Metal-free Replacement of a Maxillary Lateral Incisor with a Zirconia Ceramic Implant and a Porcelain Fused to Zirconia Crown: A Clinical Report

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Background

Titanium and titanium alloy implants are and will remain for a long time the main materials for dental implant manufacturing. Titanium alloys have been successful thanks to improvements in design and surface treatment technology. However the popularity of metal implants as a method of tooth replacement has come with increased reports of problems ranging from poor aesthetics to immune reaction to the implants[1,2,3]. Both in medicine and dentistry hosts response to implanted metals range from local soft tissue irritation to spontaneous unexplainable implant failure, to joint pain, skin irritation, fatigue and even bone necrosis. The use of bioceramics in dentistry and in dental implantology the last few years has been exponential and there has been a paradigm shift in the types of materials used for restoration of dental implants[5]. The polycrystal zirconia with its superior biomechanical properties, absence of galvanic activity[6], low plaque and bacterial accumulation[7] and resistance to oxidation has emerged as the implantable bioceramic of choice. The case presented here is that of a patient who for lifestyle and personal reasons elected to replace his failing maxillary right lateral incisor by means of metal free implant and prosthetic materials. Bioceramics and other bioinert, biocompatible non-metal materials are rapidly replacing metal alloys, Yttria-Stabilized Tetragonal Zirconia Polycrystal (Y-TZP) in which the main component is zirconia (ZrO_2) is fast becoming the material of choice for dental implantation and fixed prosthetics[8,9].

Case Report:

A 35 year-old male presented with a failing maxillary right lateral incisor (Fig. 1), the tooth had two root canal therapy done twice, recurrent infection, and an attempt at crown lengthening. Medical and dental histories were taken,

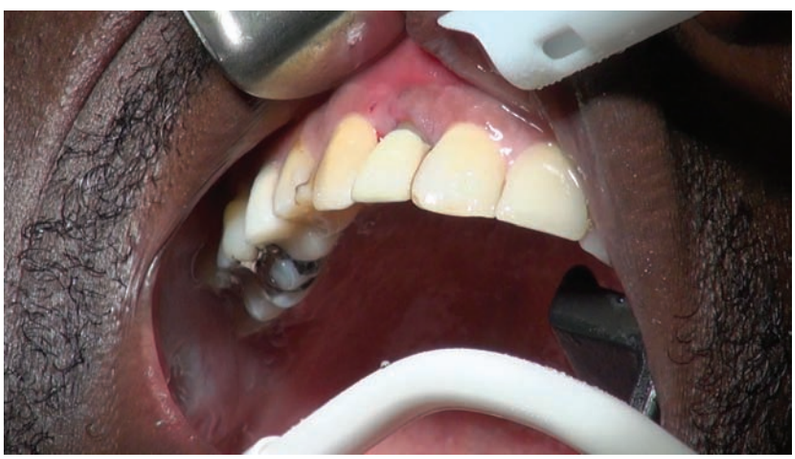

Fig. 1: Pre-Op

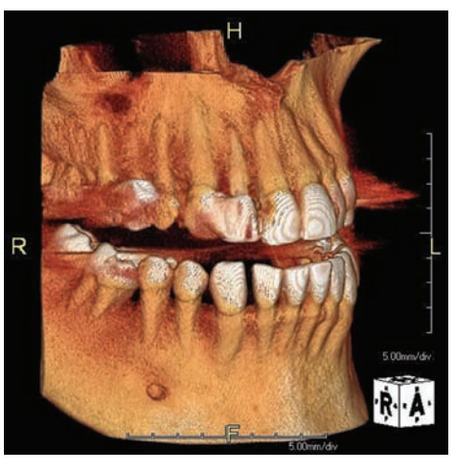

Fig. 2: Pre-Op 3D

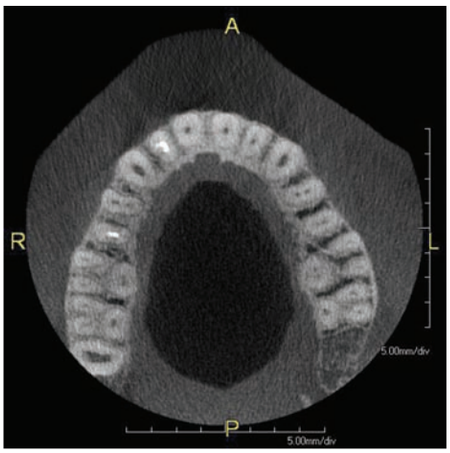

Fig. 3: Pre-Op Axial view

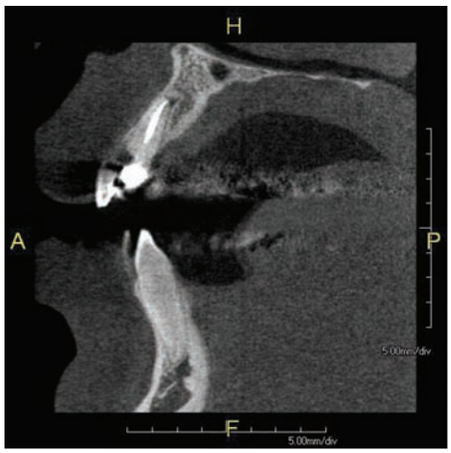

Fig. 4: Pre-Op Sagittal view

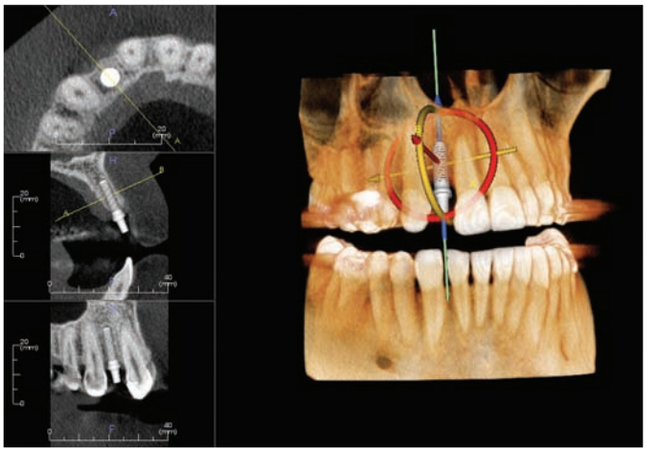

Fig. 5a: Virtual Implant Planning

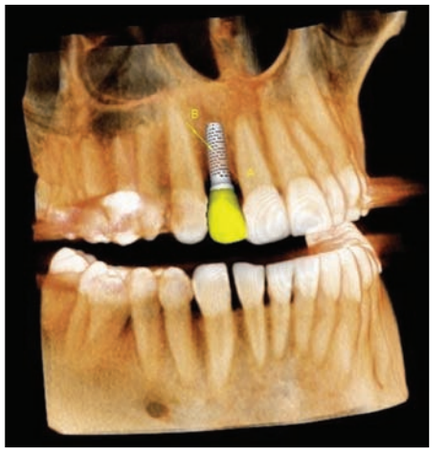

Fig. 5b: Virtual Implant Planning 3D View

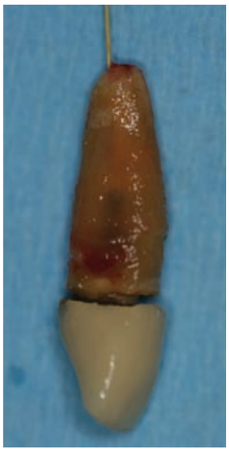

Fig. 6: Extracted tooth

clinical and radiographic exams were performed. Upon clinical examination tooth #7 had type II mobility, 2-3 mm of soft tissue recession. It also appeared on the three-dimensional radiographic examination that the process of crown lengthening resulted with a vertical bone deficiency of a little over 4mm. Examination of the three-dimensional volume (Fig. 2) axial (Fig. 3) and sagittal (Fig. 4) slices of the CBCT confirmed the clinical findings of vertical bone deficiency at site #7. A review of the medical history revealed no contraindications or sensitivity to metal or metal alloys. The patient requested however that a metal-free implant and restoration be used.

The treatment would be conducted in four phases. The first phase would consist of impressions, models, wax up an dfabrication of removable temporary prosthetics in the form of an Essix appliance. The second phase would consist of extraction of tooth #7, socket preservation combined with vertical ridge augmentation. The third phase would begin after a healing and maturation period of twelve weeks when a zirconia ceramic implant would be placed in the preserved/regenerated bone. The final phase four months after implant placement the restoration will be done using a porcelain fused to zirconia crown.

During the surgical planning phase the acquired CBCT was reviewed using the software native to the Prexion CBCT unit. After measurements and selecting implant sizes from the software library, it was determined that a one-piece zirconia implant (Zirkolith AG, Oesingen Switzerland) 4.0mm diameter with a 4.8 mm platform by 11.5 mm length would be the most adequate size tooth (Fig. 5a - 5b) for the site and delayed replacement of the previously failing. This implant configuration was selected in order to optimize both red and white aesthetics upon permanent restoration.

Extraction and Ridge Augmentation Surgery

At the time of surgery, the patient was administered topical anesthetic. A total of seven carpules of Lidocaine 2% with 1/100.000 epinephrine were administered by method of

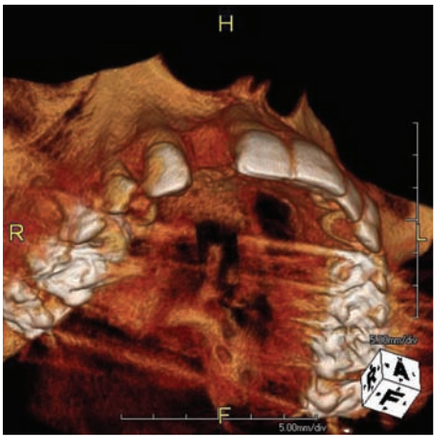

Fig. 7: Grafted Socket 3D

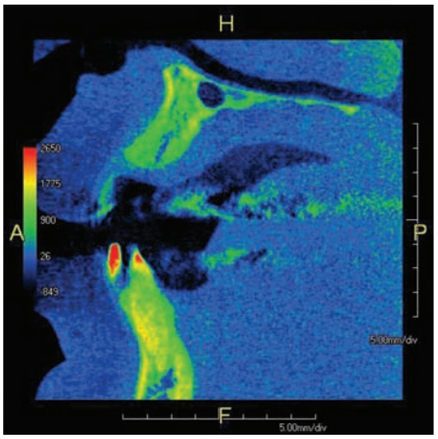

Fig. 8: Grafted Socket sagittal

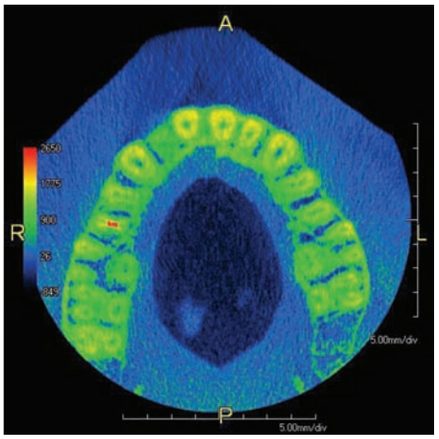

Fig. 9: Grafted Socket axial

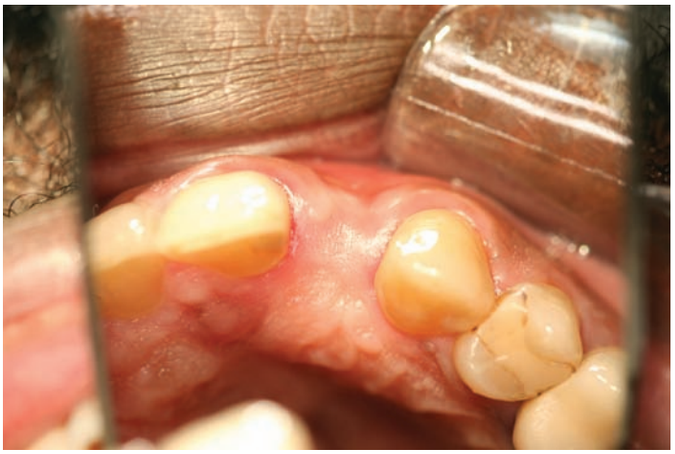

Fig. 10: Ridge post-graft occlusal view

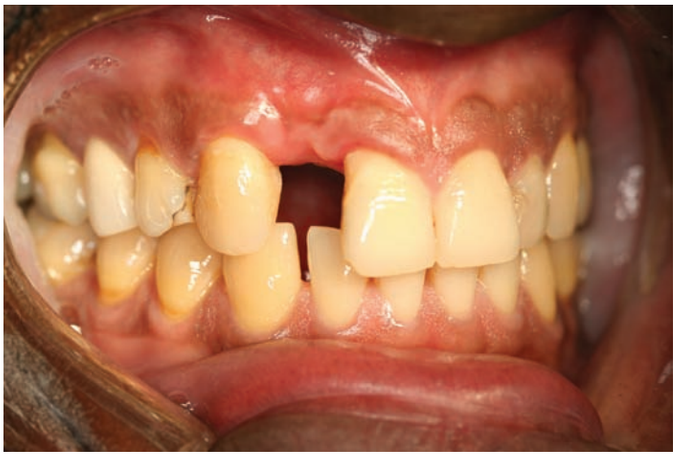

Fig. 11: Ridge post-graft buccal view

infiltration only in the areas extending from distal tooth # 6 to mesial tooth #9 buccally and palatally . An intra-sulcular incision was made which extended from mesial of tooth #9 to distal of tooth #6. Soft tissue was dissected from bone and no vertical releasing incisions were made. Tooth #7 was extracted surgically (Fig. 6), socket was rinsed and curetted with an ultrasonic piezosurgery (Mectron, Italy) using the round diamond insert. Socket preservation combined with vertical and horizontal bone augmentation was done using synthetic ceramic bone substitute Cerasorb® and a resorbable membrane Epiguide® both manufactured by Curasan AG, Germany.

Implant Placement

Twelve weeks after bone grafting, a second CBCT was taken to assess the bone graft and bone anatomy in preparation for implant surgery. (Fig. 7, 8 - 9) Clinically the site was evaluated and found to have a favorable anatomy for predictable aesthetics. (Fig. 10 - 11) During the initial phases of the osteotomy it was subjectively determined that the bone was type II quality, a common clinical finding using ceramic bone as it fully resorbs and alloys for autogenous vital bone to replace it. The osteotomy was however intentionally undersized and an insertion torque value of 55 Ncm was achieved and allowed for excellent primary stability of the implant (Fig. 12), no implant threads were exposed and no additional grafting necessary. An evaluation of the implant stability with a Periotest M (Medezintechnik Gulden, Germany) device (Fig. 13). The periotest measures implant stability by electromechanical percussion and measuring the implant's damping capacity thereby allowing for an objective assessment of implant integration/stability progress [4]. The values (PTV) of a periotest range from -8 to +50 with -8 being the highest measurement value of implant stability. Implant stability testing was done immediately after placement and PTV of an average of -4.3 were observed immediately after placement. The removable protective Essix appliance similar to the one in picture #14 was given to the patient to wear during the implant integration time. Two weeks later the patient returned for suture removal

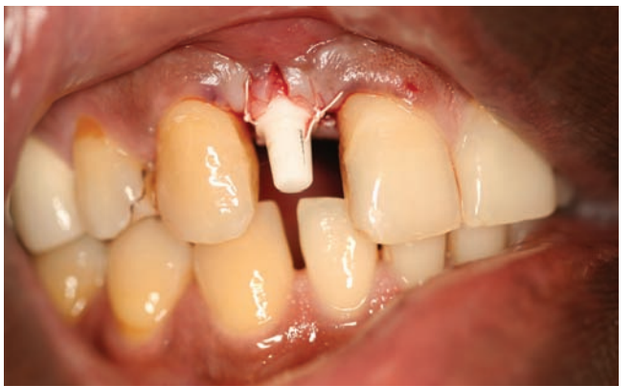

Fig. 12: Implant placed

Fig. 13: Periotest device

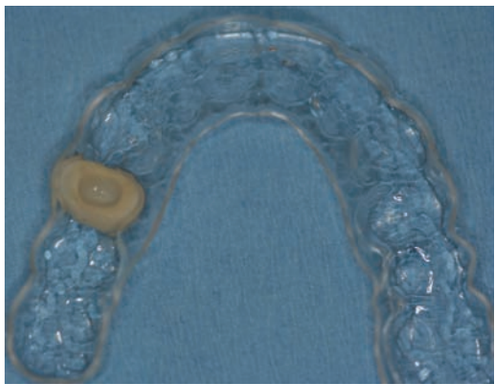

Fig. 14: Essix appliance

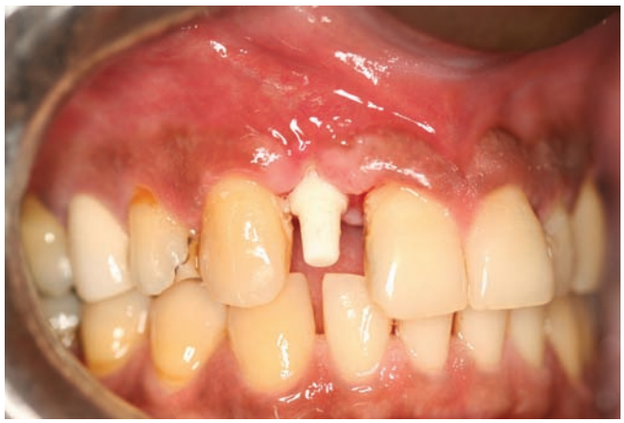

Fig. 15: Two weeks post-surgery

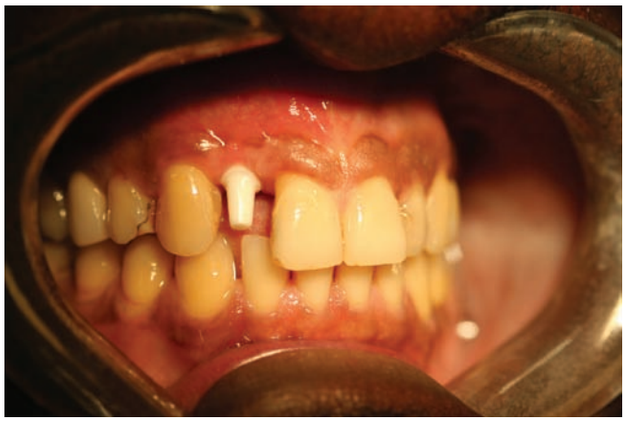

Fig. 16: Implant margin preparation

Table #1: Periotest Values (All Values are negative)

Implant Position	PTV DAY#1			PTV 2 WEEKS			PTV 4 WEEKS			PTV 2 MONTHS			PTV 4 MONTHS		
7	4.3	4.7	4.2	3.2	3.8	3.9	3.8	3.6	3.3	3.9	4.5	4.8	5.8	5.6	5.9

(Fig. 15) and healing of soft and hard tissue were in good progress. The implant stability was evaluated according to a schedule during four months of integration time (Table 1). Periotest values were collected at each post-surgery visit and the average values between the second and fourth week post-implantation initially declined to an average of -3.8 but improved up to – 5.6 confirming more optimal stability[4] to proceed with the permanent restorative phase.

Restorative:

Four months after implant placement, based on clinical examination and after confirming implant stability, it was decided that for functional and aesthetic purposes, the implant would be restored with a porcelain fused to zirconia (PFZ) crown. The implant margin on the buccal that was supragingival was reduced to the gingival level (Fig. 16) and a conventional impressions of the prepared abutment and adjacent structures was made with light and medium body polyvinylsiloxane impression material. (Fig. 17)

Once the crown was received from the dental laboratory the challenge was to bond two ceramics namely the implant abutment and the crown together in a predictable manner. The intaglio of the crown was decontaminated (Fig. 18) with Ivoclean (Ivoclar AG, Germany) and the abutment cleaned with alcohol.

Both abutment and crown were then primed with Z-Prime (Bisco, USA) (Fig. 19) and permanently bonded with a resin modified glass ionomer cement (Fig. 20). The patient was satisfied with the aesthetic and functional outcome of this top-to-bottom metal free tooth replacement (Fig. 21). He

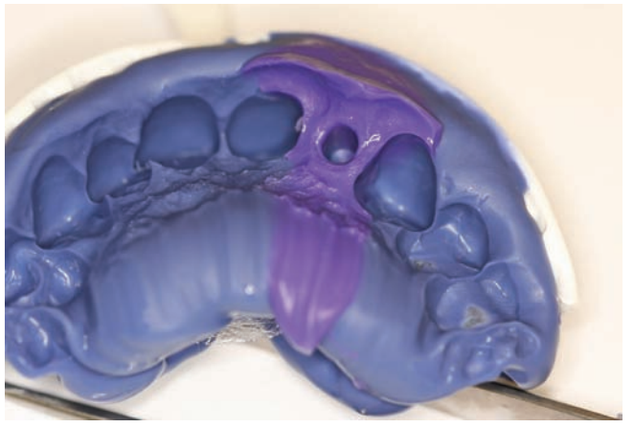

Fig. 17: Abutment level impression

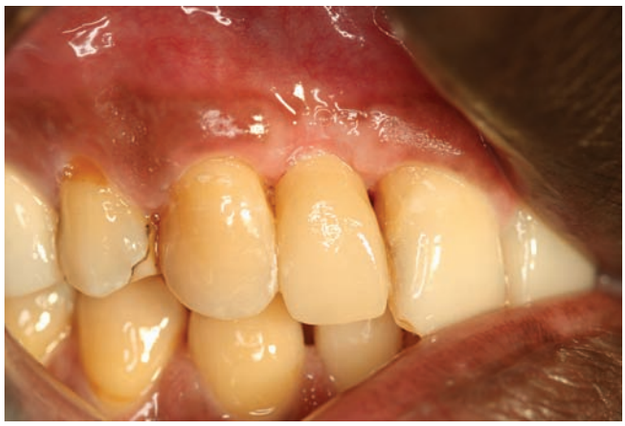

Fig. 21: Crown cemented

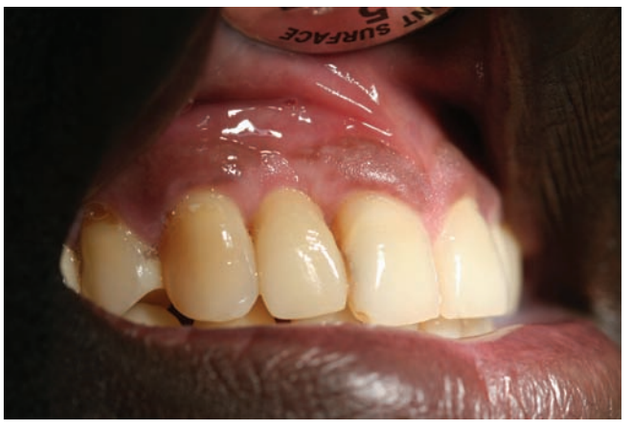

Fig. 22: Nine months post crown cementation

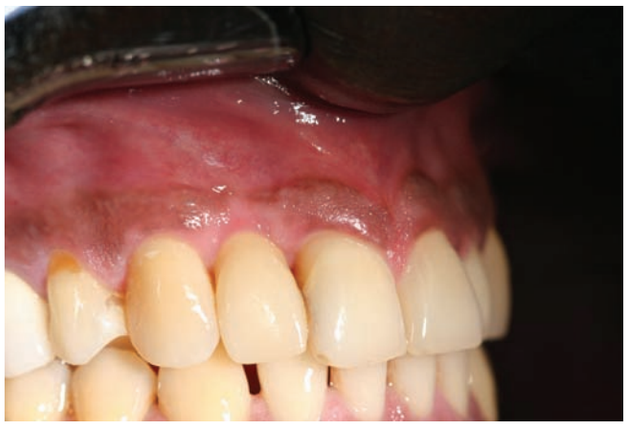

Fig. 23: 2 years post crown cementation

returned for uneventful post-crown delivery visit after 9 months (Fig. 22) and at two years both the restoration and implant are stable and functional (Fig. 23).

Conclusion:

It is now well known and documented that metal alloys will over time in the body (7) or oral environment be oxidized and the products of this oxidation/corrosion can cause metal toxicity, spontaneous implant failure and other health problems in the host. Studied for its biocompatibility, osseointegration, and low bacterial adhesion/colonization zirconia is rapidly becoming the material of choice for dental restorations, dental implants and implant prosthetics. Zirconia ceramic implants have been available for over a decade and they provide a viable alternative to titanium and titanium alloy implants. They have the added advantage of superior red and white aesthetics and demonstrate low inflammation around the implants and their prosthetics. Furthermore the one-piece and soft tissue level configuration of the implant selected for this case report is a solution where there are no subgingival connections or moving parts. ■

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