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RESTORATION OF ENDODONTICALLY TREATED ANTAGONIST MOLARS USING FULLY DIGITAL WORKFLOW WITH INTRAORAL SCANNER INTEGRATED INTO THE CAD/CAM SYSTEM. CLINICAL CASE REPORT

Emilli Lima Neves*[1], Eduardo Mukai[2], Gustavo Moreira de Almeida[3] and Jenival Correa de Almeida Júnior[4]

[1]Graduate student, Graduate Dentristy, Unime Itabuna, Bahia; [2]Coordinator of São Leopoldo Mandic, Doctoral Student in Science of Dentistry, University of São Paulo, Mukai DigitaL, São Paulo, Brazil; [3]Professor of the Specialization Course in Endodontics, Faipe, Cuiabá, Brazil; [4]Professor at the Institute of Higher Education, Faipe, Center for Advanced Dentistry, Doctoral Student at Universidade São Lepoldo Mandic, São Paulo, Brazil;

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****Corresponding author:***
Emilli Lima Neves

ABSTRACT

Coronal rehabilitation of endodontically treated posterior teeth is always a challenge for dental surgeons. Based on the minimally invasive principles of adhesive dentistry, endocrown restorations are gaining in popularity. The current clinical case is of a female patient, 65 years old, with antagonist second molars endodontically treated and old restorations showing undesirable esthetics and breakage due to malocclusion of the prostheses. With reduced interdental spaces, lithium disilicate ceramic endocrops (IPS e.max CADin a fully digital system consisting of an Omnicam intraoral scanner and CAD/CAM Cerec was the indicated restorative treatment. The specific protocol with minimal changes to perform endocrowns was followed, which promoted an excellent marginal fit and occlusal contact without the need for adjustments. Due to the superior aesthetics and the performance of the treatment in a single session, the treatment was considered excellent by the patient. After 1 year, the clinical evaluation based on the modified FDI classification showed that the aesthetic, functional and biological properties were excellent. In this clinical case, endocrown was an effective and satisfactory treatment in the rehabilitation of the masticatory and aesthetic function of non-vital posterior teeth that required good occlusion and long-term stability.

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INTRODUCTION

The aesthetic, functional and lasting rehabilitation of posterior teeth with extensive coronary destruction treated endodontically is one of the great challenges of cosmetic dentistry. The mechanical properties of these teeth are significantly different compared to vital teeth, which affects the long-term prognosis of the tooth (1, 2). Conventional treatments for the rehabilitation of endodontically treated posterior teeth, the use of intraradicular retainers (cast metallic cores or prefabricated fiberglass posts) is recommended, in order to promote the retention and stability of the coronary restorative material (1, 3). Although they present satisfactory results, the use of intra-articular retainers can lead to root perforation and thinning of the root canal walls, in addition to the removal of the last remnants of coronary tissue around the endodontic approach, causing a weakening of the dental element (4). With the advancement of adhesive technology comes the Endocrown system with the proposal of restoring endodontic teeth with great coronary loss without the use of intraradicular retainers (5) Endocrown is a monobloc restoration, where crown and core are a single piece, using the extension of the pulp chamber for macromechanical retention and adhesive cementation for micromechanical retention (5). In addition, endocrown is a solution for teeth that present a short clinical crown or atresic, calcified, curved and short canals where it is impossible to use an intraradicular pin (5-7). With the popularization of the fully digital workflow in dental clinics associated with the development/ improvement of digital intraoral scanners and computer-aided design/manufacturing (CAD/CAM) systems, the printing of endodontic crowns has replaced conventional laboratory-processed restorations (8-14). Compared to conventional full crown preparation, the use of the CAD/CAM system minimizes the clinical adjustment procedures and the incorporation of defects resulting from the preparation, in addition to allowing the treatment to be carried out in a single session (15, 16). Various materials with different compositions and physical properties can be used with this technology including, nanoceramic composite resin, lithium disilicate glass ceramic, zirconia reinforced lithium silicate, hybrid ceramic and feldspathic ceramic (17), with the dentist choosing the material most suitable for each clinical situation. It is noteworthy that the preparation protocol, parameter setting and cement type influence the final adjustment of endocrown restorations as well as their survival (17, 18). The aim of this clinical case report was to address the fully digital workflow during esthetic and functional rehabilitation of endodontically treated antagonist molars with extensive coronal destruction through endocrown restoration; highlighting its indication and use throughout the process, as well as the patient's reaction to the treatment.

CLINICAL REPORT

Female patient, 67 years old, attended the dental office for the functional and aesthetic recovery of posterior teeth 17 and 48. During the anamnesis, the patient did not report having any deleterious habits and any systemic impairment. She complained about the appearance of her teeth and the difficulty of keeping conventional dentures "whole" due to their malocclusion. The teeth were subjected to multiple root canal treatments that resulted in extensive loss of coronary tissue. The intraoral examination revealed that teeth 17 and 48 had extensive restorations with a clinical crown height of approximately 5 mm, and with limited interocclusal space. The periapical radiographic image (Figs. 2b1 and 1b2) showed filling material with satisfactory filling, normal periodontal bone structure and no presence of furcal lesion and restoration margins above the gingiva. After anamnesis, clinical examination, radiography and initial photographs, the patient was proposed to fabricate indirect adhesive restorations, endocrown in ceramic reinforced with lithium disilicate (IPS e.max® CAD, Ivoclar Vivadent AG) using the CAD/CAM CerecTM system (Dentsply Sirona), in order to allow a treatment with greater occlusal harmony and longevity of the restorations.

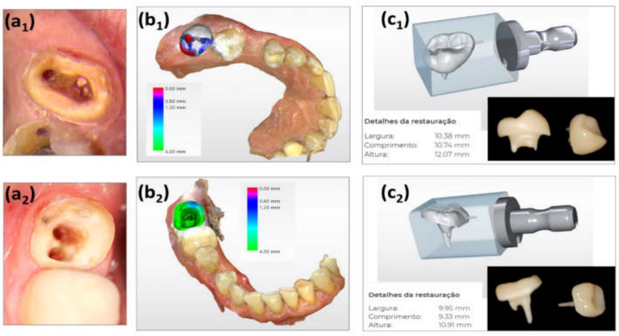

Figure 1. Initial aspect of the second molars of the maxilla (a1) and mandible (a2) right. Note the loss of most of the coronary structures exposing the root pulp canal. After intra-oral scanning, the digital images (b1 and b2) show the space available to accommodate the ceramic material and proof of the available thickness. In c1 and c2 we can see the positioning of the restorations on the block, the dimensions of the designed restoration and the milled and polished restorations using the CAD/CAM CerecTM system.

Therefore, the patient signed an Informed Consent Form authorizing the procedures to be performed. The procedures were performed in a single 2-hour session. The type of preparation was for class III endocrown (Belleflamme et al., 2017), where the occlusal box and conduit entrance are used. The cavity preparation of molars 17 (Fig. 1a1) and 48 (Fig. 1a2) was carried out with the FG INVICTA® diamond-tipped bur (American Burrs, Santa Catarina, Brazil) cylindrical-conical 2135 and frusto-conical 4138 for rounding of the axial walls followed by polishing using multilaminated drills from Komet Multilaminated Carbide Drill - H375R (Komet do Brasil Ltda, São Paulo, Brazil) and refinement with CvdentusTM piezoelectric ultrasound, model Dentsurg Pro (São Paulo, Brazil). The cutouts of the pulp walls and the pulp base were rounded and polished and used for mechanical retention of the prosthesis. The objective was to perform the entire workflow digitally, from design to milling of endocrowns using the integrated CAD/CAM system (Dentsply Sirona). Thus, the maxillary arch (Fig. $1b_1$) and mandibular arch (Fig. $1b_2$) were digitized using the Omnicam intraoral scanner (Dentsply Sirona) and transferred to the CEREC 5.1.3 software (Dentsply Sirona) where the prototypes of the crowns were designed/drawn (Figs. $1c_1$ e $1c_2$, respectivamente) and the manufacturing processes programmed for machining. From lithium disilicate blocks (IPS e.max; Ivoclar Vivadent) crowns were fabricated (Figs. $1c_1$ e $1c_2$, respectivamente) in the Sirona MC-XL milling unit (Dentsply Sirona).

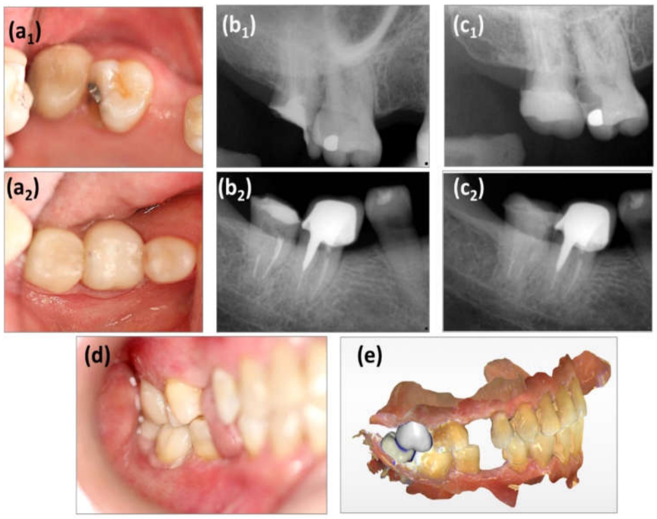

Figure 2. Occlusal view of the second molars of the maxilla (a1) and mandible (a2) after cementation and polishing of the endocrown restorations. Periapical radiographic images before (b1 and b2) and after (C1 and c2) of the endocrown restorations in the upper and lower second molars. In panoramic (d) and digital (e) views, we can see good dental occlusion of the restored antagonist molars

After crystallization, the crowns were glazed (Talmax™, Paraná, Brazil) and conditioned with 10% fluoric acid (Condac Porcelana FGM Dental group, Santa Catarina, Brazil) for 20 seconds, in order to increase their adhesion during the restoration processes. After rinsing in water with a neutralizing agent, 37% phosphoric acid was applied for 1 minute to clean the gross amount of particles present on the surface. Then, the crowns were silanized (Monobond Plus, Ivoclar Vivadent, Schaan, Liechtenstein) for 1 minute and subsequently after solvent evaporation the 3M™ Single Bond Universal adhesive (Scotchbond 3M, Minnesota, USA) was applied and light-polymerized for 30sec in each side. Allcem Core resin cement (FGM Dental Group) was applied to the inner portion of the endocrowns and then positioned on the tooth. Excesses were removed and each surface was light cured for 20s. After cementation, the contacts were checked and the part was duly polished as can be seen in Figures $2a_1$ e $2a_2$. Post-cementation periapical radiograph (Figs. $2c_1$ e $1c_2$) was taken to verify endocrown settlement on the tooth. The option of rehabilitative treatment of posterior teeth by Endocrown restorations made by the CAD/CAM system was considered satisfactory by both the patient and the professional, as it reached the initial purpose of restoring function and esthetics as can be seen in the panoramic and digital view in the Figures 2d and 2e, respectively. In addition, it avoided performing surgical procedures to recover the interocclusal space, and facilitated the reconstruction of deeply destroyed teeth. A clinical evaluation of the endocrowns at baseline and after 1 year of follow-up was carried out using the criteria and procedures for the modified FDI direct clinical evaluation (19, 20) showed that the Endocrowns restorations had clinically excellent picture regarding the aesthetic properties (comparable brightness to enamel, without staining and with ideal anatomical shape), functional (restoration retained, without fractures or cracks, harmonious interface without cracks or discolorations, without apparent wear and normal contact point) and biological (absence of carious process, gingival contour/ mucosa adjacent to the restorations, as well as other healthy periodontal structures).

DISCUSSION

Maintaining natural teeth improves the quality of life and overall health and longevity of elderly patients (21-23). Currently, restorative dentistry has sought not only to reestablish the function of dental structures, but also the esthetics and well-being of the patient, improving their self-esteem and the pleasure of smiling. In the current case report, the clinical planning and decision-making to restore the 17 and 48 antagonist molars, using the endocrowns technique, were the elements being endodociated, presenting great loss of the coronal tooth structure and extensive resin restorations causing malocclusion and unsatisfactory aesthetics, in addition to the limited interocclusal space, which makes it difficult to isolate and adhere the prosthesis (24). In addition to being less invasive, restorations with endocrowns occurred in a single 2-hour session using a fully digital system, which pleased the patient. In this session, the removal of old and poorly adapted restorations, preparation of the pulp chambers in an expulsive manner, obtaining 3D images using an intraoral scanner, design and milling of the adhesive crowns by the CAD/CAM system, post-milling treatment and cementation of the prosthesis. Comparatively, in the clinical study by Park et. al. (2020) the working time to manufacture lithium disilicate crowns, digitizing, drawing and milling and post-milling was on average 51min not exceeding 60min. The time with instrumentation, adjustment and cementation of the tooth varied depending on the patient's management, clinical situation and the skill of the operator (25).

Regardless of the CAD-CAM system, the overall time for a digital workflow is significantly less than for a conventional workflow and can be done in a single session (26). The success and longevity of endocrowns depend on several factors, such as adequate preparation techniques, operator skill, type of ceramic used and the material and method for adhesion of the prosthesis to the dentin. The restorative material of choice was lithium disilicate glass-ceramic (IPS e.max CAD) which combines high aesthetic properties, flexural strength between 360 MPa to 400Mpa capable of withstanding the loads of molar forces, modulus of elasticity similar to that of dentin, and excellent adhesion properties to dental structures with the use of appropriate adhesive system (27-31). Lithium disilicate ceramics also age better and have less plaque retention than composite resins (32). The endocrowns had intraradicular extensions which, according to a finite element analysis study, better protect the remaining structures than the classic preparation, increasing fracture resistance (33), which is the same reported by Satheesh et al. (34). However, according to Gaintantzopoulou et al. increasing the intraradicular extension of endocrown restorations may increase the marginal and internal gap of restorations (35). In the current case, the clinical evaluation of the endocrowns produced by the CAD/CAM system (Dentsply Sirona) after 1 year of follow-up showed an excellent clinical picture in terms of aesthetic, functional and biological properties; as well as patient satisfaction. Comparatively, the randomized clinical trial by El-Ma'aita Ahmad et al (2021) also showed similar survival and patient satisfaction of 100% with endocrowns manufactured with lithium disilicate (IPS e.max) after 2 years (27).

Excellent survival rate (99.0% after 44.7 ± 34.6 months) was also observed in a retrospective study of 99 endocrown restorations in molars and premolars with extensive coronal tissue loss (76 Class 3 endocrowns). and/or with occlusal risk factors such as bruxism and unfavorable occlusal relationships (48 samples). In this study, the majority of endocrowns (84 out of 99) were lithium disilicate (IPS empress 2 or IPS e.max Press) and the patient satisfaction rate was high, with 95% of the restorations being considered good or excellent (36). Based on a recent systematic review a good long-term prognosis of endocrown restorations can be expected. The review included studies between 3 to 19 years of post-restoration follow-up with a degree of success of endocrowns ranging from 72.73% to 99.57%, with the predominant failure mode being the breakage or detachment of the adhesive, which varied in the studies (37). Various surface pretreatment protocols are recommended for bonding ceramic restorations, depending on different chemical compositions. In the current study, the adhesion protocols for glass-ceramics such as lithium disilicate were respected, that is, conditioning with 10% hydrofluoric acid, which removes and exposes the crystalline structure, increasing the surface area for adhesion. The subsequent application of silane allows the resin cement to chemically bond to the ceramic surface, increasing the durability and bond strength of the restorations (38, 39). The importance of respecting the adherence protocol, thus ensuring the sustainability of the restoration, has been highlighted by several studies (40).

Summary: With the proper preparation design, as well as the cementation protocol, the lithium disilicate glass-ceramic endocrown manufactured in a fully digital system, intraoral scanner and CAD/CAM, can be a fast, viable and long-lasting alternative in restoring esthetics and function of endodontically treated antagonist molars.

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