The Use of a Dental Surgical Microscope to Aid Retrieval of a Fractured Implant Abutment Screw: A Clinical Report

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Abstract

This clinical report outlines a method to retrieve a fractured implant abutment screw through the use of high-power magnification and ultrasonic instrumentation. Furthermore, the use of manufacturer's specific components is highlighted to minimize occurrences of such clinical complications from arising.

Implant abutment/prosthetic screw loosening and fracture have been among the most common complications reported in implant prosthodontics.[1,2] A systematic review of the literature by Goodacre et al reported an incidence rate of up to 19% for implant prosthetic screw fracture.[3,4] Most reported implant abutment screw fractures were attributed to framework misfit, extended period of clinical use, or repeated retightening of loose screws.[5-9] Many early problems of screw loosening and fracture have been overcome through improvements in screw design and materials used that allow the appropriate preload to be applied.[3] Since then, the overall incidences of screw loosening has decreased from as high as 45% to 8%.[3] This makes instances of screw fracture a rare and stressful occurrence.

In implant prosthodontics, applying an appropriate level of torque to the prosthetic screws will create a clamping force (preload) between the abutment and implant interface. This minimizes the potential for abutment/prosthetic screw loosening and hence, fracture.[10] The recommended torque varies among manufacturers due to differences in screw designs and the materials used;[10] however, if the torque applied to the screw exceeds the yield strength[11] of the screw, fracture results. Haack et al[11] demonstrated that under manufacturer's recommended torque, stresses calculated for gold and titanium abutment screws did not exceed 60% of their respective yield strength, thus providing a significant buffer zone that prevents screw fracture.[11] Nonetheless, the importance of the appropriate clinical torque application cannot be overemphasized.

The importance of using manufacturer's specific torque wrenches with the proper maintenance has also been highlighted in the literature. Gutierrez et al[12] reported that the accuracy of torque wrenches diminishes following periods of extended clinical use and repeated sterilization. In fact, after 36 months of use and 72 sterilizations, the mean torque generated can exceed the designated 10 Ncm by 455%.[12] This diminished accuracy was also seen in the 20 Ncm and 32 Ncm wrenches. The authors attributed these discrepancies to corrosion of the internal components of the torque wrench, which were found to be sensitive to heat and chemical sterilization.[12] Furthermore, Goheen et al[13] demonstrated the importance of using manufacturer-specific components and that the use of dissimilar components could possibly result in inaccurate tightening. They found that experimentally determined values of torque generated by a noncompatible wrench ranged from 12% below to 43% above the specified value.[13]

A number of methods have been described in the literature for the removal of fractured dental instruments and components.[14,15] Krell et al[14] outlined the use of ultrasonic instruments for the retrieval of broken instruments and dowels. Williamson and Robinson[15] described using a modified no. 1 (Brasseler USA, Savannah, GA) bur with a slow-speed handpiece in a reverse fashion to remove a fractured abutment screw. The

Figure 1 Periapical radiographic of fractured abutment screw.

Figure 2 Fractured abutment screw seen through surgical microscope.

Figure 4 Periapical radiographic following retrieval of fractured abutment screw.

Figure 5 Internal damage within implant body caused by rotary instrumentation used in retrieval.

Figure 3 Retrieved screw fragment displaced to implant platform, as seen through surgical microscope.

objective is to have the bur blades contact the fractured portion of the screw so it will reverse out of the screw hole.[15] The implant manufacturers have also designed tools specifically for screw retrieval. One system involves drilling an access channel through the center of the remaining fractured screw, engaging it, and applying a reverse torque (abutment screw retrieval system, Nobel Biocare, Yorba Linda, CA). The other uses a Fragment Fork® (Astra Tech Inc, Waltham, MA), which is designed to be used with a contra-angle slow-speed handpiece in reverse, in an attempt to remove the remaining screw fragment by engaging irregularities in the coronal portion. Nevertheless, implant abutment/prosthetic screw retrieval is often tedious and time-consuming. Furthermore, the success of this procedure relies largely on visibility of the screw fragment, which is influenced by the depth and location of the implant, the depth of the fractured screw fragment in the screw channel, and the accessibility of light.

The purpose of this clinical report is to outline the benefit of the surgical microscope in aiding the retrieval of a fractured implant abutment screw.

Clinical report

A 36-year-old man presented to the Center for Prosthodontics and Implant Dentistry at the Loma Linda University School of Dentistry, with a failing maxillary left central incisor. The patient was classified as Prosthodontic Diagnostic Index Class I for Partially Edentate Patients. Following routine diagnostic procedures and discussion of treatment options, the patient elected to have extraction of the failing tooth and implant placement. The patient underwent minimally traumatic extraction of the maxillary left central incisor, immediate implant placement (Astra Osseospeed™ 4.0 S, Astra Tech Inc), and immediate provisionalization without flap reflection. The platform of the implant was placed 3 mm apical to the predetermined facial-gingival margin of the definitive implant restoration.[16] The definitive impression was made using polyvinyl siloxane (Aquasil Monophase, Dentsply Caulk, Milford, IL) at 6 months. A zirconium abutment (ZirAbutment 3.5/4.0, Astra Tech Inc, Waltham, MA) was prepared to provide appropriate gingival emergence, retention, and resistance form, and a new interim prosthesis was fabricated over it. While the final abutment was torqued to 25 Ncm (manufacturer's recommended torque) using a proprietary torque wrench (Osseous Technologies of America, Newport Beach, CA), it was noted that the abutment screw was fractured. Upon removal of the abutment, it was evident that the apical threaded portion of the screw was retained in the implant (Figs 1 and 2). An attempt was made to retrieve the fractured screw fragment by first using a slow-speed modified no. 1 (Brasseler USA) bur in reverse and subsequently by slotting the remaining portion of the fractured screw with a high-speed no. 1 bur (Brasseler USA) for engagement of the retrieval slotted screw driver.

Unfortunately, neither procedure was effective in removing the fractured screw fragment. To make matters worse, the subgingival placement of the implant, the depth of the fractured screw fragment within the implant body, and the lack of proper light access hindered visualization of the remaining screw fragment even with the aid of surgical loupes (Ergovision HD Loupes 2.5×, Surgitel, Ann Arbor, MI). Subsequently, an ultrasonic instrument (Satelec P5, Acteon Equipment, Bordeaux, France) with an ultrafine spreader tip (EIE2 tip, Excellence in Endodontics, San Diego, CA) was used in conjunction with a surgical microscope at 12× magnification (Zeiss OPMI pico dental microscope, Carl Zeiss SMT AG, Oberkochen, Germany). The greatly improved illumination and visualization afforded through the use of the surgical microscope allowed the retained screw fragment to be easily identified within the implant body and carefully retrieved (Fig 3). A new abutment screw was then placed and retorqued using the manufacturer's torque wrench (Astra Tech Inc) to the recommended 25 Ncm, and the new interim prosthesis cemented using temporary cement (TempBond, Dentsply Caulk, York, PA) (Fig 4).

Conclusion

The use of high-power magnification with coaxial light source to enhance visibility and direct access in conjunction with ultrasonic instrumentation was of great assistance in the retrieval of the fractured abutment screw; however, it is best to avoid being in such a predicament. To prevent screw fracture, it is important to use the manufacturer's specific components, meticulously check the centric and excursive contacts of implant-based restorations, apply appropriate preloads, and frequently replace abutment screws following repeated retorquing. In addition, appropriate maintenance of torquing devices is also important. Following a prolonged period of service, recalibration or replacement of the torque application devices is justified. The use of rotary instruments to remove fractured abutment screws must be exercised with great care, for it increases the probability of damaging the internal threads of the implant (Fig 5). Damage to the internal aspect of the implant may prevent the proper seating of a prosthetic screw, and thus render the implant nonrestorable. The long-term consequences of such internal damage are unknown and may have a bearing on the prognosis of the treatment.

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