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A Modified Preparation for Empress Endocrown: 10 Year Follow-Up

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Abstract

The endocrown is indicated for the endodontic restoration of severely damaged molars. This mono-lithic ceramic adhesive restoration requires specific preparation techniques to satisfy criteria that are primarily biomechanical in nature: a cervical margin in the form of a butt joint and a preparation of the pulp chamber that does not extend into the root canals. The remaining tooth substance is thus more robust, resulting in increased longevity. This simple and efficient concept is compatible with the philosophy of biointegrated prostheses. This type of reconstruction, which is still uncommon, should be more widely known and used. The case report presented here concerns a moderately damaged molar treated endodontically and restored with an allceramic endocrown fabricated using pressed ceramic.

Subject Areas

Dentistry

Keywords

Endocrown, Bonding, Damaged Molar, Empress 2, Prothesis

1. Introduction

For many practitioners, the use of complete glass ceramic crown restorations for severely damaged and endodontically treated molars remains problematic. Proposed in 1999 by Bindl and Mörmann as an alternative to the full post-and-core supported crown, the “endocrown” is a one-piece ceramic construction, based on concepts developed by Pissis. In 2008, Lander and Dietschi [1] presented a clinical report on endocrowns, and, in 2009, Magne and Knezevic, who were concerned about the choice of reconstruction materials, considered ceramics versus composites for endocrown molar restorations. Several studies suggested extending the

concept to maxillary premolars [1] [2] and maxillary incisors, but these proposals remain controversial.

The main objective is to dispense with metal and achieve an all-ceramic bonded reconstruction that is minimally invasive of root canals, as the use of root canals for anchoring has been cited as an important factor in weakening the tooth. Thus, the preparation for endocrowns is different from that for conventional complete crowns.

The endocrown is described as a monolithic (one-piece) ceramic bonded construction characterized by a supracervical butt joint, retaining maximum enamel to improve adhesion. The endocrown invades the pulpal chamber, but not the root canals. It is milled using computer-aided techniques or by molding ceramic materials under pressure [1].

New generations of ceramics and adhesives may lead to a view of this therapeutic device as an alternative to conventional crown-root anchored restorations. The specific preparation and bonding result in a particularly favorable reconstruction in terms of biomechanics [2].

The aim of this work is to describe, through a case report, the different procedures for the preparation and bonding of ceramic endocrowns.

2. Case Report

A 25-year-old female patient was referred to the department of prosthodontics and occlusodontics, dental consultation and treatment center, University of Casablanca, Morocco.

Radiographic and clinical examinations revealed a good root canal treatment on the first mandibular molar (46) which presented a deep pulp chamber. After removing the provisional restoration, an endocrown restoration was recommended due to the amount of remaining tooth structure and thick-ness of the walls (**Figure 1**).

Figure 1. The molar after removal of the provisional restoration.

The height of the tooth was reduced by 2 mm without touching the healthy marginal ridge.

Extracoronally, a ferrule was prepared and the finish lines were placed supragingivally.

The preparation involved eliminating undercuts in the access cavity. A cylindrical-conical green diamond bur with a total occlusal convergence of 7˚ was used to make the coronal pulp chamber and endodontic access cavity continuous. With the bur orientated along the long axis of the tooth, the preparation was carried out without excessive pressure and without touching the pulpal floor. Re-moving too much tissue from the pulp chamber walls will reduce their thickness and the width strip of enamel. The depth of the cavity should be at least 3 mm [1].

The entrance to the pulpal canal was opened. Gutta percha was removed to a depth not exceeding 2 mm to take advantage of the saddle-like anatomy of the cavity floor. This should be done with a nonabrasive instrument to maintain the integrity of the canal entrance. No drilling of dentin was carried out. The entire cavity and interocclusal space were evaluated. (See **Figure 2** and **Figure 3**)

Figure 2. The pulp chamber was exposed and the occlusal and external surfaces were prepared.

Figure 3. Impression made with silicone in one-step technique.

The endocrown was fabricated with the IPS Empress 2® (**Figure 4**). On receiving the prosthesis, a try-in was done where the marginal integrity of the restoration was checked and a make-up of the ceramic was asked.

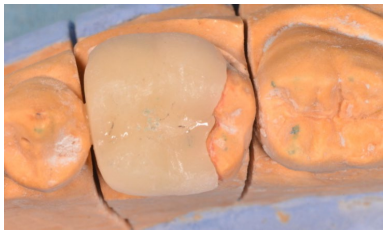

Figure 4. The endocrown on the cast.

Treatment of the endocrown: the internal surface was etched with hydrofluoric acid for 20 s (Figure 5), rinsed with running water and then placed in bicarbonate to neutralize the acidity, and dried with an air syringe. Then the silane was placed on the intrados of the endocrown.

Figure 5. Etching of internal surface with hydrofluoric acid.

The treatment of the dental surfaces consisted of cleaning and disinfection of the tissues. The rubber dam was used to achieve proper isolation (Figure 6). The peripheral enamel was etched with orthophosphoric acid for 30 seconds, rinsed and dried.

Figure 6. Rubber dam used during the bonding process of the endocrown.

Finally, the RelyX Unicem self-adhesive adhesive was placed on the intrados of the endocrown and inserted into the preparation; its excesses were removed. This type of adhesive does not require a pre-adhesive system as it has an intrinsic adhesive potential. After curing all sides, the occlusion was adjusted and a final polishing of the margins was performed.

Radiographic examination revealed proper marginal adaption (Figure 7). The result of the treatment after a 10-year follow-up is shown in Figure 8.

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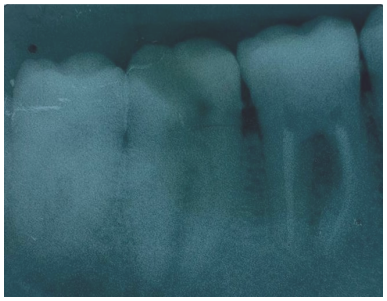

Figure 7. A post-operative radiograph of the endocrown.

Figure 8. 10-year follow-up of the endocrown.

Interventional studies involving animals or humans, and other studies that require ethical approval, must list the authority that provided approval and the corresponding ethical approval code.

3. Discussion

Advances in adhesive techniques as well as the emergence of minimally invasive dentistry are challenging the use of coronal-radicular restorations of teeth with significant loss of substance [3]. Thus, a new therapeutic arsenal based on the principle of adhesion has developed and the endocrown has its place in this system [4]. This technique was described for the first time in 1995 by Patrick Pissis [5], under the name of "monobloc technique", then under the term "endocrown" by Bindl and Mormann in 1999 [6]. It corresponds to an adhesive ceramic reconstruction anchored in the pulp chamber, thus exploiting the micro mechanical retention of the pulp walls.

In clinical studies, molar teeth restored with endocrowns have excellent short-, medium- and long-term survival rates, equivalent to those of teeth treated with traditional crowns without root posts and with minimal deterioration [6]-[8]. In addition, the clinical performance (marginal adaptation, morphology, shade) is satisfying and also comparable to that observed for crown restored molars. The main cause of failure encountered for endocrowns is detachment.

Bindl *et al.* report a premolar survival rate of 68.8% for endocrowns, compared to 97% for conventional crowns at approximately 55 months [7]. In contrast, Belleflamme *et al.* in their clinical study reported a 99% survival rate at appro-

ximately 45 months for endocrowns on molars and premolars [9]. Of the 41 premolars treated, only one had a problem. These results are truly different from the precedents and are very encouraging, but they need to be complemented by other long-term clinical studies in order to indicate this technique in routine clinical practice.

A high depth of the intracameral portion should result in a larger bonding surface and better mechanical retention of the prosthetic element [6]. However, there is no consensus on the ideal depth [10]-[12], but a minimum value of 2 mm seems to be indicated [11].

In the majority of studies, endocrowns were performed on teeth with a butt margin without the use of a cerclage. However, two recent studies seem to show that cerclage increases the fracture resistance of teeth restored with endocrowns [13] [14]. A chamfer cerclage can therefore be considered, but only if the thickness and height of the residual walls allow it and avoid the total disappearance of the peripheral enamel.

A hollow chamfer limit at the peripheral enamel can also be advantageous. It is less disruptive than a conventional chamfer and induces a cut of the enamel prisms perpendicular to their long axis, which increases the bonding surface and potentiates adhesion [15].

Ideally, the preparation margins should be supra-gingival or at least allow isolation of the prepared tooth. In fact, the establishment of an operating field allows for a safe realization of the bonding procedures [16].

Various materials allow the realization of endocrowns. Ceramics have superior esthetic properties [17], durability and less bacterial retention than composite resins [18]. Lithium-disilicate reinforced glass-ceramics have a modulus of elasticity close to that of enamel, as well as good bonding properties, and are therefore the material of choice.

The use of materials with a low elastic modulus (zirconia) often results in irreparable dental fracture rates [19]-[23]. It should also be noted that a low modulus of elasticity decreases the stress at the underlying dentin but increases it at the bonding interface, which may lead to a higher risk of debonding [24] [25].

Finally, since the main cause of failure of endocrowns in clinical studies is debonding, a system without adhesive potential coupled with an adhesive system should be preferred for the assembling, in order to obtain the best adhesion values [26]. Because of the large thickness of the materials to be penetrated during light curing, the use of a dual bonding system provides a secure bond [16].

4. Conclusion

There is no doubt that dentistry has evolved in recent decades, seeking with increasing precision to meet the demands and needs of patients while being as respectful as possible of the healthy tissues already present and the least iatrogenic possible. The endocrown seems to be proving itself and its indication is becoming unavoidable in certain cases of molars with low coronal height or minimal dete-

rioration. It is therefore an alternative of choice in the treatment of devitalized posterior teeth. Progress in bonding research is constantly evolving and the properties of existing materials are improving. Thus, bonding becomes a reliable technique if it is well mastered and allows the practitioner to considerably enlarge his panel of therapeutic possibilities by limiting the systematization to the use of root anchors.

Informed Consent Statement

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patients have given their consent for their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Data Availability Statement

We encourage all authors of articles published in MDPI journals to share their research data. In this section, please provide details regarding where data supporting reported results can be found, including links to publicly archived datasets analyzed or generated during the study. Where no new data were created, or where data is unavailable due to privacy or ethical restrictions, a statement is still required. Suggested Data Availability Statements are available in section "MDPI Research Data Policies" at https://www.mdpi.com/ethics.

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Conflicts of Interest

The authors declare no conflict of interest The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results".

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