CASE REPORT

Prosthetic oral rehabilitation using zirconia in the infrastructure of metal-free crowns: case report

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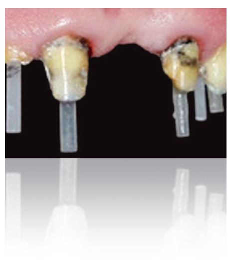
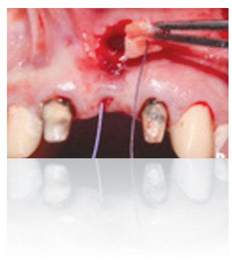
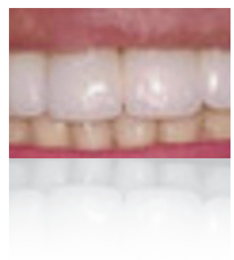

https://doi.org/10.14436/2447-911x.17.2.078-096.oar
Submitted: September 11, 2018
Revised and accepted: August 23, 2019

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How to cite: Araújo DM, Litaiff GS, Borges ZML, Linhares ML, Camargo EB, Vieira HAO, Consolaro A. Prosthetic oral rehabilitation using zirconia in the infrastructure of metal-free crowns: case report. J Clin Dent Res. 2020 May-Aug;17(2):78-96.

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The authors report no commercial, proprietary or financial interest in the products or companies described in this article.

Patients displayed in this article previously approved the use of their facial and intraoral photographs.

ABSTRACT

Fixed partial dentures represent an alternative for oral rehabilitation, combining aesthetics and function. The need for better mechanical properties of ceramic materials led to the introduction of zirconia in Dentistry. The objective of this study was to present a clinical case of oral rehabilitation with single and multiple anterior and posterior fixed prostheses, demonstrating the applicability of zirconia as an aesthetic, functional and resistant material for infrastructure and metal-free crowns.

Keywords:

Mouth Rehabilitation. Ceramics. Esthetics, Dental.

INTRODUCTION

Prosthetic oral rehabilitation represents a solution not only for tooth loss treatment, but also for the anatomophysiological and functional restoration of orofacial structures, such as chewing, aesthetics and phonetics, ensuring a balance in the stomatognathic system.[1,2,3]

The evolution of knowledge through scientific research has facilitated the diagnosis and promoted the development of techniques, restorative materials and technologies that generate new perspectives for dental treatments in order to enable the achievement of complete and satisfactory clinical results.[4] Thus, the use of ceramics emerged as an excellent alternative due to its favorable properties such as color stability, resistance to compression, thermal conductivity, biocompatibility, biomimicry, radiopacity, marginal integrity, and thermal expansion coefficient similar to the dental structure.[5,6,7]

Despite the success obtained in the use of metal-ceramic crowns, the search for restorations that, beyond strength and longevity, presented a pattern that is aesthetically compatible with a healthy natural tooth, culminated in the emergence of metal-free restorations. Alongside its greater translucency,[8] these restorations have no metallic substructure and margin, which eliminates the unsightly shading of the cervical end.[9]

Many ceramic systems were developed in an attempt to increase the resistance of this material, receiving in its composition the addition of several crystals such as alumina, leucite, lithium disilicate or zirconia.[10,11] The emergence of yttrium-stabilized zirconia (Y-TZP) enshrined a new generation of dental ceramics with greater versatility of use, due to its mechanical, physical and aesthetic properties, in addition to its greater ability to resist crack propagation[7,12,13]. This material, among the various indications in restorative dentistry, has applicability in implant-supported rehabilitation, where it is used in the structure of personalized abutments for implantation and fixed prostheses of one or several units in anterior and posterior teeth, commonly associated with the CAD/CAM system.[6,14,15]

The purpose of this clinical case report was to present an oral rehabilitation with single and multiple fixed prostheses, in order to demonstrate the applicability of zirconia as an infrastructure material for metal-free anterior and posterior full crowns.

CASE REPORT

A 46-year-old female patient was attended at the dental clinic of Amazonas Faculty (Faculdade do Amazonas-IAES, in Portuguese). During the anamnesis, the patient reported pain in elements 16 and 13, difficulty in chewing and dissatisfaction with the aesthetics of the upper teeth. She reported having started prosthetic treatment 1 year ago, that has not yet been concluded. Her medical history did not contain clinically relevant information that would disfavor the continuation of the proposed dental treatment.

In the clinical examination, the absence of dental elements 15, 14, 21, 25, 26 and 27 was observed. There was also the presence of poorly adapted temporary crowns on the abutment elements 11, 12, 13, 16 and 22 and the pontic elements 14, 15 and 21, causing inflammation and gingival bleeding. Element 23 presented temporary filling material and elements 24 and 17 had unsatisfactory amalgam restorations. In the lower arch, were observed the absence of teeth 36, 46 and 47 and unsatisfactory amalgam restorations in elements 34, 35, 37, 44 and 45 (Figs. 1 and 2).

Figure 1: Initial appearance. A) Right side view. B) Front view. C) Left side view.

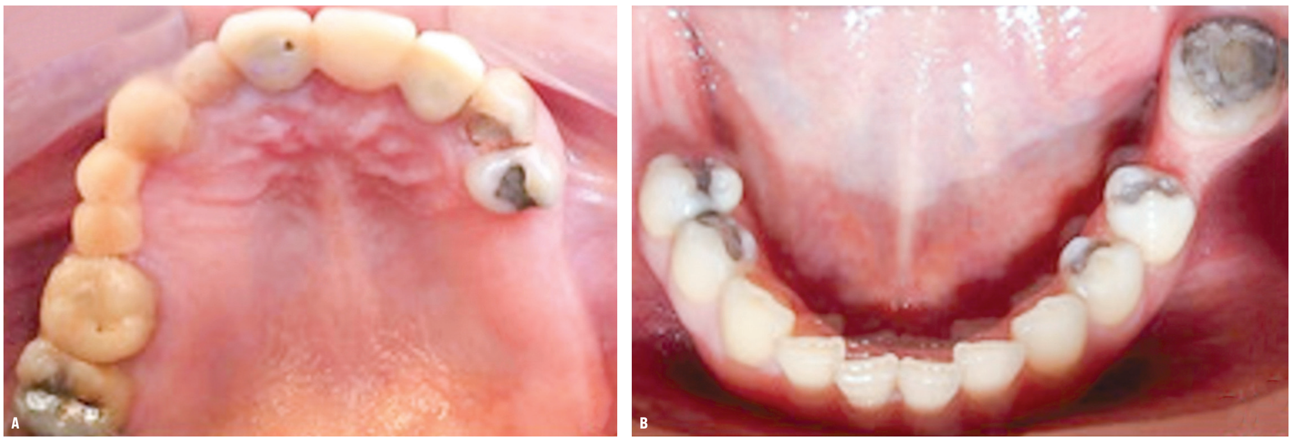


Figure 2: Initial appearance. A) Upper occlusal view. B) Lower occlusal view.

In the radiographic examination, a periapical lesion was observed in element 16, unsatisfactory endodontic treatments in elements 12 and 23, and the presence of tooth 28 included. Elements 11 and 22 had satisfactory endodontic treatment (Fig. 3).

Molding was performed to obtain the upper and lower study models, followed by the making of the facial arch record and interocclusal record, with an increase in the vertical dimension of occlusion (VDO) using the Leaf Gauge device (Fig. 4).

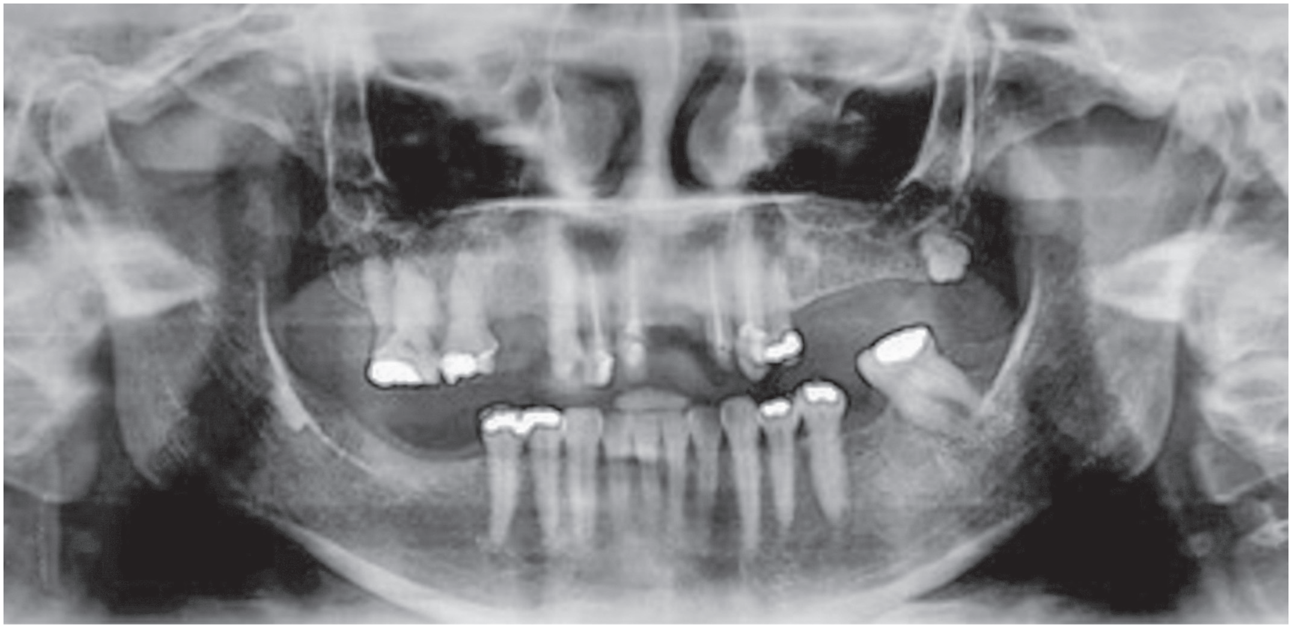


Figure 3: Initial panoramic radiograph.

Figure 4: Increased VDO.

The treatment plan was carried out based on clinical, radiographic analysis and study models mounted on a semi-adjustable articulator (4000S, Bio-Art, Brazil).

Initially, subgingival and supragingival scraping, smoothing and polishing were performed on all teeth, followed by endodontic retreatment of elements 12 and 23, and endodontic treatment for prosthetic purposes of elements 16, 13 and 24. Occlusal-distal Class II restoration was made with composite resin on element 17 in colors A2B and A2E (Z350XT, 3M / ESPE, USA). Then, the extraction of element 37 was executed, because it presented marked mesialization and active extrusion, which compromises the prosthetic installation.

After diagnostic wax-up (Fig. 5), provisional acrylic resin crowns were made in the laboratory (Fig. 6).

Figure 5: Diagnostic wax-up. **A**) Frontal aspect. **B**) Occlusal appearance.

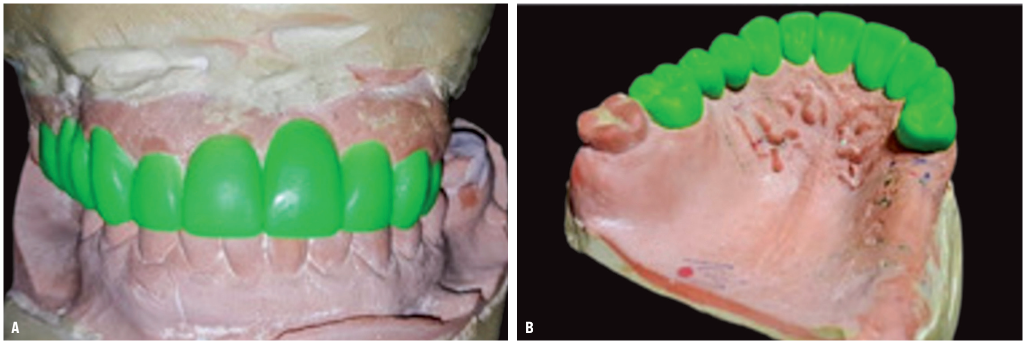
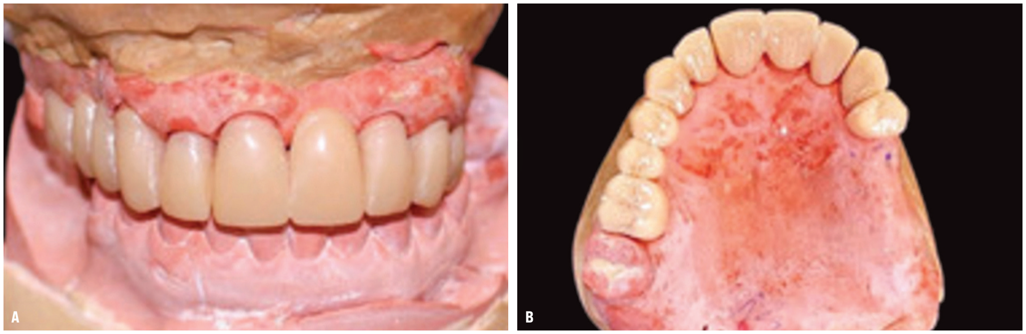


Figure 6: Temporary crowns. **A**) Frontal aspect. **B**) Occlusal appearance.



Total crown type preparations were performed on elements 23 and 24, and the remaining 11, 12, 13, 16 and 22 were refined using diamond tips (4138, 4138FF and 3118, KG Sorensen, Brazil). Temporary crowns were installed by relining, using self-curing acrylic resin in color 62 (DuraLay, Reliance, USA) and cementation with calcium hydroxide composition (Dycal, Dentsply, Brazil) (Fig. 7). Then, the patient was referred to surgery for the installation of osseointegrated implants of the morse cone platform (Blackfix, TitaniumFix, Brazil) of elements 25 and 26.

After the patient's return, the root canal desobturation of element 16 was performed, followed by indirect molding using addition silicone (ExpressXT, 3M / ESPE, USA) (Fig. 8) and a bipartite fused metallic core was made in the laboratory.

Figure 7: Aspect of the smile after installing the provisional crowns.

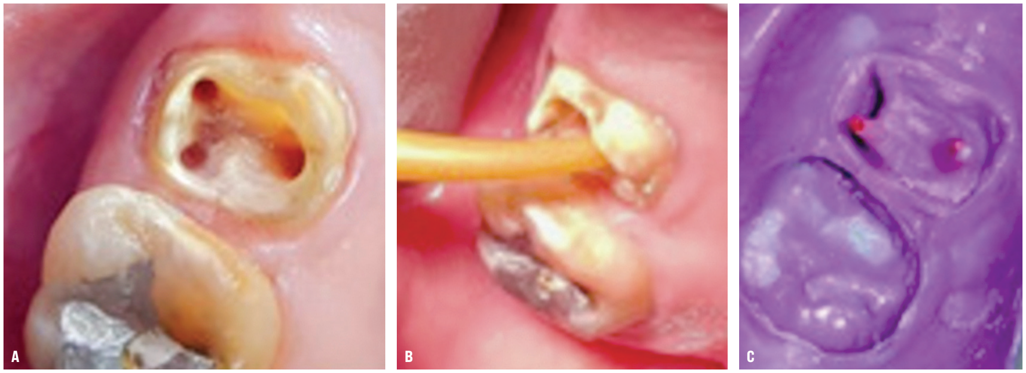


Figure 8: Molding for manufacturing the core (tooth 16). **A**) Desobturation of the root canals. **B**) Insertion of light addition silicone. **C**) Mold of the root canals.

The adaptation of the nucleus was verified by means of a periapical radiography (Fig. 9) followed by cementation with glass ionomer (Meron, Voco, Germany) (Fig. 10).

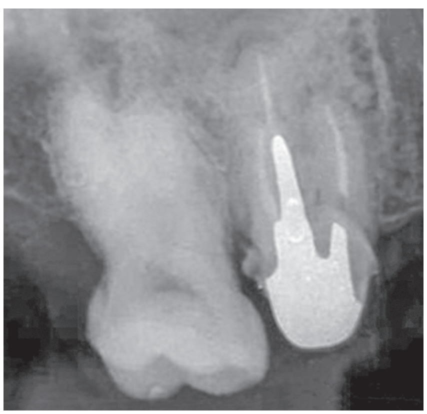


Figure 9: Adaptation of the bipartite metallic core (tooth 16).

Figure 10: Cementation of the bipartite metallic core (tooth 16). **A**) Palatal portion. **B**) Complete core.

Fiberglass pins were selected for teeth 11, 13, 22, 23 and 24 and the adaptation was carried out according to the manufacturer's instructions (Whitepost DC, FGM, Brazil). For element 12, a fiberglass pin was modeled with composite resin in color A2 (Z350XT, 3M / ESPE, USA), due to the little remaining root structure (Fig. 11).

Pins were individually cemented with A2 self-adhesive dual resin cement (RelyX U200, 3M, USA). Then, the coronary part of the filling cores was made with composite resin in color A2 (Z350XT, 3M / ESPE, USA) and the preparations for the crowns were completed (Fig. 12). The temporary crowns were relined with self-curing acrylic resin (DuraLay, Reliance, USA) and installed. Adequate adaptation of the pins was verified after cementation, using periapical radiographs (Fig. 13).

Figure 11: Adaptation of fiberglass pins. **A**) Front view. **B**) Occlusal view.

Figure 12: Cores and preparation finalized. **A**) Front view. **B**) Occlusal view.

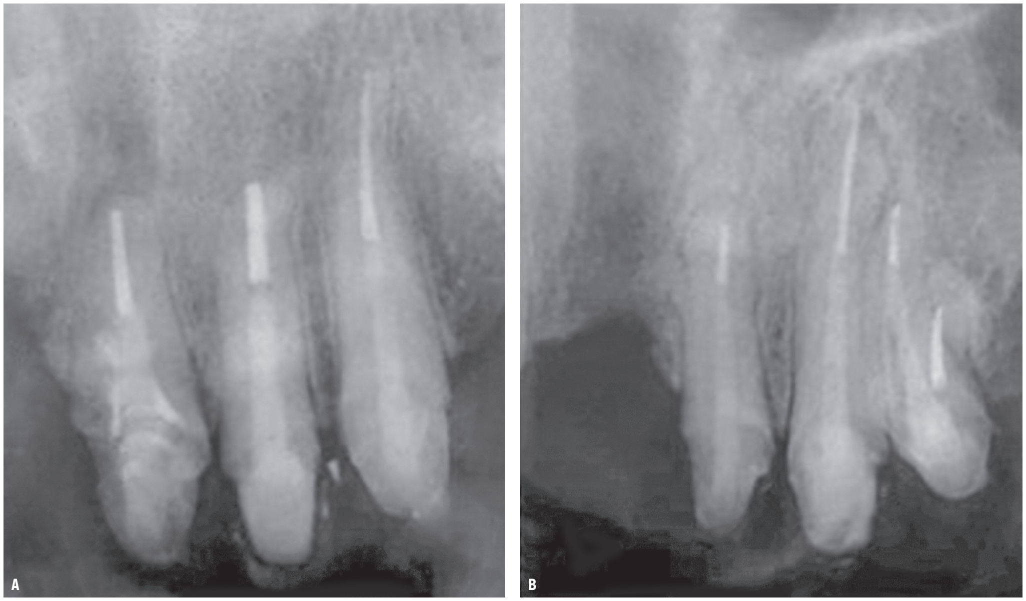


Figure 13: Checking the pins adaptation. **A**) Elements 13-11. **B**) Elements 22-24.

The analysis of the smile and the emergence profile was performed, where the need for an increase in volume and thickness of the keratinized gingiva in the region of the edge of the element 21 was observed (Fig. 14). Then, periodontal surgery was performed to subepithelial connective tissue graft from the palatal region using the "trap-door" technique. The graft was positioned and sutured in the vestibular flap, using absorbable suture thread n° 4-0 (Vicryl, Ethicon /Johnson & Johnson, Brazil) (Fig. 15).

Figure 14: Volumetric defect in the region of element 21.

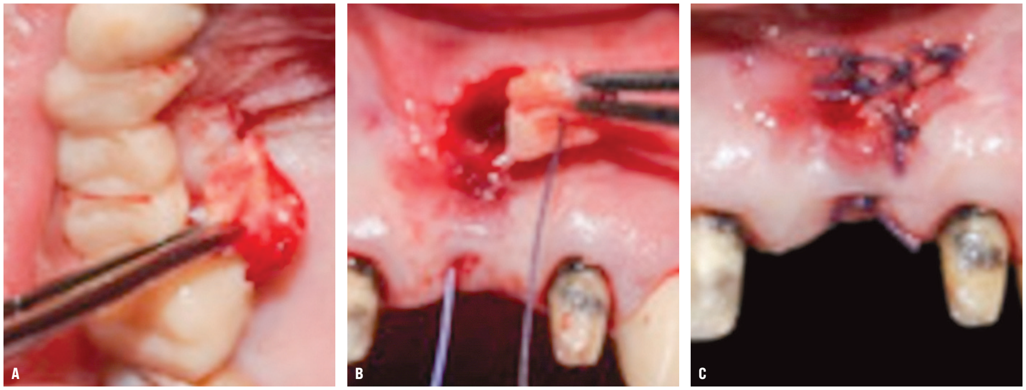


Figure 15: Subepithelial connective tissue graft surgery. A) Removal of connective tissue from the donor area. B) Insertion of the graft in the recipient area. C) Final suture.

Four months after the surgery to install the osseointegrated implants, an adequate gingival profile was established in the region, through the installation of contour healers (Fig. 16 A and B), which were removed after 10 days (Fig. 16 C). Sequentially, the work impression was carried out in two steps with addition silicone (ExpressXT, 3M / ESPE, USA), installation of the implant analogues and manufacture of artificial gingiva (Fig. 17).

Figure 16: Gingival profile in the region of osseointegrated implants. A) Surgical access. B) Healed devices installed. C) Gingival profile after 10 days.

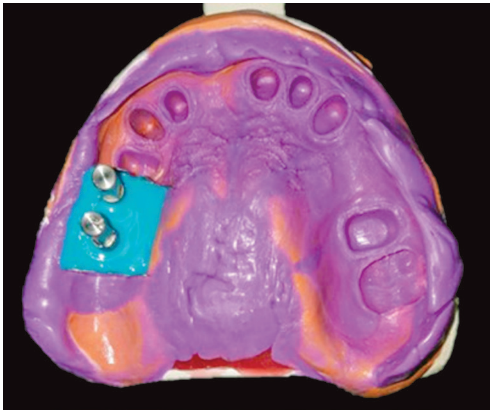


Figure 17: Working mold after making artificial gingiva.

The working models were mounted on a semi-adjustable articulator (A7 Plus, Bio-Art, Brazil), and sent to the laboratory for the manufacture of ceramic copings in yttrium-stabilized zirconia (Ice Zirkon Translucent, Zirkonzahn, Italy), by the CAD/CAM system (M5 Heavy Metal Milling Unit, Zirkonzahn, Italy) (Fig. 18).

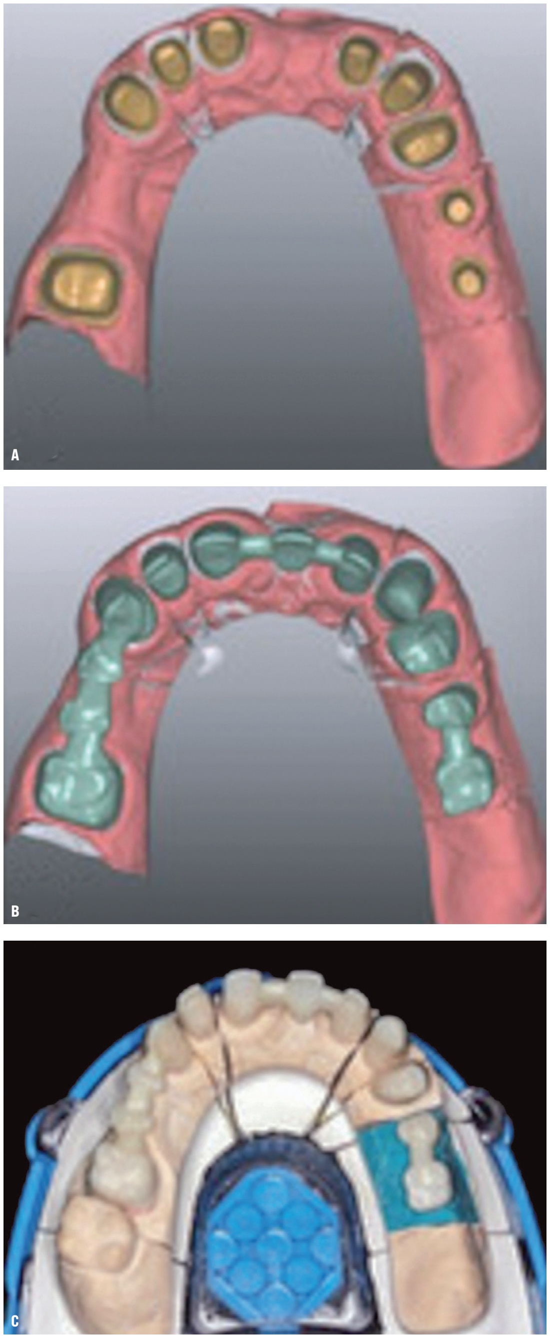


Figure 18: Confection of zirconia copings. A) Scanning the preparations. B) Infrastructure planning. C) Copings made.

The covering ceramics were applied using the stratification technique, for which the glass ceramic ICE Zirconia Ceramic and pigmentation with ICE Zirkon Stains (both Zirkonzahn, Italy) were used, in colors A2 for the cervical third and A1 for the middle and incisal thirds.

The ceramic restorations test was carried out, followed by cementation with self-adhesive dual resin cement in color A2 (RelyX U200, 3M, USA) (Fig. 19).

Concomitantly with the performance of the procedures in the upper arch, in addition to tooth extraction 37 already mentioned, a whitening treatment based on hydrogen peroxide 35% (Whitness HP Blue, FGM, Brazil) was performed in the lower arch. The amalgam restorations were replaced by composite resin (Z350XT, 3M / ESPE, USA) and a removable partial denture Class I according to Kennedy's classification was made (Fig. 20). The case was concluded by restoring aesthetics and function to the patient (Figure 21 B and D).

Figure 19: Cemented crowns. A) Front view. B) Occlusal view.

Figure 20: Rehabilitation of the lower arch.

Figure 21: Comparison of the initial and final appearance. **A**) Initial appearance without lip positioning. **B**) Final aspect without lip positioning. **C**) Initial aspect of the smile. **D**) Final aspect of the smile.

DISCUSSION

Restorative dentistry aims to restore oral function, maintain health and provide quality of life and self-esteem to the patient, by reestablishment of lost dental structure.[16] The first attempts to reconstitute the shape and function of the tooth with the use of metal-free prostheses, showed high rates of failure. The use of zirconia in prosthetic systems has expanded its indication both in the anterior and posterior regions of the oral cavity.[6]

Zirconia is a material with excellent mechanical properties when compared to other ceramics. However, factors such as accelerated aging and degradation at low temperatures, especially in the presence of water, can lead to an increase in surface roughness and the generation of microcracks, causing a decrease in their mechanical properties.[17,18] To avoid these problems, the system chosen for performing the prosthetic treatment presented is composed of yttrium-stabilized zirconia (Y-TZP), due to its high mechanical resistance, satisfactory aesthetics, tissue compatibility, indication for fixed partial denture of several elements[18,19] and durability.[20] Fixed prostheses of 4 and 3 elements were performed in the anterior and posterior region of the maxilla, 3 unitary crowns, in addition to implant-supported fixed prosthesis, thus avoiding possible material's fatigue.

In order to obtain a successful oral rehabilitation and a favorable prognosis, it is necessary to carry out an adequate prior planning, with the preparation of the diagnostic wax-up on study models mounted on an articulator. This makes it possible to restructure the static and dynamic relationship of teeth, as well as the vertical dimension of occlusion (VDO), in addition to assisting in the design of dental prostheses.[21] As a complement, the importance of making provisional prostheses is highlighted, as a way to assess the patient's response to the restoration of VDO, prior to the completion of prosthetic treatment.[22]

Rehabilitation treatment does not always involve preserving pulp vitality. In some clinical situations, endodontic treatment is necessary prior to making ceramic crowns[23] and the strengthening of endodontically treated teeth can be performed in different ways. The use of a fiberglass pin has advantages over metallic cores, such as: excellent mechanical and aesthetic properties, exemption from laboratory step, favoring adhesive cementation by light transmission, possibility of adjustment to adapt to the root canal, easy handling, good cost/benefit ratio, resistance to displacement and, consequently, to tooth fracture.[24]

A correct dental preparation's protocol performance, adequate support thickness for cores or pins and the correct prosthetic's part occlusal adjustment contribute to the high clinical success of metal-free crowns.[25] Zirconia, as an excellent alternative for prosthetic reconstruction due to its biological, functional and aesthetic aspects, is combined with modern material processing systems.[26,27] Currently, considering the advent of technology and the improvement of science and engineering from computation applied to dentistry, the use of the computer-aided design/computer-aided manufacturing (CAD/CAM) system leads to a reduction in the time needed for making the pieces, high flexural strength values and eliminating the need for molding, offering a restorative work reliable, predictable, economical, with less possibility of failures during manufacturing and clinical application, provided that the choice of material used is appropriate for each indication.[28] Comparisons between traditional manufacturing techniques and digital systems demonstrate that the digital ones are dimensionally stable, have better quality and good performance whereas conventional types can suffer variations capable of interfering in the procedure's final result.[29,30,31]

The cementation process of prosthetic crowns is a factor capable of significantly interfering in the results of rehabilitation with metal-free ceramic. Some characteristics of conventional cementing materials, such as zinc phosphate or modified ionomeric cement, lead to unsuccessful procedures due to aesthetic failures, displacement of the prosthetic part and marginal infiltration.[32] Adhesive cementation ensures greater retention, marginal adaptation and a low degree of solubility, offering greater resistance to fracture.[26,33] Self-adhesive resin cements emerged in order to overcome the limitations of conventional and resin cements, making it an interesting alternative for cementing zirconia-based metal-free crowns.[32] They have in their composition phosphate monomers, such as 10-methacryloyloxydecyl dihydrogen phosphate (10-MDP) which is a bifunctional organic molecule. One end of this molecule joins the metal oxides of ceramics (zirconia) and the other has groups that copolymerize with the resinous matrix of cements, such as silanes and primers, creating a type of chemical bond or adhesion.[34,35]

Despite their excellent properties, fixed prostheses in zirconia can suffer clinical complications such as secondary caries lesions, loss of dental vitality, fracture of the pillar element, development of periodontal disease and, more often, flakes of the ceramic coating.[18,36,37] Therefore, it is essential that the professional knows about the types, indications, advantages and disadvantages of each ceramic system, so that he can offer an adequate rehabilitation treatment for the patient.

Zirconia-based ceramic systems have high rates of longevity among metal-free systems used in fixed partial dentures.[38] Although there is still a need for further studies to determine the efficiency of long-term rehabilitation, it is observed that posterior fixed prostheses with zirconia infrastructure have offered results similar to those obtained by metal-ceramic prostheses, exhibiting excellent survival after 5 years[36] or up to 10 years after its realization.[39]

CONCLUSION

Zirconia is an indicated material for use in metal-free fixed partial in anterior and posterior oral regions, considering its biological, functional and aesthetic aspects. The reported case was initially satisfactory, requiring regular follow-up to assess long-term clinical success.

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