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AESTHETIC AND FUNCTIONAL REHABILITATION BY ASSOCIATING INJECTION-MOLDED, IMMEDIATE-LOADED, TWO-PIECE ZIRCONIA IMPLANTS AND CERAMIC VENEERS

REABILITAÇÃO ESTÉTICA E FUNCIONAL ASSOCIANDO IMPLANTES DE ZIRCÔNIA DE DUAS PEÇAS MOLDADOS POR INJEÇÃO, SUBMETIDOS À CARGA IMEDIATA E FACETAS DE CERÂMICA

REHABILITACIÓN ESTÉTICA Y FUNCIONAL MEDIANTE LA ASOCIACIÓN DE IMPLANTES DE ZIRCONIO DE DOS PIEZAS MOLDEADOS POR INYECCIÓN, DE CARGA INMEDIATA Y CARILLAS CERÁMICAS

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ABSTRACT
Objective: The present case describes the clinical and radiographic results of 24 months of two-piece injection-molded zirconia implants with immediate loading, as well as the aesthetic and functional planning performed in the anterior maxilla. Case presentation: A 36-year-old female patient was referred to a dental school due to dissatisfaction with the aesthetics of her smile and the absence of dental elements 22 and 24. Prosthetic rehabilitation of the anterior maxilla was performed, including implant-supported prosthesis with zirconia implants and ceramic veneers, using a digital workflow. The patient was followed up for 24 months, with good clinical and radiographic results. Conclusions: The aesthetic and functional rehabilitation performed in the patient's maxilla, with veneers and ceramic crowns, was successful and contributed to the patient's psychological and emotional well-being, in addition to restoring occlusal stability, through the orientation of the canine and the adequate protrusion of the anterior teeth.

KEYWORDS: Zirconia implants. Veneers. Implant-supported prosthesis. Digital workflow. Patient satisfaction.

RESUMO
Objetivo: O presente caso descreve os resultados clínicos e radiográficos de 24 meses de implantes de zircônia moldados por injeção de duas peças com carga imediata, bem como o planejamento estético e funcional realizado na maxila anterior. Apresentação do caso: Uma paciente de 36 anos foi encaminhada a uma faculdade de odontologia devido à insatisfação com a estética de seu sorriso e à ausência dos elementos dentários 22 e 24. Foi realizada reabilitação protética da maxila anterior, incluindo prótese implanto-suportada com implantes de zircônia e facetas de cerâmica, usando um fluxo de trabalho digital. O paciente foi acompanhado por 24 meses, apresentando bons resultados clínicos e radiográficos. Conclusões: A reabilitação estética e funcional realizada na maxila do paciente, com facetas e coroas de cerâmica, foi bem-sucedida e contribuiu para o bem-estar psicológico e emocional do paciente, além de restaurar a estabilidade oclusal, por meio da orientação do canino e da protrusão adequada dos dentes anteriores.

PALAVRAS-CHAVE: Implantes de zircônia. Facetas. Prótese suportada por implante. Fluxo de trabalho digital. Satisfação do paciente.

RESUMEN
Objetivo: En el presente caso se describen los resultados clínicos y radiográficos de 24 meses de implantes de zirconio moldeados por inyección de dos piezas con carga inmediata, así como la

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planificación estética y funcional realizada en el maxilar anterior. Presentación del caso: Paciente femenina de 36 años de edad que fue remitida a una facultad de odontología por insatisfacción con la estética de su sonrisa y ausencia de elementos odontológicos 22 y 24. Se realizó rehabilitación protésica del maxilar anterior, incluyendo prótesis implantosoportada con implantes de zirconio y carillas cerámicas, mediante un flujo de trabajo digital. El paciente fue seguido durante 24 meses, con buenos resultados clínicos y radiográficos. Conclusiones: La rehabilitación estética y funcional realizada en el maxilar del paciente, con carillas y coronas cerámicas, fue exitosa y contribuyó al bienestar psicológico y emocional del paciente, además de restaurar la estabilidad oclusal, a través de la orientación del canino y la adecuada protrusión de los dientes anteriores.

PALABRAS CLAVE: Implantes de zirconia. Carillas. Prótesis implantosoportada. Flujo de trabajo digital. Satisfacción del paciente.

INTRODUÇÃO

Installing dental implants has become routine in the oral rehabilitation of partially or completely edentulous patients. In recent years, implants made of titanium and zirconia alloy with a micro-rough surface have been studied in detail as alternative materials to replace lost dental elements and have shown to be biologically well tolerated and exhibit adequate osseointegration [1–6].

As the search for metal-free aesthetics has been growing, Implant Dentistry has had to challenge new horizons. One of the themes of frequent debate today is the choice between zirconia or titanium as dental implants. Comparing zirconia to titanium is equivalent to comparing ceramics to metals. The advantages of ceramics are high-temperature resistance, wear resistance, chemical stability, and mainly white color, while disadvantages include low fracture toughness [7].

The most stable phase of zirconia at room temperature is the monoclinic, which, upon heating, transforms into tetragonal and cubic phases [8]. However, when cooled to room temperature, cracks are formed due to the increase in volume from the tetragonal phase to the monoclinic phase, which decreases the mechanical strength of zirconia [9]. To prevent that, small amounts of calcium (CaO), magnesia (MgO), ceria (CeO2), and yttria (Y2O3) in a solid solution of ZrO2 can be used to stabilize the tetragonal or cubic phase of ZrO2 at room temperature, depending on the amount of oxide added [10].

Over the last 25 years, special attention has been given to the effect of modified zirconia surfaces on osseointegration in experimental animal studies. These preclinical studies revealed bone apposition on zirconia implants with various surface modifications, including sandblasting [11], etching [12–14] sintering, and plating [1,15]. In the zirconia implant, after 4 weeks, the mineralized bone matrix is in direct contact with the implant surface [16]. The presence of osteoids and osteoblasts indicates ongoing bone formation, while the presence of osteoclasts and Howship's lacuna in old bone indicates resorption of pre-existing bone. At 8 weeks, bone formation ceases due to the absence of both osteoids, and osteoblasts and the presence of bone marrow indicates bone maturation16. Although pre-clinical data point to an excellent acceptance of zirconia implants in relation to titanium, the literature lacks clinical data with medium and long-term follow-up of rehabilitation using these

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materials, especially considering manufacturing by injection, in two pieces and predicting primary stability for immediate loading [16].

The following clinical case describes the treatment of a patient with great esthetic expectations, upper midline deviation, presence of anterior tooth with discoloration, endodontic treatment, and absence of dental elements 22 and 24, region 22 being atresia for implant installation, with little bone thickness and healed ridge. The objective was to describe the 24-month follow-up clinical and radiographic results of two-piece injection-molded zirconia implants and immediate single crowns, installed in edentulous sites in the maxillary lateral incisor and premolar region. Additionally, it describes the planning and the esthetic and functional work performed in the anterior maxilla.

MÉTODO

This is a case report study based on the clinical data of a 36-year-old female patient.

CASE REPORT

A 36-year-old female patient, in good general health, was referred to Ilapeo College due to the absence of dental elements 22 and 24. She reported dissatisfaction with her smile, not only due to the absence of these elements, but also due to the presence of an anterior dental element with color alteration by endodontic treatment, deviated upper midline, projection of anterior teeth, and stained anterior restorations (Figure 1A-C). After clinical and radiographic evaluation, and considering that the esthetics were the main complaint, it was decided to perform a prosthetic rehabilitation of the maxilla, including implant-supported prosthesis with zirconia implants. Written consent was given by the patient.

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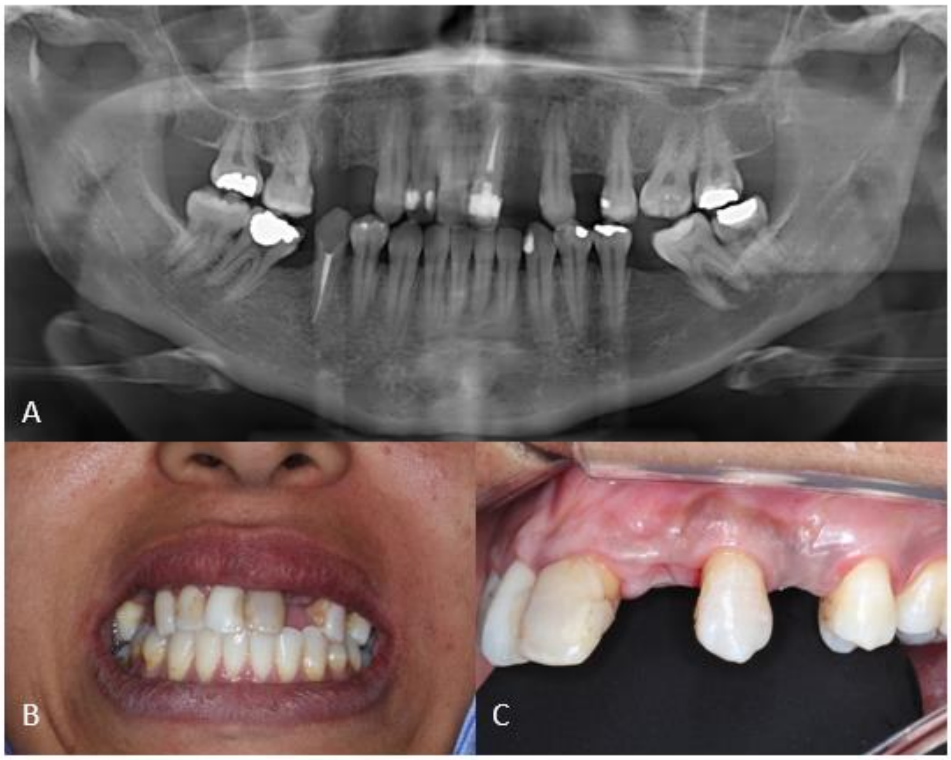

Figure 1. Panoramic radiographic of patient´s initial condition (A). Extraoral frontal view of patient´s initial aspect (B). Intraoral lateral view evidencing the absence of elements #22 and #24 (C).

Surgical and prosthetic procedures

The same surgical and prosthetic protocol was applied for both implants, in regions #22 and #24. 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 injection-molded yttria-stabilized zirconia implants (Zirconia Implant, Neodent) were placed in regions 22 (3.75x13mm) and 24 (4.3x13mm) (Figure 2A-B) reaching final installation torque of 45N.cm, which allowed immediate provisionalization. Peek Abutments (Neodent) (Figure 3A) were then selected and installed to support the provisional acrylic resin prostheses (Figure 3B). Sutures were placed to close the surgical wound and removed 10 days later. Periapical radiographs were obtained to verify the correct positioning of the implants (Figure 3C).

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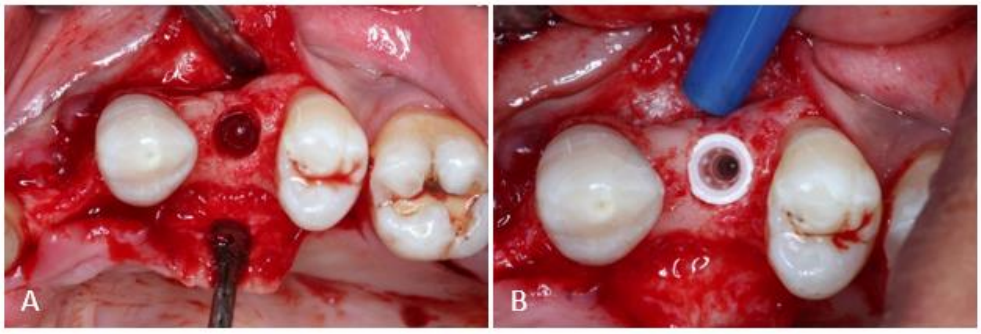

Figure 2. Occlusal view of bone bed preparation (A) and two-piece zirconia implant bone level final position in region #24 (B).

Figure 3. Lateral view of Peek abutments (A). Clinical (B) and radiographic (C) aspects of immediate provisionalization.

After 3 months, the Peek abutment of implant 24 was removed and intraoral scanning was performed using a compatible scanbody. A 3.75x4.0x1.5mm Zirconia Base (Neodent) was selected and the monolithic zirconia crown was designed in Dental System software (3shape), processed on a CAD/CAM milling machine (M series, Aman Girrbach AG) and crystallized in a ceramic oven (Therm, Aman Girrbach AG). The crown was cemented onto the Zi Base in the printed model and then it was installed with a torque of 32N.cm (Figure 4A-B).

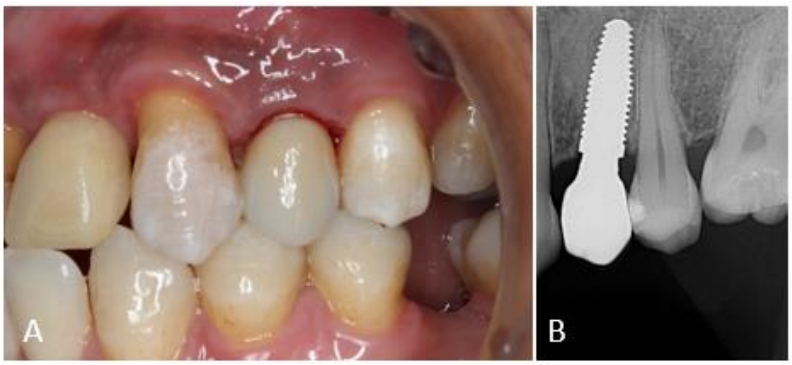

Figure 4. Clinical (A) and radiographic (B) aspects after 3 months of region 24 monolithic crown.

To provide the patient with a complete rehabilitation of the maxilla, 3.75x13mm Helix GM implants (Neodent) were inserted in regions #14 and #15, under abundant irrigation and following the

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manufacturer drilling sequence. GM Mini Conical Abutments (Neodent) were inserted and one month thereafter provisional acrylic crowns were installed.

Esthetic and functional reverse planning of the anterior maxilla

For the final rehabilitation of the patient, including a definitive crown for the region 22, reverse planning was carried out, with the concern of restoring aesthetics and function.

Photos were taken to evaluate the smile and the midline and final length were marked with a blue pen for the diagnostic wax-up. Impressions were taken and the models were mounted onto a semi-adjustable articulator, using a Lucia´s Jig, for the evaluation of possible premature contacts that required occlusal adjustment before treatment.

Then, already with Maximum Habitual Intercuspation (MHI) coinciding with Centric Relation (CR), the patient underwent intraoral scanning (Virtuo vivo, Straumann Institut AG, Basel, Switzerland) (Figure 5) to make a diagnostic wax-up and mock-up (Figure 6) with bisacrylic resin (Protemp – 3M).

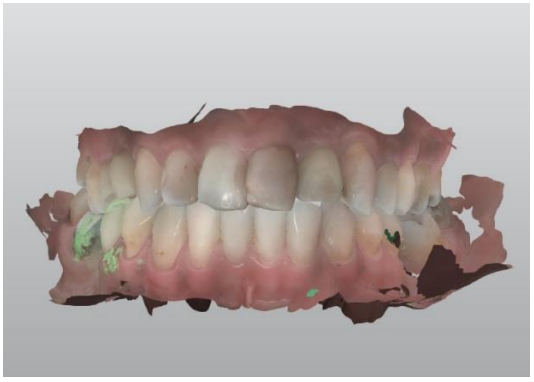

Figure 5. Intraoral scanning image (Virtuo Vivo, Straumann Institut AG, Basel, Switzerland).

Figure 6. Clinical aspect with mock-up.

After approval of the mock-up by the patient, a provisional crown for #21 was initially made to make a filling core with a fiberglass pin (Whitepost - FGM), then the restorations of teeth 11 and 12 were removed, the amount of remaining dental tissue was evaluated and the restorations were redone, before the prosthetic preparations.

Next, preparations were made using the silicone guides obtained after the diagnostic wax-up (Figure 7A). The patient was then submitted to a new intraoral scan with the appropriate scanbodies in

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position (Figure 7B) and provisional crowns were made in bisacrylic resin Protemp (3M) over all the elements being treated.

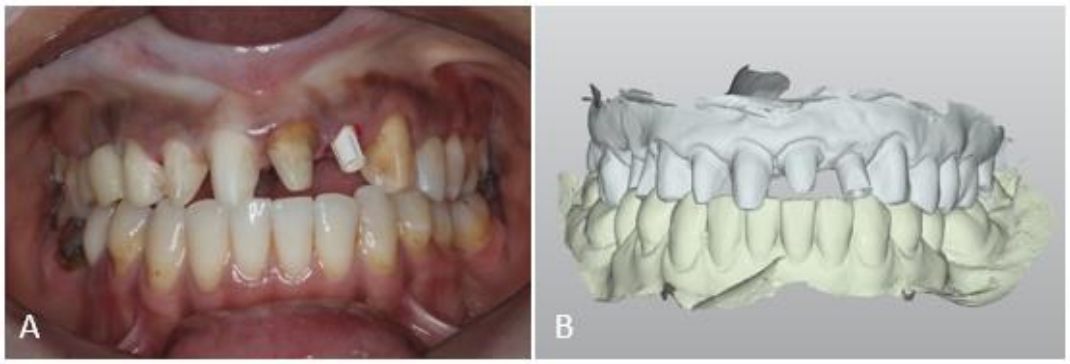

Figure 7. Frontal view of prepared anterior elements and Peek CR in region #22 (A). Intraoral scanning image for restoration confection (B).

The ceramic veneers and crowns (E-MAX) were tried in and installed. The veneers were cemented with Variolink Neutral resin cement (Ivoclair-Vivadent) as recommended by the manufacturer. The prostheses on GM Mini Conical Abutments (GM, Neodent) #14 and #15 were screwed down with a torque of 10N.cm, the prosthesis on #21 was cemented with U-200 (3M) and the prosthesis on #22 was cemented on the Zirconia Base with U-200 (3M), outside the mouth and subsequently screwed into the mouth with a torque of 32N.cm. A ceramic veneer was cemented onto it with Variolink Neutral (Ivoclair-Vivadent) following the sequence determined by the manufacturer (Figure 8A-C).

Figure 8. Lateral view of region #22 prosthesis (A-B) and frontal view of the complete maxillary rehabilitation (C).

The Portuguese version of OHIP–14 (Oral Health Impact Profile) questionnaire [17,18] was used to evaluate the Quality of Life related to Oral Health, as a measure of patient satisfaction during the treatment. The patient was asked before treatment, and after 6, 12, and 24 months post-surgery, how often, in the prior 6 months, she presented the problems related to her mouth and teeth evaluated by the questionnaire.

Clinical and radiographic follow-up

Both Zirconia implants were followed clinically and radiographically every 3 months, and no complications were observed or reported during the follow-up period. At the 24-month follow-up, both

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implants and the aesthetic and functional rehabilitation of the anterior maxilla showed clinical and radiographic success. Implants presented complete osseointegration and stability, absence of signs of peri-implantitis, and good maintenance of the marginal bone level (Figure 9A-B). Also, excellent soft tissue esthetics were observed, presenting a harmonious shape of the interdental papillae, inserted gingival appearance, and precise shape of its margin (Figure 9 C).

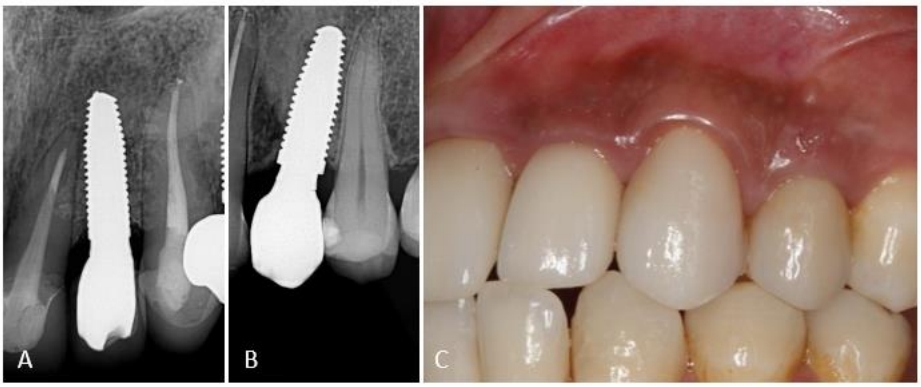

Figure 9. Radiographic (A-B) and clinical (C) aspects after two years of follow-up. Bone level maintenance great soft tissue esthetics were observed.

Regarding patient satisfaction, at the screening, the subject reported having occasionally, often, and very often experienced several problems related to her mouth and teeth which resulted in an OHIP-14 score of 18.85. However, 6 months after implant placement, the OHIP-14 score decreased to 0, revealing the patient´s great satisfaction even before the whole rehabilitation was completed, which remained at the 2-year follow-up visit.

DISCUSSION

Patients´ physical and mental health are strongly affected by missing or defective anterior teeth. Besides the function, the success of implant treatment should also consider esthetics and patient satisfaction, including their quality of life [19,20]. In cases of implant rehabilitation in the esthetic zone, the combination of visually pleasing prosthesis and harmonic healthy peri-implant soft tissue is mandatory [21]. Also, when besides edentulous areas the patient presents defective teeth in the anterior region, careful treatment planning is fundamental in order to meet the esthetic challenges of the rehabilitation [22].

In the present clinical case, two injection-molded two-piece zirconia implants were installed in the anterior maxilla. The use of zirconia as an alternative and more esthetic material for dental implants has already shown favorable outcomes regarding bone and soft tissue responses in both pre-clinical [23] and clinical studies [24–26]. A study with minipigs showed that the zirconia implant when compared to the titanium implant, presented equivalent and non-inferior bone integration, bone formation, and maintenance of alveolar bone level [23]. Also, in vitro studies have shown comparable or even better soft tissue behavior around zirconia discs, with better healing responses, which might positively affect peri-implant soft tissue health [24].

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Another clinical case report described the treatment of two patients, who did not have one of the upper premolars and were rehabilitated with the installation of the same two-piece injected zirconia implant model and immediate individual crowns. Both patients were followed up for 12 months, during which clinical and radiographic success was observed, absence of signs of peri-implantitis, complete osseointegration, maintenance of marginal bone level, and excellent soft tissue aesthetics. Therefore, the clinical report suggested that treatment with a two-piece zirconia implant and zirconia prosthetic components is a reliable and successful alternative to single elements and immediate rehabilitation, with predictable short-term results about peri-implant health and aesthetics [27].

A clinical study that evaluated the behavior of soft tissues around two-piece zirconia implants, showed healthy peri-implant conditions, with no signs of peri-implantitis within 15 months of observation. Furthermore, in cases of buccal bone defects, guided bone regeneration was applied, and no mucosal recession was observed. Additionally, an increase in marginal mucosal level could be detected [28]. Another study has shown a healthy status of the peri-implant soft tissues, with most patients presenting very low plaque index and bleeding index, which might reflect the low affinity with plaque and reduced inflammatory infiltrate [29]. In the present case, peri-implant soft tissues also remained healthy and with great esthetic outcomes within the observation period.

In the present case, digital workflow was applied which provides important information regarding adequate position and contouring of crowns and ceramic veneers. CAD-CAM manufacturing enables the use of monolithic zirconia restorations, which have shown good clinical performance with a low rate of complications reported. Moreover, they seemed to be a well-accepted option and present aesthetically satisfactory outcomes for dentists and patients [30,31]. Additionally, the monolithic crowns used in this case were fabricated as hybrid cement-screw-retained, since they were cemented extra orally on the Zirconia bases, preventing the issue of cement extrusion that could lead to biological complications [30]. Regarding the ceramic veneers, lithium disilicate was the chosen material for this case, which has been reported to present greater fracture toughness and biaxial strength when compared to other materials, besides its similarity to the enamel. Therefore, they are indicated in cases of teeth discoloration and teeth with extensive restorations with great survival rates [32].

It has been shown that Oral Health-Related Quality of Life is negatively affected in patients with anterior missing teeth, and therefore, its rehabilitation is critical for physical and mental health [33]. Moreover, any small defect in the esthetic zone is projected in the patient´s smile, becoming an issue in daily life. In the present case, the patient reported having had trouble regarding her mouth and teeth resulting in a high OHIP-14 score that reveals a great impact on her quality of life, as discussed before [34]. However, after the rehabilitation with immediately loaded zirconia implants and ceramic veneers, the patient reported to be completely satisfied and the OHIP-14 score was decreased to zero. Patient satisfaction has also been reported by other authors related to single tooth restorations in the esthetic zone34 and zirconia implants submitted to immediate loading [35].

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Accordingly, the present clinical case corroborates with the literature. It is worth highlighting, within this context, the importance of aesthetic and functional rehabilitation, carried out in the premaxilla region, with ceramic veneers and crowns, which, in addition to contributing to the patient's psychological and emotional well-being, returned occlusal stability, through canine guidance and adequate protrusion of the anterior teeth, indispensable factors for the success of the rehabilitation.

CONCLUSION

The two-piece injection molded zirconia implant showed clinical and radiographic success over 24 months, through implant stability, absence of signs of peri-implantitis, complete osseointegration of the implant, good maintenance of marginal bone level (<2 mm in the first year) and excellent soft tissue aesthetics, without any prosthetic complications. The aesthetic and functional rehabilitation, carried out in the patient´s anterior region of the maxilla, with ceramic veneers and crowns contributed to the patient's psychological and emotional well-being, in addition to restoring occlusal stability, through canine guidance and adequate protrusion of the anterior teeth. Despite the satisfactory results, more clinical studies are needed to confirm these outcomes in the long-term and with a representative sample size.

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