

CASE REPORT

Computer-aided Design/Computer-aided Manufacturing Protocol for Immediate Loading with Zirconia Implants

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ABSTRACT

Yttria-tetragonal zirconia polycrystal (Y-TZP) is a material globally accepted for restorative and implant dentistry. The patient's increased demand for more biologic and esthetic materials has made metal-free treatment a routine in everyday dental practice. Zirconia implants have more recently appeared into our armamentarium and is today the treatment of choice for patients with metal allergies and other immune disorders that are related with metal sensitivities as well as esthetic demanding cases. The present case report describes the protocol used for immediate zirconia implants and immediate loading for the full-mouth rehabilitation using computer-aided design/computer-aided manufacturing (CAD/CAM) technology.

Keywords: Zirconia implant, Ceramic implant, CAD/CAM, Immediate loading, Acid etched, Rough surface.

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INTRODUCTION

Yttria-tetragonal zirconia polycrystal (Y-TZP) materials have been used in the past decade as an alternative for crowns and bridges in restorative and implant dentistry, and today it is accepted as a viable treatment alternative.¹⁻³

The osseointegration potential of zirconia within the bone is supported by many different histology studies.⁴⁻²⁸ Moreover, the CeraRoot implant osseointegration has been recently described in an animal histology study.⁶

Everyday, the patients are demanding more and more esthetic and biocompatible materials as well as metal-free solutions. In this sense, patients that were reactive to have metal implants in their body are very receptive to zirconia implants.

Moreover, the patients being diagnosed with metal allergies and/or sensitivities are on the increase. Of special

interest is the so-called MELISA[®] test which is a blood culture that reports the lymphocyte stimulation by different metal samples.^{29,30}

It is very much recommended before placing a metal implant, to do a well documented patient anamnesis taking special attention to any of the following signs that are related to metal allergies and sensitivities: skin allergies, autoimmune disorders, chronic fatigue, liquen, psoriasis, muscular pain, headaches, fatigue, stomach problems. This is more important because most of the metal allergies are developed after a long-term of exposure with the metal. This means that even though a patient may not be sensitive to a metal at present, in the future they can develop such sensitivity. This is the reason why the surgeon should look out for these signs before the implantation of a metal in the patients jaws. If any of the signs were present then the implant of choice would be a zirconia implant. Everyday more and more patients are aware of their potential illness and conditions, and they look out for the best treatments and materials for their body. It is very important to inform the patient that they have the metal-free treatment choice. If the patient is not well informed of their treatment options, this could end up in a legal problem if the patient is diagnosed with a metal allergy and sensitivity, where the surgeon did not consider these possibilities or offer the patient alternative treatment.

The present case report is the first full mouth oral rehabilitation with immediate zirconia implants and immediate loading with the computer-aided design/computer-aided manufacturing (CAD/CAM) protocol.

CASE PRESENTATION

The patient was a 45-year-old woman, nonsmoker and in good general health. The patient's chief complaint was the esthetics of her smile and that she wanted a metal-free solution for her mouth (Figs 1 to 3).

Diagnosis

The patient's oral hygiene was good. Several posterior teeth were missing both in the maxilla and mandible (14, 15, 16, 17, 26, 27, 47, 47, 35, 36, 37). The remaining teeth were considered to be hopeless due to endodontic failures in conjunction with apical granulomas and pain (Fig. 4). The

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Fig. 1: Extraoral examination—Gummy smile (frontal view)



Fig. 2: Extraoral examination—Gummy smile (lateral view)



Fig. 3: Intraoral examination



Fig. 4: Preoperative panoramic X-ray

biotype of the gums was thick providing a better esthetic prognosis for the treatment with implants. Study casts were mounted in the articulator and intraoral and extraoral pictures were taken (Fig. 5).

Extraoral Examination

The extraoral images show a gummy smile together with an hyper mobile upper lip. The teeth in the upper left were more extruded than the one's on the right side, and thus the occlusal plane was inclined 20° in respect to the horizontal plane. The midline of the upper and lower jaws was centered with the face and lips.

Treatment Objective

The objective of the treatment was to provide an esthetic metal-free full mouth rehabilitation. A wax-up was done providing a horizontal plane and the gingival contours were reposition in a more apical and harmonic position (Fig. 6). This wax-up was then translated into a surgical guide that was going to be used to place the implants in an optimal position (Fig. 7).



Fig. 5: Study models mounted in articulator

Treatment Plan

The plan was to extract all teeth and place zirconia implants immediately together with an immediate temporary restoration. The treatment was to be done in the upper jaw first and 2 weeks later to do the same in the lower jaw. Finally 3 to 4 months after surgery, change the temporary restorations with the final zirconia rehabilitation.



Fig. 6: Diagnostic wax-up



Fig. 7: Surgical guide with Essix appliance

Surgery

The patient was first sedated with intravenous medication. All the upper teeth were extracted with a flapless approach and taking care not to damage the bone. All the apical granulomas were extracted with a curette and profound irrigation was done to provide clean extraction sockets. The surgical guide was placed into the upper jaw and the implant osteotomies were started for the two central incisors. The surgical guide had an opening in the incisal edge slightly palatal, because the implant direction must follow exactly the same direction of the crown. The two drills placed into the surgical holes demonstrate the optimal position and inclination for the osteotomies. The two implants that were to be placed for the upper central incisors was CeraRoot 21 (12 mm) (Oral Iceberg SL, Barcelona). The implant was placed deep into the gum following the crown margin reference provided by the surgical guide. After the two central implants were placed then the upper cuspids followed, and then the first bicuspid and the first molar, giving a total of 4 implants in each side. In the posterior sites where the teeth were missing, the implants were placed transmucosal without raising a flap. The sinus was also elevated with osteotomes using the BAOSFE technique.^{31,32} The bone that was used for grafting was Bio-Oss (Geistlich, Switzerland). After

the implants were placed, the surgical guide was then used for the gingivectomy with an electric knife to correct the patient's gummy smile (Figs 8 to 10). Then CeraCrowns were placed into the implants and a pick-up impression was done with Impregum (3MESPE, Germany). CeraRoot lab analogs were placed into the CeraCrowns and the impressions were then poured with stone. The design of the initial wax-up was then used to produce a CAD/CAM PMMA temporary restoration for the upper arch. The upper arch restoration was cemented into the patient's mouth 2 hours after surgery using Fuji Temp (GC America). The patient was placed under antibiotic medication for 6 days after surgery (Figs 7 to 15).

Two weeks after the surgery in the upper arch, the patient came for the surgical treatment in the lower arch, under sedation. The same procedure described for the upper jaw was applied for the lower jaw, except for the sinus elevation. Three CeraRoot 14 (12 mm) implants were placed in both of the side (position 47, 44, 43 and 33, 34, 36) (Figs 11 and 12). Impressions of the front four implants were taken and poured with stone and implants laboratory analogs. Computer-aided design/computer-aided manufacturing PMMA bridge was milled using the diagnostic wax-up that was done before surgery. Two hours after surgery, the lower temporary restoration was cemented with Fuji Temp (GC America).



Fig. 8: CeraRoot implants placed in upper jaw



Fig. 9: Surgical guide margin for gingivectomy



Fig. 10: Gingivectomy with electric knife



Fig. 11: Surgery day lower jaw



Fig. 12: Panoramic X-ray. Surgery day, lower jaw.
Fifteen days postoperative upper jaw



Fig. 13: One week postoperative lower jaw. Three weeks postoperative upper arch



Fig. 14: Soft tissue healing after 3 months postoperative.
Impressions for final zirconia bridges in lower mandible



Fig. 15: Try-in of lower zirconia frameworks

Two weeks postsurgery, the soft tissue was healing well and the patient reported that she was very comfortable with the immediate temporary prosthesis (Fig. 13).

The implants and temporary restorations were allowed to heal for 3 months. After that time, they were removed and final impressions were done of the upper and lower arches. (Fig. 14).

The lower arch was designed to be restored with three bridges one anterior and two posterior. The zirconia bridge framework was designed to full contour except for a 1 ml of porcelain thickness in the facial aspect for esthetic reason. The three bridges were tried in the patients mouth and cemented after the fit and occlusion were proved to be satisfactory (Fig. 15).

A second set of PMMA was milled and delivered to the patient to improve the esthetic outline and serve as a guide for the final zirconia restorations (Figs 16 and 17). This temporary restoration was left for 2 months in the patients mouth to allow enough time for the soft tissues to adapt and remodel to the newer bridge design (Fig. 18).

Finally, two zirconia frameworks (teeth 17 to 11 and 21 to 27) were milled to restore this patient. The zirconia bridges were tried for an optimal esthetic, occlusion and fit. The bridges were finally cemented with FujiCem (GC America). The 1 year follow-up revealed a very good clinical aspect both of the gums and the ceramic restorations (Fig. 19).

The 2 years follow-up, X-ray demonstrated an optimal stability of both hard and soft tissues (Fig. 20).



Fig. 16: Cementation of three zirconia bridges in lower jaw. Second set of temporary prosthesis in upper jaw



Fig. 17: Lip displays with upper temporaries and final lower ceramic bridges



Fig. 18: Upper jaw. Zirconia frameworks



Fig. 19: One year postsurgery

Considering the before and after situation, the patient expressed her satisfaction and gratitude for the whole metal-free oral rehabilitation.

DISCUSSION

This is the first case report of a full-mouth rehabilitation with immediate ceramic implants and immediate loading using the CAD/CAM technology.

The CAD/CAM technology and the actual software allow us to work virtually in the lab using the scanned stone models of the patient.

The protocol described in this case report includes the following basic steps:

- Before surgery:
 - Study models mounted in articulator
 - Diagnostic wax-up
 - Surgical guide from the diagnostic wax-up
 - Scan the diagnostic wax-up.
- Day of surgery:
 - Make implant impressions and stone models
 - Scan the model with implant analogs
 - Match the virtual wax-up with the new model with implants



Fig. 20: Two years postsurgery

- Mill the temporary rehabilitation with PMMA material
- Cement the bridge with temporary cement.

This protocol is not suitable for every case. It is indicated only in cases with large amount of bone and thick biotype of soft tissues. This is important because the implants must be very stable to be able to support the immediate temporary restorations with minimizing the risk of implant failure.

Moreover, the design for the temporary rehabilitations must be thick in order to avoid fractures that could compromise the implants. For this reason, the temporary restorations are enlarged in the palatal and lingual aspects.

Finally, it is very important to note that all patients with such an extensive treatment must undergo a very strict maintenance and surveillance program. This is to control the patients oral hygiene and the quality of the peri-implant tissues that will determine the patient's treatment prognosis.

CONCLUSION

Zirconia implants can be a viable treatment modality for immediate implants and immediate loading of the full arches, provided that large amount of bone and a healthy thick biotype is present.

Computer-aided design/computer-aided manufacturing (CAD/CAM) technology allows us to virtually diagnose and design the patients restorations so that work can be done in advance in the lab some days before the surgery. This way just after surgery, the temporary bridge can be milled right away, therefore, the patient receives his temporary restoration in a short-time.

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