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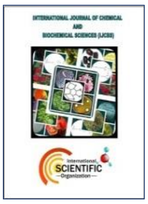

Influence of Biomimetic Restorative Strategies and CAD-CAM Materials on Fracture Behavior, Internal Fit and Marginal Adaptation in Endodontically Treated Molars: A Narrative Review

Amira Amr Mohamed[1], Ahmad Khaled Abo El-fadl[2], Sara Mehanna Foudah[3]*

[1]*M.B.S.SCH*

[2]*Professor, Fixed Prosthodontics department, Ain Shams university, Egypt*

[3]*Associate Professor, Fixed Prosthodontics department, Ain Shams university, Egypt*

Abstract

Endodontically treated molars, particularly those with extensive mesio-occluso-distal defects, are structurally compromised and more prone to cusp deflection and fracture due to loss of tooth integrity following caries removal and endodontic procedures. Traditional restorative approaches have relied on post-core systems and full-coverage crowns; however, these methods often require extensive removal of remaining tooth structure and may be associated with unfavorable biomechanical behavior. Recently, more conservative adhesive strategies such as endocrowns and overlays have been introduced as biomimetic alternatives aimed at preserving sound tooth tissue while restoring function. These restorations are commonly fabricated using CAD/CAM materials such as lithium disilicate ceramics and hybrid ceramics, each offering distinct mechanical properties in terms of strength, stiffness, and stress distribution. Lithium disilicate provides high fracture resistance but may present brittle failure patterns, whereas hybrid ceramics demonstrate improved elasticity and more favorable stress dissipation. In addition, the use of short fiber-reinforced composite as a biomimetic base has been proposed to enhance fracture toughness and reduce crack propagation by acting as an internal stress distributor. Internal and marginal adaptation is critical for restoration longevity, and modern 3D evaluation methods allow more comprehensive assessment compared to conventional techniques.

Keywords: Endocrown; Overlay; CAD/CAM materials; Fiber-reinforced composite.

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1. Introduction

Endodontically treated teeth (ETT), especially molars with extensive mesio-occluso-distal (MOD) defects, are structurally compromised and exhibit an increased risk of cusp deflection and fracture. The compromised structural integrity of the remaining dental tissues with the caries removal and endodontic treatment, hindering these teeth from functioning as a resilient mono-block unit and instead making them susceptible to fracture [1] The prudent selection of the restorative materials and designs that effectively restore the tooth as a structurally integrated functional unit capable of optimal biomechanical performance under occlusal loading continued to be the clinical challenge [1-2]. For many years, restoration of ETT relied on conventional post and core systems with full-coverage crown with substantial radicular post space preparation and coronal removal of surrounded sound tooth structure [2]. However, modern approaches introduced adhesive partial-coverage restorations that have been advocated as more conservative alternatives to those conventional options [3]. Lithium disilicate (LDS) CAD/CAM ceramics (e.g., IPS e.max CAD, Tessera) are generally regarded as high-strength, high-stiffness indirect restorative materials with reliable adhesive bonding, which in vitro translates to high load-to-fracture values for partial-coverage restorations and endocrowns [4].

However, their brittleness can lead to more unfavorable (less repairable) fracture patterns under extreme loading or unfavorable stress concentrations [4]. In contrast, hybrid ceramics/resin–ceramic materials (polymer-containing CAD/CAM blocks such as VITA Enamic/Cerasmart-class materials) typically show lower absolute fracture strength than LDS. Still, their more compliant, damage-tolerant microstructure may help dissipate stresses and is frequently associated with more favorable, repairable failures (restoration fractures rather than deep root fractures) in laboratory testing [5-6]. Moreover, Fiber reinforcement has been widely used in restorative dentistry to improve the mechanical performance of resin-based materials. Fiber incorporation, such as glass fibers, polyethylene fibers, and carbon fibers into resin matrices, enhances fracture toughness, flexural strength, and resistance to crack propagation. These fibers act as stress distributors within composite structure, bridging cracks and preventing their rapid propagation, which improves the longevity of restorations, particularly in high-stress posterior regions. Among fiber-reinforced materials, Short Fiber-Reinforced Composite (SFRC) represents a significant advancement that may affect the mechanical behavior of ETT.

Beyond mechanical strength and mode of failure, proper adaptation plays a critical role in the longevity of restorations. Inadequate adaptation leads to increased cement thickness and the presence of interfacial defects, which may compromise the marginal seal and increase the risk of debonding, secondary caries, and crack formation. Three-dimensional (3D) fit analysis was introduced and performed using digital softwares to quantitatively evaluate internal fit and marginal adaptation. Methodologically, some authors used datasets of the prepared tooth and the corresponding restoration to be imported as STL files and aligned using a best-fit algorithm. Discrepancies between the two surfaces were calculated, allowing precise measurement of internal gaps and marginal discrepancies [7-9]. This review aims to critically evaluate the current evidence regarding restorative options for ETT, with particular concern with the effect of the restorative designs such as endocrowns and fiber-based overlays and the effect of material selection such as lithium disilicate and hybrid ceramics on the fracture behavior, internal fit and marginal adaptation of structurally compromised endodontically treated molars.

2. Methodology of the Review

This narrative review was conducted through a comprehensive literature search of peer-reviewed articles published up to 2025. Databases including PubMed, Scopus, and Google Scholar were queried using combinations of the following keywords: "Endodontically treated teeth," "Endocrowns," "Fiber-reinforced composites, "Biomimetic restorations," and "Fracture resistance." Inclusion criteria were studies discussing restorative options for ETT, their mechanical and clinical performance, material comparisons, and biomimetic principles.

3. Restoration of Endodontically Treated Teeth

For years, endodontic failure was mainly attributed to apical leakage; however, coronal leakage later identified as a key factor. Ray and Trope demonstrated that the quality of coronal restoration has a greater impact on periradicular status than the quality of root canal treatment, highlighting importance of proper coronal sealing. Endodontically treated teeth can be restored either directly or indirectly, with the main goal of preserving tooth structure and ensuring long-term durability. Restorative management of endodontically treated teeth (ETT) remains controversial [9-10]. These teeth are more prone to fracture due to loss of structural integrity from caries, trauma, and cavity preparation rather than dentin change [11]. Advances in adhesive systems allow more conservative restorations, such as endocrowns and overlays, when sufficient bonding surface is available, though optimal design and material selection are still debated [12].Treatment depends mainly on the remaining coronal structure [13]. Minimal loss can be managed with adhesive composite restorations without posts [14], while moderate loss may require occlusal coverage [13-15]. Extensive loss necessitates post-core systems with a ferrule effect [16-17], although outcomes vary [18]. In severely compromised teeth where ferrule cannot be achieved, extraction and implant placement may be considered (Fig 1) [15-19].

3.1. Different modalities to restore endodontically treated teeth

3.1.1. Post-core Restoration

For teeth with extensive coronal destruction, post-core systems are used to support crowns by retaining core material and replacing lost tooth structure [12-20]. However, posts mainly provide retention rather than strengthening the tooth. Fiber posts are now more commonly used due to their elastic modulus being closer to dentin, though studies show mixed evidence regarding fracture resistance compared to metal posts [13]. Posts are more indicated in anterior teeth and premolars, while their use in molars is limited. New materials like PEEK posts aim to reduce catastrophic failures associated with rigid posts.

3.1.2. Endocrown

Endocrowns, first described by Pissis and introduced in 1999 for posterior teeth, are monoblock adhesive restorations that utilize pulp chamber for retention [21-22]. Preparation: Includes 2–3 mm cuspal reduction, butt margins, 8° taper, and supragingival margins when possible [23-25].They are indicated when traditional post-core is not feasible. Endocrowns are conservative, require less chair time, and preserve more tooth structure. Studies show comparable or higher fracture resistance than post-core systems [26]. However, premolars show higher failure rates due to reduced bonding area and higher leverage forces [12].

- ***Ferrule effect***

Although typically not included modified designs with a ferrule and shoulder margin can improve fracture resistance and load distribution [24]. However, results vary depending on margin design (shoulder, chamfer, bevel), and selection is case-dependent. The ferrule effect refers to a circumferential collar of tooth structure encircling the parallel dentinal walls, extending 360 degrees above the finish line of the preparation. This design concept is comparable to the butt joint preparation; however, it incorporates an additional 90-degree shoulder margin located on the axial wall [27]. This margin, typically 1 mm in width and positioned within sound enamel, provides short axial walls that enhance resistance to shear stresses. Consequently, it contributes to improved marginal load control and more favorable stress distribution toward the pulpal floor. A study by D. Taha et al. evaluated the influence of different margin designs and occlusal thicknesses on the fracture resistance and failure modes of endodontically treated teeth restored with polymer-infiltrated ceramic endocrown restorations, highlighting the biomechanical significance of preparation design [25].

- ***Pulp chamber preparation***

This may include removing undercuts, maintaining 8–10° divergence to allow proper seating of the restoration. Increasing depth does not improve fracture resistance and may increase failure risk due to wedging effects. Composite filling in the pulp chamber was suggested as it may eliminate undercuts, improve restoration fit, and reduce cement thickness (Fig 2). However, evidence on improving fracture resistance is inconsistent, making its benefit mainly procedural rather than structural [28].

- ***Immediate dentin sealing (IDS)***

IDS involves bonding freshly cut dentin before impression or scanning, improving bond strength and sealing. It may enhance adhesion and reduce sensitivity but shows inconsistent effects on fracture resistance [5].

3.1.3. Overlays

Overlays restore teeth without filling the pulp chamber, relying mainly on adhesive bonding. They preserve key anatomical structures like the compression dome and bio-rim, improving stress distribution and fracture resistance. Compared to endocrowns, overlays avoid pulp chamber extension and full axial preparation, reducing structural weakening while maintaining tooth integrity.

- ***Preparation***
- ***Margin Design in Overlay Preparations***

Preparation design influences marginal fit and fracture behavior. Butt-joint margins are conservative and commonly used in adhesive restorations. Shoulder margins provide increased material thickness and improved fracture resistance. Chamfer margins are frequently used in CAD-CAM overlays and promote smoother stress distribution.

- ***Occlusal Design Variations***

Flat (tabletop) designs simplify preparation and may improve marginal adaptation, while anatomical designs follow natural cusp–fossa morphology and enhance biomechanical performance. Overall, simplified designs may enhance adaptation, whereas anatomical designs improve strength (Fig 3). Moreover, the cuspal coverage design may include functional cusp coverage as a conservative approach targeting load-bearing cusps or full cuspal coverage (overlay). Different coverage designs significantly influence fracture resistance outcomes.

- ***The Morphology-Driven Preparation Technique (MDPT) in overlays***

The Morphology-Driven Preparation Technique (MDPT) is a minimally invasive approach for posterior indirect adhesive restorations that preserves tooth structure by tailoring preparation to natural tooth morphology and functional anatomy. It aligns with biomimetic principles, optimizing stress distribution through adhesive bonding rather than standardized geometries.

3.2. Restorative material selection

Advances in adhesive dentistry and high-strength ceramics have reduced the need for post-core systems, enabling reliable restoration of posterior teeth using adhesive indirect restorations.

- ***Materials***

3.2.1. Lithium disilicate

Lithium disilicate (LS2) glass ceramic is a well-established CAD-CAM restorative material used for anterior and posterior restorations. It provides excellent esthetics and adequate mechanical strength. IPS e.max CAD shows a flexural strength of ~360 MPa and modulus of elasticity of ~95 GPa. In its pre-crystallized state, it contains ~40% lithium metasilicate crystals with reduced strength (~130–150 MPa), which increases after crystallization at ~850°C for 25 minutes into lithium disilicate (~70% crystal volume) [29]. Newer materials such as Tessera (Dentsply Sirona, USA) demonstrate improved mechanical performance compared with conventional lithium disilicate systems.

3.2.2. Hybrid ceramics

Hybrid ceramics include polymer-infiltrated ceramics (e.g., Vita Enamic) and resin nanoceramics (e.g., Cerasmart) used for indirect restorations. These materials combine ceramic and polymer networks, improving flexibility, stress distribution, and marginal quality. Vita Enamic contains ~86% ceramic and has a modulus of elasticity of ~30 GPa, close to dentin. Cerasmart contains ~71% fillers and demonstrates flexural strength of ~231 MPa. These materials are suitable for dynamic loading conditions, although long-term fatigue data remain limited. Other materials such as Lava Ultimate and CERASMART® are also widely used hybrid CAD/CAM materials with favorable mechanical properties. Fracture resistance is generally critical for indirect restorations materials and is defined as the stress intensity at which crack propagation leads to failure. Material flaws and microdefects act as crack initiation sites, making ceramic restorations particularly sensitive to internal imperfections and influencing clinical longevity. A comparsion between lithium disilicate and hybrid ceramics is shown in Table 1.

3.2.3. Fiber Re-in forced composite as a bio-base

Fiber reinforcement has been widely used in restorative dentistry to improve the mechanical properties of resin-based materials. The incorporation of fibers such as glass, polyethylene, and carbon fibers into resin matrices enhances fracture toughness, flexural strength, and resistance to crack propagation. These fibers function as internal stress distributors, bridging cracks and limiting their progression, thereby improving restoration longevity, particularly in posterior high-stress areas. Short Fiber-Reinforced Composite (SFRC) represents a major advancement, containing randomly oriented short glass fibers within a resin matrix, providing multidirectional (isotropic) reinforcement. Unlike continuous fiber systems, SFRC is easier to apply clinically as a bulk restorative material without precise fiber positioning. A study by Pascal Magne et al. evaluated large MOD restorations in maxillary molars with severely undermined cusps and found that an SFRC base combined with a CAD/CAM inlay achieved the highest survival rates, more favorable reparable failures, and no shrinkage-induced cracks. They also suggested that in low-cost restorations, an SFRC base significantly improves performance and failure mode of directly layered restorations [18]. Therefore, further studies are needed to assess effect of SFRC bio-base under indirect restorations. Fiber placement in pulp chamber may limit crack propagation due to its elastic and woven structure. However, conflicting findings exist. Aly Nour et al. reported that SFRC under direct occlusal veneers did not improve failure mode, which agrees with Rocca et al., but contrasts with Magne et al. and Fráter et al. [30-31], who reported improved survival and failure modes, attributing this to fibers acting as crack stoppers and stress absorbers [31-32]. These discrepancies may be related to differences in SFRC core thickness (2.5–3 mm and 1–2.5 mm in some studies versus 1 mm in Aly Nour et al.), suggesting that thickness may influence outcomes. Overall, literature remains inconclusive regarding the effect of SFRC biobase on failure mode.

4. Fracture behavior (Fracture resistance and Mode of failure)

➢ *Effect of the restorative design and material selection on the fracture strength and mode of failure*

The development of biomimetic dental materials and restorative approaches had a significant impact on the restorative management of endodontically treated molars. Contemporary biomimetic approaches aim to reproduce the histological architecture and stress-distribution patterns of natural teeth, promoting restorations that function as integrated structural complexes rather than as isolated rigid substitutes. Within this context, endocrowns were suggested as conservative alternative for the rehabilitation of such teeth, relying on adhesive retention and intracoronal anchorage with preserving the residual tooth structure. More recently, biomimetic principles have expanded to include the use of “smart” dentin-replacing materials and fiber-reinforcement concepts, leading to evolution of novel restorative designs such as intracoronal fiber-based overlays.

4.1. Restorative design

Regarding restoration design, in many studies overlay restorations showed significantly higher fracture resistance endocrowns regardless the used materials [8-33]. This can be explained by the more favorable stress distribution associated with the fiber-based overlay concept, which provides additional reinforcement of the remaining tooth structure and reduces stress concentration within the pulpal chamber compared with the intracoronal wedging action of endocrowns [8-33]. The more uniform thickness of overlays may also contribute to improved load dissipation and enhanced fracture resistance [8-33]. Fildisi et al. reported findings of the favorable design of ovelays and further related them to the fracture behavior of intact teeth [8]. They demonstrated that molars restored with endocrowns exhibited fracture strength values even lower than those of sound teeth, whereas overlay restorations achieved fracture resistance comparable to that of intact teeth [33]. These results were corroborated by other authors who confirmed that indirect adhesive restoration designs, particularly overlays, can reproduce the mechanical performance of natural teeth [33]. In the early-2000s, Bindl et al demonstrated that lining the pulp chamber and cavity margins with composite resin reinforces the remaining tooth structure by eliminating undercuts and creating a more favorable internal geometry, while Magne et al later showed that this composite layer also improves cavity sealing and helps maintain the integrity of the endodontic treatment [33].

More recently, in 2021, Feldisi et al attributed the higher fracture resistance of overlay restorations to the strengthening effect of composite build-up on the pulpal walls [8-33]. Several experimental studies have demonstrated that incorporation of fiber reinforcement beneath composite or indirect adhesive restorations enhances structural performance and promotes more favorable, reparable fracture patterns [34-35]. Polyethylene and glass fibers have been shown to increase fracture resistance and, more importantly, to shift failure modes toward fractures located above the cemento-enamel junction by acting as stress-modulating layers that interrupt crack initiation and propagation [34-35]. The fiber network functions as a stress breaker, dissipating occlusal loads and preventing catastrophic crack transmission into the root structure [34-35]. Plenty of Investigations by Dere, Garoushi, Göhring, Belli, and others reported that fiber-reinforced restorations exhibit higher resistance to fracture and a predominance of restorable failures [34-35]. In overlay restorations, Monaco and colleagues further demonstrated that increasing fiber thickness positively influences fracture strength, while later studies, including those of Rocca, indicated that fiber placement primarily modifies fracture mode rather than absolute strength, depending on fiber type, thickness, and location [36-37].

Collectively, these findings support the concept that the SFRC as a fiber-based polymeric structure beneath overlays contributes to a biomimetic stress-distribution mechanism, enhancing structural integrity and reducing the risk of irreparable tooth fractures [36-37]. This was further supported by the higher incidence of favorable fracture modes observed for overlay restorations in many studies [36-37]. Moreover, Greater extension of the endocrowns into the depth of the pulp chamber may have increased stress concentration in the surrounding weakened dentin, thereby predisposing to a higher incidence of irreparable fractures, this was pointed out previously in the studies by El Ghoul et al. and Feldisi and his colleague [8-38]. Finite element analysis by Gomes de Carvalho and co-workers indicated that preparations with simplified, non-retentive geometry promote a more homogeneous stress distribution [33]. In contrast, complex retentive designs introduce multiple internal angles that act as stress concentrators and potential sites for crack initiation [33]. Smooth, non-retentive surfaces were also shown to shift harmful tensile stresses into more favorable compressive stresses, thereby reducing the risk of structural failure [33].

4.2. Restorative material

Hybrid CAD/CAM restorative-materials characterized by a nanoceramic-dominant matrix exhibited significantly higher fracture strength than lithium disilicates in many studies irrespective of the design [39]. This finding may be attributed to the favorable elastic modulus and improved stress distribution behavior of polymer-based hybrid ceramics compared with highly brittle glass ceramics, allowing them to better resist occlusal loading and delay crack propagation [35-40] (Table 2). The resistance of a material to structural failure is governed by its fracture toughness, which reflects its ability to oppose the initiation and catastrophic propagation of cracks under applied loading [35-40]. An interesting recently published work by Garoushi S et al focused on initial failure, final failure, and the interval between both -for a lithium disilicate material (IPS e.max CAD) and three polymer-based ceramics- and showed the inferior performance of lithium disilicate compared with all three polymer-based ceramics, among which CERA-SMART was included [9]. Similar findings were further supported by other investigations evaluating fracture toughness, which reported values of approximately 1.4 MPa·m1/2 for glass-based ceramics, whereas higher values were recorded for polymer-based ceramics, reaching up to 2.9 MPa·m1/2 [41].

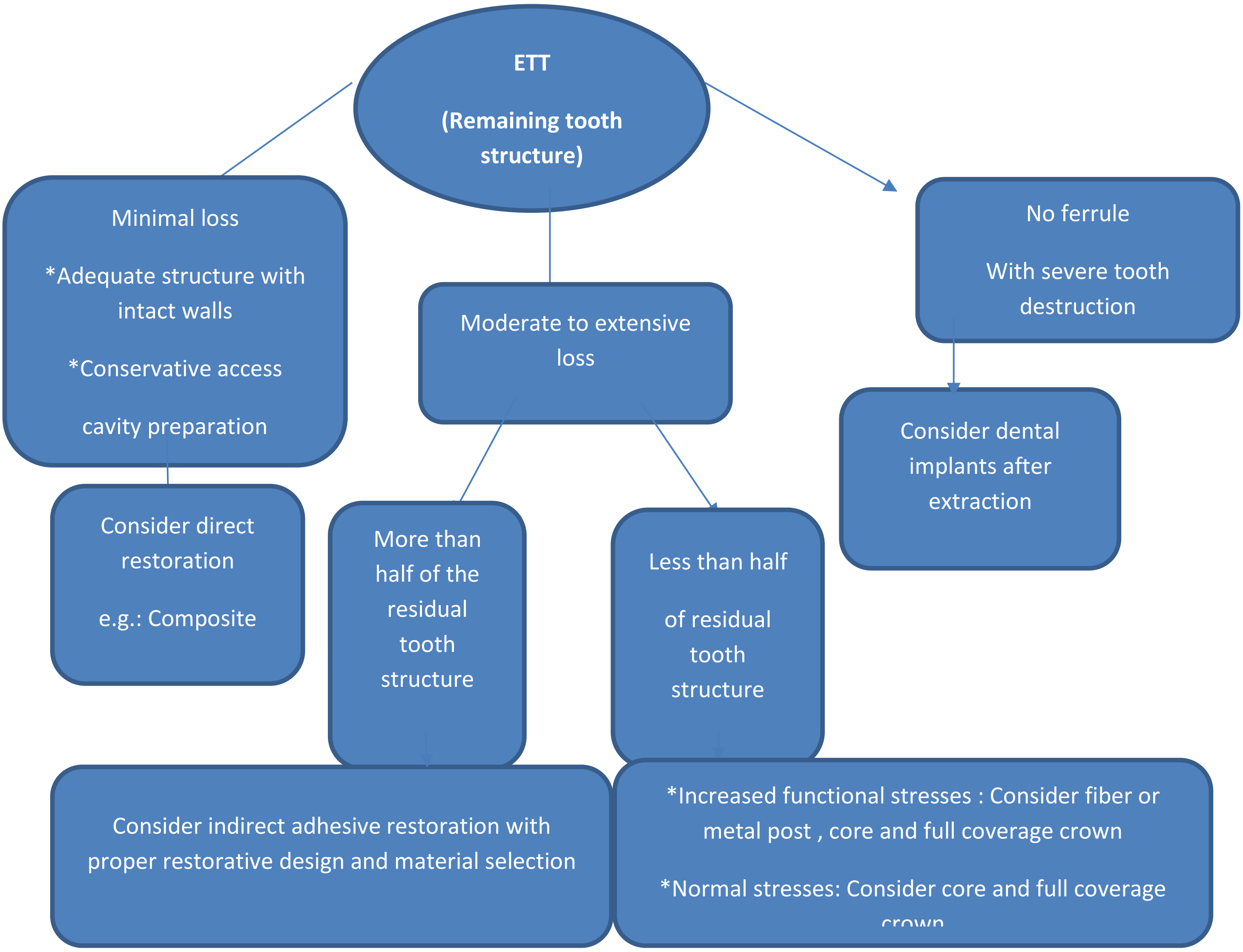

Fig 1. A flowchart showing different restorative options for ETT

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Fig 2. An occlusal view for an endocrown preparation with sealed pulpal floor with composite and the yellow arrow points to the butt margin

Fig 3. An occlusal view for an overlay preparation with the yellow arrow points to SFRC

Table 1. Comparison between CAD/CAM Lithium Disilicate and Hybrid Ceramics

Property	Lithium Disilicate CAD/CAM (e.g IPS e.max CAD)	Hybrid Ceramics (e.g VITA Enamic, Cerasmart)
Material nature	Glass–ceramic (lithium disilicate crystals in glass matrix)	Resin matrix reinforced with ceramic network (PICN or nano-ceramic filled resin)
Main composition	~60–70% lithium disilicate crystals in glass phase	~70–86% ceramic + polymer phase (varies by brand)
Flexural strength	High: ~350–500 MPa (after crystallization)	Moderate: ~150–250 MPa
Elastic modulus	High stiffness: ~60–110 GPa	Low–moderate: ~10–30 GPa
Fracture toughness	Higher	Lower but more resilient (absorbs stresses)
Wear behavior	Higher wear on opposing teeth (more abrasive)	More enamel-friendly (similar to dentin behavior)

Table 2. Failure mode classification

Failure Type	Description	Favorable/Unfavorable
Type I	Fracture line above CEJ	Favorable
Type II	Fracture Line Below CEJ	Unfavorable

Table 3. Methods used for internal fit and marginal gap evaluation

Technique	Principle	Advantages	Limitations
Silicon replica technique	Replica used to measure cement gap	Simple and not expensive	Limited precision
Micro- CT	Three-dimensional radiographic evaluation	Highly accurate and not destructive	Expensive
Triple scan protocol	Superimposition of digital scans	Rapid and reproducible	Requires advanced software

In light of these findings, the failure mode analysis in the studies revealed a material-dependent pattern [37]. Owing to the higher fracture toughness of hybrid ceramics, as previously discussed, together with the expected stronger adhesive interaction with resin cement as a polymer-based material, a greater tendency for tooth involvement in the fracture was observed at high loads [7-8]. It may be due to the greater load they withstand before failure. Considering that fractures located above the Cemento-Enamel-Junction (CEJ) are clinically regarded as favorable (Table 2), Eldamanhoury et al showed a higher percentage of favorable failures was recorded for lithium disilicate than hybrid ceramics, despite the latter exhibiting markedly higher fracture resistance values [42]. Similar findings by Hashem RM. et al and other studies were reported [43].

5. Internal fit and marginal adaptation

- ***Effect of restorative design and material on the internal fit and marginal adaptation***

Generally, optimal adaptation is essential for uniform stress distribution at the restoration–tooth interface and long-term retention [38]. It also helps prevent bacterial leakage. Traditional evaluation methods relied on 2D point measurements or silicone replica techniques, which assess only limited areas [20-38]. More recently, the triple-scan technique using softwares as Geomagic Control X software (USA) has been introduced to assess full-surface internal and marginal adaptation of restorations [44]. This 3D approach allows non-destructive, comprehensive evaluation of the entire intaglio surface, providing practical and reproducible measurements while preserving specimens for further testing. However, its accuracy depends on precise scanning and alignment, which affects the reliability of deviation analysis [9].The three-dimensional fit of the restorations was assessed and described by Holst et al. using as the triple scan protocol within a 3D inspection software environment (Geomagic Control X) [45]. The main advantages of this approach include its rapid execution, simplicity, and non-destructive nature, allowing preservation of the specimens while enabling the identification of spatial discrepancies at multiple reference locations.

The reliability and accuracy of the triple-scan technique and 3D surface analysis are primarily dependent on the precision of the digital scanning process and the superimposition quality of the acquired three-dimensional datasets [46-47]. Moreover, Elagwany M et al recently published a study that supports a better marginal fit for overlay design [48]. The authors emphasized that cavity depth is a parametric factor that increases vertical discrepancies. Further support is provided by the conclusions of Gaintantzopoulou et al. and Yooseok et al, who identified axial wall height as a primary geometric determinant. Compared with preparations with reduced axial height, increased axial wall height enlarges the available surface area for friction between the cemented abutment and the internal surface of the restoration, which may consequently hinder complete seating [48-49]. Park et al provided an additional explanation, suggesting that decreased scanning accuracy in regions distant from scanner, along with the limited detection of undercut areas, may adversely affect the proper seating of restoration [49]. With respect to influence of material type on marginal and internal adaptation, most studies demonstrated comparable performance for used materials. This may be attributed to use of an identical CAD/CAM workflow and standardized milling protocols, with machine parameters individually optimized for each material, thereby minimizing potential differences in fit [50-51].

In this regard, Hasanzadeh et al. demonstrated that endocrowns fabricated from Vita Enamic, IPS e.max CAD, and Vita Suprinity exhibited no significant differences in marginal adaptation [50]. In contrast, other investigations by Godil et al have shown superior adaptation for lithium disilicate ceramics compared with polymer-based PEEK materials [51]. These authors attributed this discrepancy to differences in material composition, emphasizing that the semi-crystalline structure of PEEK, with filler particles embedded within the resin matrix, leads to a milling behavior that differs from that of lithium disilicate [51]. This observation was further corroborated by the micro-CT analysis conducted by Elagwany et al, which demonstrated a more irregular marginal configuration for PEEK restorations compared with the smoother and more precisely milled margins of lithium disilicate restorations [48]. In contrast, Osman et al. reported superior adaptation for PEEK compared with lithium disilicate [52]. However, a review of their methodology revealed that lithium disilicate restorations fabricated using pressing technique rather than CAD/CAM machining, and adaptation was assessed using the silicone replica method [52]. These methodological differences in both fabrication and evaluation techniques may account for discrepancy between the different studies (Table 3).

6. Conclusions

The restoration of endodontically treated teeth (ETT) has undergone a notable evolution, transitioning from conventional post-and-core crowns toward more conservative, biomimetic approaches such as endocrowns and overlays. The biomechanical performance of such teeth and the success of these contemporary restorations depends on multiple factors such as proper restorative design selection, proper adaptation and the use of materials that closely mimic the natural dental tissues. The literature provided no cutting edge on the specific indication for restorative designs and materials. It also lacks the clarity regarding the effect of the restorative approaches on the internal fit and marginal adaptation in ETT. More studies are needed to investigate the effect of the restorative designs and materials on fracture strength, fracture modes, internal and marginal adaptation.

Author contributions

Amira Amr Abd-El-Khalek, Ahmed Khaled Abo El Fadl, and Sara Mehanna Foudah contributed to the review work. Data collection methodology were performed by Amira Amr Abd-El-Khalek and Sara Mehanna Foudah. The first draft of the manuscript was written by Amira Amr Abd-El-Khalek and Sarah Mehanna Fouda. Amira Amr Abd-El-Khalek, Ahmed Khaled Abo El Fadl, and Sarah Mehanna Fouda commented on previous versions of the manuscript. Amira Amr Abd-El-Khalek, Ahmed Khaled Abo El Fadl, and Sarah Mehanna Fouda read and approved the final manuscript.

Declaration of conflict of interest

The authors declare no conflict of interest

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