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Review Article

CAD-CAM Endocrowns Vs. Crowns

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Received: January 03, 2020; **Published:** January 18, 2020

Abstract

Introduction: Endocrown is a one-piece restoration that takes strength from the pulp chamber of root canal treated tooth. The basic concept behind the endocrown is that it develops a bonded all-ceramic restoration that takes its strength partially from the pulp chamber and is metal-free. For a very grossly decayed tooth, using a post and taking strength from the canals that are already weakened after endodontic treatment leads to decreased strength of the tooth, and hence endocrowns are a good alternative.

Aim of Work: This review article talks about endocrowns and their advantages over the conventional full-coverage crowns.

Methodology: This review is a comprehensive research of PUBMED from 1999 - 2018.

Conclusion: Endocrowns are an easier and conservative alternate for full coverage crowns. Glass ceramic restoration when used with CAD-CAM make a monolithic restoration that has more strength, and because of the butt joint there is better distribution of forces along the joint and the axial walls and hence reduces the force applied on the pulpal floor. The endocrowns are a perfect example of bio integration and are a good alternative to restore grossly decayed posterior teeth.

Keywords: *Endocrowns; Full-Coverage Crowns; Monolithic Preparation; Cervical Sidewalk; CAD-CAM*

Introduction

Full coverage ceramic restorations are not always the perfect restoration for root canal treated molars, and many practitioners tend to avoid it in cases where it's not required [1]. Endocrowns were proposed by Bindl and Mormann and were based on the concept which was developed by Pissis [2,3]. They are basically a one-piece restoration that takes strength from the pulp chamber of root canal treated tooth. The first clinical report on endocrown was submitted by Lander and Dietschi in 2008 [4]. The basic concept behind the endocrown is that it develops a bonded all-ceramic restoration that takes its strength partially from the pulp chamber and is metal-free. For a very grossly decayed tooth, using a post and taking strength from the canals that are already weakened after endodontic treatment leads to decreased strength of the tooth [5-7].

Methodology

We did a systematic search for CAD-CAM Endocrowns vs. Crowns using PubMed search engine (http://www.ncbi.nlm.nih.gov/) and Google Scholar search engine (https://scholar.google.com). All relevant studies were retrieved and discussed. We only included full articles.

The terms used in the search were: Endocrowns, full-coverage crowns, monolithic preparation, cervical sidewalk, CAD-CAM.

Preparation of endocrown vs. conventional crowns

The tooth preparation that is done for Endocrowns is very different compared to that of conventional crowns [8]. Endocrown is basically manufactured as a one-piece restoration that extends in the pulp chamber of the tooth. It strives to preserve the enamel to facilitate good adhesion and has a supracervical butt joint that is present on the occlusal surface of the tooth [9]. Endocrowns have an extension that goes in the pulpal chamber and thus preserves the canal width that is violated during post space preparation. Endocrowns can be made through Computer-Aided Designing or by pressure milling (Figure 1) [10].

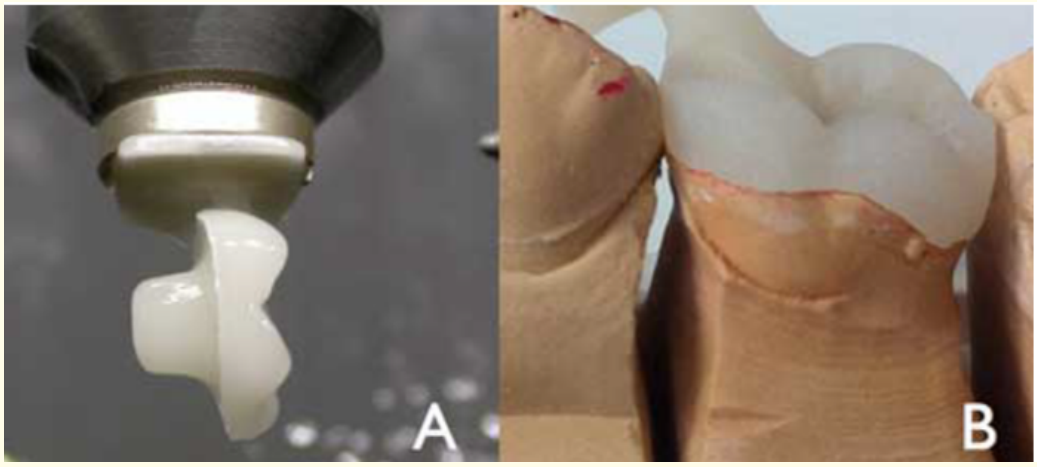

Figure 1: *Two techniques of endocrown preparation. A-using CAD-CAM B- by milling under pressure [10].*

Steps in preparation of endocrown

Before we start with the tooth preparation for Endocrowns, the first thing that needs to be done is to ensure good endodontic treatment [10].

Depth of the pulpal chamber

Sufficient enamel should be present to facilitate good adhesion. The pulp chamber should have sufficient depth for better retention of the endocrown.

Hayes., *et al*. conducted a study where they concluded that the depth of the pulp chamber if more than 2 mm facilitates better retention of the Endocrown, depth less than 2 mm will lead to fracture whereas more than 5mm also causes irreversible root fracture [11]. Another study conducted by Dartora., *et al*. [12] compared the fracture resistance for Endocrowns with depths 5 mm, 3 mm and 1 mm and concluded that more the depth of the endocrown in the pulp chamber, better is the retention produced [12]. The shape of the pulp chamber cavity is generally trapezoid in the lower molars and triangular in upper molars [10].

Occlusal preparation

The occlusal reduction focuses on reducing the height of the tooth overall to give appropriate clearance from the opposite tooth. The minimum reduction that is to be done is around 2 mm and is made in the axial reduction. Tooth surfaces are grooved and are then reduced accordingly. A wheel bur should be used for the reduction, and it has to be held parallel to the tooth's occlusal surface (Figure 2). The aim is to make a flat surface on the tooth, and the extent of the cervical margin is determined. The cervical margin is also called as the cervical sidewalk. The extent of the cervical margin should be supragingival, but if required depending on the amount of tooth structure available or any other esthetic requirement, the cervical margin can also be extended sub gingivally. In areas where the cervical margin has to change, its position should be done within the limit of 60 degrees [10].

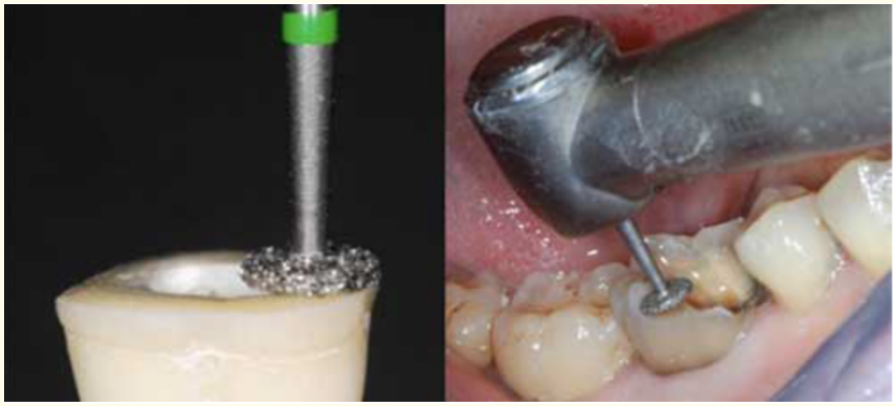

Figure 2: *Using a wheel bur parallel to the occlusal surface of the tooth to create the cervical sidewalk [10].*

Axial preparation

During the axial preparation, the focus has to be on removing the undercuts in the pulp chamber (Figure 3). For this purpose, a conical or a cylindrical bur can be used, and the endodontic access cavity and pulp chamber become continuous. Precaution should be taken so as to not touch the pulpal floor and to not do excessive cutting in the chamber walls that will reduce the thickness of enamel. Once the axial preparation is done, it is very important to finish the walls of the preparation so that there are no rough surfaces since an impression must be made and they will impair the same. A red or yellow band bur can be used to smoothen the walls of the preparation [10].

Figure 3: *Axial preparation of the tooth using a conical diamond bur [10].*

After the tooth preparation is done, the impression is made for the same in elastomeric materials like polyvinyl siloxane. For CAD-CAM crowns these impressions are then digitized according to the database of the machine using the bio generic option (Figure 4). A lithium disilicate block is milled in the machine to make the Endocrown. The fit of the Endocrown is then checked in the patient's mouth, and all the high points and marginal discrepancies are removed. The fit is rechecked until the most appropriate bite is seen (Figure 5). Once the correct fit is obtained, the crown is sintered, glazing is done, and any pigments, if needed, are added [13].

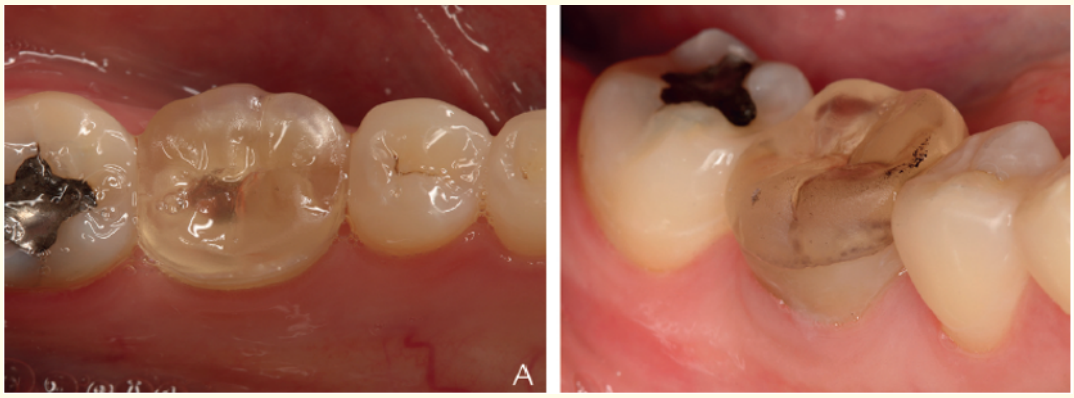

Figure 4: *Milled lithium disilicate endocrown being fitted in the patient's mouth to check the occlusal clearance and marginal discrepancies [13].*

Figure 5: *Prepared endocrown ready for cementation [10].*

Cementation of the endocrown

Cementation of the Endocrown is similar to that of any ceramic crown and requires complete isolation. The internal surface of the restoration must be etched with 5% hydrofluoric acid for 20 seconds and rinsed. The restoration then must be dried for 20 seconds, and a silane coupling agent has to be applied to it. The adhesive cement is mixed and applied on the Endocrown which is then seated on the prepared tooth. Any excess cement is then removed from all the surfaces, and the cement is cured (Figure 6) [13].

Figure 6: *Cementation of endocrown [13].*

Discussion

Lithium disilicate endocrowns have been used for a long time now. Otto., *et al.* compared the outcome of Endocrowns through a span of 12 years in 55 patients and concluded that endocrowns had a high success rate (Table 1). The Endocrowns were made with Cerec III and Vita Mark II in a CAD-CAM System [14].

Tooth	Success rate
Molar	90.5%
Premolar	75%

Table 1: *The Success rate of Endocrowns in molars and premolars [14].*

Biacchi., *et al.* suggested that Endocrowns are less susceptible to Hybrid layer degeneration and hence are more long-lasting compared to normal full-coverage crowns in terms of adhesion [15]. They concluded that endocrowns were more superior in terms of compressive strength and fracture resistance and promoted good esthetic functions and biomechanical integrity [15]. Endocrowns are a more conservative approach to treatment compared to conventional crowns as the supragingival portion of the tooth is saved from cutting, which is generally compromised in the full coverage crowns and hence more enamel is present which enhances the bonding of endocrowns [16].

The main disadvantage of full coverage restoration is excessive cutting, which causes excessive application of force and moisture contamination due to subgingival margins [16]. In cases of CAD-CAM endocrowns, the restorative portion of the endodontic treatment can be completed in a single visit, which is not possible for cases with full coverage crowns with post cementation [13].

CAD-CAM is the preferred choice for making endocrowns since its more time saving compared to heat pressed systems [17]. CAD-CAM systems have the option of biogeneric selection that is a database from which the anatomy of the tooth and the antagonist can be selected, and hence the step of waxing for occlusion is eliminated. In cases where an intraoral scanner is not present with the dentist, a traditional impression can be made and later scanned thereby eliminating the need for an intraoral scanner [13].

Endocrowns are suggested for a tooth that has a clinically low crown with calcification present in the roots or when the roots are very slender and cannot support a post [10]. The cervical margin for endocrown should be at least 2 mm wide for the most part of the circumference to facilitate a good adhesion, and if that's not possible then endocrowns are contraindicated. Glass ceramic restorations are the best choice for making endocrowns as they are biocompatible and have the advantage of biomimicry since the coefficient of wear is very close to enamel [9].

The glass-ceramic restoration also offers a single monolithic restoration that enhances bonding.

The cervical sidewalk that is made in endocrown offers a butt joint that enhances bonding, the conventional full coverage restorations require crimping that is prohibited in endocrowns. A broad and stable surface is achieved, which offers better distribution of compressive forces along the butt joint and the wall of the pulp chamber. The preparation is parallel to the occlusal surface that distributes the force along the major axis of tooth, and hence that increases retention [9].

Conclusion

Endocrowns are an easier and conservative alternate for full coverage crowns. Endocrowns take their anchorage from the pulp chamber, which is less traumatic as compared to the alternates where posts are required for better retention. The margin of the restoration is placed supragingival and hence facilitates preservation of the periodontium at the margins and makes impression making easier, maintaining more natural tooth structure thereby enhancing strength. Glass ceramic restoration, when used with CAD-CAM, make a monolithic restoration that has more strength and because of the butt joint there is better distribution of forces along the joint and the axial walls and hence reduces the force applied on the pulpal floor. The endocrowns are a perfect example of bio integration and are a good alternative to restore grossly decayed posterior teeth.

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Volume 19 Issue 2 Februray 2020