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‘Endo Crowns’ – A Narrative Review

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ABSTRACT: For teeth that have had extensive coronal structural loss due to endodontic treatment, endocrowns provide a contemporary and conservative restorative method. In contrast to traditional crowns, endocrowns are made as a single unit and do not require post-and-core systems since they use the pulp chamber for macromechanical retention. A number of variables, including adhesive luting tactics, preparation methods, and material selection, affect the success of endocrowns. The strength and durability of endocrowns have been improved by developments in CAD/CAM technology, high-strength ceramics, and hybrid polymer-ceramic materials. Their indications include cases where traditional post-retained crowns are not practical, short or brittle roots, and severely damaged molars. Contraindications, however, include high occlusal loads brought on by parafunctional habits, weak adhesion potential, and insufficient pulp chamber depth. The use of sticky resin cements for the best retention and fracture resistance is supported by recent research. Endocrowns provide a dependable and minimally invasive substitute for conventional full-coverage restorations, offering long-term clinical success when used with the right case selection and technique.

I. INTRODUCTION

A single-unit restoration called an Endo Crown is made for teeth that have received endodontic treatment, or root canal therapy. It merges the crown with a core that extends into the pulp chamber for extra retention and is usually composed of ceramic or composite. Particularly helpful are endodontic crowns for molars and premolars with substantial structural loss. [1]

In order to restore the function and appearance of a tooth, a prosthetic crown—also known as a dental crown—covers the visible part of the tooth. Both essential and non-essential teeth can be covered with it. Crowns require extensive tooth preparation and can be composed of ceramic, metal, PFM (porcelain fused to metal), or composite materials. [2]

Key Differences Between Endo Crown and Prosthetic Crown [3]

Feature	Endo Crown	Prosthetic Crown
Indication	Used for endodontically treated teeth with significant structural loss	Used for both vital and non-vital teeth
Retention	Retained by bonding to the pulp chamber and enamel	Retained by a prepared tooth structure and post (if needed)
Tooth Preparation	Requires minimal removal of remaining tooth structure	Requires more extensive preparation, often involving ferrule effect
Post Requirement	No post required, retention comes from bonding	May require a post and core for additional support
Material	Ceramic (E.max, zirconia) or composite	Ceramic, metal, PFM, zirconia, composite
Best for	Molars and premolars with large cavities	Any tooth, especially when coronal structure is more intact
Longevity & Strength	Good long-term success in molars due to monoblock structure	Stronger in cases where ferrule effect is achieved
Procedure	Easier, single-step adhesive bonding	More complex, especially if a post is needed

Clinical Considerations

When ferrule is not possible and there is little to no remaining tooth structure, endo crowns are a great option. When there is enough tooth structure left or when more mechanical retention (post and core) is required, traditional prosthetic crowns are the recommended option. A conservative dental repair called an endocrown is made especially for teeth that have undergone endodontic treatment and have substantial coronal damage. [4]

Endocrowns preserve more of the original tooth structure by using the inside walls of the pulp chamber for retention, in contrast to standard crowns, which frequently call for supports and considerable tooth preparation. Usually, materials like composite resins or ceramics are used to construct them. [5]

Indications for Endocrowns:

Molars with Significant Damage: Endocrowns work especially well for molars that have had root canal therapy and show a significant loss of coronal tooth structure. Effective repair is made possible by their design, which eliminates the need for extra retention techniques like posts. [6]

Adequately Structured Premolars: Although endocrowns are typically preferred for molars, they can also be used for premolars if there is enough tooth structure left and ideal occlusal conditions. However, careful case selection is crucial because premolars have smaller pulp chambers and distinct force dynamics. [7]

Contraindications:

Anterior Teeth: Because of cosmetic considerations and the distinct functional demands placed on anterior teeth, it is often not advised to apply endocrowns in these teeth. Additionally, endocrowns are less practical in anterior teeth due to their inadequate surface area for bonding. [8]

Teeth with Inadequate Enamel: For successful bonding, a sufficient amount of enamel is necessary. Teeth lacking adequate enamel may not provide the necessary adhesion for an endocrowns, leading to potential restoration failure.

Various materials used for Endo crowns

Endo crowns are monolithic restorations designed for endodontically treated teeth with significant coronal destruction. The choice of material for an end crown is crucial, as it influences the restoration's durability, aesthetics, and overall success. Below is an overview of various materials used in fabricating end crowns, along with their properties:

1. Lithium Disilicate Glass-Ceramic (e.g., IPS e.max):

Properties:

Aesthetics: Offers excellent translucency and color matching, closely mimicking natural tooth structure.

Strength: Demonstrates high flexural strength, making it suitable for withstanding occlusal forces.

Bonding: Provides strong adhesion to tooth structures due to its favorable bonding properties. [9]

2. Zirconia:

Properties:

Strength: Known for its exceptional mechanical strength and fracture resistance, making it ideal for patients with heavy occlusal forces.

Aesthetics: Traditionally more opaque, but advancements have improved its translucency.

Bonding: Requires specific surface treatments to enhance bonding efficacy.

"Zirconia endocrowns (Zolid HT+, Ceramill, AmannGirrbach) were investigated for their fracture resistance and failure modalities." [10]

3. Feldspathic Porcelain:

Properties:

Aesthetics: Highly esthetic with excellent translucency, closely resembling natural enamel.

Strength: Lower flexural strength compared to other ceramics, making it more suitable for anterior applications.

Bonding: Offers good bonding properties with appropriate surface treatments.

"The endocrown is suitable for all molars, particularly those with clinically low crowns, calcified root canals or very slender roots." [11]

4. Composite Resin:

Properties:

Aesthetics: Good color matching with natural teeth, though may be prone to discoloration over time.

Strength: Lower mechanical strength compared to ceramics; however, its elasticity can be beneficial in absorbing occlusal forces.

Bonding: Exhibits excellent bonding capabilities with tooth structures.

"The low stiffness materials such as resin composites accompany the natural flexural movements of the tooth, reducing stress arising at the interfaces." [12]

5. Hybrid Materials (e.g., Resin-Nano Ceramic):

Properties:

Aesthetics: Combines the esthetic properties of ceramics with the flexibility of resins.

Strength: Offers a balance between strength and elasticity, providing resistance to chipping and fractures.

Bonding: Demonstrates good bonding properties due to its resin component.

"Materials such as zirconia or metal increase the risk of irreparable fracture." [13]

The location of the tooth, the degree of dental structure loss, aesthetic needs, and occlusal issues should all be taken into account when choosing the material for an endo crown. Because of its strength and beauty, lithium disilicate glass-ceramic is frequently chosen, but zirconia is used in situations where greater strength is needed. In certain situations when their special qualities are beneficial, composite resins and hybrid materials could be taken into consideration.

Preparation steps for an endo crown

For teeth that have undergone endodontic treatment and have substantial coronal damage, an endo crown is a conservative restorative alternative. Unlike standard crown treatments, it requires careful preparation, which is crucial to its effectiveness. The main procedures for getting a tooth ready for an endo crown are listed below: [14-17]

Assessment and Diagnosis:

Conduct a thorough clinical and radiographic evaluation to ensure the tooth is suitable for an endo crown. Confirm that the root canal treatment is adequately performed and that there are no signs of periapical pathology.

Occlusal Reduction:

Reduce the occlusal surface by approximately 2 mm to create space for the restorative material. This uniform reduction helps in maintaining the structural integrity of the restoration.

Axial Wall Preparation:

Prepare the axial walls with a slight taper, ensuring they are approximately 1.5–2 mm in height. This taper aids in the proper seating of the restoration.

Pulp Chamber Preparation:

Utilize the existing pulp chamber for additional retention. The depth of the pulp chamber should be maintained without extending into the root canals. This design enhances the stability of the endocrown.

Margin Design:

Create a circumferential butt joint margin at the cervical area. This margin design provides a stable and durable interface between the tooth and the restoration.

Surface Treatment:

Smooth all prepared surfaces to eliminate any sharp angles or irregularities. A smooth surface ensures better adaptation and bonding of the restorative material.

Impression and Temporization:

After preparation, take an accurate impression of the tooth to fabricate the endo crown. Place a temporary restoration to protect the prepared tooth until the final restoration is ready.

Luting agents used for endo crowns

Because it affects the restoration's longevity and retention, the luting agent selection is crucial to the long-term success of endocrowns. Because of their superior mechanical qualities and bonding ability, resin-based cements are typically chosen. An outline of popular luting agents for endocrowns is provided below: [18-20]

1. Adhesive Resin Cements:**Total-Etch (Etch-and-Rinse) Systems:**

Description: These cements require a separate etching step with phosphoric acid, followed by the application of a bonding agent before the cement is applied.

Advantages: They provide strong adhesion to both tooth structure and restorative materials, leading to enhanced retention and fracture resistance.

Considerations: The technique is sensitive and requires careful isolation to prevent contamination.

Self-Etch Systems:

Description: These cements combine the etchant and bonding agent into a single application, simplifying the procedure.

Advantages: They reduce postoperative sensitivity and are less technique-sensitive compared to total-etch systems.

Considerations: Bond strength may be slightly lower than that of total-etch systems, especially on enamel surfaces.

Self-Adhesive Resin Cements:

Description: These cements do not require separate etching or priming steps, as they are designed to adhere directly to the tooth structure.

Advantages: They simplify the cementation process and reduce the potential for technique errors.

Considerations: Some studies suggest that self-adhesive cements may exhibit lower bond strengths compared to total-etch systems.

2. Glass Ionomer Cements (GIC):

Description: GICs are water-based cements that chemically bond to tooth structure and release fluoride.

Advantages: They are easy to use and have a long history of clinical success.

Considerations: GICs have lower bond strength and are more brittle compared to resin cements, which may lead to cohesive failures in the cement layer.

Research indicates that "the fracture pattern in the CG-groups, where all the endocrowns fractured, leaving the underlying teeth intact may be due to the low bond strength of the Glass ionomer cement which always results in cohesive failure." [21]

3. Resin-Modified Glass Ionomer Cements (RMGIC):

Description: These cements combine the properties of resin and glass ionomer, offering improved bond strength and reduced solubility.

Advantages: They provide better mechanical properties than conventional GICs and are less technique-sensitive than resin cements.

Considerations: While they offer a balance between GICs and resin cements, their bond strength may still be inferior to that of adhesive resin cements. [22]

Factors Influencing Luting Agent Selection:

Restorative Material: The choice between ceramic and composite endocrowns can influence the selection of the luting agent. For instance, certain cements may be more compatible with specific restorative materials.

Tooth Preparation: The amount of remaining tooth structure and the design of the preparation can affect the choice of luting agent.

Clinical Conditions: Factors such as isolation capabilities, moisture control, and occlusal forces should be considered when selecting a luting agent.

while various luting agents are available, adhesive resin cements, particularly those utilizing a total-etch approach, are often recommended for end crowns due to their superior bond strength and retention properties. However, the final selection should be tailored to the specific clinical scenario and the materials involved. [23]

Latest advancements in Endo crowns

Endo crowns have evolved significantly with advancements in materials and techniques, enhancing their effectiveness in restoring endodontically treated teeth.

1. Advanced Materials:

Hybrid CAD/CAM Materials: Recent developments in hybrid materials, such as resin-ceramic composites, offer a balance between strength and aesthetics. These materials are designed for use with computer-aided design and manufacturing (CAD/CAM) systems, facilitating precise and efficient fabrication of endo crowns. [24]

High-Performance Polymers: Materials like BioHPP (high-performance polymer) are gaining attention for endo crown construction due to their favorable properties, including elasticity and stress-distributing characteristics. These polymers offer an alternative to traditional ceramic materials, potentially reducing the risk of irreparable fractures.

2. Enhanced Techniques:

Digital Workflow Integration: The integration of digital workflows in dentistry has streamlined the design and fabrication of endo crowns. Utilizing CAD/CAM technology allows for precise modeling and milling of restorations, improving fit and function. [25]

Anatomical Preparation Designs: Optimising stress distribution and fracture resistance in endocrowns has been made possible by research into various occlusal reduction designs, such as anatomical versus conventional butt joint preparations. The durability of the restoration can be increased by customising the preparation design for the particular clinical situation.

For teeth that have had endodontic treatment, endocrowns are a restorative alternative, especially when placing a standard crown is difficult. Successful application requires knowledge of their indications and contraindications. [26]

Indications:

Extensive Coronal Damage: Endocrowns are suitable for molars with significant loss of coronal structure, where traditional crown retention is compromised.

Short or Fragile Roots: They are indicated for teeth with short, dilacerated, or fragile roots, where conventional post-and-core restorations may pose a risk.

Clinically Low Crowns: Endocrowns are beneficial for molars with low clinical crowns, providing adequate retention without the need for extensive tooth preparation.

Contraindications: 5,[27]

Inadequate Pulp Chamber Depth: A minimum pulp chamber depth of 3 mm is recommended for sufficient retention; shallower chambers may not provide adequate support.

Insufficient Cervical Margin Width: If the cervical margin is less than 2 mm wide for most of its circumference, achieving a reliable adhesive bond can be challenging.

Poor Adhesion Potential: Situations where proper adhesion cannot be assured, such as in cases of extensive subgingival tooth structure loss, contraindicate the use of endo crowns.

Parafunctional Habits: Patients with habits like bruxism, which subject teeth to excessive lateral forces, may not be ideal candidates due to the increased risk of restoration failure.

A conservative restorative option for endodontically treated teeth with substantial coronal destruction—especially molars—is an endo crown. Intra radicular posts are not necessary with this monolithic restoration since it uses the pulp chamber for macro mechanical retention. Compared to conventional post-and-core systems, its application has a number of benefits.

Uses of Endo crowns: [28,29]

Restoration of Severely Damaged Molars:

Endocrowns are particularly effective for molars with extensive coronal damage, providing a reliable alternative to conventional post-and-core restorations.

Teeth with Challenging Root Morphology:

They are suitable for teeth with curved, calcified, short, or narrow root canals, or in cases where fractured instruments in the canal prevent the application of a post.

Minimally Invasive Restoration:

Endocrowns offer a conservative and minimally invasive approach, providing functional and aesthetic rehabilitation while preserving tooth structure.

Alternative to Conventional Crowns:

They serve as a suitable alternative to the conventional post-core restoration and full-coverage restoration, especially in cases where traditional methods are not feasible.

In cases when conventional restorative techniques may be difficult or less successful, endodontic crowns offer a long-lasting and aesthetically pleasing way to restore teeth that have undergone endodontic treatment by utilising the internal structure of the tooth.

II. CONCLUSION

An important development in restorative dentistry, endo crowns provide a conservative and efficient remedy for teeth that have undergone endodontic treatment. Careful adhesive techniques, appropriate case selection, and material selection are critical to their effectiveness. Endo crowns remain a strong, aesthetically pleasing, and functionally effective substitute for conventional restorations thanks to continuous advancements in materials and digital procedures. It is anticipated that their use in routine practice will increase as more clinical data becomes available, confirming their status as an important therapeutic option in contemporary prosthodontics.

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