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Keywords
Removal; abutment screw; dental implant; fracture; impression coping; customized drill guide.

Abstract
This clinical report introduces a method for safe retrieval of a broken implant abutment screw. A reverse-tapping rotary instrument has been introduced in the market and is widely used to retrieve broken screws; however, it is difficult to use the rotary instrument unless an access hole for engagement of the rotary instrument is positioned directly on the center of the top of the broken screw remnant. Poor visibility is another limitation to make an access hole. To keep the position of the rotary instrument at the center of the broken screw, a customized drill guide was fabricated, modifying an implant impression coping with self-cured acrylic resin, all easily found in daily practice. The broken screw was easily removed, not damaging the internal threads of the implant. This technique could be applied to most implant systems when a specific removal kit for each implant system is not prepared.

During implant treatment, various complications can occur. The six major categories of potential complications are aesthetic, phonetic, functional, biological, mechanical, and ergonomic. Screw loosening represents the most common mechanical complication in implant-supported fixed dental prostheses. Goodacre et al reported a screw fracture incidence rate of up to 19%. Aglietta et al also reported that the 5- and 10-year estimates of abutment/screw fracture rates were 2.1% and 4.1%, respectively, with a 95% confidence interval.

Removal of a broken abutment screw is a time-consuming and challenging process because of poor visibility, especially when the internal connection type of implant has been used. Nevertheless, removal of a broken abutment screw is also important to keep the implant in continuous function. To remove a broken screw, Luterbacher et al reported a case using a specially designed service set available for the Straumann implant system (Institut Straumann, Waldenburg, Switzerland); however, this method was disadvantageous because it was difficult in practice and it could only be applied to the Straumann implant. Some practitioners introduced a method to make self-made drivers. Williamson and Robinson modified a low-speed No.1 bur (Brasseler USA, Savannah, GA) with a heatless stone into a slotted screwdriver. Yilmaz and McGlumphy introduced a fork-shaped rotary instrument engaged into the hole, which was drilled into the center and periphery of the broken screw. Walia et al also reported a method of using an ultrasonic instrument for retrieval of the broken screw; however, these methods risked damaging the internal threads of the implants, potentially leading the implant to be unusable.

Various companies have released many screw removal kits. Most were designed to remove a broken screw with a self-tapping rotary instrument that could pull out the broken screw with reverse action, engaged to the central hole made on top of the broken screw; however, retrieving a broken screw with these rotary instruments is not so easy in practice because it is difficult to make an access hole for engaging these self-tapping rotary instruments.

The current clinical report introduces a novel rotary instrument and a customized drill guide to make an access hole on top of the broken screw. The rotary instrument could be safely used thanks to the customized drill guide, and it could be compatible with most of the implant systems.
Clinical report

This clinical report was approved by the Institutional Review Board of the National Health Insurance Medical Center (NHIMC), Gyeonggi, South Korea. A 50-year-old male patient presented at the Department of Prosthodontics, NHIMC, when an implant crown had fallen out. The implant was placed 7 years ago and was restored using a screw-retained metal ceramic crown. During the ensuing 7 years, a periodic check-up was performed every 6 months. Screw loosening was found at 40 months, and the screw was retightened. At 56 months, the patient visited again for the screw loosening and porcelain chipping. A new abutment was connected, and a new cement-retained crown was made.

Clinical examination revealed that the abutment screw was fractured and the screw remained 2 mm below the platform of the implant fixture (Fig 1). To remove the fractured screw, an endodontic explorer was used first with a counter-clockwise manner so as not to damage the inner thread of the implant under the surgical microscope light for better visibility. Removing the screw with the hand instrument failed, so it was decided to use a novel rotary instrument with a customized drill guide.

A reverse tap drill (BRT 20 drill; Implanova Co. Ltd., Gimhae, Korea) was designed to have a cutting blade with a counter-clockwise spiral thread (Fig 2). As the instrument was turned counter-clockwise in the hole that had been self-tapped in the center of the remaining screw, it became more engaged to the hole with a wedge effect, and then the remaining screw could be pulled up.

The most important step in removal of the remaining screw was to make an access hole in the center of the broken screw. To make the hole, a #329 tungsten carbide bur (Brasseler USA, Savannah, GA) was used with water spray in a high-speed handpiece (KaVo Dental Corp, Lake Zurich, IL). This bur was guided by a customized device to be positioned precisely. The customized drill guide was fabricated using an implant impression coping that could specifically fit to the internal structure of the implant fixture (Fig 3). To be able to maintain the bur position at the center of the coping, the impression coping was modified using autopolymerizing acrylic resin (Pattern Resin; GC Corporation, Tokyo, Japan). The channel of the impression coping was filled with autopolymerizing acrylic resin, and when the resin reached the dough stage, a #329 bur was inserted. The bur was moved back and forth until the resin completed polymerization (Figs 4 and 5).

The central access hole with a depth of 0.5 mm was made with a #329 bur on top of the broken screw, and the reverse tap drill was used in a contra-angle handpiece with a counter-clockwise...
Figure 5 Completed customized drill guide. Autopolymerized acrylic resin has been chemically cured and it will guide a high speed bur position at the center.

Figure 6 Remaining screw fragment was retrieved by using reverse tap drill.

Figure 7 Retrieved screw fragment and suprastructure.

damaged. The implant was restored using a new abutment and a new crown (Fig 8).

Discussion

In this case, the patient showed hyperactive masseter muscles, wear facets on multiple teeth, and linea alba on both sides of the buccal mucosa. With these signs, it could be assumed that excessive occlusal forces had been applied to the implant crown. Screw fracture is attributed to excessive overload, fatigue, improper placement techniques, and nonpassive fit of the superstructures. In the current clinical situation, the reason for screw fracture might have been occlusal overload leading to repeated screw loosening. It might have reached the level beyond yield strength of the screw to fracture it. According to Misch, “To avoid screw fracture, several precautions were suggested including: (1) confirming adequate fit of the prosthesis; (2) avoiding occlusal overload of the prosthesis; (3) having an adequate number of implants to bear the occlusal load; (4) avoiding excessive angulation of implants to occlusal load; (5) applying recommended screw tightening torque with a torque wrench; (6) using the correct fixation screw; (7) replacing loose screws instead of retightening them; (8) reinforcing periodic maintenance; and (9) scheduling an immediate dental visit if the patient detects looseness of the prosthesis.”

There are some precautions in making an access hole on top of the broken screw with the drill guide. First, the broken screw could be pushed forth by the high-speed bur because the bur rotates clockwise during the action. Therefore, only very light touch should be applied when the high-speed bur is used. Second, intermittent force under abundant water spray is required so as not to generate excessive heat while making the hole. The bur should not constantly touch the broken screw because it could generate excessive heat. Finally, it is important to fix the drill guide at the right position while the high-speed bur is being used to make an access hole. Since the channel of the impression coping is used for the bur access, the impression coping cannot be fixed to the implant as it is used for impression making. If stability of the custom drill guide becomes an issue, additional autopolymerizing acrylic resin could be applied around the impression coping to form a handle.
Conclusion
A 50-year-old male patient presented with a broken implant restoration that was connected into an internal-hex type implant. To retrieve the remnant of the broken abutment screw in the fixture, a novel rotary instrument was used. A customized drill guide was fabricated by modifying an impression coping to keep the position of the rotary instrument at the center on top of the broken screw. The broken screw was easily removed, not damaging the internal thread of the implant.

References