







CASE REPORT

Clinical and radiographic success of injection-molded 2-piece zirconia implants submitted to immediate loading: A 12-month report of two cases

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Abstract

This case report describes the treatment of two patients who presented with single edentulous sites in the region of upper premolars and were rehabilitated through the placement of injection-molded 2-piece zirconia implants and immediate single crowns. Three months after surgery, definitive prostheses were confectioned through digital workflow. Both patients were followed for 12 months during which clinical and radiographic implant success were observed, concerning implant stability, absence of peri-implantitis signs, complete implant osseointegration, good marginal bone-level maintenance, and excellent soft tissue esthetics. No biological or mechanical complications were observed within this period.

KEYWORDS

case report, dental implant, esthetics, prostheses and implants, yttria-stabilized tetragonal zirconia

1 | INTRODUCTION

Titanium implants are considered the gold standard for the treatment of partially or totally edentulous patients, presenting high success and survival rates; however, their use also has some drawbacks.¹⁻³

In esthetics regions, it is important to consider that some recession of peri-implant tissue can occur over time, and thereby, the titanium alloy devices may become visible through the soft tissues, especially in cases of thin biotype, compromising the esthetics of the rehabilitation, in particular in patients with a high smile line.⁴

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Furthermore, knowing that biofilm formation on implants' surfaces, as well as the quality and quantity of plaque adhesion, play an important role in peri-implant tissue health and implant success or failure.^{4,5} Another factor to be considered is the significantly higher bacterial adhesion presented by titanium devices when compared

with those with ceramic surfaces, as previously demonstrated by in vivo studies.^{6,7}

High-strength, partially stabilized zirconia, was therefore introduced in the early '90s as a new ceramic implant material and a feasible alternative.^{8,9} In vitro studies and animal studies have shown favorable biological

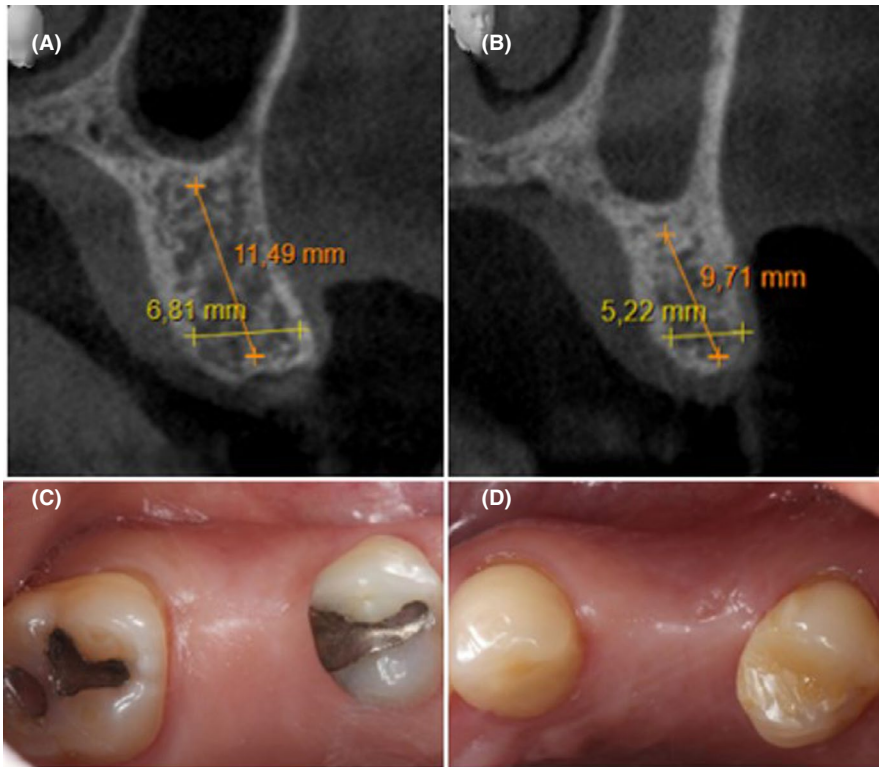


FIGURE 1 (A–D) Patient 1 pretreatment conditions. CBCTs and occlusal photographs of regions 15 (A and B) and 24 (C and D)

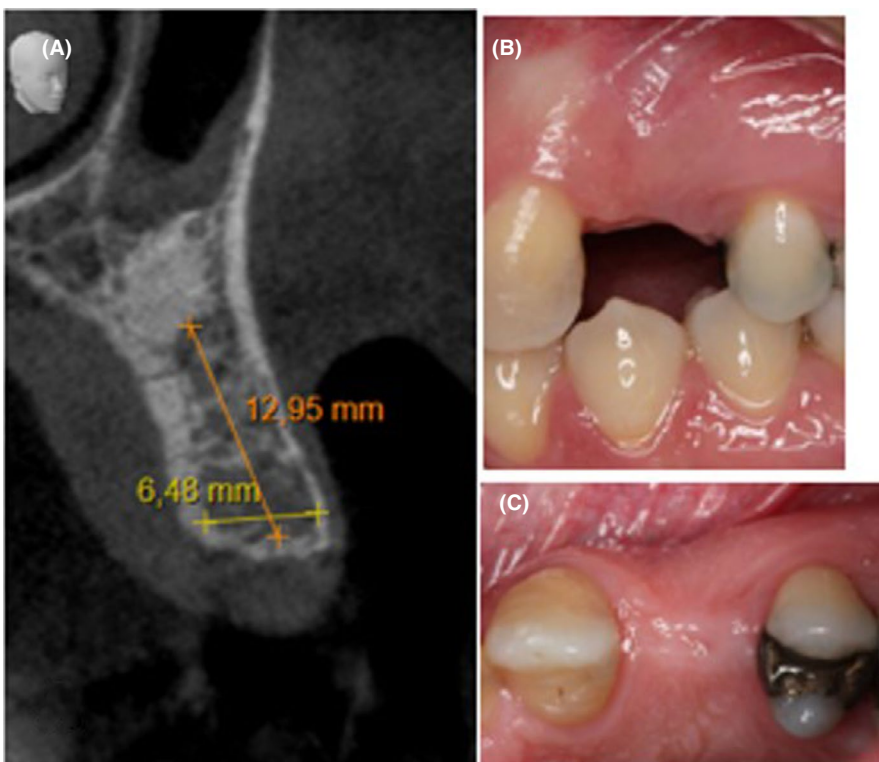


FIGURE 2 (A–C) Patient 2 pretreatment conditions. CBCT (A), lateral (B), and (C) occlusal photographs of region 24

responses to zirconia since then, as well as successful osseointegration.^{2,10,11}

Initially, one-piece zirconia dental implants were the only ones available; however, these have shown several surgical and prosthetics disadvantages, such as wound

healing complications and unintended loading during the healing period,³ whereas two-piece implants may minimize those issues by providing prosthetic versatility, with the possibility of abutment angulation, as well as better implant positioning.¹⁰

Yttria-stabilized tetragonal zirconia polycrystal (YTZP) has been chosen as the material of choice for ceramic implants fabrication, because of its superior corrosion and wear resistance characteristics, as well as higher flexural strength than other ceramics.¹¹

More recently, the technique of injection molding, which is based on plasticity shaping of a zirconia formulation into the form of an implant body, has shown some additional advantages. Animal studies have demonstrated that injection-molded zirconia implants present osseointegration properties that are equivalent to those of titanium implants and significantly greater than those of machined zirconia implants.^{12,13}

During the last two decades, the use of zirconia implants has increased, especially because of their esthetic qualities and metal-free approach¹⁴; however, clinical data concerning treatment with injection-molded 2-piece zirconia implants are still lacking. This case report aims to describe the 12-month clinical and radiographic outcomes of two patients who presented with single edentulous sites in the region of upper premolars and were rehabilitated through the placement of injection-molded 2-piece zirconia implants and immediate single crowns.



FIGURE 3 Implant placement using the transfer piece

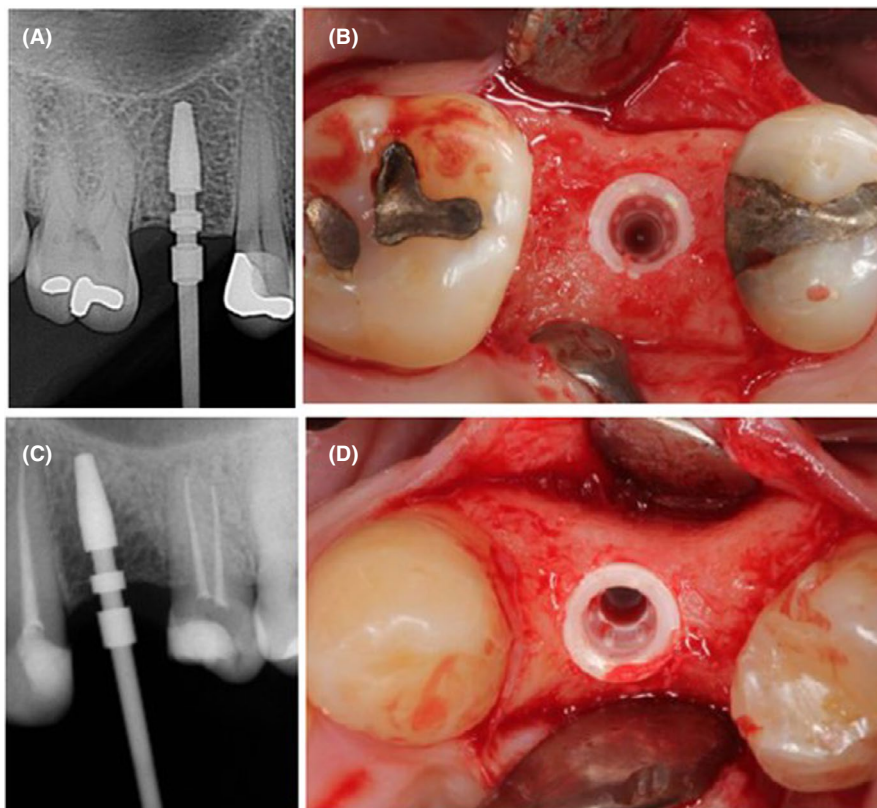


FIGURE 4 (A–D) Patient 1 intraoperative periapical x-rays (A and C); clinical aspects of two-piece zirconia implants showing bone-level final position (B and D)

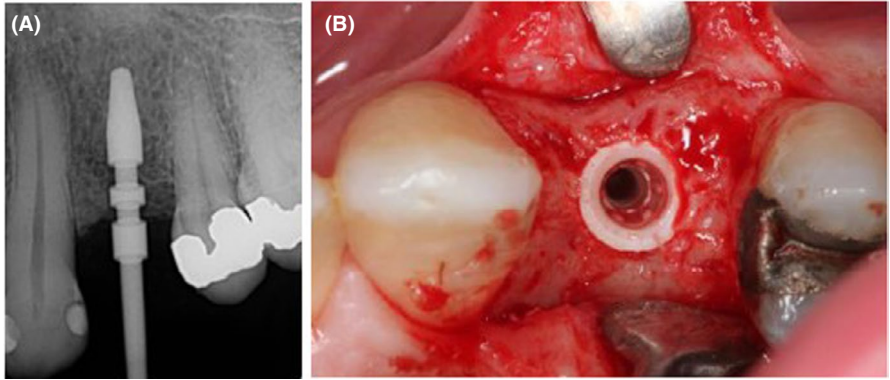


FIGURE 5 (A) Patient 2 intraoperative periapical x-ray (A); clinical aspects of two-piece zirconia implant showing bone-level final position (B)

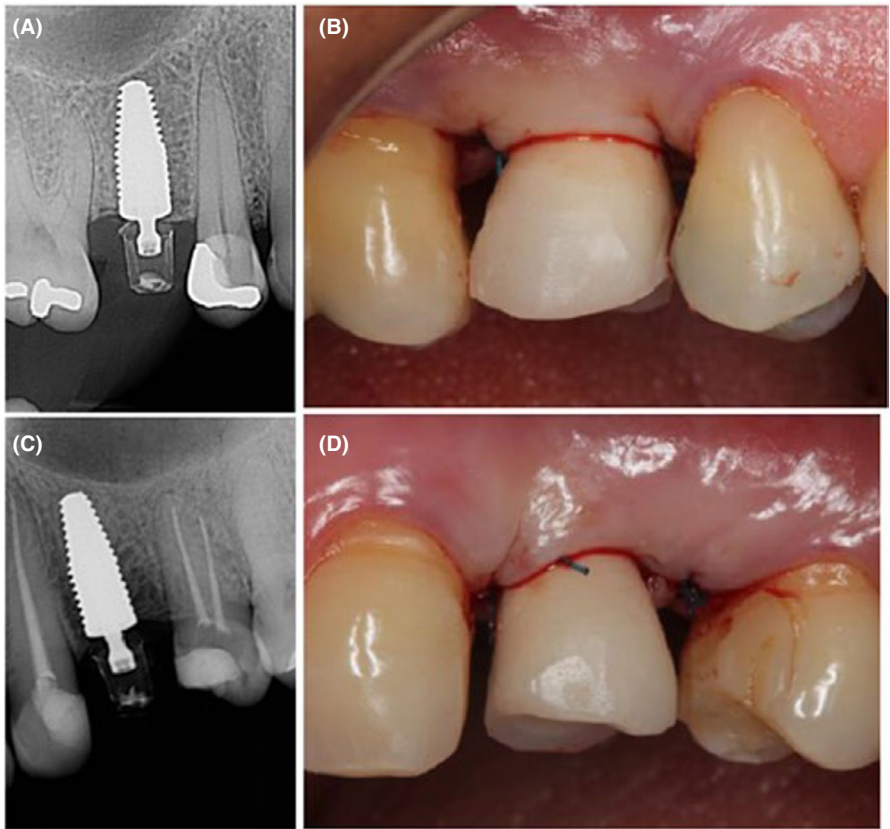


FIGURE 6 (A–D) Patient 1 postsurgical with immediate loading—periapical x-rays and lateral photographs of regions 15 (A and B) and 24 (C and D)

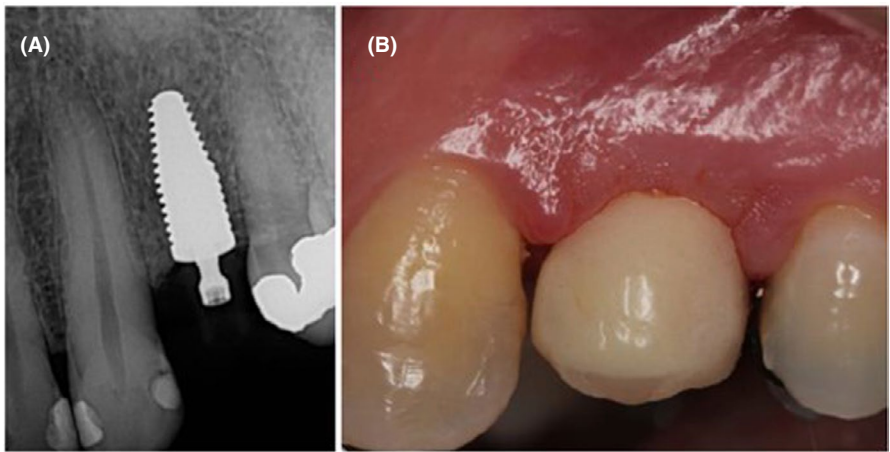


FIGURE 7 (A–B) Patient 2 postsurgical with immediate loading—periapical x-rays (A) and lateral photograph (B)

2 | CASES REPORT

Two patients were referred to ILAPEO College (Curitiba, Brazil) in need of rehabilitation through single-unit implant-supported prostheses. Cone beam computed tomography (CBCT), periapical x-ray, and photographs were obtained for diagnosis and planning purposes. Patient 1 was a 43-year-old woman missing teeth 15 and 24 (Figure 1A–D), and patient 2 was a 35-year-old woman

missing the left maxillary first premolar (Figure 2A–C). Both patients were in good general health. Implant sites were radiographically assessed as presenting bone type II (Lekholm & Zarb classification¹⁵).

The same surgical and prosthetic protocol was applied for both patients. After local anesthesia and incision, a small flap was raised. The site preparation sequence was performed as recommended by the manufacturer and with adequate irrigation. Two-piece yttria-stabilized zirconia

FIGURE 8 (A–B) CAD design of final crown of patient 1 (A) and patient 2 (B)

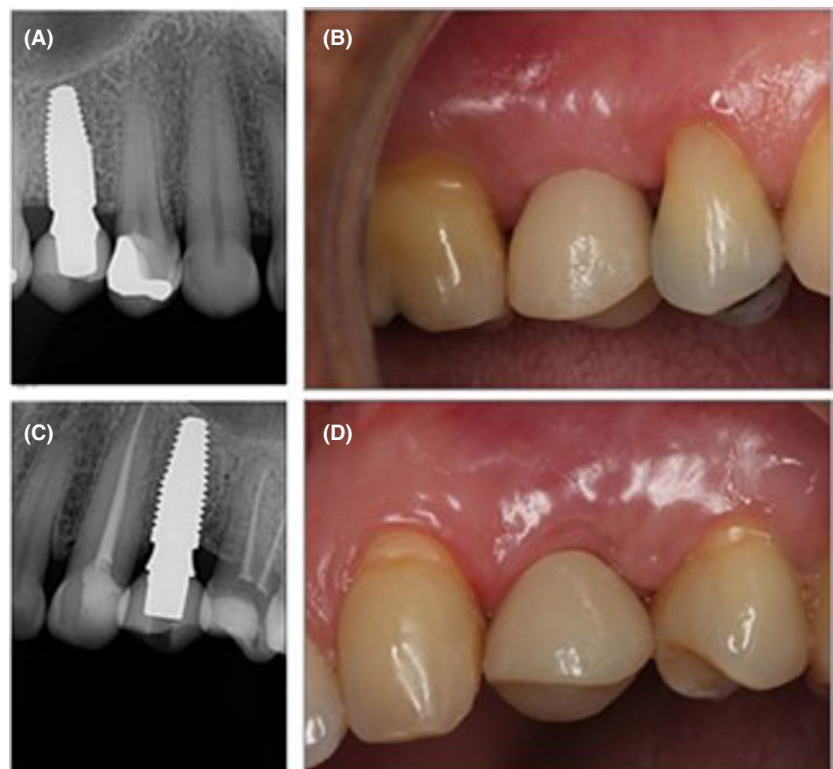
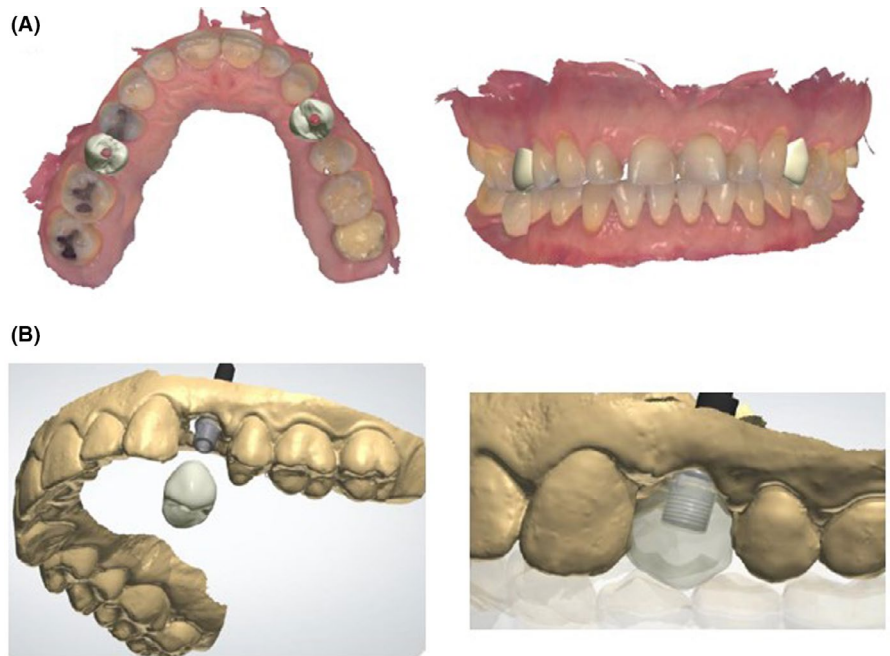


FIGURE 9 (A–D) Patient 1: Periapical x-rays and lateral photographs of final crowns of implants 15 (A and B) and 24 (C and D), 3 months after surgery

implants (Zirconia implant, Neodent) were placed using the transfer piece (Figure 3)—two 4.3×11.5 mm implants in the edentulous sites of patient 1 and one 4.3×10 mm implant in that of patient 2—all with a final insertion torque of 60 N.cm, thus allowing immediate loading. Periapical x-rays were obtained to check the correct implant positioning (Figures 4A,C and 5A). Peek abutments (Neodent) were then selected and placed to support the provisional prostheses (Figures 6 and 7). Sutures were placed to close the wound and removed 10 days thereafter.

After 3 months, the peek abutments were removed, and intraoral scanning was performed using the compatible scan bodies. Zirconia base abutments (Neodent) were selected, and lithium disilicate ceramic crowns were designed in Dental System software (3shape; Figure 8), processed in a CAD/CAM milling machine (M series, Aman Girschbach), and crystallized in a ceramic furnace (Therm, Aman Girschbach).

The crowns were cemented extraorally on the zirconia bases using RelyX U200 (3 M), and these were screwed to

the implants after proper occlusal adjustment (Figures 9 and 10).

The patients were followed clinically and radiographically every 3 months, and no complications were observed or reported during the follow-up period. At the 12-month follow-up, both patients presented clinical and radiographic implant success, by means of implant stability, absence of signs of peri-implantitis, complete implant osseointegration, good marginal bone-level maintenance (<2 mm at the first year)¹⁶ and excellent soft tissue esthetics presenting harmonic interdental papillae shape, attached gingival appearance, and accurate form of their margin¹⁷ (Figures 11 and 12).

3 | DISCUSSION

Dental implants rehabilitation is a favorable and widely spread modality for the treatment of edentulism, providing

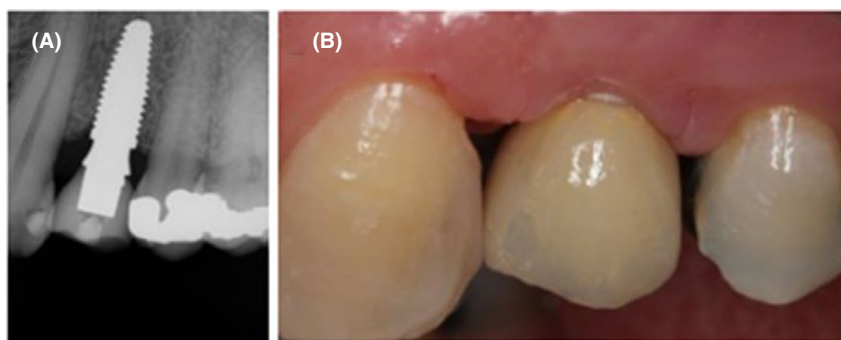


FIGURE 10 (A–B) Patient 2: Periapical x-ray and lateral photograph of final crown of implant 24, 3 months after surgery

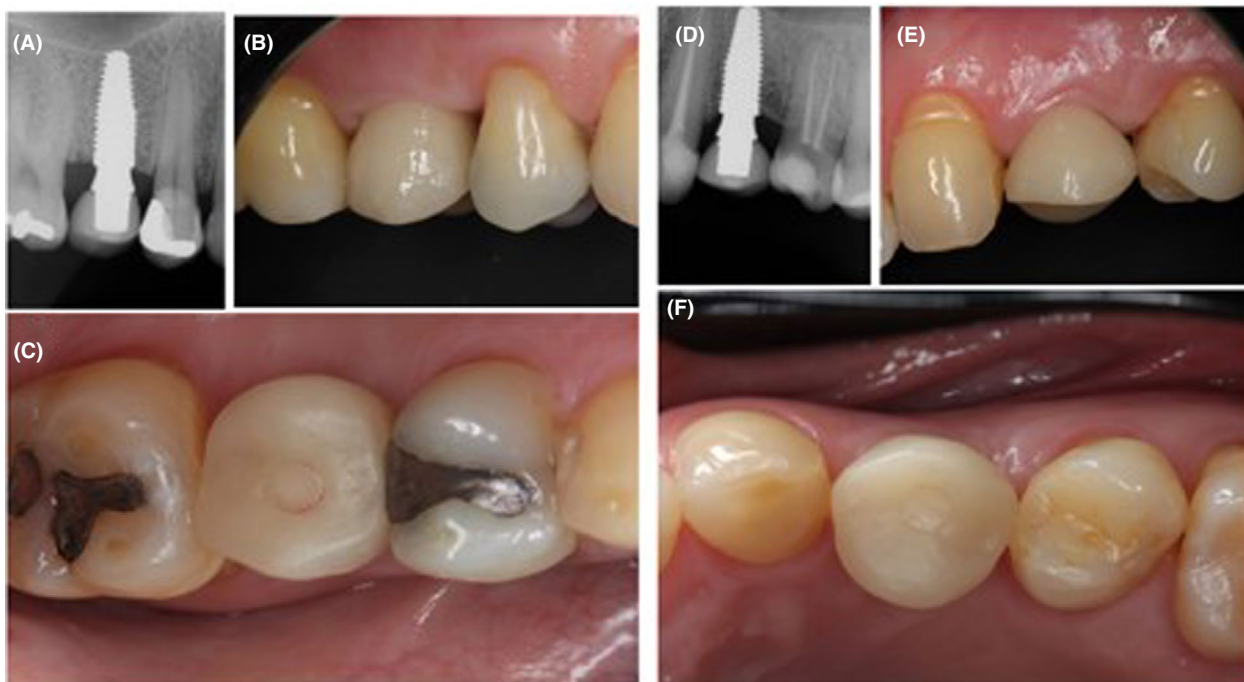


FIGURE 11 (A–F) Clinical and radiographic aspects of patient 1's rehabilitation at the 12-month follow-up visit

functional and biological benefits, as well as high predictability.¹⁸ Treatment planning should consider each patient's local conditions and particular needs.

The use of ceramic implants has shown very satisfactory results regarding biological, mechanical, esthetics, and optical properties.¹⁹ A clear advantage for ceramic vs. titanium implants is that the white to ivory color allows better maintenance of soft tissue color. This is especially important in cases in which the patient presents a thin peri-implant soft tissue or when mucosa recession may occur over time.^{20–22} Also, an irritation-free attachment of zirconia implants and abutments with peri-implant soft tissues has been demonstrated, as well as a comparable or even better soft tissue healing response around these when compared to titanium devices.^{11,23}

A prospective clinical study found that most patients treated with 2-piece zirconia implants presented low plaque and bleeding indices, indicating healthy peri-implant soft tissues in up to 6 years, which according to the

authors might be explained by zirconia's low affinity with plaque and reduced inflammatory infiltrate. Furthermore, marginal bone levels were reported to be stable over time.²

Several animal studies have demonstrated that bone integration of thread zirconia implants is comparable to titanium implants under different loading conditions and has increased removal torque values.^{6,24,25} An *in vitro* study showed that cell attachment and proliferation of osteoblast-like cells on YTZP disks were comparable to those of titanium surface. Other authors showed more pronounced adhesion, proliferation, and differentiation of osteoblasts in modified zirconia surface than titanium.^{26,27} In the presented clinical cases, all 3 implants were successfully osseointegrated by the 3-month follow-up (Figures 7A and 8A).

Moreover, it has been reported that surface modifications potentially increase the osseointegration properties of zirconia implants. Concerning to the technology of injection molding, one of the great advantages of this production process is thought to be the ability to manufacture and design the surface of the zirconia implant in a single step, by incorporating the desired surface topography (roughness) directly into the mold.²⁸ Preclinical studies have demonstrated that injection-molded 2-piece zirconia implants present significantly higher bone-implant contact than machined zirconia implants and equivalent bone-level maintenance to titanium implants.^{14,28}

Another important point to consider in the planned protocol for the cases presented is the use of the zirconia base, which allows extraoral cementation of the prosthetic restoration and, consequently, better removal of excess material before final crown placement. This step is important since extruded excess cement may compromise peri-implant tissues health.^{2,29}

To the best of our knowledge, this is the first 12-month follow-up clinical report on the use of injection-molded 2-piece zirconia implants. All three single-unit rehabilitation showed clinical and radiographic success of implant osseointegration and satisfactory preservation of soft tissue color within this period. Besides the natural aesthesis results, the rehabilitation resulted in a reliable surgical and prosthetic solution in the short-term. No biological or mechanical complications were observed. Further studies should be performed to evaluate long-term outcomes.

4 | CONCLUSION

The clinical cases suggest that treatment with injection-molded 2-piece zirconia implants and zirconia abutments is a successful and reliable alternative for single-unit

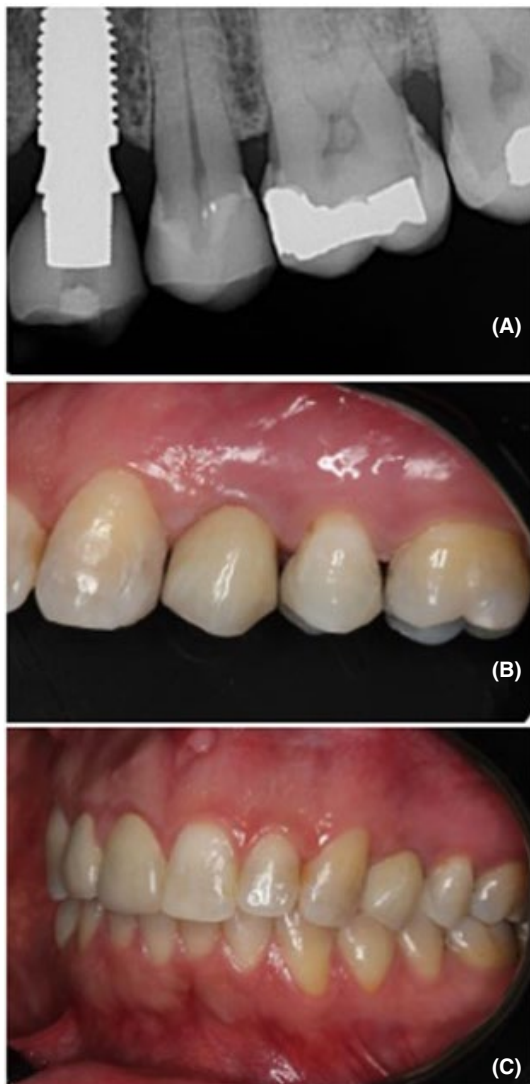


FIGURE 12 (A–D) Clinical and radiographic aspects of patient 2's rehabilitation at the 12-month follow-up visit

immediate rehabilitation, with predictable results in the short-term concerning esthetics and peri-implant tissues health.

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CONFLICTS OF INTEREST

The authors G.T., J.U., W.C., S.R.B. and L.C.T., and C.P.V., declare to work for the company that sponsored the devices used in the study, but state they have no financial interest that might have influenced data reporting.

AUTHOR CONTRIBUTIONS

G.T., J.U., and S.R.B. involved in patients' treatment. W.C. involved in manuscript writing and revision. C.P.V. involved in manuscript writing. L.C.T. involved in conceptualization and critical revision.

CONSENT

A written consent has been obtained from the patient.


DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of this study are available within the article.

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