

Ceramic Implants and Dental Implant Rehabilitation, Part III

Fixed, Full-Arch Treatment With a Cement-Retained Prosthesis

INTRODUCTION

Dental implants have predominantly used titanium alloys for the past 50 years. Ever since the introduction of the All-on-4 treatment by Maló et al¹ 20 years ago, titanium alloy implants have been established as the cornerstone for full-arch, implant-supported restorations. However, over the last 15 years, zirconia implants have undergone significant evolution,² emerging as a reliable—though more complex—option for full-arch, implant-supported restorations.^{3,4} This progress, coupled with the success of ceramic implants, has led to growing patient demand for comprehensive, metal-free implant solutions in full-arch cases.

The reasons why patients seek metal-free dental implants are metal allergies,⁵ systemic inflammation, exacerbation of chronic diseases, or previous failures with titanium implants. However, from the practitioner's standpoint, the most prevalent complications associated with titanium dental implants are peri-implant mucositis^{6,7} and peri-implantitis. Reports suggest peri-implant mucositis occurs in 40% to 80% of titanium implant patients, while peri-implantitis affects 10% to 56% of implant patients.⁸

Even though the etiology of peri-implant disease is multifactorial, more and more evidence has emerged correlating peri-mucositis and peri-implantitis to titanium alloy degradation⁹ and the cytotoxic effects of metal particles in the local tissues.¹⁰ Greater levels of dissolved titanium were detected in submucosal plaque around implants with peri-implantitis when compared to healthy implants.¹¹ These findings continue to explore and establish the clear connection between titanium dental implants and the prevalence of peri-implant disease.

In zirconia implants, the prevalence of peri-implant disease seems to be less prevalent. One well-cited study reported that clinical experience with zirconia implants indicates that peri-implantitis seems to be less of a problem with ceramic implants than with titanium implants.² A more recently published study showed zero peri-implantitis during a followup of ceramic implants for up to 12 years.¹² Therefore, ceramic implants can potentially be a solution for this current global epidemic of peri-implantitis.¹³

The first 2 articles in this series (published in the March 2023 and



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October 2023 issues of *Dentistry Today*) focused on single-unit; extended edentulous; and full-mouth, removable treatment with ceramic implants. The following case report illustrates a full-mouth reconstruction with use of 100% metal-free zirconia dental implants to achieve a predictable and clinically optimal result.

CASE REPORT Diagnosis

A 54-year-old female patient presented to our office for an evaluation of her existing dental condition in both her maxillary and mandibular arches. The patient had multiple provisional restorations on her upper anterior teeth (Figures 1 to 3) and was looking to restore her dentition to proper form, function, and aesthetics.

Upon clinical examination, deep periodontal probing depths with bleeding were present around implant Nos. 2, 3, 5, and 19, indicating localized peri-implantitis and peri-mucositis. The loss of dentition in various posterior quadrants resulted in the collapse of vertical dimension, causing further force and wear on the anterior teeth and restorations. Recently placed implant No. 13 had a poorly contoured provisional due to lack of restorative space. The patient had generalized wear and fractured restorations due to parafunctional habits and decay on the lower anterior teeth.

Relevant medical history included the following autoimmune conditions: Crohn's disease, Hashimoto's thyroiditis, and plaque psoriasis localized to the head and neck area. The patient, who herself was a health practitioner, described her main concern as inflammation in her mouth, which contributed to the rise of systemic inflammatory cytokines and potentially negatively affected her systemic health.

Treatment Plan

Due to a history of peri-implantitis, metal-free ceramic implants were requested, which the patient had difficulty finding for full-mouth reconstruction. All risks, benefits, and viable alternatives of other treatment options were reviewed with the patient. It was decided that full-mouth reconstruction would provide the best prosthetic, functional, and aesthetic outcome for the patient with an excellent long-

term prognosis. The treatment entailed the removal of all failing teeth and implants and subsequent replacement with a fixed, full-arch, ceramic, implant-retained prosthetic. The approach in the mandible was to place zirconia implants in the posterior regions and place ceramic-bonded restorations on the lower natural teeth.

PreVu dental software (PreVu Software) was used to perform a simulated smile design (Figure 4) that guided the dental laboratory in creating a proper diagnostic wax-up for the case, which also allowed the patient to envision herself with her new smile and discuss aesthetic goals of the case. Using Planmeca Romexis CBCT planning software (Planmeca), the zirconia implants were virtually positioned, determining the exact placement sites and sizes of the ceramic implants (Figure 5). The dental implants chosen for this reconstruction were SDS Implants (Swiss Dental Solutions) monobloc, for immediate loading, and 2-piece, for delayed loading.

Surgery

On the day of surgery, the patient was sedated, and local anesthesia was administered. Natural teeth were extracted with the use of elevators and forceps. Titanium implants were explanted by a reverse torque technique using a fixture removal kit (DMZ Dental). Non-restorable ceramic implant No. 13 was explanted using piezo surgery initially, then elevators and forceps. Osteotomy and placement of the new implants were performed by a socket-guided technique. Implants were placed at the tooth extraction sites, implant removal sites, or adjacent to an extraction site (Figure 6). A-PRF membranes were used in the extraction sockets to speed up the healing process and as a graft material for the internal sinus lift site Nos. 2, 3, 14, and 15. Soft tissue was re-approximated around the implants (Figures 7 and 8) using Glycolon 4.0 sutures (Osteogenics). Implant restorative posts and collars were adjusted to achieve a path of draw for the cementable temporary res-



Figure 1. Initial assessment photograph showing the patient's smile before treatment.



Figure 2. A retracted smile photo showing the poorly contoured provisionals and the wear and decay on the lower dentition.



Figure 3. Preoperative panoramic radiograph used in treatment planning to identify anatomic structures and the existing dental condition.



Figure 4. Virtual smile design photos with PreVu software.

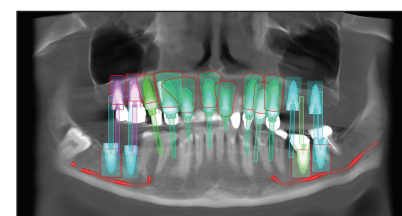


Figure 5. Digital treatment planning showing the proposed location and position of the dental implants.

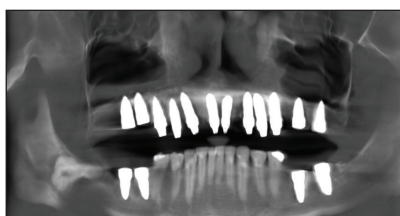


Figure 6. An immediate postoperative radiograph showing the one-piece and 2-piece SDS ceramic implants (Swiss Dental Solutions).

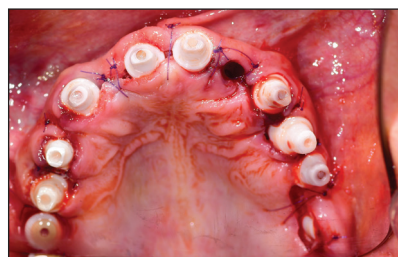


Figure 7. Immediate post-op photograph of the maxilla showing the precise position of the dental implants, as well as the keratinized tissue on the buccal.



Figure 8. Post-placement, retracted view showing adequate clearance for the fixed provisionals.

toration. The maxillary arch was scanned using an intraoral i700 scanner (Medit). The provisional restoration was designed by GALA dental arts laboratory and produced in-house with a Flexcera Smile Ultra+ resin (Desktop Health) on a Max 3D printer (Asiga). The temporary was cemented using Bifix Temp cement (VOCO), and the occlusion was adjusted to spread the occlusal forces evenly during the healing phase (Figure 9).

Prosthetics Phase

The final restorative phase of treatment was initiated after 5 months of healing to ensure full osseointegration. Temporary restorations were removed, and implant integration was verified using the Periotest device (Medizintechnik Gulden eK). Posts were delivered on the 2-piece implants, at site Nos. 2, 3, 14, 15, 18, 19, 30, and 31, using Ketac GI cement (Solventum) and PEEK screws torqued to 5 Ncm² while the cement was setting. Implants were modified to ensure that the collars were in line with the level of the soft tissue (Figure 10). Mandibular anterior teeth and mandibular posterior implants were prepared using preparation guides to ensure adequate occlusal and facial reduction. A final intraoral scan of the preparations was taken using the i700 scan-



Figure 9. Retracted view of the fixed provisionals delivered immediately after surgery.



Figure 10. Taken after the healing period, this occlusal photograph shows the final delivery and preparation of all abutments.

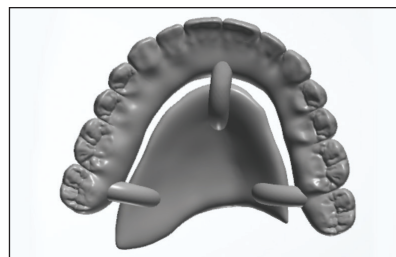


Figure 11. The spider shell temporaries were made using the digital wax-up.



Figure 12. A retracted view of the new provisionals once the implants integrated.

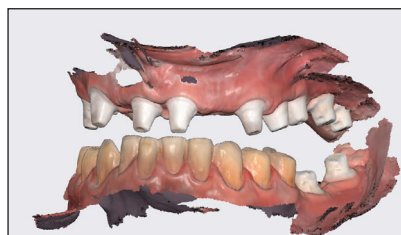


Figure 13. A digital image of the final scan of the preparations in the upper and lower arches in the proper relationship.



Figure 14. Final scan of the approved provisionals with the Medit i700 scanner.

ner. Temporary restorations were fabricated to an ideal vertical dimension. For the fabrication of the maxillary arch, a 3D printed spider shell (Figure 11) was used and relined with Structur bis-acryl material (VOCO). The palatal index ensured proper placement of the temporary bridge over the preparations. The provisionals for the lower arch were made using VPS putty mold and Structur bis-acryl material (Figure 12).

The temporary restorations were scanned using Medit Software and

indexed to the preparation scans. Bite registration and the new vertical dimension were transferred from the temporary restorations to the final scans (Figures 13 and 14). Full-face photos were taken to evaluate the harmony with the facial structures and communicate tooth position changes needed for the final prosthesis fabrication (Figure 15).

Laboratory Considerations

Final intraoral scans of preparations, temporary restorations, and

the bite registration were forwarded to the dental laboratory (GALA Dental Art) along with the photos and detailed changes requested. The maxillary final restoration was fabricated in 4 fixed partial denture segments (2-3-4-5), (6-7p-8), (9-10p-11), and (12-13-14-15). The material used for the maxillary restoration was a combination of monolithic zirconia for the molar region and porcelain layered zirconia for units No. 5 to 12 to enhance aesthetics (Figure 16). The lower arch was restored with

splinted monolithic zirconia crowns on implant Nos. 18 and 19 and 30 and 31. Natural teeth restorations on teeth Nos. 20 to 28 were fabricated with IPS e.max (Ivoclar) pressed layered ceramic to provide enhanced bonding strength to the tooth structure (Figure 17).

Delivery

The patient returned for final restoration placement after 3 months due to her active travel schedule. Provisional restorations were removed, along with all remaining temporary cement. The final restorations were verified for fit. The patient examined the appearance and aesthetics of the final prosthetics and approved them for final cementation. Implant-supported zirconia restorations were cemented with RelyX Unicem 2 (Solventum), and the lower e.max restoration over natural teeth was bonded using ScotchBond universal (Solventum) and RelyX Veneer Cement (Solventum). A canine guidance occlusal scheme was used for the rehabilitation to reduce lateral forces on the posterior restorations to help prevent fracturing of the prosthetics. After the final delivery, an occlusal guard was also delivered to the patient with strict postoperative care and hygiene instructions. The final result was a complete functional and aesthetic rehabilitation that exceeded the patient's own expectations (Figures 18 to 20).

DISCUSSION

Zirconia implants have shown high levels of success and survival in delayed- and immediate-loading cases.¹⁴⁻¹⁶ However, unlike titanium implants, which have multiple restorative abutment options, specifically for difficult-to-restore or surgically challenging cases, zirconia dental implants have limited restorative options. Multi-unit abutments, custom abutments, and non-engaging screw-retained abutments that are often used in full-arch, fixed prosthetic restorations are not widely available for zirconia implants. The particular case presented in this article was completed with a combination of one-piece mono-block ceramic implants and 2-piece ceramic implants with a combination of cementable and



Figure 15. Facial analysis using the provisionals before the final definitive restorations were made.



Figure 16. Final maxillary restorations.



Figure 17. Final mandibular restorations.



Figure 18. Final close-up photograph of the delivered restorations.



Figure 19. Final panoramic radiographs of the completed case.



Figure 20. Facial photograph showing the facial harmony after a full-mouth rehabilitation.

screw-retained posts. The main drawback of treatment with one-piece ceramic implants is the need to place the implants perfectly parallel to achieve a path of draw for a cemented prosthesis. In the hands of a skilled and experienced zirconia dental implant practitioner, much is possible with zirconia dental implants but often requires a higher degree of planning; more precise implant positioning; and achieving the desirable outcome of predictability, stability, and longevity. The SDS zirconia implant model that was used for this case had a dynamic thread tailored for immediate implantation and achieved the high primary stability needed for immediate loading. The implant had a large tulip, contributing to ease of preparation and customization of the restorative portion of the implant and enhancing emergence profile. A one-piece implant design streamlines the immediate temporization process after the surgery, as there is no need to deliver an abutment on the implant prior to placement of the temporary restoration. In the posterior region, due to the need to perform an internal sinus lift procedure, an SDS 2-piece zirconia implant design was chosen to minimize the tongue and mastication forces applied to the implants during the healing phase and to simultaneously prevent implant loss due to early loading.

Splinting implants helps distribute the forces exerted during biting and chewing across multiple

implants and minimize micro-movements. This prevents excessive stress on individual dental implants and the supporting bone. This can be an important factor for implant success, as excessive movement can lead to bone resorption and compromise long-term stability.

CONCLUSION

With the evolution of ceramic implantology, various implant materials and restorative options are available to patients seeking full-arch implant solutions. Deciding which material and method to use in each case depends on clinical and patient demands. The treatment plan for this case proved to be successful because it achieved the patient's goal of having an implant-supported, fixed prosthesis on 100% metal-free zirconia implants with healthy hard- and soft-tissue integration. ♦

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