2-Piece Zirconia Implant for the Replacement of a Mandibular Molar: 1-Year Follow-up

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INTRODUCTION

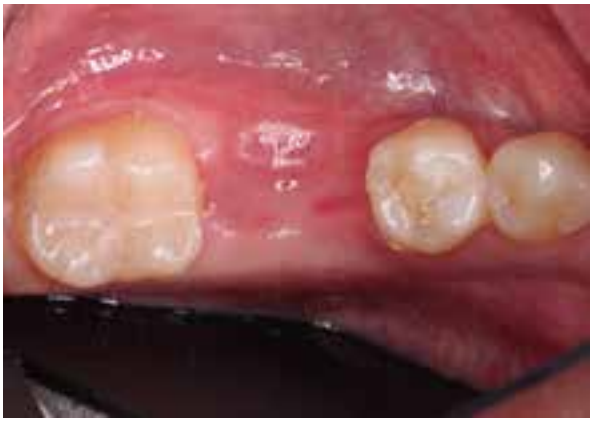
Titanium has long been considered the material of choice and the standard of care for tooth replacement, with success and survival rates well above 90% after 10 years[1, 2]. Despite the excellent results and biocompatibility reported for titanium implants, the demand for metal-free alternatives has increased. Patients are seeking alternatives to titanium for 2 main reasons: 1) the belief that they suffer from a metal allergy or 2) they are seeking a holistic approach to their treatment. Although the incidence of titanium allergy is low (0.6%), it can provoke type I and IV hypersensitivity reactions that will resolve only with the removal of the implant[3]. Zirconium Dioxide (Zirconia, ZrO^2) is a ceramic obtained from a reduction-chlorination reaction of Zirconium, a metal. At the end of this process, one can obtain Zirconium Dioxide powder (ZrO^2). This material is now a ceramic, and has lost all of the metallic properties of the raw material.

Zirconia has been shown to have equal capacity for osseointegration when compared to titanium[4], and ability to withstand occlusal forces[5, 6]. Investigation periods of up to 5 years have reported survival and success rates of more than 95% in humans[7, 8], making them a viable alternative for tooth replacement. Commercially available Zirconia implants can be one or two-piece. One-piece zirconia implants with an integrated abutment and pre-determined restorative margin have limitations due to their inability to allow for angle correction, require a high degree of surgical precision and only accept a cementable restoration. Advances in manufacturing have allowed for the development of two-piece systems with either cement or screw-retained abutments. These systems have allowed clinicians to broaden their prosthetic options, including angle correction via angled abutments, the ability to deliver screw-retained restorations as well as improved options for soft tissue management. This case report describes the replacement of a missing mandibular molar with a two-piece, screw-retained zirconia implant.

MATERIAL AND METHODS

1. Diagnosis

A 40-year-old male with a non-contributory medical history presented to the UCLA Dental Implant Center with missing tooth #19. The tooth had been previously extracted due to endodontic failure. At the time of extraction, a socket augmentation procedure was performed utilizing a Xenograft (Bio-Oss®, Geistlich Pharma North America, Princeton, NJ). The patient was presented with two options to replace his missing tooth: 1) a fixed partial denture prosthesis and 2) a dental implant. The patient did not want to prepare pristine teeth for a prosthesis and requested a zirconia implant due to concerns with titanium particle release.



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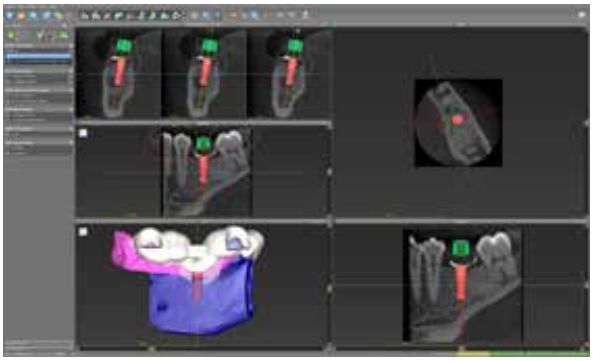
2. Treatment Plan

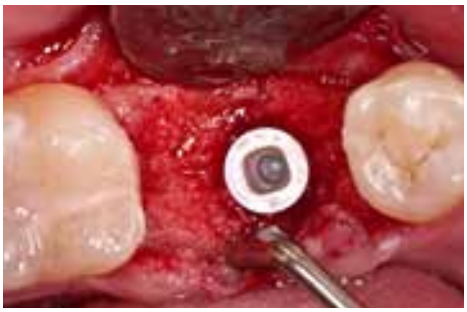
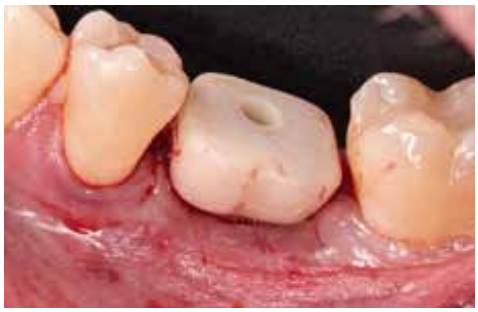
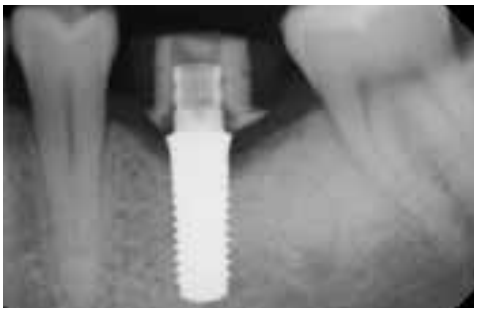
After 5 months of healing, a CBCT was obtained to assess bone volume and to allow for digital workflow. The DICOM files were uploaded to a digital planning software (CoDiagnostix®, Dental Wings GmbH, Chemnitz, Germany) and the case was planned for guided surgery. A digital scan of the wax up was uploaded to the planning software for proper positioning of the implant. A digital surgical guide was generated and produced in a desktop 3D printer (Form 2, Formlabs, Somerville, MA).



3. Surgery

After obtaining informed consent, the patient was given a pre-operative dose of 2 grams of Amoxicllin and 600mg of Ibuprofen. Local anesthesia was applied via local infiltration utilizing Lidocaine 2% at 1:100.000 Epinephrine. A mid-crestal incision was made and a full-thickness muco-periosteal flap was released. The surgical guide was seated and drilling protocol was followed as per manufacturers recommendations following a guided protocol. A 4.1 x 10 mm PURE 2-piece Zirconia implant (Straumann®, Basel, Switzerland) was placed at 35Ncm. A custom healing abutment was fabricated utilizing a Vita-CAD Temp® and tightened to 15Ncm. The site was closed with 4-0 Chromic Gut sutures in a single interrupted fashion. A post-operative peri-apical x-ray taken to verify seating of the temporary abutment. Post-operative care included Amoxicillin 500mg TID for 7 days and Ibuprofen 600mg q6h as needed. The patient was instructed not to function on the left side during the osseointegration period to avoid loading of the implant.



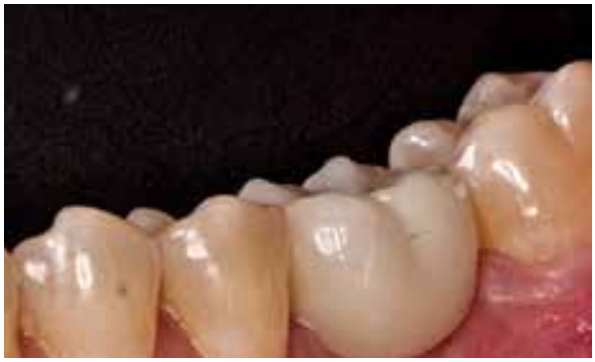
4. Restorative Phase

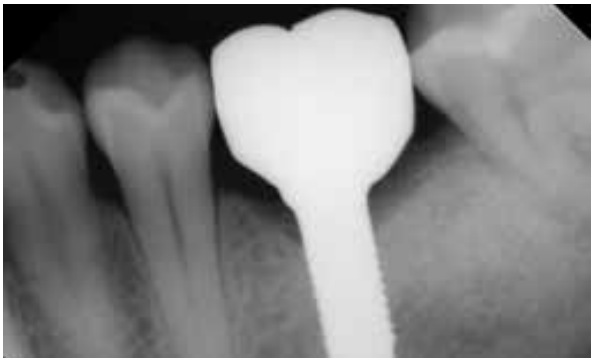
8 weeks after implant placement, the patient returned to the clinic for final impression procedures. The customized healing abutment was removed, soft tissue was evaluated and a direct customized impression coping was fabricated using a dual cure self-adhesive resin and an open tray impression was taken with PVS.

Final impressions

The cast was digitally scanned and a full contour crown was designed using Exocad software for the Straumann® PURE base abutment. The restoration was designed as a cementable-screw retained hybrid. A full contour restoration was milled using Katana STML, followed by application of surface stain and glaze. The restoration was tried in for contacts, occlusion, shape and shade and once the adjustments were done it was prepared for cementation.

To ensure an accurate and reliable connection between the PUREbase and the Zirconia restoration an MDP containing cement was utilized, starting with a pre-treatment phase. This first step increases bond strength and includes air-abrasion of the Zirconia bonded surface using Aluminum Oxide (particles 50µm) in a pressure not exceeding 2 bars, followed by application of a phosphate monomer containing ceramic primer (Clearfil Ceramic). At this point the PUREbase will be screwed on a lab analogue, and the access hole will be plugged using Teflon-tape to prevent unintentional blocking. Dual cure resin cement was applied both on the restoration and the PUREbase abutment, the restoration was seated and excess cement was removed. Special attention must be taken to ensure that the restoration is fully seated prior to curing it. Once seating was verified, it was light cured for 20 seconds, post cure for an additional 60 seconds and it was allowed to fully set for an additional 5 minutes. A sharp instrument (scaler or scalpel) can be utilized to remove the excess cement from the restoration. The restoration was then torqued to 35Ncm and the screw access hole was plugged with Teflon tape, finalizing the closure using a tooth colored composite restoration.





1 year follow-up

DISCUSSION

In this case report, a two-piece zirconia implant has been utilized for the replacement of a missing mandibular molar (Straumann® PURE 2-piece Ceramic Implant, Straumann, Basel, Switzerland). These implants are manufactured from Zirconium Dioxide and have a micro-roughened surface produced by large-grit sand blasting and acid etching. In vivo studies investigating the osseointegration capacity of this surface have suggested that the healing pattern of zirconium dioxide implants does not differ from their titanium counterparts[4, 9]. Zirconia has also been shown to be a more tissue-friendly material, demonstrating less bacterial adhesion, less inflammatory infiltrate, and increased micro-circulation compared to titanium[10,11,12]. Furthermore, survival and success rates with zirconia implants have been reported to be comparable to those of titanium implants in investigation periods of up to 5 years[7, 8].
Two-piece zirconia implants offer advantages to a one-piece system. As a screw-retained, two-piece design, it eliminates the issues of cementation and excess cement. A screw-retained system offers more prosthetic flexibility and allows for better manipulation of the soft tissues during the provisional phase. Overall, a two-piece system provides better surgical and prosthetic flexibility. As clinicians, we have seen a steady increase in the demand for metal-free alternatives for tooth replacement. This has been accompanied by a response from industry leaders in developing zirconia implant systems. In our clinical experience, zirconia implants can be a viable alternative to titanium

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