

Zirconia implants for natural tooth replacement in the aesthetic zone

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Replacing the natural tooth with dental implants has become the standard of care in the practice of dentistry.^{1, 2} From single-tooth replacement to complete maxillary and mandibular implant-supported restoration, patients all around the world enjoy the benefits of implant dentistry.^{1, 2} The success rates of implants have been well documented in the dental literature over the last 50 years. Advances in surgical techniques have allowed for a more conservative, minimally invasive protocol to ensure that soft-tissue contours are preserved.³⁻⁸ Advancements in digital workflow procedures, prosthetic and cosmetic protocols, and reconstructive materials has allowed the implant team to deliver not only aesthetic but also biologically sound implant-abutment restorations that can preserve bone and soft-tissue attachment levels long term.³⁻⁸

However, there are some potential problems with modern two-piece titanium implant designs and maintenance of such implants, affecting not only long-term success rates

but also short-term observation periods.^{9, 10} Titanium implants with surface enhancements, alterations and various coatings have been shown to present the dental implant team with challenges in maintenance schedules when portions of the implant become exposed to the oral cavity, for example as a result of breakdown of the soft-tissue seal around the abutment or implant collar, enabling bacterial biofilm to form on the surface and initiating peri-mucositis and/or peri-implantitis.¹¹⁻¹⁴ Additionally, in areas where there is a deficiency of attached keratinised tissue, a thin tissue biotype or recession of the peri-implant tissue around the definitive implant restoration, this can contribute to the initiation of peri-mucositis and/or peri-implantitis.¹⁵⁻¹⁷

Other factors that can contribute to peri-implant disease include:

- lack of oral hygiene, causing inflammation and bone loss;
- tobacco use;



Fig. 1: Pre-op clinical view, right view. **Fig. 2:** Pre-op clinical view, anterior view. **Fig. 3:** Pre-op clinical view, left view. **Fig. 4:** Pre-op CT scan, panoramic view. **Fig. 5:** Edentulous site #14 before correction. **Fig. 6:** Creation of a naturally contoured emergence profile preceding implant placement.

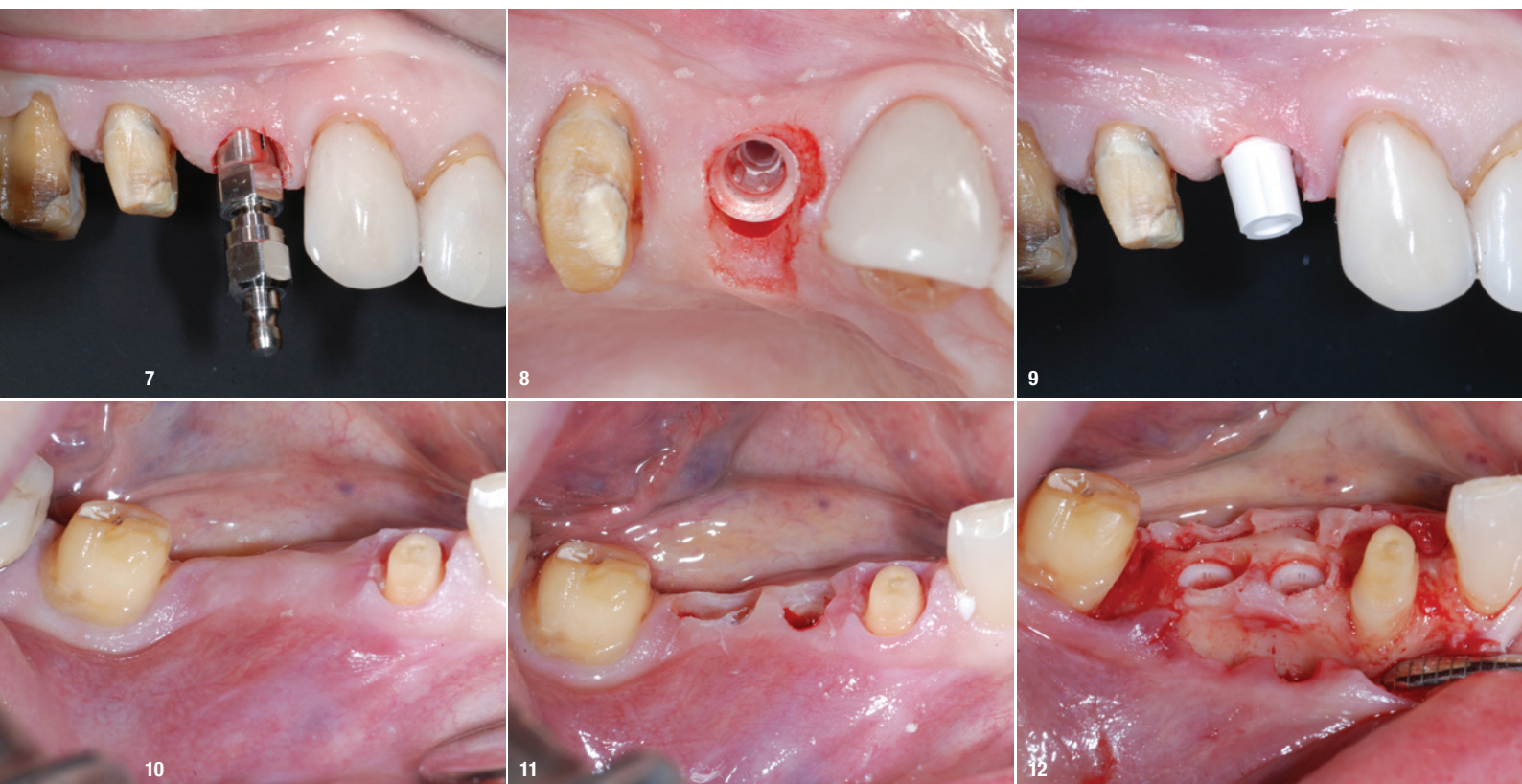


Fig. 7: Minimally invasive zirconia implant placement with the carrier mechanism attached. **Fig. 8:** Implant placed in site #14, occlusal view. **Fig. 9:** PEEK provisional abutment seated, prior to preparation. **Fig. 10:** Pre-op clinical view of the mandibular right posterior. **Fig. 11:** Creation of the sculpted osteotomies in the mandibular right posterior. **Fig. 12:** Zirconia implants placed sub-crestally within the sculpted osteotomies created in the alveolar ridge.

- genetic factors; and
- corrosion of the base material of the titanium implant.^{18–21}

When the peri-implant tissue lacks volume and thickness, aesthetic complications can also occur with titanium implants.^{15–17} Discoloration of the facial tissue can lead to premature breakdown of the titanium implant complex.

Zirconia has been used in complete crowns, prostheses and final abutments for many years. It has a high strength, its white colour avoids the unaesthetic grey appearance of the peri-implant tissue associated with metal-containing abutments and restorations, and it has been shown to be a successful alternative to titanium for dental implant designs.^{22–25}

Additional benefits of zirconia as a dental implant material are the following:

- a high level of biocompatibility and fracture toughness;
- reduced bone resorption and inflammatory response around zirconia dental implants;
- reduced biofilm levels around zirconia implants; and
- flexibility of preparation of the collar and implant body, allowing for resolution of critical surgical placement issues that can arise with regard to implant placement depth, spatial arrangement and trajectory.^{26–29}

In patients with increased potential for peri-implant disease and infection, a metal-free dental implant option should be considered.³⁰ Patients who have diabetes, patients who have undergone radiation therapy or chemotherapy, patients with a history of taking any bisphosphonates and younger individuals suffering from premature tooth loss should all be considered for zirconia dental implants.^{31, 32} The following case report will outline the use of zirconia dental implants to replace the natural teeth in various edentulous sites and teeth requiring immediate extraction and implant placement in a patient undergoing full-mouth rehabilitation.

A 64-year-old non-smoking female patient presented for rehabilitation of previous restorations, teeth in which endodontic treatment had failed and edentulous spaces (Figs. 1–3). Radiographic examination revealed that teeth #14, 45, 46 and 35 were missing and confirmed the failed treatment of teeth #25 and 26 (Fig. 4).

The patient agreed to new complete zirconia crowns on the previously treated teeth, excluding the remaining third molars, and consulted for implant treatment in sites #14, 25, 26, 46, 45 and 35. After reviewing the benefits of metal-free dental implants and ceramic restorations, especially when placed adjacent to remaining natural teeth, the patient chose zirconia dental implants and an immediate restoration protocol. Prior to the commencement of treatment, records were taken, involving a series of facial

and intra-oral digital photographs, 3D intra-oral scanning and smile design consultation.

Based on the patient's desired aesthetics, function and treatment sequence, a master diagnostic design file was created and used to guide the surgical guides, fabrication of the provisional restorations, and implant length and diameter selection, and as a preview of the patient's initial design criteria. The restorative clinician prepared the posterior sextants for aesthetic provisional restorations to be used as surgical guides and a template for creation of the provisional restorations and pick-up of the provisional abutment (Figs. 5 & 6).

Following a minimally invasive placement protocol, a 4.3 × 11.0 mm two-piece implant (Zi, Neodent) was placed in site #14 to an initial torque of 50 Ncm (Figs. 7 & 8). A PEEK provisional abutment was placed (Fig. 9), prepared and picked up into the provisional restoration. The margins and contours of the implant–restoration complex were adjusted outside of the mouth, and the provisional restoration was seated with temporary cement over the previously prepared teeth #16 and 15 and screwed on to the implant #14.

Proceeding with the mandibular right posterior quadrant, after an appropriate local anaesthetic had been administered, the previous provisional restoration was removed (Fig. 10). Utilising a #8 round surgical length diamond bur,

sculpted osteotomies were created, laying the foundation for natural soft-tissue contours to be formed (Fig. 11). Once these had been created, a crestal incision was made and a full-thickness flap was raised to reveal the underlying alveolar crestal contours to help support the natural soft-tissue contours that start undergoing maturation at the initial surgical placement. After this, two zirconia implants were placed, a 4.3 × 11.0 mm implant in site #45 and a 4.3 × 10.0 mm implant in site #46, both to an initial torque of 50 Ncm (Fig. 12). After the placement of PEEK provisional abutments, the aforementioned retrofitting protocol was performed to complete the immediate provisional restoration (Fig. 13), followed by closure utilising a continuous sling suture technique with #4/0 e-PTFE suture material (Fig. 14).

Following the surgical plan, the maxillary left posterior sextant was next to be treated. Extraction of teeth #25 and 26 was accomplished using a minimally invasive protocol (Fig. 15). Debridement of all soft tissue in the extraction sockets was followed by site preparation. After the internal sinus lift protocol at site #26 had been completed and a small amount of platelet-rich fibrin and grafting material had been placed into the elevated sinus area at the apex of site #26, two 4.3 × 13.0 mm zirconia implants were placed to an initial torque of 50 Ncm. Platelet-rich fibrin and grafting material were placed around the implants to fill in the defects that remained after implant placement (Fig. 16). Following the provi-

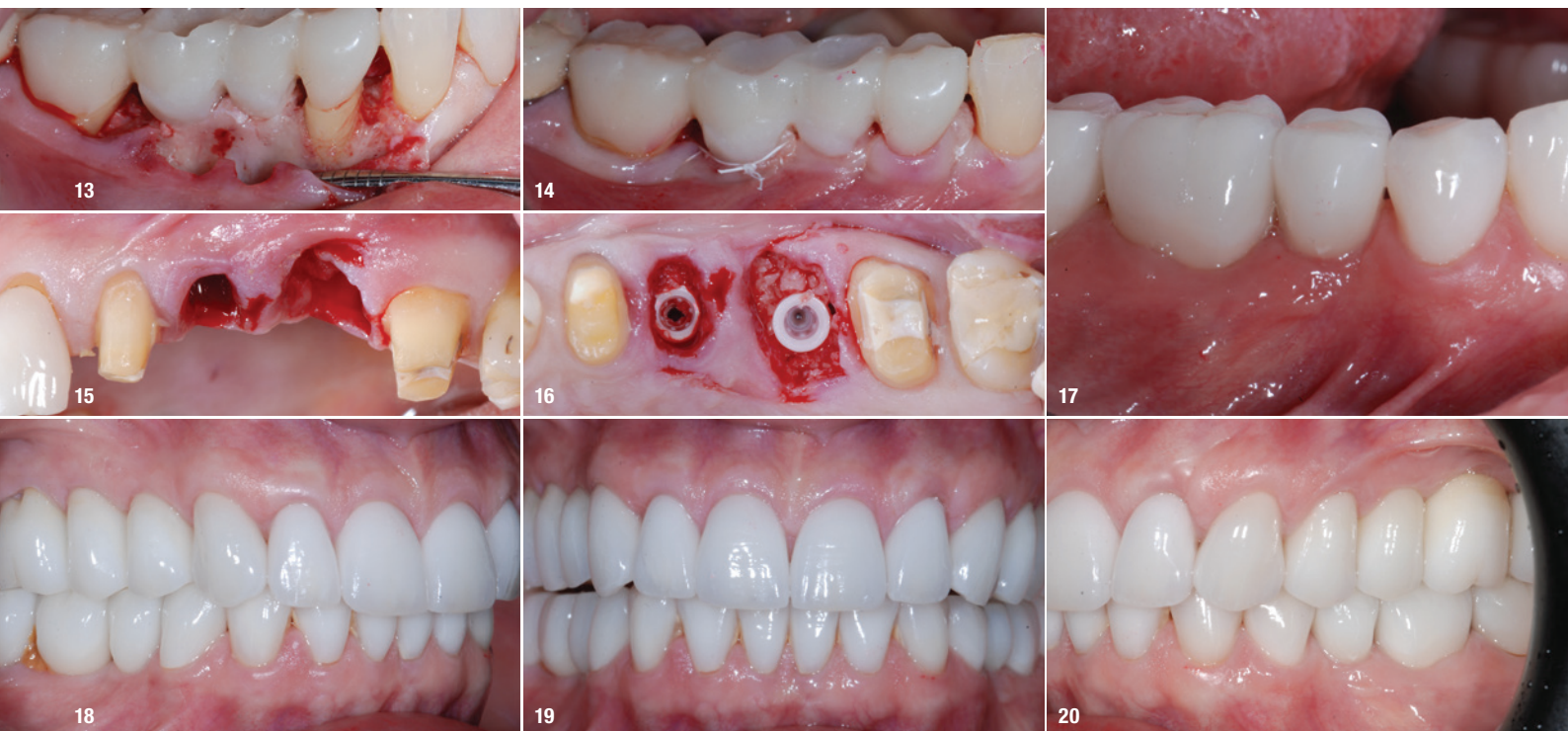


Fig. 13: Retrofitting of the surgical guide–provisional complex to the prepared PEEK abutments. **Fig. 14:** Continuous sling sutures. **Fig. 15:** Atraumatic extraction of teeth #25 and 26. **Fig. 16:** Zirconia implant placement with grafting complex seated, using minimally invasive protocols. **Fig. 17:** Definitive restorations on implants #46 and 45. **Fig. 18:** Final clinical view, right view. **Fig. 19:** Final clinical view, anterior view. **Fig. 20:** Final clinical view, left view.



Fig. 21: Final smile. **Fig. 22:** Final digital periapical radiograph of implant #14. **Fig. 23:** Final digital periapical radiograph of implants #25 and 26. **Fig. 24:** Final digital periapical radiograph of implant #35. **Fig. 25:** Final digital periapical radiograph of implants #46 and 45.

sionalisation procedure previously outlined, the site was provisionalised and the entire provisionalised dentition adjusted.

After an observation period of four months, the patient was scheduled with the restorative clinician for placement of the final custom abutments and zirconia restorations (Figs. 17–25). Natural-looking soft-tissue aesthetics was achieved, and the soft-tissue contours of the implant sites exhibited balance and symmetry with those of the natural teeth.

Discussion

Compared with older, conventional tooth replacement options, dental implants are the preferred method for managing edentulous areas, from single-tooth replacement to full-mouth rehabilitation. Additionally, using a metal-free implant option significantly reduces the incidence of peri-implantitis, tissue discoloration, aesthetic complications, and soft-tissue irritation and inflammation. Advancements in zirconia implant designs and protocols have simplified zirconia implant placement and restoration procedures, which follow common procedural techniques, similar to those of titanium implants. Less biofilm formation is a significant benefit observed with zirconia implants placed in single and multiple sites adjacent to the remaining natural dentition. We and other clinicians worldwide have observed significant reduction of tissue inflammation, crestal alveolar bone loss and aesthetic complications. We recommend additional clinical studies and case reports and continue to demonstrate the benefits of zirconia as an implantable material compared with titanium.



about the author



Dr Paul Petrunaro has been in private periodontics and implantology practice since 1988. He is a fellow of the International and American College of Dentists and a diplomate of the International Congress of Oral Implantologists. Dr Petrunaro is renowned for his diversified seminars and lectures on advanced periodontal, oral surgery, implant surgery and reconstruction, and digital dental procedures. He is also considered an expert in the treatment of severe maxillary atrophy, use of zygomatic implants, management of previous failed implant procedures and rapidly growing field of metal-free implant dentistry. Dr Petrunaro has educated clinicians around the world for the last 25 years and continues to contribute to developments in technology and pave the way for more efficient methods of treatment for patients seeking to have their missing teeth restored with dental implants.

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