reality they only provide a general but sometimes unstable fit. Instead, the customized guide cylinder modified from the original impression post used in this study provided a perfect fit and superior stability. It is worthwhile to note that, although a manual screw removal instrument was used in this study, use of a rotary screw removal instrument installed in a dental handpiece is feasible with the modified guide cylinder too. This reduced the complexity of the clinical manipulation, particularly in the subgingival environment, which is deep and can be easily filled with saliva and blood.

Finally, clinicians should identify the reasons for any failure in order to prevent future fractures. To lower the incidence of abutment screw loosening and fracture, clinicians must remain cautious about certain concerns at different stages of the treatment. During the initial assessment, clinicians should plan for an adequate number of implants to bear the occlusal load and avoid the excessive angulation of implants to occlusal load. When delivering a prosthesis, clinicians should use the correct fixation screw; using one supplied by the manufacturer of the implant fixture is recommended. The recommended screw tightening torque should be applied with a torque wrench. Adequate fit of the prosthesis should be confirmed, and occlusal overload of the prosthesis

should be avoided. Lastly, clinicians should perform periodic maintenance and arrange for an immediate dental visit if the patient detects looseness of the prosthesis. Once screw loosening occurs, loose screws should not be retightened, but rather should be replaced with new screws [19,20]. Because damage may occur following screw loosening, the gravity of screw loosening should not be underestimated [17].

Conclusion

A fractured abutment screw fragment was successfully and safely removed using an alternative approach in which a customized guide cylinder modified from an "impression post" was applied. With the aid of the customized guide cylinder, a special removal instrument with sharp-edged tips can directly locate and reverse out the fragment without damaging the surface features or the internal threads of the implant. Overall, the method was safer and simpler than alternative methods, so if a removal kit for a specific implant system or a guide component is not available, this alternative approach may be the procedure of choice for clinical usage.

Conflict of Interests

The authors declare that they have no conflict of interests.

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