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Using a Porcelain Furnace to Debond Cement-Retained Implant Crown from the Abutment after Screw Fracture: A Clinical Report

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Abstract

When a screw fracture occurs on a cement-retained, implant-supported restoration, the abutment and restoration are completely separated from the implant's internal connection. Traditionally, an access hole is drilled through the crown to retrieve the broken screw, and the restoration can be placed again as a screw-retained restoration. This clinical report documents a patient whose broken abutment screw was retrieved from the restoration by burning off the cement and separating from the abutment without drilling an access hole.

Cement-retained implant-supported restorations are very common among practitioners because of the improved esthetics, passivity, and more favorable occlusal loading.[1,2] In addition, cement-retained crowns appeal to practitioners of all levels of clinical expertise due to their marked similarity to fixed prosthodontics.[3] Among the complications associated with cement-retained implant-supported restorations, abutment screw loosening is common,[4,5] and can eventually lead to screw fracture. A systematic review by Chaar et al reported that incidence of abutment screw loosening occurred 4.3% in short-term and 10.0% in long-term studies that examined cement-retained, implant-supported restorations.[5] If excessive lateral forces are placed on the loose abutment screw, it can fracture from the creation of a longer lever arm, and there is a tendency for the abutment and crown to dislodge with a screw fragment within the fixture.[6] A systematic review by Goodacre et al reported that screw fracture can occur in 4% of patients.[4] In a recently published systematic review, Sherif et al found slightly higher failure rates for studies involving cement-retained groups at a 95% confidence interval level.[3] For patients with cement-retained, implant-supported restorations, perforating part of the crown, commonly the occlusal aspect, can provide access to the fractured screw for subsequent removal.[7] While this may provide the patient with a solution for the fractured screw, esthetics and mechanical properties of the implant-supported restoration may be altered, influencing the longevity and preservation of the restoration.[4]

Cement-retained, implant-supported restorations can be luted permanently or be retrievable. A variety of cements have been used for these restorations, ranging from zinc oxide eugenol to resin-reinforced glass ionomer, and this can influence the clinical retrieval. In a recent study Mehl et al reported that all cements tested exhibited a significant decrease in crown retention when bonded to crowns with a cement gap thickness of 50 μm or more.[8] This could be explained by the greater cohesive properties that resinous cements possess and a greater shear bond strength to titanium in comparison to other groups. Squier et al supported these findings. Studying the retentive capabilities of different cement systems, they determined that resin composite and resin-reinforced glass ionomer cement exhibited the highest retentive strengths.[9] However, once the abutment screw fractures, it would be difficult to retrieve the crown without causing irreversible damage to the crown, regardless of the cement selection.

Figure 1 Initial presentation of fractured screw and implant-supported crown.

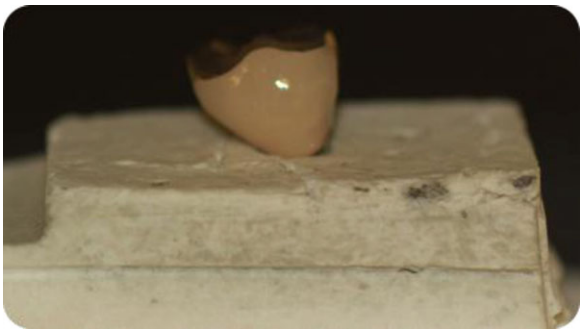

Figure 2 Abutment and crown embedded in a refractory firing block.

The purpose of this clinical report was to describe a patient situation where the cement-retained, implant-supported crown was retrieved by debonding from the abutment using a porcelain furnace after a screw fracture.

Clinical report

A 62-year-old Caucasian man presented to The Ohio State University College of Dentistry Dental Faculty Practice Clinic with an avulsed cement-retained, implant-supported ceramo-metal restoration on left mandibular first molar (Fig 1). His record indicated that a 4.3 mm diameter implant (Replace Select; Nobel Biocare, Zurich, Switzerland) was placed in 2006. Two-stage implant protocol was strictly followed, and at 4 months the implant was uncovered, and a healing abutment was placed. A closed-tray impression technique was used, and the final impression was made with a polyether impression material (Impregum Penta; 3M ESPE, St. Paul, MN). The definitive restoration was cemented using zinc oxide eugenol temporary cement (TempBond Original; Kerr Corp., Orange, CA) in February 2007. Clinical examination revealed a fractured abutment screw in which the apical portion remained inside the implant's internal connection. The screw was subsequently loosened and removed with the use of a sharp scaler and applying a counterclockwise movement to the fractured component within the implant's internal connection. Once the broken screw

Figure 3 Successful cement burnout and separation of crown from abutment.

Figure 4 Abutment reseated and torqued to 35 Ncm.

Figure 5 Crown recemented.

portion was retrieved, the implant's internal connection was inspected for possible damage to the internal threads. A decision to replace the fractured screw was made, along with recementing the previous crown to the existing abutment. Rather than perforating the crown to locate the screw access, a method of debonding the cemented crown from the abutment using

a porcelain furnace was completed based on the temperature range reported by Linkevicius et al, where average cement disintegration temperatures for zinc phosphate, dual-cure resin cement, and glass ionomer cement were observed at approximately 306 to 363°C.[10]

The cement-retained, implant-supported restoration was embedded in a refractory firing block (Fig 2) and placed in a porcelain furnace (VITA Vacumat 500; VITA Zahnfabrik, Bad Sackingen, Germany) at 350°C. The block was placed in the furnace for 5 minutes, holding the temperature at 350°C under no vacuum. Once the programmed firing cycle was over, the block was set aside to cool. With the aid of two crile forceps (Miltex Integra, LifeSciences Corporation, Plainsboro, NJ) clamped on both components, the prosthetic parts were successfully separated by exerting a pulling movement, and a new screw was placed inside the abutment (Fig 3). Residual cement was carefully removed from the intaglio surface of the crown and from the abutment using a steam cleaner (Eureka Hot Shot; White Consolidated Industries, Cleveland, OH). The retrieved abutment was placed on the implant (Fig 4), and a periapical radiograph was taken to verify absolute seating to the implant platform. The abutment was tightened to 35 Ncm, and the screw access hole was filled with cotton pellets and a polyester urethane dimethacrylate composite resin material (Fermit; Ivoclar Vivadent Inc., Amherst, NY). The crown was cemented using zinc oxide non-eugenol cement (TNE; Temrex Corp., Freeport, NY) (Fig 5). Any excess cement was carefully removed, and a final periapical radiograph was taken to verify the absence of leftover luting agent. The occlusion was verified with the use of articulating paper (AccuFilm; Parkell Inc., Edgewood, NY) to detect any off-centric contacts and lateral excursive interferences that may have contributed to the loosening and subsequent fracture of the screw. The patient was scheduled for regular recall every 4 months.

Discussion

Screw loosening is a challenging prosthetic complication of cement-retained, implant-supported restorations.[11] Several techniques have been described to locate the abutment's screw access hole without causing any irreversible damage; however, there is no literature available regarding the debonding of a cemented crown from the abutment following heat treatment provided by a dental porcelain furnace. Disintegration of dental cements such as zinc phosphate, dual-cure resin cement and glass ionomer cement can occur at a range of approximately 306 to 363°C.[10] This range is also safe for the metal-ceramic restoration based on studies describing post-soldering techniques. Post-soldering temperature is described at 649°C, and this temperature did not have any significant effect on the metal or veneering porcelain.[12] Therefore, the temperature setting of 350°C used to debond the crown from the abutment is within the range of porcelain furnace temperature that would not jeopardize the integrity of the restoration and allow safe retrieval.

The most widely used method to retrieve a loosened implant-supported prosthesis is to perforate the lingual or occlusal portion of the porcelain restoration in hopes of finding the screw access hole for subsequent removal. Dental ceramics exhibit an inherent brittle nature and are susceptible to fracture when high speed, coarse diamond burs are used to adjust feldspar porcelain restorations.[13] In addition, their poor thermal conductivity increases their vulnerability to thermal shock.[14] It is well documented that one important cause of premature failure of dental ceramic restorations is abrasive grinding-induced subsurface damage using high-speed dental hand pieces and diamond burs.[15] Heat generated from abrasive grinding under copious water irrigation has the potential to induce thermal stresses and subsequent crack propagation of the veneering material. These microcracks produce stress concentrations within the ceramic and reduce the overall mechanical strength of the prosthesis. Chang et al demonstrated that even with 46 μm size abrasive diamond particles of fine diamond burs, these were able to produce excessive heat through friction generated during the porcelain removal process under abundant, three-port quenching water irrigation.[14] Any degree of thermal subdamage arising from grinding techniques may thereby facilitate premature failure of the dental ceramic through chipping or fracture.

With the use of the debonding technique described above when the abutment screw from a cement-retained implant prosthesis has completely fractured off, the operator does not jeopardize the integrity and strength of the implant-supported restoration through grinding and access hole location techniques. Nevertheless, the clinical presentation of an avulsed implant-supported restoration does not represent the most common clinical occurrence. Therefore, more research is needed to understand and avoid the loosening of implant-supported, cement-retained restorations, and more conservative, harmless retrieval techniques of dental prostheses are needed.

Conclusion

This clinical report described a patient where a fractured abutment screw was safely retrieved from the restoration by debonding the cement and separating from the abutment with the use of a porcelain furnace. This allowed the integrity of the restoration to remain intact by not drilling an access hole through the crown.

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