

Retrieval of a Fractured Zirconia Implant Abutment Using a Modified Crown and Bridge Remover: A Clinical Report

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Abstract

This clinical report describes a novel method to retrieve the internal connection of a fractured zirconia abutment through modification of a crown and bridge remover. Furthermore, the strengths and limitations of using a zirconia implant abutment will be highlighted.

Traditionally, titanium has been used extensively as a material for implant abutments due to its excellent mechanical reliability;¹ however, the inherent gray color of titanium usually cannot be masked in situations with thin gingival biotype, giving the appearance of gingival discoloration.² Furthermore, in the event of gingival recession, exposure of the titanium abutment can be visually unpleasant.³⁻⁶ Although these restorations may be prosthetically viable, they are often considered a failure from an esthetic viewpoint.⁷

In 1993, Prestipino and Ingber advocated aluminum oxide (alumina) as an esthetic alternative material to titanium for implant abutments.⁸ Due to alumina's favorable inherent esthetic properties, alumina abutments have shown great potential for restorations in the esthetic zone.^{8,9} To create proper gingival emergence, retention, and resistance form, early alumina abutments were prepared manually with a high-speed rotary instrument. Although the low thermal conductivity of aluminum oxide allows the abutment to be prepared safely in the mouth,⁹ manual preparation with a rotary instrument could introduce deep subsurface flaws in the ceramic abutment.¹⁰⁻¹² These flaws would act as stress concentrators, which in turn could reduce the overall strength of the material.¹⁰⁻¹² In fact, a high abutment fracture rate (7%) for single implant alumina abutments has been reported.¹³

Similar to aluminum oxide, zirconium oxide as a framework material may enhance esthetics due to its white color. Besides possessing high flexural strength (~1000 MPa), zirconia also exhibits good tissue compatibility, nontoxicity, and intrasulcu-

lar adaptability, making it a widely used esthetic replacement material for implant abutments.^{8,14-21} Nevertheless, for a material to be used predictably as an implant abutment, in addition to its physical properties, the significance of abutment design, pattern of stress distribution, and degradation of material properties as a result of fatigue must also be considered.²¹

Shear forces produced during mastication may create bending movements and high stresses at the abutment/implant interface.²² Therefore, the wall thickness of the zirconia abutment should not be reduced below 0.5 to 0.7 mm.²³ In addition, because there is only a limited degree of rotational freedom on the abutment/screw assembly interface, any misfit^{24,25} can generate wedging forces on the inner walls of the ceramic abutment accentuated by the torque application to the fixation screw.²¹ Modification of the zirconia abutment is possible using high-speed preparation with copious irrigation,²⁶ but similar to alumina, is susceptible to the introduction of deep surface flaws.^{12,27,28} Furthermore, the low temperature degradation of zirconia, especially in the presence of moisture (water, vapor, body fluid, steam sterilization) causes its spontaneous transformation from a tetragonal phase into monoclinic phase, thereby decreasing the overall strength of the material.²⁹⁻³¹ The aforementioned factors can individually or collectively cause the fracture of a zirconia abutment.

The purpose of this clinical report is to outline the benefit of using a modified crown and bridge remover to safely retrieve the fractured internal connection of a zirconia abutment.



Figure 1 Facial view of the fractured ceramic abutment.



Figure 3 Interim prosthesis and ceramic abutment fragments.

Clinical report

A 41-year-old male patient was being treated at the Center for Prosthodontics and Implant Dentistry, Loma Linda University School of Dentistry, for a failing left lateral incisor (#10) due to periodontal disease. Following standard diagnosis and treatment planning procedures, an implant (Nobel Active™ 3.5 × 13 mm, Nobel Biocare USA, Yorba Linda, CA) was immediately placed and provisionalized.³² The patient did not have a history of bruxism or parafunctional habits. Eleven months after the implant placement, the final impression of implant #10 was made using poly(vinyl siloxane) (Aquadil Monophase, Dentsply Caulk™, Milford, IL). A hexed direct plastic abutment (Nobel Active Procera Wax-up Sleeve, Nobel Biocare USA) was waxed duplicating the gingival emergence established by the interim prosthesis placed immediately following implant placement. The wax pattern was then scanned (Procera® Forte, Nobel Biocare USA) and milled into a zirconia abutment (Procera® Zirconia Oxide, Nobel Biocare USA). An interim prosthesis was then made on the finished abutment based on the diagnostic wax pattern with proper incisal guidance and esthetics matching the contralateral incisor.

The zirconia abutment was placed and hand tightened onto the implant. The fit was verified with periapical radiograph, and the abutment screw was torqued to 35 Ncm (manufacturer’s



Figure 4 Periapical radiograph displaying the fractured ceramic abutment.



Figure 2 Occlusal view of the fractured ceramic abutment with abutment screw in place.



Figure 5 Full thickness flap reflection to completely expose the implant platform and remaining ceramic abutment structure.



Figure 6 Crown and bridge remover modified to create a sickle-shaped instrument.

recommendation, Nobel Biocare). The new interim prosthesis was adjusted to ensure minimal centric and eccentric contacts and cemented using zinc oxide eugenol cement (IRM, Dentsply International, York, PA).

The patient noticed loosening of his maxillary left lateral implant interim prosthesis after a meal 1 week prior to his 12-week follow-up appointment. Fortunately, neither the interim prosthesis nor any portion of the fractured abutment became dislodged prior to his appointment.

After removing the interim prosthesis and the fractured fragments of the zirconia abutment with cotton pliers (Figs 1–3), it was noted that the base portion of the abutment remained tightly lodged inside the internal connection of the implant. A periapical radiograph was taken to identify the remaining ceramic implant abutment (Procera[®] Zirconia Oxide, Nobel Biocare USA) (Fig 4) fragments. Due to the presence of soft tissue inflammation and active bleeding, visual access to the implant site was significantly compromised. Despite numerous attempts with an ultrasonic device, explorer, and periodontal curettes, the removal of the lodged fractured abutment fragment was not successful.

Local anesthesia was then administered, and a full thickness flap was reflected to expose the coronal aspect of the implant for direct visualization of the fractured base portion of the abutment (Fig 5). In addition to repeating the aforementioned methods, various diamond and carbide burs with a high-speed handpiece were used but without significant progress. The tip of a crown and bridge remover (CRP1, Pulpdent, Watertown, MA) was then modified with a heatless stone (767A, Brasseler USA, Savannah, GA) to form a small sickle-shaped instrument (Fig 6). The modified tip was then inserted into the intaglio portion of the implant and was used with a back-action motion as it engaged the base of the abutment (Fig 7). The fractured portion of the zirconia abutment was successfully and completely removed without damage to the implant as verified by the periapical radiograph (Fig 8).

Conclusions

Although management of fractured implant components can at times lead to novel innovation, it is also strenuous, time consuming, and often discouraging. To avoid being in such a

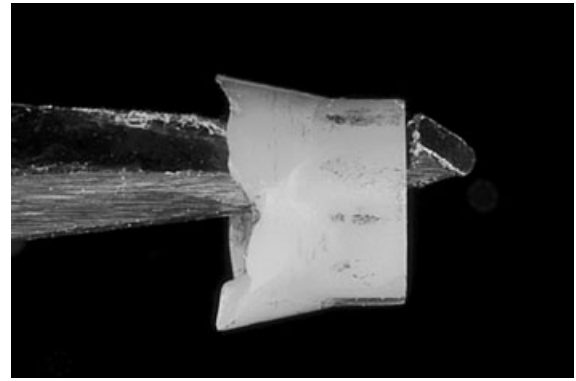


Figure 7 Demonstration of the modified tip engaging the base of the zirconia abutment, followed by a back-action motion to retrieve the fractured portion.

predicament, it is important to understand the properties and limitations of the materials used to make the components. The incidence of ceramic implant abutment fracture can be minimized by proper case selection (anterior area versus posterior, proper occlusal scheme, and avoiding situations with unfavorable parafunctional habits), using copious irrigation when modifying the abutment with a high-speed rotary instrument, ensuring complete abutment seating radiographically prior to applying torque to the abutment screw, maintaining a minimal abutment thickness of 0.5 mm, and using other materials such as titanium or a metal alloy when the thickness requirement is not met.

In this report, as instruments that could potentially damage the implant and/or injure surrounding tissues were used (e.g., diamond and carbide burs with a high-speed handpiece), a full thickness flap was reflected to gain optimal visibility and access.

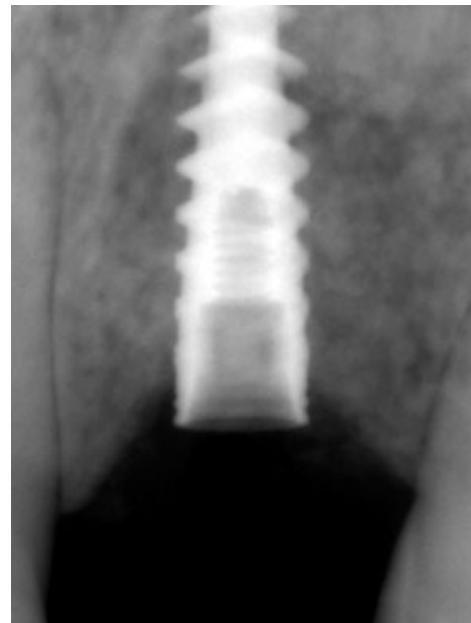


Figure 8 Periapical radiograph after the abutment has been retrieved.

The use of the modified crown and bridge remover may allow for a simple retrieval of the fractured ceramic abutment without the necessity of flap reflection.

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