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# Endocrowns: Redefining the Restoration of Endodontically Treated Teeth – A Comprehensive Review

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***Abstract*—Various restorative techniques have been employed for a long time to restore endodontically treated teeth. The outcome of an endodontic procedure determines the clinical success of the treated tooth. Prevention of healthy dental structure is essential to help mechanical stabilization of tooth restoration integrity, increasing the amount of suitable surfaces for adhesion and thus positively creating an impact on long-term success. Endocrowns are an innovative restorative approach for endodontically treated teeth, offering a conservative alternative to conventional post-and-core techniques. This monolithic restoration integrates the crown and core as a single unit, using the pulp chamber for retention and adhesive bonding for stability. Clinical evidence suggests that endocrown /preserves more tooth structure, reduces the risk of root fractures, and demonstrates excellent marginal adaptation. Despite their advantages, success depends on proper case selection, material choice, and bonding protocol. This article reviews the design principles, materials, indications, preparation techniques, and clinical performance of endocrown as a modern restorative solution for structurally compromised endodontically treated teeth.**

## I. INTRODUCTION

Endodontic treatment is common in dental practice.(1) However, it can weaken the tooth and reduce its mechanical properties due to the loss of tooth structure. This loss of structure reduces the fracture resistance, affecting the tooth's long-term survival rate.(2,3)

The type of restorative material used, along with proper restoration, conserves the integrity of the tooth and also increases its longevity.(4) The final restoration depends upon the number of remaining structures and the type of tooth. For example, anterior teeth with an adequate amount of tooth structure can be restored with a direct restoration, eliminating the need for a full-coverage crown. In case of posterior teeth, cuspal coverage is most important to restore anatomic function, and the higher stress they endure.(5,6) Conventional rehabilitation strategies have relied on post-and-core systems followed by full-coverage crowns.(4) The use of posts combined with full coverage restorations is a well-established approach, yet does not follow the minimal invasive principles of adhesive dentistry.(7)

With the advancements in adhesive dentistry, CAD/CAM technology, and high-strength ceramics such as lithium disilicate and zirconia, endocrowns have gained popularity as a minimally invasive option providing excellent esthetics, strength, and longevity.(2,7) Pissis was the first to describe the ceramic monoblock technique for restoring teeth with substantial coronal structural loss in 1995. On the other hand, Bindl and Mormann coined the term "endocrown" in 1999. The endocrown is a full-coverage, monolithic restoration that utilizes the pulp chamber for macromechanical retention and adhesive bonding for micromechanical stability. This approach eliminates the need for intraradicular posts, preserves maximum tooth structure, and simplifies clinical procedures. These restorations achieve macromechanical retention by being anchored to the internal portion of the pulp chamber and to the cavity margins, and micromechanical retention through adhesive cementation.(2,3)

Given the paradigm shift towards minimally invasive and adhesive restorative concepts, endocrowns have gained considerable attention in recent years. This review aims to synthesize current evidence on endocrowns with respect to their indications, advantages, material choices, biomechanical performance, clinical outcomes, and limitations, while highlighting their relevance in modern prosthodontic practice.(8,9)

## II. RISK AND SHORTCOMINGS OF THE CONVENTIONAL POST AND CORE

The conventional post and core technique, though long considered the standard for restoring endodontically treated teeth with extensive coronal loss, presents several inherent risks and limitations. Procedural accidents such as strip perforations in an apical area of the lateral root surface and incidents of root fractures increase with post placement. Preparation of the post space necessitates additional removal of radicular dentin, which compromises the structural integrity of the root and increases susceptibility to vertical or horizontal root fractures.(10)

Nowadays, the use of prefabricated glass fiber–reinforced posts (GFRPs) has been introduced as an attempt to improve stress distribution and bonding within the root canal system. These posts can be adhesively bonded to radicular dentin through a resin–dentin interface, offering better biomechanical compatibility compared to metallic posts. However, achieving a reliable and durable bond inside the root canal remains a clinical challenge. Factors such as difficulty in controlling tissue moisture, managing the smear layer, and adequately removing volatile adhesive components often compromise the quality of adhesion. As a result, the bonding effectiveness within the root canal is unpredictable, which can ultimately affect the longevity and success of the restoration.(9,10)

Materials commonly used for core build-up—such as amalgam, glass ionomer cement, and composite resin—have several drawbacks. Glass ionomer materials lack the necessary strength to endure occlusal forces, making them unsuitable for high-stress areas.(1) Amalgam, despite its long history of use, presents multiple disadvantages. In teeth with limited coronal structure, additional retention features like pins are often required, which can further compromise the remaining tooth structure. Moreover, amalgam can cause esthetic issues when used beneath ceramic crowns and may result in gingival tattooing due to metal ion migration.(6) These limitations emphasize the need for more advanced restorative solutions that combine strength, adhesion, and esthetic compatibility.

Composite resins have been considered an ideal core build-up material due to their adhesive properties and compatibility with many posts. However, the negative side, they show polymerization shrinkage leading and subsequent microleakage.(7,9).

## III. INDICATIONS FOR ENDOCROWN

Endocrown restorations are advised for endodontically treated teeth that have lost a substantial amount of coronal structure and present limited interocclusal space, making it difficult to obtain sufficient material thickness for traditional crowns.(1,2,3). They are especially appropriate in cases where little to no coronal tooth structure remains above the cementoenamel junction (CEJ) and achieving a ferrule effect would require the placement of a post. Furthermore, endocrowns are indicated in cases involving curved, calcified, short, or narrow root canals, or when fractured instruments within the canal prevent the safe placement of a post. In such situations, endocrowns provide a conservative, adhesive alternative that preserves remaining tooth structure while ensuring functional and aesthetic restoration.(7)

Regarding premolars, endocrowns are indicated when the cementation surface area is adequate, specifically when supragingival walls of approximately 1–2 mm in height and at least 2 mm in thickness are present, along with a pulp chamber depth of at least 3 mm. However, the successful application of this approach depends on the presence of sound cervical enamel, which enhances the effectiveness of adhesive bonding procedures.(5)

## IV. CONTRAINDICATIONS

In case of severe dental tissue removal, in which, after preparation, the finish line of the endcrown is completely below the cement-enamel junction, the use of an endocrown may not be appropriate because of the increased risk of tooth fracture and the decreased retention of the restoration.(3,6) Nevertheless, certain studies indicated that a depth of at least 2 mm was necessary to ensure sufficient stabilization

Teeth with extensive cracks, fractures, or thin remaining walls that compromise structural integrity are also unsuitable for endocrown restorations. In addition, patients with parafunctional habits such as bruxism or clenching pose a higher risk of restoration failure due to excessive occlusal stresses.(6)

## V. MATERIALS USED FOR THE CONSTRUCTION OF ENDOCROWNS

A variety of restorative materials have been developed for endocrown fabrication, aiming to achieve a balance between strength, esthetics, and long-term adhesion. Among these, lithium disilicate ceramics, zirconia, resin composite blocks, and hybrid ceramics are most frequently utilized.(1,2) The highly recommended material is lithium disilicate glass ceramic material. The reason is that it provides high mechanical properties, aesthetic outcomes, and can bond to the tooth surface. Also, it exhibits the highest fracture resistance compared to other materials.

Zirconia-reinforced lithium silicate glass-ceramic is a glass-based ceramic material that incorporates zirconia particles into its matrix to enhance its mechanical and physical properties. However, it may reduce the bonding strength of the material between the tooth structure and the restoration. Additionally, catastrophic tooth failure may occur due to high modules of elasticity that concentrate stress on the weakest points.(1,7)

Zirconia is widely used because of its excellent mechanical properties, making it suitable for high-stress situations like bruxism. It is a polycrystalline ceramic material devoid of glass phases. However, zirconia cannot be etched using routine methods, which can result in low bond strength and the potential debonding of the restoration. however, their lower translucency and bonding challenges require special surface conditioning. On the other hand, Resin composite materials have an elastic modulus closer to dentin, promoting favorable stress distribution and ease of intraoral repair, though they may show reduced wear resistance over time.(9)

## VI. STEPS IN PREPARATION OF ENDOCROWN

Endocrown restorations achieve macromechanical retention through anchorage to the pulp chamber and cavity margins. The main purpose of the use of endocrowns is to attain a bonded restoration that is minimally invasive of root canals. This requires a specific preparation technique that differs from traditional crowns. Although some modifications can be made to improve aesthetics, and to compensate for biomechanical and other requirements.(8)

## VII. OCCLUSAL PREPARATION

The occlusal reduction focuses on reducing the height of the tooth overall to give appropriate clearance from the opposite tooth. The goal in preparation is to achieve an overall reduction in the height of the occlusal surface of at least 2 mm in the axial direction[1]**.** To achieve occlusal reduction, one approach is to drill 2 mm guide grooves, followed by a wheel diamond bur to reduce the occlusal surface. The diamond is directed along the long axis of the tooth, parallel to the occlusal plane. The aim is to make a flat surface on the tooth, and the extent of the cervical margin is determined.The bur helps maintain proper alignment and creates a flat surface, resulting in a butt joint margin. The cervical margin is also called the cervical sidewalk. Ideally, the margins should be kept supragingival all over. but in areas where the aesthetic requirements or clinical factors require a difference in level, a slope of no greater than 60° should be between the different cervical levels.(8)

A butt joint, also known as a cervical sidewalk, refers to a 90-degree circumferential band of enamel margin with a width of 1 to 2 mm. This type of margin enhances bonding and provides a stable surface that can withstand compressive stresses.(1,4)

## VIII. AXIAL PREPARATION

During this step, undercuts in the access cavity are eliminated. For this purpose, a conical or a cylindrical bur can be used; approximately 7 degrees is utilized to make the pulp chamber and endodontic access cavity in continuous alignment. The depth of the cavity should be at least 3mm. The recommended endocrown measurements are a 3 mm diameter cylindrical pivot and a 5 mm depth for the first upper premolars, and a 5 mm diameter and a 5 mm depth for molars.(9)

The diamond should be held parallel to the long axis of the tooth; the pulpal floor should remain untouched, and excessive pressure should be avoided. Care should be taken not to touch the pulpal floor or remove too much material from the chamber walls, as this could reduce the enamel thickness. The internal line angles should be rounded to decrease stress concentration within the ceramic material, thereby minimizing the risk of fracture.(10)

## IX. PULP CHAMBER PREPARATION

Using a cylindrical conical diamond bur with a 7-degree occlusal taper, the undercuts are removed in the access cavity, creating a continuous chamber and access cavity. The bur should be held parallel to the long axis of the tooth. It should not touch the pulp chamber to create smooth, tapered walls. The excessive pressure should be avoided to prevent a reduction in wall thickness.

Gutta-percha is removed to a depth not more than 2 mm to take advantage of the saddle-like anatomy of the cavity floor. However, some researchers advised that extension into canals can reduce stress distribution properties and result in decreased marginal and internal adaptation. Some researchers recommend using immediate dentin sealing with a bonding agent immediately after preparation to improve adhesion and reduce microleakage.

## X. FERRULE EFFECT

The use of a ferrule is not commonly involved in endocrown preparation. The ferrule effect refers to a collar encircling the dentin's parallel walls, extending in a 360-degree manner above the preparation's shoulder. (1,8)

In this design, it follows the same concept as the butt joint, but with the addition of a 90-degree shoulder margin positioned on the vertical wall, the butt joint design is less complex and has superior marginal integrity and internal adaptation

## XI. MANUFACTURING

Endocrowns are generally fabricated using two main techniques: the heat-pressing method and CAD/CAM technology. In the heat-press technique, a standard impression—usually created with polyether or polyvinyl siloxane—is utilized to produce a cast in the dental lab. A wax model is formed on this cast, and ceramic blocks are later heat-pressed in a furnace into a heat-resistant mold to generate the final restoration. This approach provides various advantages, including ease of use, time savings, and an accurate marginal fit.(2,4)

The CAD/CAM technique uses computer-aided design and computer-aided manufacturing technology to fabricate an endocrown. A digital intraoral scan is performed after the tooth has been prepared in order to precisely document the structure of the created cavity and its surrounding structures. CAD software is then used to design the restoration.(5,9) A ceramic block is milled as part of the subsequent CAM procedure to produce the finished restoration. Once the design is finalized, it is sent to a CAM milling unit, where the restoration is milled from a It allows for the selection of anatomical features that adapt to the scanned preparation and the opposing tooth, eliminating the need for diagnostic wax prefabricated block of restorative material such as lithium disilicate, zirconia, hybrid ceramic, or composite resin. Following milling, the restoration may undergo post-processing steps like crystallization, sintering, glazing, or polishing, depending on the material used. The utilization of CAD/CAM technology offers numerous advantages. It allows for the selection of anatomical features that adapt to the scanned preparation and the opposing tooth, eliminating the need for diagnostic wax.(10)

## XII. CEMENTATION

Adhesive cement is crucial as it offers micromechanical retention in the endocrown. It aids in stress distribution, leading to enhanced fracture resistance. If it is inappropriate, it could result in microleakage, potentially leading to secondary caries and periodontal issues.(5)

Resin cements are widely used for endocrown cementation due to their superior bonding strength, aesthetic qualities, high mechanical performance, and low solubility. They are classified into two main types: conventional resin cements and self-adhesive resin cements. The conventional technique involves two separate steps—etching and bonding—which can extend the procedure time and increase the risk of contamination, making the process more technique-sensitive. To overcome these limitations and simplify the procedure, self-adhesive resin cements were introduced. (11)

Based on the polymerization method, resins are categorized as self-cured, light-cured, or dual-cured. Dual-cured resin cements combine the advantages of both self-curing and light-curing, making them particularly suitable for use in deep cavities. Following cementation, it is crucial to remove any excess cement, especially in subgingival areas. Radiographic evaluation can be performed to confirm the complete removal of residual cement. (12)

## XIII. CONCLUSIONS

Endocrowns have emerged as a highly preferred restorative choice for the rehabilitation of endodontically treated teeth. Compared to traditional post-core and crown systems, they are more conservative, deliver superior aesthetics, ensure adequate retention, and exhibit excellent mechanical performance. The incorporation of advanced materials—such as lithium disilicate, zirconia, and hybrid ceramics—combined with CAD/CAM technology, has greatly enhanced the precision, durability, and visual appeal of these restorations.

In summary, endocrowns offer a biomimetic and minimally invasive approach for restoring endodontically treated posterior teeth, merging functional dependability with aesthetic quality. As adhesive systems and digital dentistry continue to progress, endocrowns are set to emerge as a conventional treatment option.

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