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Lithium disilicate endocrowns for molars: A case series with short-term follow-up

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ABSTRACT

Background: Endocrowns have emerged as a conservative restorative option for endodontically treated posterior teeth with extensive coronal destruction. Advances in adhesive dentistry have reduced reliance on intraradicular posts, favouring restorations that preserve radicular dentin and utilize the pulp chamber for retention. Although the use of endocrowns in molars is well documented, additional clinical reports detailing standardized preparation designs, adhesive protocols, and short-term outcomes remain valuable for guiding clinical decision-making.

Case series: This case series describes the management of three endodontically treated permanent molars restored with lithium disilicate ceramic endocrowns. All teeth presented with extensive coronal structure loss and adequate pulp chamber depth for macromechanical retention. A standardized preparation design incorporating a butt-joint cervical margin, circumferential enamel preservation, and a pulp chamber depth of approximately 4 mm was employed. Endodontic therapy was completed using rotary nickel–titanium instrumentation, sodium hypochlorite-based irrigation, and warm vertical obturation. Endocrowns were fabricated from lithium disilicate ceramic and adhesively luted using a resin cement following hydrofluoric acid etching (20 s) and silanization. Clinical and radiographic follow-up was performed at 6 and 12 months.

Outcomes: At the final follow-up, all restorations remained intact, functional, and asymptomatic. Marginal adaptation was satisfactory, periodontal tissues were healthy, and no radiographic evidence of periapical pathology or restorative failure was observed.

Conclusion: Within the limitations of this short-term case series, lithium disilicate endocrowns demonstrated favorable clinical and radiographic performance in endodontically treated molars. These cases illustrate a reproducible clinical protocol and emphasise biomechanical and adhesive considerations rather than comparative efficacy.

Clinical significance: Lithium disilicate endocrowns provide a conservative, adhesive-based restorative alternative for severely compromised molars, eliminating the need for intraradicular posts while preserving radicular dentin and supporting predictable short-term outcomes when appropriate case selection and bonding protocols are employed.

1. Introduction

Over the years, restoring endodontically treated teeth has been a much-debated topic in dentistry. Since the beginning, continuous innovations and advancements have aimed to improve the way these teeth are rehabilitated, making the process more efficient, conservative, and long-lasting [1].

Root canal treatment is a routine dental procedure, but it can sometimes weaken the tooth structure. When part of the tooth is lost, its strength and resistance to fracture may decrease, which can affect how long the tooth lasts. This loss of structure can occur due to tooth decay, injury, or during the creation of the opening for the root canal [2].

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Traditionally, the gold standard for restoring endodontically treated teeth (ETT) with significant loss of tooth structure has been the use of full-coverage crowns—either metal-ceramic or all-ceramic—with or without a post. However, with advancements in dental materials and a growing emphasis on conserving natural tooth tissue, modern restorative approaches have shifted away from aggressive micromechanical techniques toward more conservative and adhesive-based methods.

These principles extend to endodontically treated teeth as well, leading to the development of the endocrown as an alternative restorative approach. In 1995, Pissis first introduced the heat-pressed ceramic monoblock technique, which utilized the pulp chamber to enhance the macromechanical retention of the restoration [3].

With the growing focus on minimally invasive dentistry and advancements in adhesive techniques, endocrowns have emerged as a conservative alternative for restoring endodontically treated teeth [4]. The term "endocrown" was first introduced by Bindl and Mörmann in 1999 [5].

Initially, endocrowns were fabricated using alumina- or spinell-reinforced non–silica-based ceramics and silica-based feldspathic ceramics, produced either through heat-pressing or, later, CAD/CAM technology. Over time, glass ceramics became the preferred material due to their ability to undergo surface modification—through hydrofluoric acid etching or air abrasion—which enhances their bond to tooth structures [3].

Ceramic endocrowns, particularly those fabricated from glass ceramics, continue to be widely used due to their superior esthetics, wear resistance, and adhesive potential. Zirconia has been reported to exhibit higher fracture resistance compared with other ceramics; however, its non-etchable nature limits predictable adhesive bonding and often necessitates reliance on macromechanical retention or alternative surface treatments. In contrast, lithium disilicate ceramics offer a favorable balance between strength and reliable adhesive bonding through hydrofluoric acid etching and silanization. For this reason, lithium disilicate was selected in the present cases to prioritize adhesive retention and marginal integrity in teeth restored without intraradicular posts.

Composite and hybrid materials have also been proposed for endocrown fabrication and may serve as alternatives to ceramics in selected clinical situations. Composite endocrowns exhibit an elastic modulus closer to dentin, which may favor stress distribution and reduce interfacial stress, but they are more susceptible to occlusal wear and marginal degradation over time. Hybrid ceramic–polymer materials aim to combine ceramic strength with resin resilience, although long-term clinical evidence remains limited. Consequently, material selection for endocrowns should be guided by occlusal load, remaining tooth structure, and bonding conditions, with ceramics representing one option among several restorative strategies [6,7].

The cases presented in this series were not intended to redefine restorative concepts or establish clinical superiority, but rather to demonstrate a consistent, protocol-based application of lithium disilicate endocrowns in molars, including justification for preparation dimensions, margin design, and adhesive procedures. By reporting short-term clinical and radiographic outcomes, this case series aims to contribute practical insights into the clinical execution of endocrowns while acknowledging the inherent limitations of observational case reporting [8].

2. Case selection and ethical considerations

The cases presented in this manuscript represent three consecutive patients treated within a defined clinical period who required restoration of endodontically treated molars with extensive coronal tooth structure loss. Cases were not selectively chosen based on outcome, and no cases were excluded on the basis of anticipated or observed treatment success.

At the time of manuscript preparation, no failed, complicated, or adverse outcomes related to the described restorative procedures had occurred within the available short-term follow-up period. The authors acknowledge that the limited duration of follow-up inherent to case reports restricts the ability to identify late complications such as debonding, ceramic fracture, or secondary caries, which is recognized as a limitation of the present report.

Written informed consent was obtained from all patients for treatment and for the use of clinical data and images for academic publication according to World Medical Association Declaration of Helsinki (2013 revision). This case series was prepared in accordance with the CARE (CAse REport) guidelines, ensuring transparent and complete reporting of patient information, diagnostic reasoning, clinical procedures, and outcomes. Formal institutional ethical approval was not required, as the manuscript reports retrospective, anonymized clinical cases without experimental intervention, in compliance with local institutional and national regulations.

3. Clinical procedures and evaluation criteria

3.1. Endodontic procedures

All treatments were performed under rubber dam isolation. Working length determination was carried out using an electronic apex locator, with radiographic confirmation. Root canal instrumentation was completed using a rotary nickel–titanium system following a crown-down preparation sequence.

Irrigation was performed using 3% sodium hypochlorite throughout instrumentation. Manual dynamic agitation was employed to enhance irrigant penetration, followed by a final rinse with 17% ethylenediaminetetraacetic acid (EDTA) for smear layer removal. The canals were subsequently flushed with saline and dried using sterile paper points.

Obturation was completed using a warm vertical compaction technique with gutta-percha and an epoxy resin–based sealer. Following obturation, the pulp chamber was sealed using a resin-modified glass ionomer cement, providing a coronal seal and a stress-moderating base beneath the definitive restoration.

3.2. Restorative preparation design and biomechanical rationale

After completion of endodontic therapy, teeth were prepared for endocrown restorations. The preparation design was standardized across cases and included:

- Pulp chamber depth of approximately 4 mm, selected to enhance macromechanical retention and improve stress distribution along the pulpal walls.
- Cervical margin height of approximately 2 mm, positioned supragingivally to preserve circumferential enamel, optimize adhesive bonding, and facilitate marginal integrity.
- Occlusal reduction of approximately 2 mm, providing sufficient ceramic thickness to resist functional loading while minimizing unnecessary tooth structure removal.

A circumferential butt-joint margin was selected in all cases to minimize cervical stress concentration and provide uniform ceramic thickness. Internal line angles were rounded, and pulpal walls were prepared with gentle divergence of approximately 6–10°, following standard endocrown preparation guidelines.

3.3. Periodontal considerations and Laser Crown lengthening (Case 1)

Laser-assisted crown lengthening was performed following periodontal evaluation. Biologic width was respected and a healing period of 4 weeks was allowed before impression making.

3.4. Impression technique and restoration fabrication

A two-step putty-wash polyvinyl siloxane impression technique was used. Endocrowns were fabricated from lithium disilicate ceramic and adhesively luted following hydrofluoric acid etching (20 s), silanization, and total-etch adhesive protocol.

3.5. Occlusal scheme

Restorations were adjusted to achieve stable centric contacts in maximum intercuspation with no excursive interferences.

3.6. Follow-up evaluation Criteria

Clinical and radiographic follow-up was performed at 6 and 12 months. Healing status, restoration integrity, and periapical status were assessed. Restoration survival was defined as the presence of an intact, functional endocrown without need for repair or replacement.

4. Case reports

4.1. Case report 1

A 34-year-old male patient visited the Department of Conservative Dentistry and Endodontics complaining of pain in his lower left back tooth region. Clinical and radiographic examination confirmed a diagnosis of Pulpal necrosis with chronic apical periodontitis, and nonsurgical endodontic retreatment was subsequently initiated under rubber dam. After completing the root canal treatment, the tooth showed an interocclusal clearance of 1.5 mm, a pulp chamber depth of 4 mm, and a cervical margin height of 2 mm(Fig. 1). Considering the remaining tooth structure and wall thickness, a lithium disilicate ceramic endocrown was planned as the post-endodontic restoration.

In the absence of periapical pathology, definitive endocrown restoration was initiated soon after completion of root canal therapy. Two millimeters of gutta-percha were removed from the canal orifices, which were then sealed first with Biodentine, Interlig glass fibers & Smart Dentin Replacement Plus. The tooth preparation featured a butt-joint margin and a central retentive cavity created with a coarse-grit diamond bur, extending 4 mm from the pulp chamber roof to the intracoronal cavosurface margin.The pulpal chamber walls were prepared with a gentle divergence of approximately 6–10°, following standard endocrown preparation guidelines, to enhance macromechanical retention and facilitating passive seating of the endocrown and optimizing adhesive retention, as recommended by Bindl and Mörmann and later studies on endocrown biomechanics [5,6]. The buccal and lingual walls were reduced using a WR-13 bur to achieve an interocclusal clearance of approximately 2 mm.

Laser-assisted crown lengthening was performed using a Biolase Waterlase system to achieve adequate clinical crown height for optimal restorative retention. Extracoronal finish lines were placed supragingivally, and any undercuts within the cavity were filled using conventional resin composite. Shade selection was performed prior to the restorative procedure, resulting in the choice of shade A3.

An impression was made using a polyvinyl siloxane putty–wash technique(Coltene Speedex). A preliminary putty impression was recorded, followed by syringing of light-body material around the prepared tooth. The putty impression was reseated to obtain a detailed final

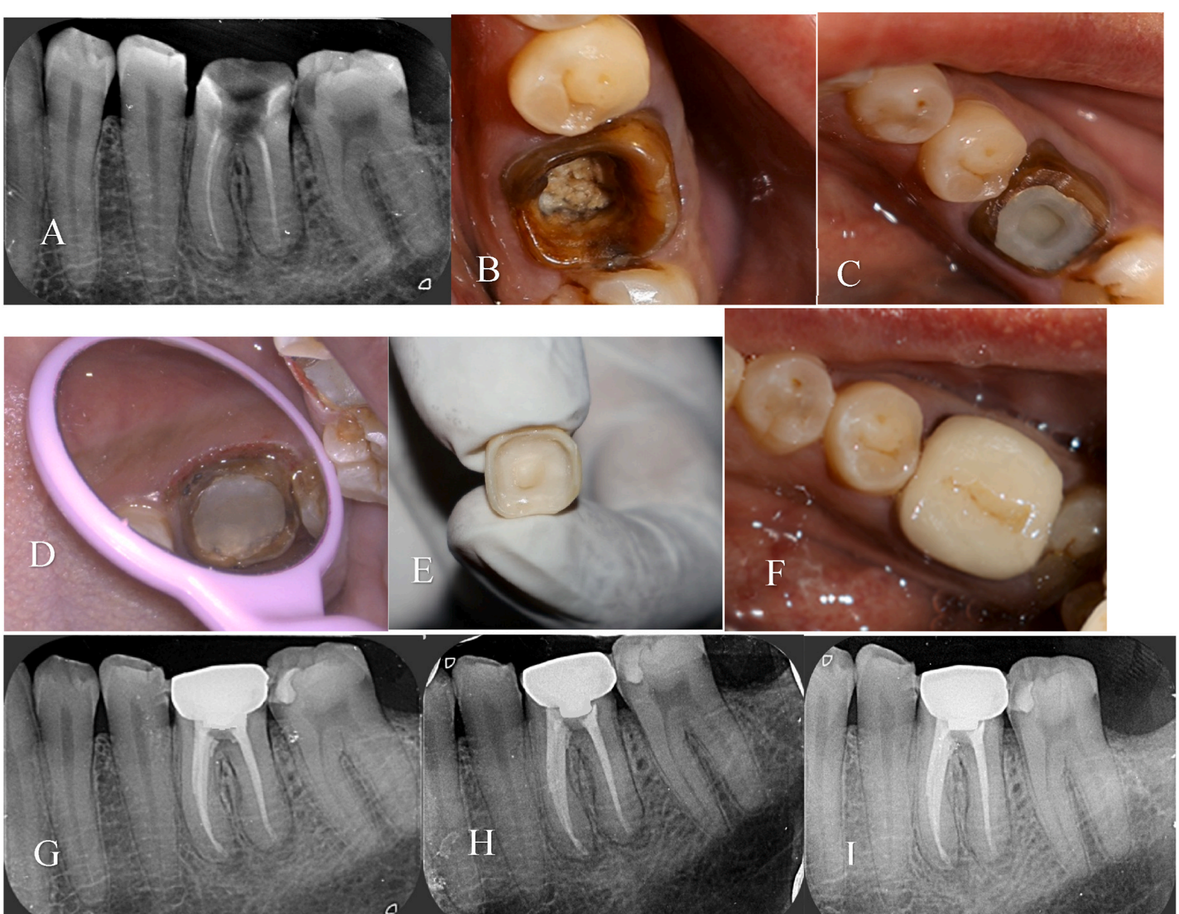

Fig. 1. Case report 1: (a) Preoperative intraoral periapical radiograph, (b) Preoperative Intraoral photograph, (c) tooth preparation,(d) Laser Crown lengthening, (e) endocrown, (f) Cementation, (g) postoperative radiograph (h) follow up 6months (i) follow up 1year.

impression and sent to the laboratory for prosthesis fabrication. Upon receiving the final prosthesis, a try-in was performed to evaluate the marginal fit and shade accuracy before final cementation.

The intaglio surface of the lithium disilicate endocrown was etched using 5% hydrofluoric acid for 20 seconds, followed by thorough rinsing and silane coupling agent was then applied for 1 min. The prepared tooth was isolated using a rubber dam(GDC) and etched with 37% phosphoric acid for 20 seconds, followed by rinsing and gentle drying with cotton.

A total-etch dual-cure resin luting cement(FGM Allcem Core) was applied to the intaglio surface of the endocrown, which was then adhesively bonded to the prepared tooth. Light curing was performed for 3 seconds to facilitate removal of excess cement, followed by final polymerization for 40 seconds on all surfaces. Post-cementation evaluation revealed satisfactory marginal adaptation, proper occlusal harmony, and favorable radiographic findings.

4.2. Case report 2

A 44-year-old male patient presented to the Department of Conservative Dentistry and Endodontics with a chief complaint of swelling in the lower right back tooth region. Clinical examination revealed an intraoral swelling, along with a draining sinus tract. Radiographic and clinical evaluations confirmed a diagnosis of pulpal necrosis with chronic apical abscess, and non-surgical endodontic retreatment was initiated under rubber dam. Considering the remaining tooth structure and wall thickness, a lithium disilicate ceramic endocrown was planned as the post-endodontic restorative option.

Following completion of endodontic therapy, the patient was placed under periodic clinical review. Definitive restorative treatment was deferred until resolution of the sinus tract and initial signs of periapical healing were confirmed, ensuring elimination of active infection prior to placement of an adhesive definitive restoration. During this healing phase, the tooth was restored with a provisional resin composite restoration to maintain function and prevent coronal microleakage.

Once clinical healing was evident, the tooth was prepared for an endocrown restoration the tooth exhibited an interocclusal clearance of 1.5 mm, a pulp chamber depth of 4 mm, and a cervical margin height of 2 mm(Fig. 2). Considering the remaining tooth structure and wall thickness, a lithium disilicate ceramic endocrown was selected as the definitive post-endodontic restoration.

A 2 mm of gutta-percha were removed from the canal orifices, which were then sealed using resin-modified glass ionomer cement. Tooth preparation involved creating a butt-joint margin and a central retentive cavity with a coarse-grit diamond bur to a depth of 4 mm from the pulp chamber roof to the intracoronal cavosurface margin.

The buccal and lingual walls were subsequently reduced with a WR-13 bur to obtain an interocclusal clearance of approximately 2 mm. Supragingival finish lines were established extracoronally, and any internal undercuts were blocked with conventional resin composite. Shade selection was carried out prior to the restorative procedure, resulting in the choice of shade A2.Impression and cementation procedure was performed similar to the earlier case report.

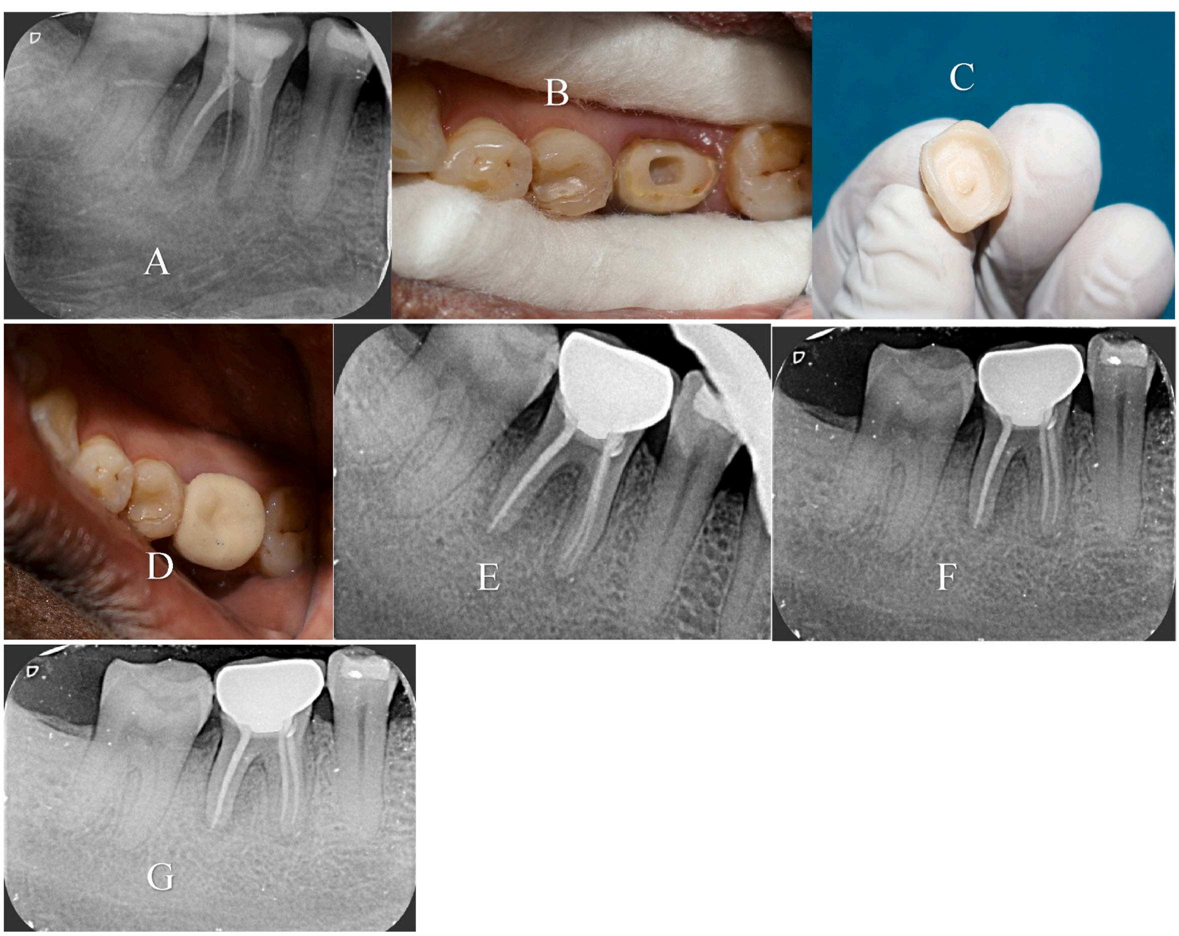

Fig. 2. Case report 2: (a) Preoperative intraoral periapical radiograph, (b) tooth preparation, (c) endocrown, (d) cementation, (e) postoperative radiograph (f) follow up 6months (g) follow up 1year.

4.3. Case report 3

A 41-year-old female patient presented to the Department of Conservative Dentistry and Endodontics with a complaint of pain in the lower right back tooth region. Clinical and radiographic evaluation revealed Pulpal necrosis associated with asymptomatic apical periodontitis, for which non surgical endodontic retreatment was initiated under rubber dam.

Working length was determined using an electronic apex locator and confirmed radiographically. Cleaning and shaping were carried out using a rotary nickel–titanium instrumentation system in a crown-down sequence. Irrigation was performed with 3% sodium hypochlorite, activated using manual dynamic agitation, followed by a final rinse with 17% EDTA to remove the smear layer. Obturation was completed using a warm vertical compaction technique with gutta-percha and an epoxy resin-based sealer(AH Plus(Dentsply DeTrey GmbH, Konstanz, Germany)). The pulp chamber was sealed with submicron hybrid composite (Brilliant EverGlow; Coltene, Altstätten, Switzerland).

After completion of endodontic treatment, the tooth was prepared for an endocrown (Fig. 3). The preparation incorporated a circumferential butt-joint margin located supragingivally, an occlusal reduction of approximately 2 mm, and a pulp chamber depth of nearly 4 mm to enhance macromechanical retention. Internal line angles were rounded, and enamel margins were preserved where possible.

A definitive impression was made using a two-step putty-wash technique with polyvinyl siloxane material. The endocrown was fabricated from lithium disilicate ceramic. Prior to cementation, the internal surface of the restoration was etched with 5% hydrofluoric acid for 20 seconds, rinsed, dried, and treated with a silane coupling agent. The tooth surface was conditioned following a total-etch adhesive protocol, and the restoration was adhesively luted using a dual-cure resin cement under rubber dam isolation.

At 6- and 12-month follow-up visits, the restoration was clinically intact, asymptomatic, and functional. Radiographic evaluation revealed normal periapical healing with no evidence of debonding, marginal deterioration, or secondary pathology.

5. Follow-up and outcomes

Patients were reviewed after 6 months. Clinical and radiographic findings revealed intact margins without microleakage, stable occlusion, absence of periapical pathology, and excellent esthetics and function.

6. Discussion

The clinical success of an endodontically treated tooth relies not only on precise root canal therapy but also on an appropriate and well-executed restorative procedure. Restoring such teeth presents a significant challenge to clinicians due to the wide range of available treatment options.

Advances in adhesive technologies, composite resins, fiber-reinforced posts, and indirect ceramic materials have revolutionized contemporary restorative approaches. Among these, adhesive indirect partial coverage restorations play a crucial role in preserving the biomechanical integrity of structurally compromised nonvital posterior teeth [8,9].

The indications for the use of an endocrown include molar teeth with extensive coronal destruction and those presenting with short,

Fig. 3. Case report3: (a) Preoperative intraoral periapical radiograph, (b) Preoperative Intraoral photograph, (c) tooth preparation(side view), (d) endocrown, (e) cementation, (f) postoperative radiograph (g) follow up 6 months (h) follow up 1 year.

dilacerated, or structurally fragile roots. Conversely, endocrowns are contraindicated in patients with parafunctional habits, in cases where the pulpal chamber depth is less than 3 mm or the cervical margin height is less than 2 mm, and in situations where adequate isolation and reliable adhesive bonding cannot be achieved [10–12].

The advantages of conservative bonded restorative techniques include the preservation of dental and periodontal tissues, reinforcement of the remaining sound tooth structure, and the provision of superior esthetic, ergonomic, and cost-effective outcomes [13].

Endocrowns provide a favorable alternative to conventional and post-and-core restorations due to their conservative and straightforward preparation. Their success can be attributed to factors such as the simplified preparation technique, adequate occlusal thickness, and compatible elastic modulus.

While conventional crowns rely on a ferrule for retention, this often requires the removal of healthy enamel and dentin, which can compromise bonding. In contrast, endocrowns utilize a ferrule-less design, preserving tooth structure and optimizing adhesive potential [14].

They are fabricated using the “monoblock porcelain technique,” in which the pulpal walls contribute to macromechanical retention, while adhesive cementation provides additional micromechanical retention [15].

The difference between post- and core-retained full crown and endocrown is summarized in Table 1.

The type of tooth restored with an endocrown is an important factor influencing clinical success. Bindl et al. reported a 31% failure rate of endocrowns in premolars, attributing it to the smaller adhesive surface area. In contrast, Belleflamme et al. suggested that endocrowns are a reliable restorative option for both molars and premolars, even in cases with extensive tooth structure loss or high occlusal loads.

Supporting this, a systematic review by Sedrez-Porto et al. concluded that endocrowns placed on molars demonstrated comparable or superior clinical survival rates and fracture resistance compared to conventional restorations using intraradicular posts, direct resin composites, or inlay/onlay restorations [16].

According to Zou et al., endocrowns are primarily indicated for molars due to their larger bonding surface area and favorable crown base-to-height ratio. Premolars present greater leverage forces and smaller adhesive surfaces, resulting in a higher failure rate compared to molars [10].

Most premolar endocrown failures result from adhesive loss, which is usually repairable. The marginal gap also critically influences the restoration's long-term success [11].

A study by Altier et al. compared the fracture resistance of endocrowns fabricated from lithium disilicate ceramic and indirect resin composite. The results indicated that lithium disilicate ceramic endocrowns exhibited significantly higher fracture strength than those made from indirect composite materials [17].

However, a recent study by Tribst et al. concluded that leucite-reinforced ceramics demonstrated more favorable stress distribution and could serve as a reliable alternative to lithium disilicate for endocrown fabrication [8,18,19].

Endodontic retreatment in teeth restored with endocrowns presents unique clinical challenges. The monolithic nature of lithium disilicate ceramics, while advantageous for strength and esthetics, complicates access during retreatment due to the difficulty of ceramic removal without damaging the remaining tooth structure. Ultrasonic and rotary diamond instruments are often required, increasing chairside time and the risk of iatrogenic damage. Therefore, meticulous endodontic treatment and confirmation of periapical health prior to definitive endocrown placement are critical to minimize the need for future retreatment [5,11,20,21].

Teeth without periapical pathology allow immediate placement of definitive adhesive restorations following root canal treatment. In contrast, teeth presenting with periapical lesions require a staged approach, including provisionalization and confirmation of healing before definitive restoration. Immediate endocrown placement in the presence of active periapical infection may compromise long-term success. Hence, clinical and radiographic resolution should guide the timing of lithium disilicate endocrown placement [22–26].

Two different pulp chamber sealing approaches were employed in this case series based on clinical presentation, remaining tooth structure, and restorative objectives. In Case 1, the pulp chamber floor was sealed using a combination of Biodentine, Interlig glass fibers, and Smart Dentin Replacement Plus (SDR+). Biodentine was selected for its bioactive properties, favorable sealing ability, and elastic modulus close to dentin, which may contribute to stress distribution at the dentin–restoration interface. The incorporation of glass fibers provided additional reinforcement within the pulp chamber, while the overlying SDR + offered improved flow, adaptation, and stress-modulating polymerization behavior, creating a reinforced and stress-absorbing intracoronal foundation. This multimaterial approach is particularly advantageous in teeth with extensive coronal destruction, where additional internal reinforcement and stress dissipation are desirable [27–29].

In contrast, Cases 2 and 3 utilized resin-modified glass ionomer cement (RMGIC) for pulp chamber sealing. RMGIC was selected due to its chemical adhesion to dentin, fluoride release, and adequate sealing ability, particularly in cases managed with a staged restorative approach following endodontic treatment and periapical healing. While RMGIC does not provide the same level of stress modulation or reinforcement as fiber-reinforced or resin-based systems, it offers simplicity, moisture tolerance, and satisfactory clinical performance when used as a base beneath adhesively luted indirect restorations [30,31].

Both sealing strategies demonstrated satisfactory short-term clinical outcomes in this case series. However, the Biodentine–fiber–SDR + combination may offer biomechanical advantages in heavily compromised teeth, whereas RMGIC represents a reliable and less technique-sensitive alternative in situations where biological sealing and procedural simplicity are prioritized. Long-term comparative clinical studies are required to determine whether these material-based differences translate into meaningful differences in survival or failure patterns of endocrown restorations.

Table 1
Comparison of endocrown with conventional post-and-core/full-coverage crown restorations [12].

Parameter	Conventional Post- and Core-Retained Full-Coverage Crown	Endocrown
Tooth Structure Removal	Requires removal of excessive radicular dentin for post space preparation	Does not require removal of radicular dentin
Ferrule Design	Requires ferrule preparation involving removal of sound enamel and dentin	Ferrule-less or minimal preparation, preserving tooth structure
Occlusal Thickness of Prosthesis	1.5–2 mm – less occlusal stress distribution	3.0–7 mm – allows better occlusal stress distribution
Interface Complexity	Multiple interfaces between dentin, luting cement, post material, core, and final restoration, leading to stiffness mismatch	Monoblock design – single unit structure minimizes stiffness mismatch
Overall Stress Behavior	Less favorable due to multiple interfaces	Greater occlusal stress absorption due to monoblock structure

7. Conclusion

Endocrowns offer a simple, conservative, and minimally invasive restorative option for endodontically treated posterior teeth by reducing the number of restorative interfaces and preserving sound tooth structure. Their clinical success depends largely on appropriate case selection, adequate adhesive bonding, and correct material choice. Within these parameters, endocrowns demonstrate favorable functional and esthetic outcomes. However, long-term prospective clinical studies are still required to further validate their durability and survival rates.

CRediT authorship contribution statement

Mohit Kumar Jyotiyana: Writing – original draft, Validation, Resources, Data curation. **Ashwini B. Prasad:** Writing – review & editing, Formal analysis, Conceptualization. **Deepak Raisingani:** Supervision, Methodology. **Harshit Srivastava:** Writing – review & editing, Formal analysis. **Charu Thanvi:** Writing – review & editing, Visualization.

Patient consent statement

We have obtained a complete written informed consent from the patient for the publication of this study and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Submission declaration

This manuscript has not been published previously, is not under consideration for publication elsewhere, and its publication has been approved by all authors. If accepted, it will not be published elsewhere in the same form, in English or in any other language, without the written consent of the copyright holder.

Declaration of generative AI use

During the preparation of this manuscript, **ChatGPT (OpenAI, GPT-based language model)** was used for language refinement, grammar correction, and improvement of scientific clarity. The authors take full responsibility for the originality, accuracy, and integrity of the content.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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