Vol. 6, No. 4 • Winter 2015

SPECTRUM Implants

THE JOURNAL OF CLINICAL & PRACTICAL ORAL IMPLANTOLOGY

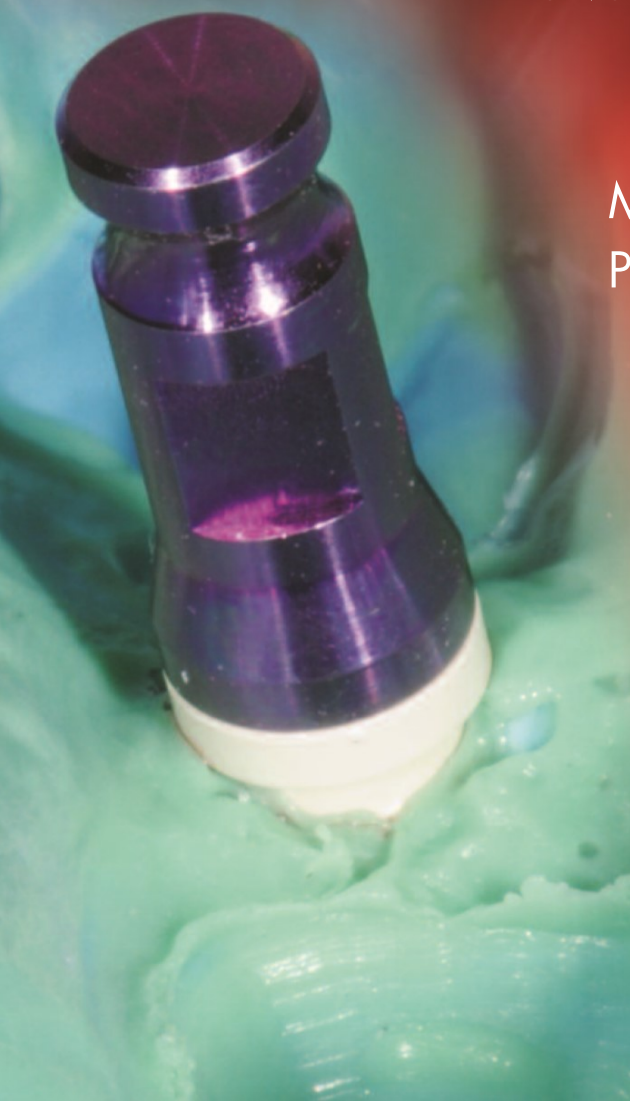
Immediate Loading in the Edentulous Mandible

Implant-induced post-traumatic inferior alveolar nerve neuropathy

Managing implant failure

Metal-Free Replacement of a Maxillary First Premolar with a Zirconia Ceramic Implant

Dental Implant Material and Design



Metal-Free Replacement of a Maxillary First Premolar with a Zirconia Ceramic Implant:

A Clinical Case Report

Dr. Sammy Noumbissi

Introduction and Background

Fixed, functional, safe and aesthetic replacement of dentition with dental implants has long been a challenge and, for more than four decades, titanium and titanium-alloy implants have been, and continue to be, the mainstream and most used material in implant dentistry. Thanks to the stability of the TiO_2 layer (oxide layer) on their surface, titanium alloys are exceptionally resistant to the oxidative effects of corrosion, but they are not 100% immune to corrosive attack.

The number of manufacturers has increased, and manufacturing protocols have also evolved leading to a variety of alloys of dental implants, as a result, these changes have led to the modification in the percentage of titanium and the insertion of new components in the alloys. Most dentists, today, are trained to use and offer titanium and titanium-alloy dental implants which are all metal.

Increasing reports[1,3] of sensitivity to titanium and titanium-alloy dental implants, with responses ranging from local soft tissue irritation to spontaneous unexplainable implant failure[2], joint pain, skin irritation, fatigue, and even bone necrosis, have been made. Many of the implant-related health problems have been attributed to the oxidation/corrosion events that occur in the presence of bodily fluid, material fatigue[4], stress, galvanism[5], exposure to the harsh oral environment, material wear and any combination of all these factors.

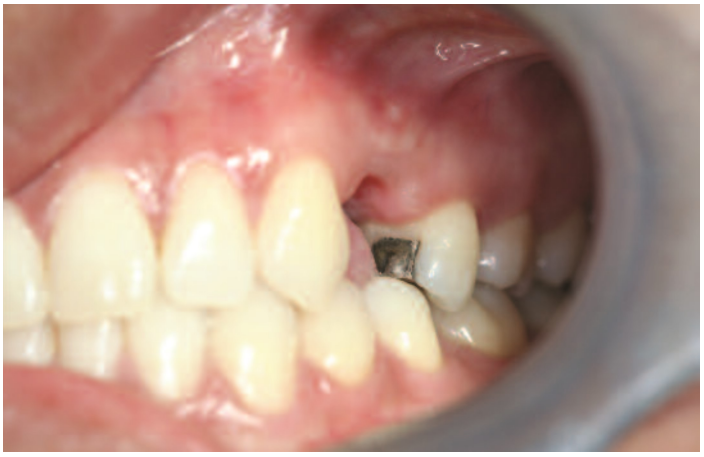


Figure 1: Pre-Op intraoral

A well investigated phenomenon in orthopedics, and to a lesser extent in the dental literature, byproducts released by implants under corrosion attack[6] will spread to other distant organs via lymphatics[7] and blood stream to the spleen, liver and, in some instances, cross the blood-brain barrier. Such by-products have been shown to induce metal toxicity, and present severe challenges to the implant recipient's immune system and general health. In recent years, both for aesthetic and functional reasons, there has been a paradigm shift in the types of materials used for

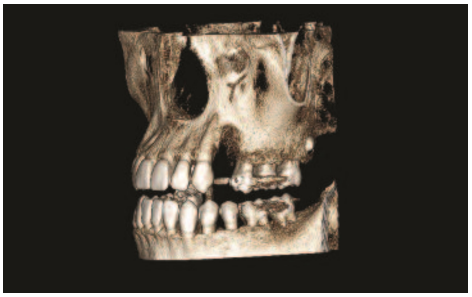


Figure 2: Pre-Op 3D view from CBCT

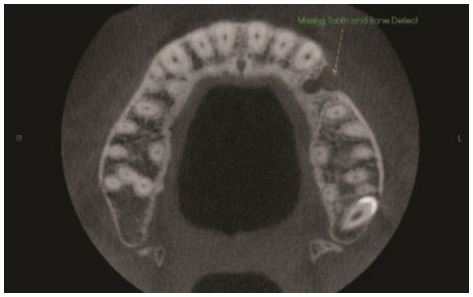


Figure 3: Pre-Op axial view from CBCT

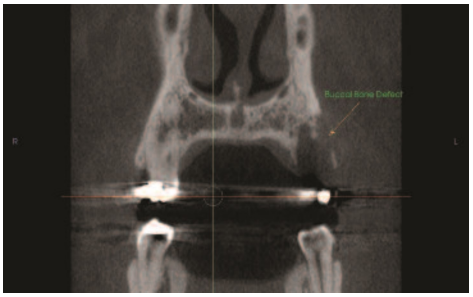


Figure 4: Coronal view pre-op

implantation and restoration of dental implants. Bioceramics and other truly bioinert and biocompatible non-metals materials are rapidly replacing metal alloys, and polycrystal zirconia, also know as zirconium dioxide (ZrO_2), has emerged as the material of choice[9] because it is an inert bioceramic which has excellent biomechanical properties, does not conduct heat, and does not allow galvanic activity[8]. Unlike titanium zirconia, it is not susceptible to corrosion attack in the oral environment. Alumina-toughened zirconia (ATZ), and yttria-stabilized tetragonal zirconia polycrystal (Y-TZP), are the bioceramic materials of choice in use today for manufacturing ceramic implants.

Case Report

A 27 year-old female presented with a missing maxillary left first premolar. The tooth which, according to the patient, had two rounds of root-canal therapy was extracted six weeks prior at another clinic in an emergency situation (Figure 1). Medical and dental histories were taken and clinical and a radiographic exam was performed as well. Clinical observation of the edentulous space suggested a defect in the buccal bone, and this finding was confirmed by the examination of the 3D (Figure 2), axial (Figure 3) and coronal slices (Figure 4) from the CBCT. The patient was informed that there was a chance that the implant would not be placed during the first surgery, and that the chances of immediate fixed temporization of the implant would be minimal. The treatment was established, and would consist of ridge augmentation, implant placement, interim prosthetics and permanent-fixed prosthetics. A review of the medical history revealed that patient reported no sensitivity to metals but preferred to have a tooth replaced with metal-free biomaterials.

During the surgical planning phase, the acquired CBCT was reviewed and it was observed that tooth #12 was bi-rooted (Figure 4), and there was enough interradicular bone width and height to obtain adequate initial stability immediately after placement. Based on the radiographic data using the InVivo treatment planning software, it was determined that a one-piece Y-TZP zirconia implant (Zirkolith AG) 4.0mm diameter, with a 4.8 mm platform by 12mm length (Figure 5), would be the most adequate size for the site and replacement of tooth #12 (Figure 6).

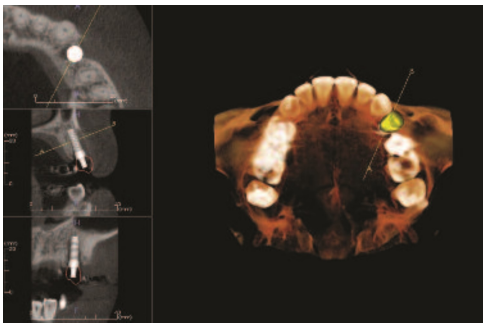


Figure 5: Virtual implant planning

Figure 6: Zirkolith Evo 4.0 X 12mm

Ridge Augmentation and Implant Placement Surgery

In preparation of implant placement, impressions were also made in order to fabricate an implant protective device and a temporary crown (Figure 7) for the patient to wear during the implant integration into the bone. At the time of surgery, the patient was administered local anesthetic. A total of five carpules of lidocaine 2% with 1/100.000 epinephrine were administered, by infiltration, only in the areas extending distal of tooth #11 to mesial of tooth #14, both buccally and palatally. An intra-sulcular incision was made, and it extended from mesial of tooth #14 to mesial of tooth #11. A mucoperiosteal flap was raised, the bone was exposed, and the four-walled defect socket was visualized (Figure 8).

The osteotomy was performed under sequential drilling using profuse irrigation, starting with a Loma Linda drill. This initial drill was positioned in a manner that the interradicular bone was engaged in a slightly palatal position, but emerging buccally at the coronal level (Figure 9). The following steps of the drill sequence were done in accordance with the Zirkolith surgical kit workflow for the selected implant configuration. During the initial phases of the osteotomy, it was subjectively determined that the bone was type II quality and, hence, favorable for

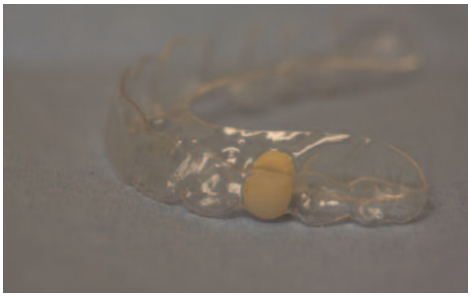


Figure 7: Implant protective/Essix appliance

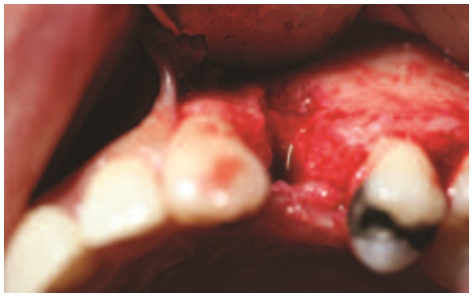


Figure 8: Buccal bone defect

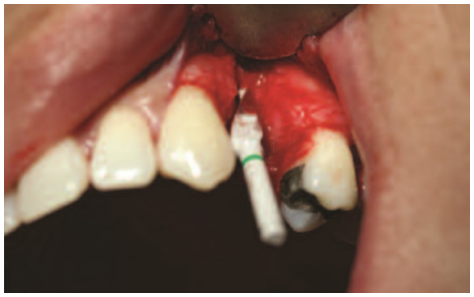


Figure 9: Ostetomy

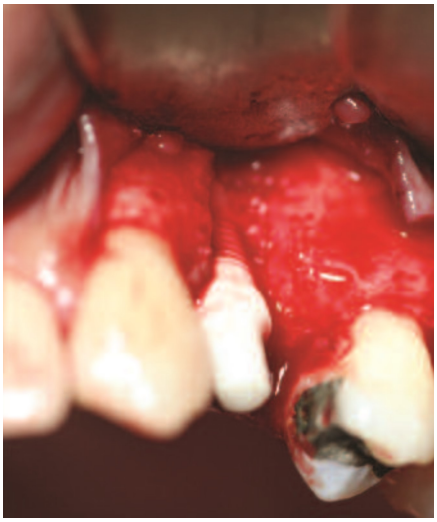


Figure 10: Exposed buccal threads

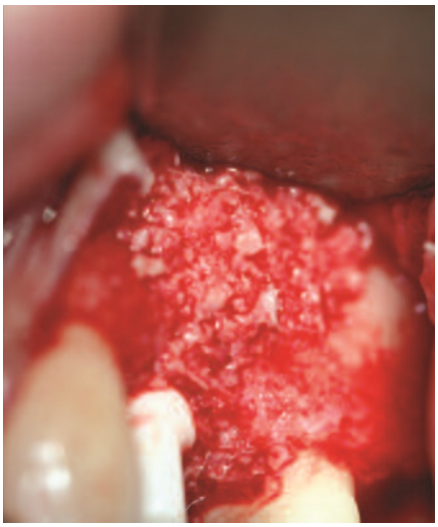


Figure 11: Bone Graft

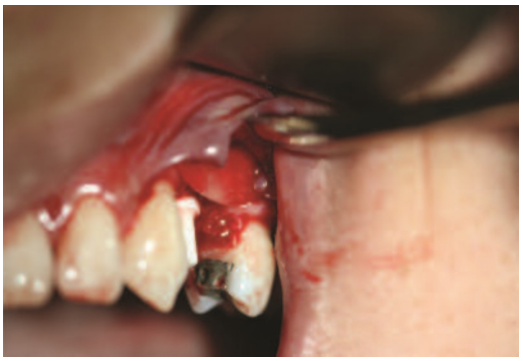


Figure 12: Collagen membrane

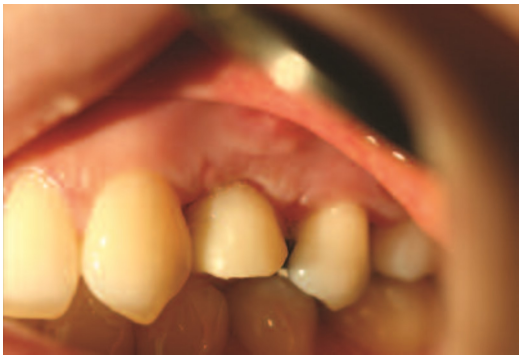


Figure 13: Provisional crown

good primary stability of the implant. The implant was inserted at a speed of 20rpm, and a torque of 40 Ncm, two third of the buccal threads were exposed (Figure 10), and the stability of the implant was measured with a Periotest™ and recorded at a value of -3.6. Bone graft, using mineralized cancellous bone (PUROS, Zimmer AG), was placed to cover the exposed threads (Figure 11), and a resorbable collagen membrane (Figure 12) was placed. Two sutures were placed mesial and distal of the implant platform, and the temporary crown was provisionally cemented to the implant abutment. Three weeks later, the sutures were removed (Figure 13).

Restorative

Four months after implant placement, based on clinical examination and after determining adequate implant stability with the Periotest™ (Figure 14), it was decided that, for functional and aesthetic purposes, both the implant and tooth #13 would be restored with a porcelain-fused-to-zirconia (PFZ) crowns. Conventional impressions using a pick-up impression cap (Figure 15) of the implant and adjacent prepped tooth were made with light and medium body polyvinylsiloxane impression material (Figure 16), and a stone model made (Figure 17). Once the crown was received from the dental laboratory, the challenge was to bond two ceramics, namely the abutment and the crown together, in a predictable manner on the implant. The intaglio of the crown was decontaminated with Ivoclean (Ivoclar), and the abutment cleaned with alcohol. Both abutment and crown were, then, primed with Z-Prime (Bisco) (Figure 18) and finally bonded with resin-modified glass-ionomer cement. The patient was satisfied with the aesthetic and functional outcome of this top-to-bottom metal free tooth replacement (Figure 19). Three years later, the patient returned for additional dental procedures, implant #12 and tooth #13 were evaluated, and the red aesthetics had improved, since initial crowns delivery (Figure 20).

Figure 14: Periotest

Conclusion

Dental implants have been a very successful and predictable option to replace missing teeth. Titanium and titanium alloys have long been considered the gold standard of materials for dental implantation. It is now well known and documented that metal alloys, including titanium, will, over time, be oxidized in the body or oral environment, and the products of this oxidation/corrosion can cause metal toxicity, spontaneous aseptic implant failure, and other systemic health problems in the host. Over time, more procedures have been performed, thereby, exposing a greater number and genetically-diverse group of people to titanium and its alloys. Studies and clinical observations have been made,

Friends of IAOCI

IAOCI curasan straumann Pure Ceramic Implant Pending FDA clearance ZIRKOLITH zsystems implants

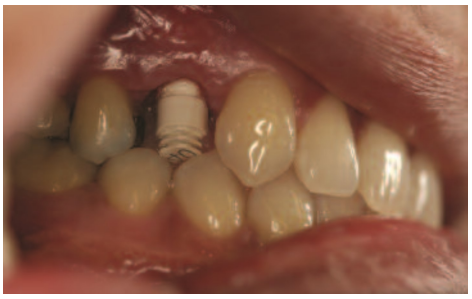


Figure 15: Impression cap on abutment

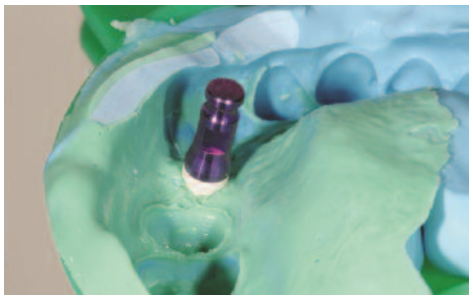


Figure 16: Impression

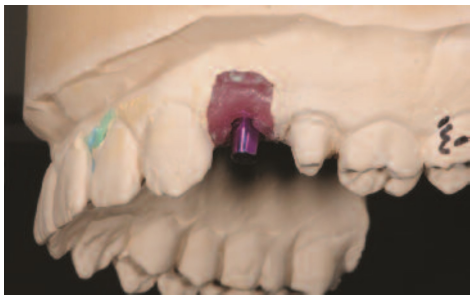


Figure 17: Model

Figure 18: Cleaning and priming materials

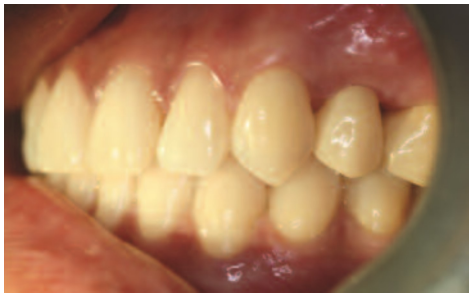


Figure 19: Immediate post crown delivery

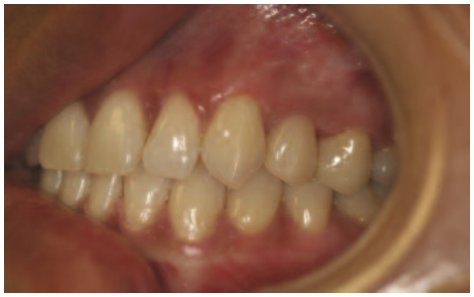


Figure 20: Three years post op

and reported of, various responses to the alloys from the patients, but also about the materials' response over time to the environment in which they are placed and required to function.

The search for alternative, more stable and less toxic materials, has been ongoing and, today, whether it is for restorative or direct implantation, bioceramics, especially zirconia, is an acceptable and proven material in dental implantology. It is, therefore, necessary that clinicians attune themselves to this evolution, as it appears our patients have also evolved in terms of their health and dental care choices and expectations. ■

About the author

Dr. Sammy Noumbissi *obtained his Doctorate in Dental Surgery from Howard University in Washington DC. He then attended Loma Linda University where he received three years of formal training in Implant Dentistry which culminated with a certificate and a Master of Science degree in Implant Dentistry. He has published abstracts and articles in peer reviewed dental journals namely the Journal of Dental Research, the Journal of Oral Implantology and the Journal of Implant and Clinical Dentistry. He lectures nationally and internationally across the globe in metal free dental implantology. He is a member of the editorial board of the Journal of Implant and Advanced Clinical Dentistry and a reviewer for the Journal of Oral Implantology. Dr. Noumbissi practices in Silver Spring, Maryland USA.*

References

1: Evrard L. et al. Allergies to dental metals. Titanium: a new allergen. Rev Med Brux. 2010 Jan-Feb;31(1):44-9.

2: Siddiqi A et al. Titanium allergy: could it affect dental implant integration? Clin Oral Implants Res. 2011 Jul;22(7):673-80.

3: Chaturvedi TP. An overview of the corrosion aspect of dental implants (titanium and its alloys). Indian J Dent Res. 2009; 20(1):91-8.

4: Anders S. Zirconia as a biomaterial for odontological applications Effects of composition and manufacturing processes on fracture resistance. Umeå University Odontological Dissertations, Series No 114

5: Gettens et al. Electrical Implications of Corrosion for Osseointegration of Titanium Implants. J Dent Res. 2011 90(12):1389-1397.

6: Lugowski SJ et al. Release of metal ions from dental implant materials in vivo: Determinations of Al, Co, Cr, Mo, Ni, V, and Ti in organ tissue. J Biomed Mater Res 1991;25:1443-58.

7: Weingart D. Titanium deposition in regional lymph nodes after insertion of titanium screw implants in maxillofacial region. Int J Oral Maxillofac Surg. 1994; 23 :450-2.

8: Lee S. et al. Peri-implant and systemic release of metallic elements following insertion of a mandibular modular endoprosthesis in Macaca fascicularis. Acta Biomater. 2009 Nov; 5(9):3640-6.

9: C. Piconi, G. Maccauro. Review Zirconia as a ceramic biomaterial. Biomaterials 1999 (20): 1 -25.