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CLINICAL REPORT

Titanium implant wear from a zirconia custom abutment: A clinical report

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ABSTRACT

This clinical report describes damage to a 1-piece zirconia abutment where both biological and mechanical complications developed, resulting in premature loss of the implant. Scanning electron microscopy showed significant damage to the internal connection of the implant. When using 1-piece zirconia abutments with a titanium internal connection, periodic recall and identification of wear is necessary, especially in patients with repeated screw loosening. (J Prosthet Dent 2019;■:■-■)

The success and longevity of an endosseous dental implant and the associated implant-supported restoration depend on both mechanical and biological factors.[1] Mechanical factors include loosening and fracture of the prosthetic or abutment screws and wear or fracture of components in the system, whereas biological factors include the development of peri-implantitis and lack of osseointegration.[2,3]

Although screw loosening is a well-recognized mechanical complication with implant-supported restorations,[4] the possible detrimental effects of repeated loosening or the prolonged use of unstable implant prostheses have not been widely documented. Reasons for screw loosening include inappropriate implant position and occlusal scheme, inadequate preload, variations in component dimensions, differences in fit and accuracy, tension on abutment, improper screw design, and excessive occlusal forces.[5] Although protocols for managing fractured abutments and prosthetic screws have been suggested, protocols for evaluating and managing loose screws are limited.[6]

Zirconia abutments are widely used in the esthetic zone. Zirconia has high strength, good biocompatibility, and excellent esthetics.[7-9] The density and strength of zirconia are higher than those of titanium.[10] With repeated loading, fretting, and loosening of the components, wear at the titanium-zirconia interface has been observed.[11,12] Even though this can lead to titanium particles in the peri-implant tissues, no differences in biological complications have been reported.[13,14] One-piece zirconia abutments, however, do exhibit a significantly lower fracture resistance than titanium abutments and have more mechanical complications.[15,16] Therefore, a titanium base has been advocated to reinforce the zirconia abutment and prevent fracture and wear at the implant-abutment interface.[10,17] The purpose of this clinical report was to present a patient with a 1-piece zirconia abutment who experienced both biological and mechanical complications around an osseointegrated implant, resulting in eventual implant loss.

CLINICAL REPORT

A 39-year-old African-American woman presented at The Ohio State University College of Dentistry complaining of a "loose crown." The patient's medical history

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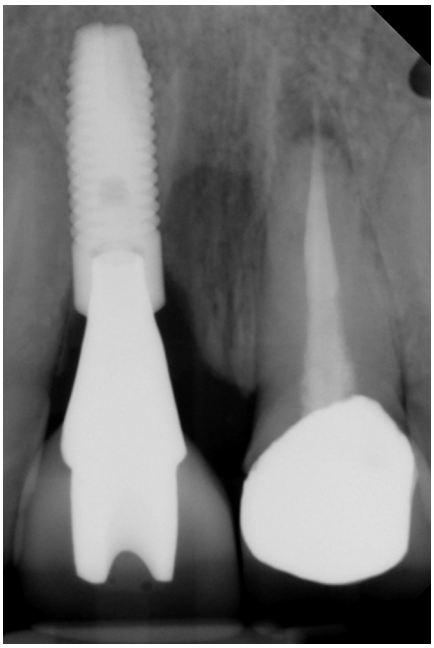

Figure 1. Preoperative periapical radiograph showing 1-piece zirconia abutment.

was nonsignificant, and according to the American Society of Anesthesiologists, she was classified as American Society of Anesthesiologists grade I. After careful clinical examination, she was diagnosed with peri-implant mucositis and a loosened implant-supported crown on the right maxillary central incisor. The tooth had been lost as a result of trauma and replaced by an endosseous dental implant (4.0×13 mm Astra OsseoSpeed; Dentsply Sirona), followed by immediate placement of an interim restoration 3 years previously. Six months later, a cement-retained, implant-supported ceramic crown (e.max; Ivoclar Vivadent AG) was fabricated as the definitive restoration on a 1-piece zirconia custom abutment (Atlantis; Dentsply Sirona) and cemented with a zinc oxide non-eugenol temporary cement (TempBond NE; Kerr Corp) (Fig. 1). The patient did not comply with periodic recall appointments.

Two years later, the patient presented with the implant crown that had been loose for "quite some time" and had been retightened multiple times by a dentist in private practice. The decision was made to remove the crown to access the screw and better evaluate the clinical condition. The patient was informed of the possibility of the ceramic crown fracturing, and an impression was made of the maxillary teeth. A crown remover (GC Plier; GC America) was used, and upon removal, the crown fractured. The 1-piece zirconia abutment, however, remained intact and was removed for evaluation. The zirconia connection showed significant discoloration and had visible titanium particles embedded (Fig. 2). A transmucosal healing abutment was placed, and an

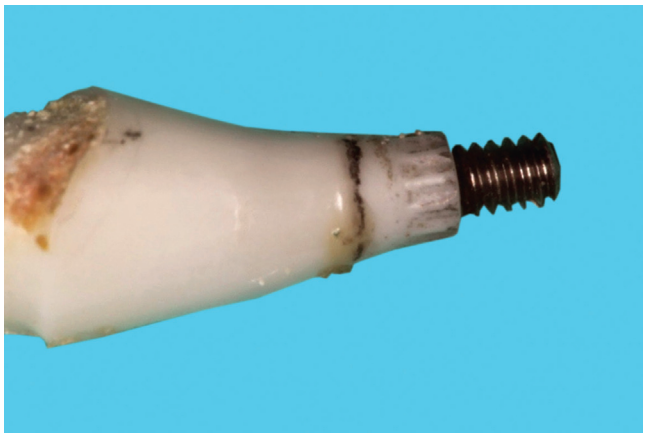

Figure 2. Worn implant abutment with staining and titanium particles embedded.

Figure 3. Cone-beam computed tomography image showing lack of facial bone and loss of osseointegration.

interim removable partial denture was fabricated and delivered. The patient was rescheduled for a definitive impression for a new crown.

At the following appointment, the healing abutment was removed in preparation for the definitive impression. However, movement and discomfort was noted when the open-tray impression coping was tightened. A periapical radiograph was made to confirm seating of the impression coping and provide additional information. Radiographic bone loss, pain on percussion, increased peri-implant sulcus depth, and implant mobility were observed in the patient. The implant had lost osseointegration and was deemed hopeless. The patient was informed and rescheduled for cone-beam computed tomography (CBCT) scanning and for treatment planning.

The CBCT scan confirmed the diagnosis and revealed a significantly patent nasopalatine canal in close proximity to the implant threads, as well as a lack of facial bone (Fig. 3). Owing to the significant alveolar bone loss, an explantation procedure with simultaneous guided bone regeneration was suggested and completed using

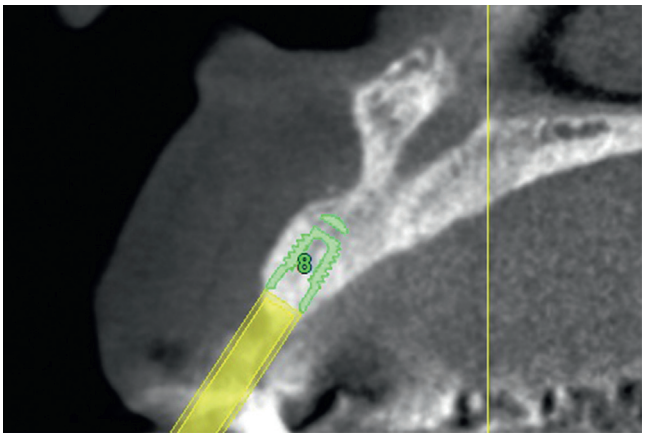

Figure 4. Cone-beam computed tomography image made after grafting showing proposed implant placement.

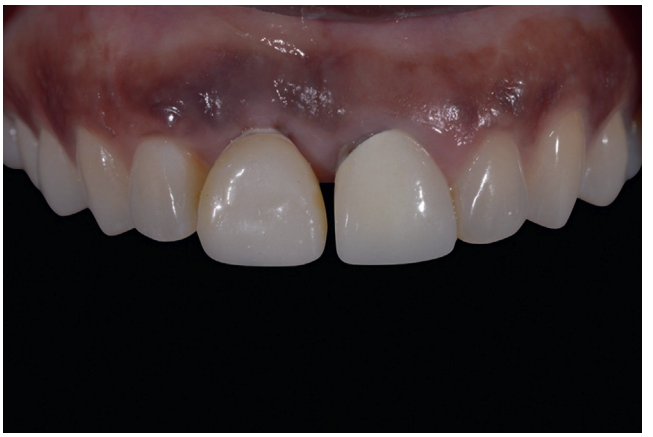

Figure 5. Intraoral view of unfavorable proportions and poor esthetics.

Figure 6. Intraoral view of gold-hue titanium abutment and preparation on adjacent tooth.

1.5 mL of hydrated freeze-dried bone allograft (AlloGraft; Straumann USA) and a resorbable collagen membrane (BioMend Extend; Zimmer Biomet Dental). Healing progressed without complications. Six months later, another CBCT was ordered to evaluate the grafted site and plan the surgical implant placement. Because of anatomical limitations, a 3.7×8.0-mm endosseous implant was selected and placed without complication (TSV; Zimmer Biomet Dental) (Fig. 4).

Four months after the surgery, the implant was uncovered, and a new interim crown was fabricated to develop the peri-implant soft tissue contours. The interim crown had unfavorable proportions, and as a result, the adjacent crown on the left maxillary central incisor was planned for replacement to improve esthetics (Fig. 5). The existing metal-ceramic crown was removed, and new interim restorations were fabricated using autopolymerized polymethyl methacrylate (Jet Acrylic; Lang Dental Manufacturing Co). Once the patient approved the esthetics, an open-tray impression with a customized transfer coping was made for the implant restoration. A gold-hue custom titanium abutment was designed and milled to follow the soft tissue contours and optimize esthetics, and 2 zirconia ceramic crowns (Beyond Zircona; ORIGIN and VM9 porcelain; Vita) were fabricated. The abutment was evaluated clinically and tightened to 30 Ncm following manufacturer recommendations (Fig. 6). The definitive restorations were then evaluated for proximal contacts, fit, occlusion, and esthetics. The implant-supported crown was cemented using interim cement (TNE; Temrex Corp), whereas the tooth-supported crown was cemented with self-adhesive, autopolymerized resin cement (SpeedCEM Plus; Ivoclar Vivadent AG) (Fig. 7).

To assess what had occurred on the internal connection of the original failed implant, the implant was retrieved and embedded in orthodontic resin. A scanning electron microscope was used to visualize the surface at 100-μm level. The scanning electron microscope image showed significant surface changes in the hexagonal configuration of the internal connection where the angled surface of the implant was rounded along with surface indentations on the walls (Fig. 8).

DISCUSSION

The patient care presented in this manuscript demonstrated both mechanical and biological complications with a 1-piece zirconia abutment, resulting in early loss of both restoration and fixture. Although it is not possible to determine if one complication lead to another, wear at the implant-abutment interface may have significantly contributed to the complications that were observed. A better understanding of the changes that may occur on the internal surface of an osseointegrated implant and the clinical implications may be beneficial.

Other factors may have contributed to the failure of the implant prosthesis. Although it had achieved osseointegration, the implant was placed close to the adjacent tooth and lacked adequate thickness of the facial

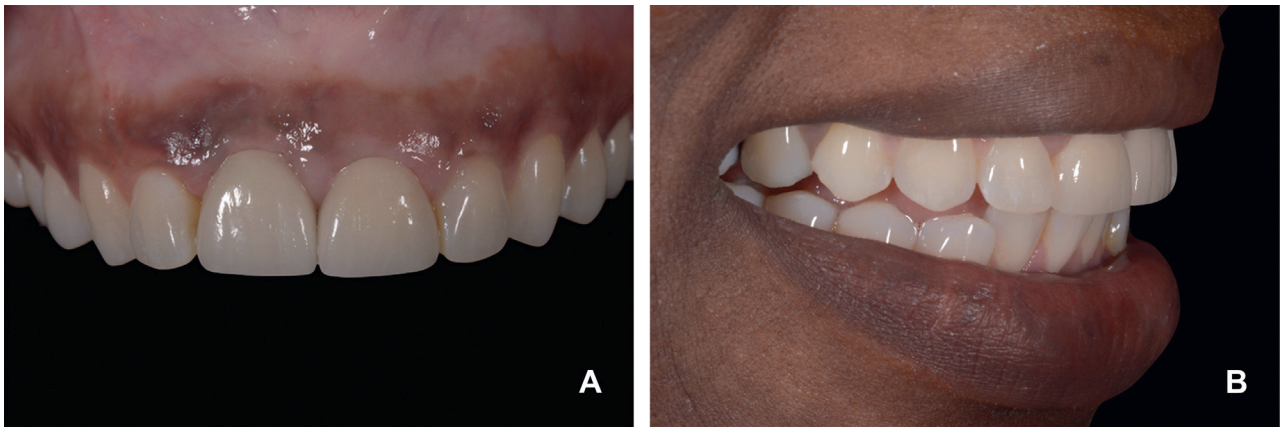

Figure 7. Definitive restorations. A, Intraoral view. B, Extraoral view.

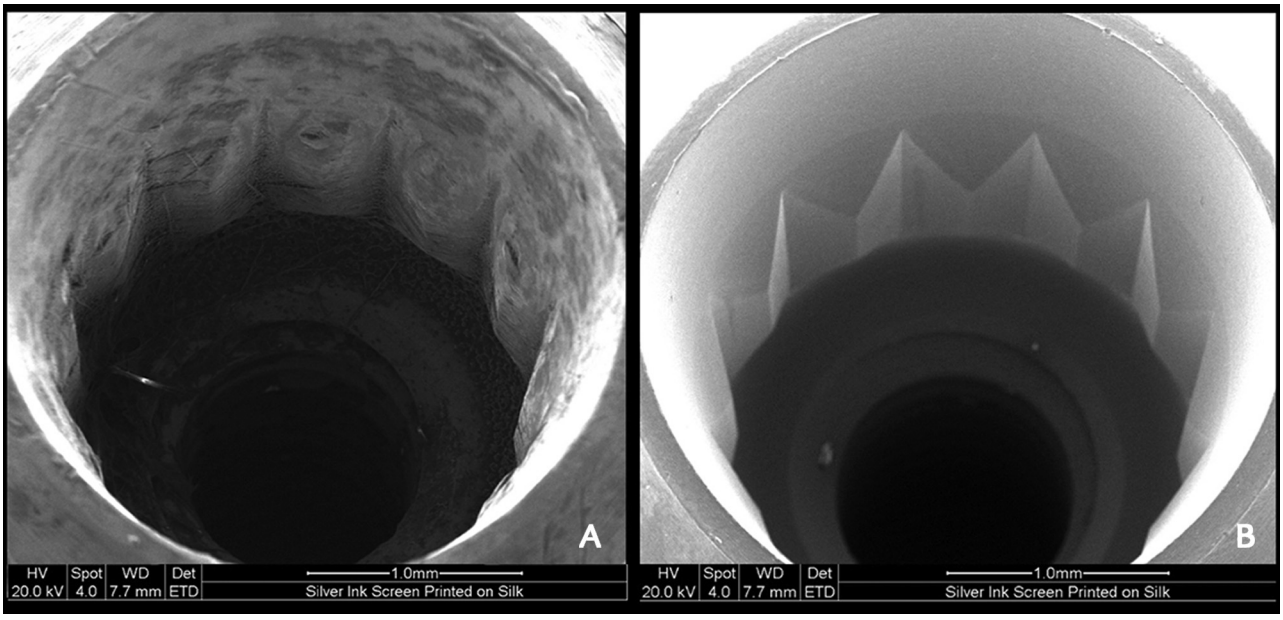

Figure 8. Scanning electron microscope images. A, Worn internal surface of failed implant. B, Unused implant fixture at 100-µm level.

plate of the bone. The patient also had increased vertical overlap of the anterior teeth and limited restorative space, which may have created an unstable biomechanical situation.[18] All of these factors were addressed with the new definitive restorations, which had improved 3D positioning of the implant body, a more favorable titanium-to-titanium implant-abutment interface, and a shallower anterior guidance in harmony with the patient's envelope of function, resulting in a satisfactory esthetic and functional outcome.

SUMMARY

This clinical report described a 1-piece zirconia abutment in which both biological and mechanical complications developed and the implant was lost prematurely. Periodic recall examinations and awareness of potential wear at the abutment-implant interface are important considerations to ensure longevity of the prosthesis.

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