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Biomimetic Rehabilitation of a Structurally Compromised Endodontically Treated Mandibular First Molar Using a CAD/CAM Endocrown: A Case Report

Abstract
Purpose: To present the biomimetic rehabilitation of a structurally compromised endodontically treated mandibular first molar using a CAD/CAM-fabricated endocrown as a conservative alternative to conventional post-core restorations.
Case report: A 21-year-old male patient presented with deep carious destruction of tooth 46, associated with extensive loss of coronal tooth structure and periapical pathology. Clinical and radiographic evaluation led to a diagnosis of pulp necrosis with asymptomatic apical periodontitis. Nonsurgical root canal treatment was performed under magnification using a multivisit protocol, incorporating calcium hydroxide intracanal medication and obturation with a bioceramic sealer. A one-month follow-up demonstrated a reduction in periapical radiolucency, indicating initiation of healing. Given the limited residual tooth structure and absence of a favorable ferrule, a biomimetic approach was adopted. Following deep margin elevation, an endocrown preparation was performed to utilize the pulp chamber for added macromechanical retention while preserving radicular dentin. A fully digital workflow using the CEREC system enabled fabrication of a monolithic lithium disilicate-based endocrown (Dentsply Tessera). Adhesive cementation was carried out using a dual-cure resin cement following appropriate surface treatment and bonding protocols. The restoration exhibited satisfactory marginal adaptation, occlusal harmony, and functional stability. Post-cementation radiographic evaluation confirmed proper seating of the restoration along with continued periapical healing.
Conclusion: Endocrowns fabricated using CAD/CAM technology represent a predictable and minimally invasive biomimetic alternative for the rehabilitation of structurally compromised endodontically treated teeth. Appropriate case selection, adhesive protocols, and digital workflows contribute to favorable clinical and biological outcomes.

1. Introduction

Extensive coronal destruction in endodontically treated teeth (ETT) poses a serious restorative challenge, especially when the remaining tooth structure is not sufficient to support sufficient retention and resistance form to permit conventional full-coverage restorations [1-4]. Such teeth have traditionally been restored using post-core systems to retain a coronal restoration, although such an approach often necessitates further removal of radicular dentin, which may compromise the structural integrity of the root and increase the risk of catastrophic failure [5-8].

The concept of biomimetic restorative dentistry has become prominent in recent years, focusing on the preservation of the remaining tooth-restoration complex and the use of adhesive techniques to strengthen the residual tooth-restoration complex [9-12]. In this paradigm, endocrowns have developed as a predictable and conservative alternative to the rehabilitation of ETT with a significant loss of coronal support. As opposed to traditional endocrown restorations, which require intraradicular preparation to achieve retention, endocrown restorations derive retention by virtue of the pulp chamber and adhesive bonding to the internal walls, therefore, minimizing the need to perform intraradicular preparation to achieve retention [13-16]. Clinical trials and systematic reviews have shown good results with endocrowns, and reported survival rates with endocrowns are equal to or better than with conventional post-core crowns, especially in molars [17-20]. The monoblock structure that is formed by adhesive cementation is thought to facilitate a more homogeneous stress distribution, decreasing stress concentration in the root, and increasing fracture resistance [21-23]. Moreover, the development of adhesive systems and restorative materials, especially lithium disilicate and reinforced glass ceramics, has enhanced the mechanical performance and longevity of such restorations¹-two-three [24-27]. The predictability and efficiency of endocrown fabrication have been further enhanced with the integration of computer-aided design and computer-aided manufacturing (CAD/CAM) technologies. Due to digital workflows, it is possible to achieve a precise delineation of margins, the optimum occlusal morphology, and better marginal adaptation, which contribute to better clinical outcomes [28-31]. Chairside systems, like CEREC, enable the manufacture and delivery of restorations in a streamlined process, without compromising on accuracy and consistency.

Although these benefits exist, proper case selection is crucial, especially in cases where there are subgingival margins, limited ferrule, or compromised occlusal conditions [20,32]. The current case report presents biomimetic rehabilitation of a structurally diminished mandibular first molar with a CAD/CAM-fabricated endocrown, emphasizing the clinical decision-making model, adhesive evaluation, and incorporation of a digital workflow model to produce desirable functional and biological outcomes.

2. Case Presentation

A 21-year-old male patient presented with the chief complaint of food lodgment and decay in the lower right posterior region for a duration of one year. Clinical examination revealed extensive carious destruction of tooth 46 (FDI mandibular first molar), with only the buccal wall and distal marginal ridge remaining intact. The lingual wall and mesial marginal ridge were lost, with the defect extending subgingivally, compromising the cervical seal and restorative accessibility (Figure 1).

Figure 1. Preoperative intraoral clinical view of tooth 46 showing extensive coronal destruction.

Periodontal probing depths were within normal limits, indicating the absence of periodontal involvement despite the subgingival extension of the lesion. Pulp vitality testing using a cold test elicited no response, suggestive of loss of pulpal vitality. Radiographic examination demonstrated a radiolucency involving enamel, dentin, and pulp, associated with a well-defined periapical radiolucency. (Figure 2a)

Figure 2. Radiographic sequence of root canal treatment in tooth 46. (a) Preoperative radiograph showing extensive caries with periapical radiolucency; (b) Working length determination; (c) Intracanal calcium hydroxide dressing; (d) Master cone fit; (e) Post-obturation radiograph after 10 days.

Based on clinical and radiographic findings, a diagnosis of pulp necrosis with asymptomatic apical periodontitis was established (AAE).

2.1 Endodontic Management

Endodontic therapy was initiated under rubber dam isolation and magnification using a dental operating microscope to enhance visualization and procedural accuracy. Access cavity preparation revealed four distinct canals, mesiobuccal, mesiolingual, distobuccal, and distolingual, consistent with the anatomical complexity of mandibular molars.

Working length determination was performed using an electronic apex locator and confirmed radiographically (Figure 2b), ensuring accuracy and minimizing the risk of over- or under-instrumentation. Biomechanical preparation was carried out using rotary instrumentation under copious irrigation with 5% sodium hypochlorite, selected for its potent tissue-dissolving and antimicrobial properties. This was followed by 17% EDTA to remove the inorganic component of the smear layer. Passive ultrasonic irrigation (PUI) was used to increase the penetration of irrigants and disrupt biofilms in the canal system, thereby improving disinfection efficacy[18],[21].

As there was periapical pathology, a multi-visit endodontic treatment was implemented. The intracanal medicament was calcium hydroxide administered 10 days, with each administration lasting 30 seconds (Figure 2c), due to its high pH and well-recorded antimicrobial effects, as well as its capability to promote periapical healing and neutralize the residual bacterial toxins[17].

The patient was asymptomatic at the next visit, and the canals were dry, which means that the disinfection was adequate. To ensure that the apical sealing was proper and obturation was done using a bioceramic sealer to verify master cone fit (Figure 2d), and obturation was completed (Figure 2e). The use of bioceramic sealers was preferred because of their bioactivity, their ability to seal, and their potential in promoting periapical healing through the formation of hydroxyapatite.

2.2 Restorative Decision-Making

A one-month delay was purposefully added before final restoration to determine the biological response after the endodontic treatment. The patient was still asymptomatic at the time of recall, and the radiographic appearance showed that the size of the periapical radiolucency had decreased, indicating that the patient had commenced the healing process.

The tooth had a large amount of coronal loss and a lack of effective ferrule. In these cases, there is an increased risk of root fracture because of further removal of radicular dentin and poor distribution of stresses. [5-8] Thus, a biomimetic restorative strategy was taken.

The reason endocrown restoration was selected is that it has the ability to use the pulp chamber to provide macromechanical retention and retain the underlying tooth structure, and avoid the need to prepare post space. Also, when bonded together using adhesives, it becomes a monoblock system, which facilitates good stress distribution and promotes overall good structural integrity of the restored tooth. [13-16]

2.3 Tooth Preparation and Margin Management

The existence of subgingival margins has not been an easy task for the isolation and adhesive procedures. To overcome this, deep margin elevation (DME) was done utilizing composite resin to move the cervical margins to a suprangingival level. This method enhances isolation, predictability of bonding, and accuracy of impressions, which are all in line with minimally invasive and biomimetic principles [24, 25].

Following placement of a gingival retraction cord to expose the margins, endocrown preparation was carried out (Figure 3). The design of the preparation included a butt-joint margin to ensure even distribution of occlusal forces, divergent axial walls to ensure proper insertion and seating of the restoration, and the use of a pulp chamber to retain the same without causing unnecessary extension of the radicle. The design reduces the stress concentration in the root and encourages the desirable stress distribution under functional loading.

Figure 3. Endocrown tooth preparation demonstrating butt-joint margin and pulp chamber retention.

2.4 CAD/CAM Workflow

To increase the precision, reproducibility, and clinical efficiency, a completely digital workflow was utilized. Intraoral scanning was carried out after tooth preparation to capture the prepared tooth, adjacent dentition, and occlusal relationships, and a digital bite registration to accurately record maxillomandibular relations (Figure 4a, 4b). The obtained dataset was further processed in terms of CAD software, where the path of insertion (insertion axis) was carefully calculated to enable optimum seating of the restoration, as well as to avoid undercuts (Figure 4c). Then, the accurate delineation of marginal was performed, which is essential to attain optimal marginal adaptation and avoid microleakage (Figure 4d).

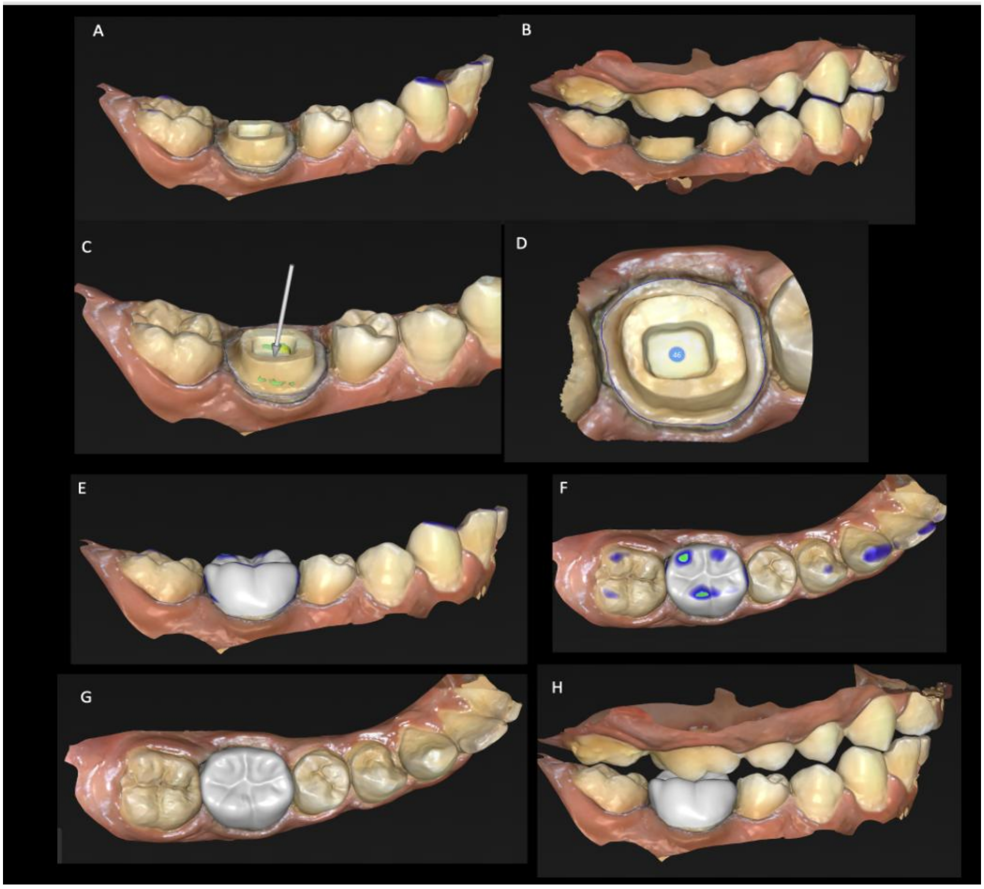

Figure 4. Digital CAD workflow for endocrown fabrication: (a) Intraoral scan; (b) Bite registration; (c) Determination of insertion axis; (d) Margin delineation; (e) CAD design of the endocrown; (f) Evaluation of proximal contacts; (g) Occlusal view of the design; (h) Digital occlusal relationship assessment.

The digital design stage enabled careful manipulation of the morphology of the restoration. The design of occlusal anatomy was in harmony with opposite dentition, to ensure appropriate cusp-fossa relationships and functional occlusion. Digital adjustment of proximal contacts was performed to achieve optimal contact tightness, thus reducing the risk of food impaction but avoiding excessive contact pressure (Figure 4e-h). This virtual design process minimizes variability of operators and makes predictable results by allowing modification in real time before fabrication. The completed digital design can be viewed in Figure 5.

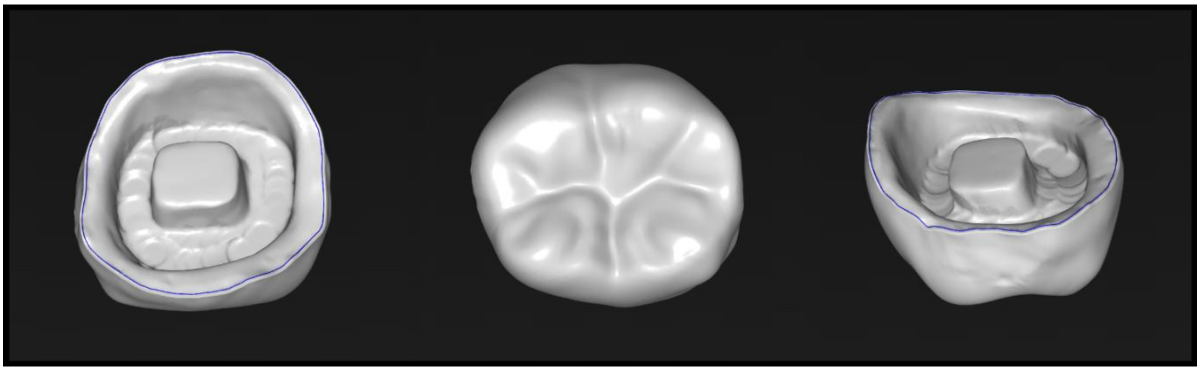

Figure 5. Final digital design of the endocrown.

The restoration was made of a Dentsply Tessera™ CAD/CAM block which is an advanced lithium disilicate material chosen due to its preferred combination of high flexural strength, fracture resistance, and esthetic translucency which makes it especially suitable in adhesively retained restorations. Milling has been done on a Primemill unit that allows the fabrication of high precision with a fine marginal detail and a true internal adaptation (Figure 6a-d). The manufacturing process of subtractive manufacturing provides consistency and reduces discrepancy related to the traditional laboratory process.

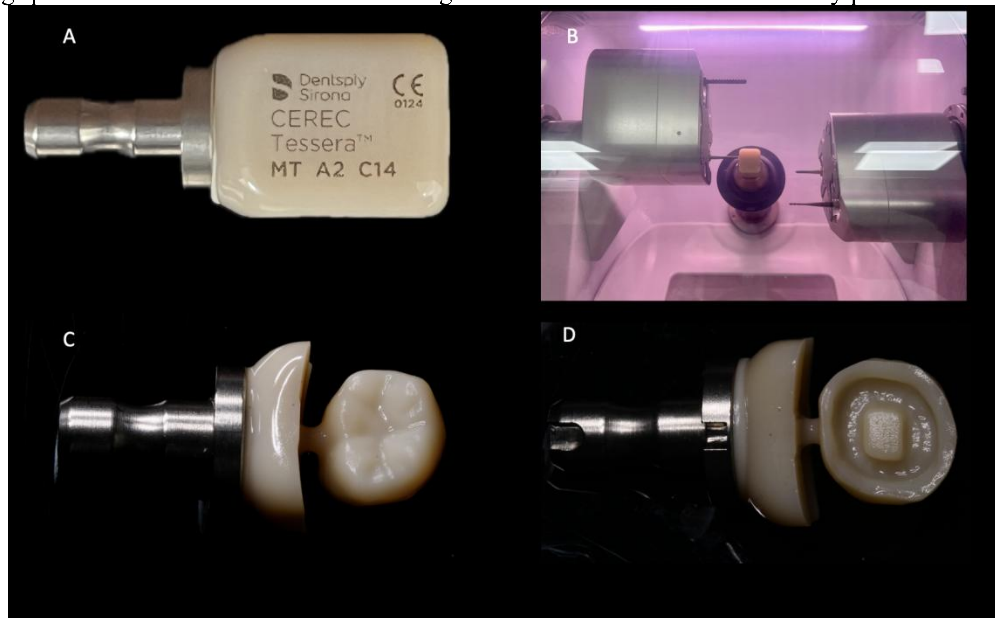

Figure 6. CAM workflow for fabrication of the endocrown: (a) Dentsply Tessera CAD/CAM block; (b) Milling using the Primemill unit; (c) Milled endocrown, occlusal view; (d) Milled endocrown, intaglio surface.

After milling, the restoration was then stained and glazed using the CEREC furnace (Figure 7a-c). This thermal treatment increases the mechanical properties of the material by making it stronger and more durable and stabilizing its end optical properties.

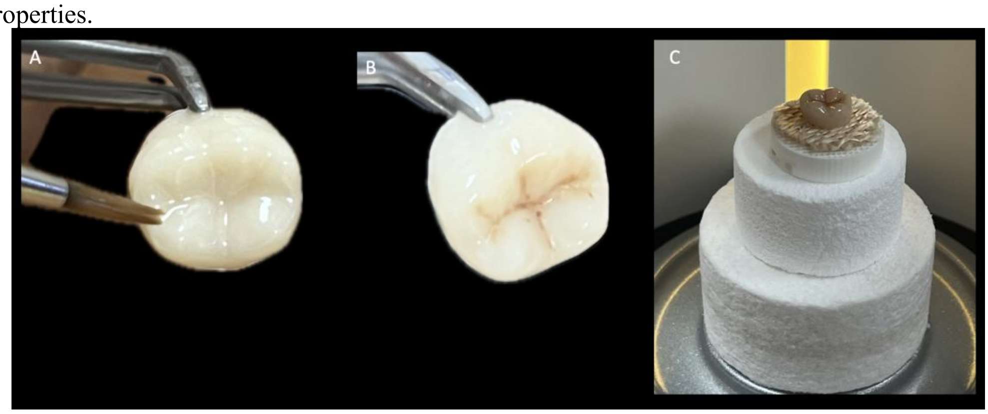

Figure 7. **Characterization of the restoration: (a) Glazing; (b) Staining; (c) Sintering/crystallization process.**

The last restoration (Figure 8a-c) showed accurate morphology, proper marginal adaptation, and clear occlusal anatomy. These findings are in line with the recorded benefits of CAD/CAM fabrication, such as a better fit, fewer marginal discrepancies, and greater clinical predictability [28-31].

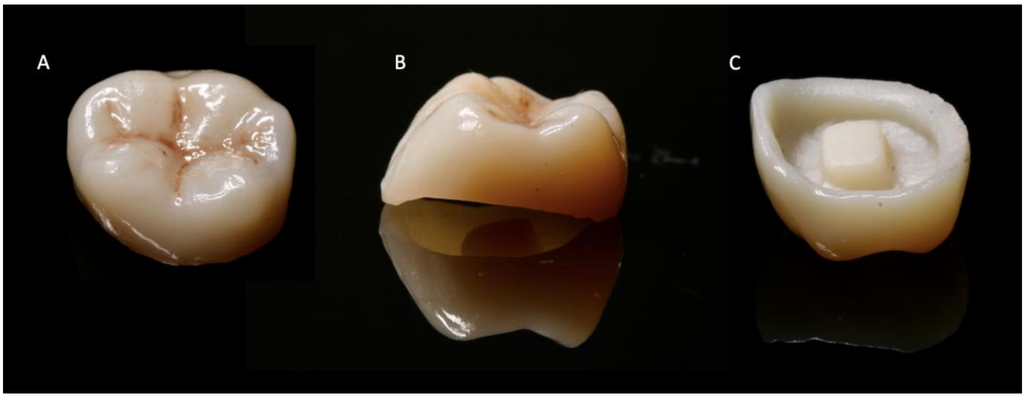

Figure 8. Final milled endocrown restoration: (a) Occlusal view: (b) Lateral view: (c) Intaglio surface.

2.5 Adhesive Cementation

Adhesive cementation was performed to achieve optimal bonding and reinforce the tooth-restoration complex. The intaglio surface of the endocrown was conditioned using 5% hydrofluoric acid for 20 seconds to create micromechanical retention, followed by thorough rinsing and drying. A 37% phosphoric acid application for approximately 30 seconds was used as a cleaning step to remove reaction by-products and enhance surface energy. A silane coupling agent was then applied and allowed to react for 60 seconds, establishing chemical bonding between the ceramic surface and the resin cement (Figure 9a-c) [24, 26].

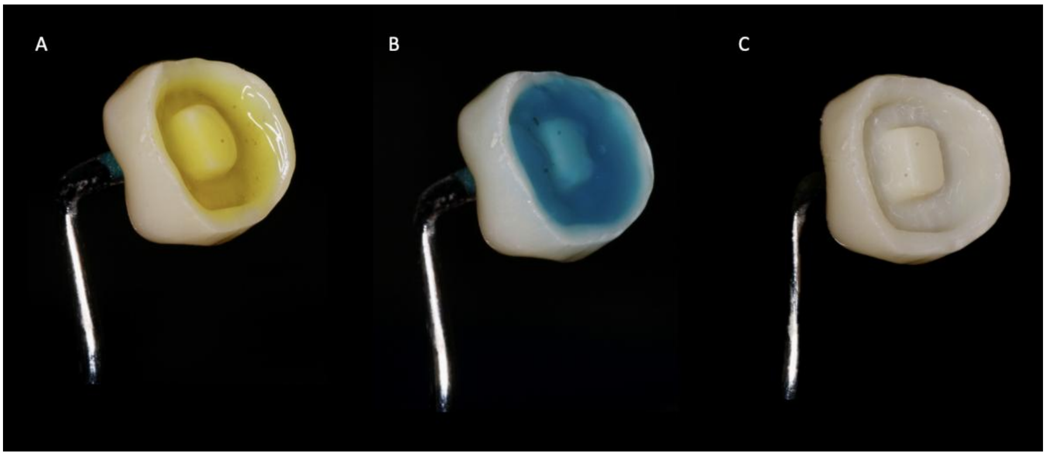

Figure 9. Surface treatment protocol for adhesive cementation: (a) Hydrofluoric acid etching; (b) Phosphoric acid cleaning; (c) Application of silane coupling agent.

The tooth surface was treated using an etch-and-rinse protocol, wherein enamel was etched with 37% phosphoric acid for 15-20 seconds and dentin for 10-15 seconds, followed by rinsing and gentle air-drying to maintain a moist dentin surface. A universal adhesive system (Prime & Bond) was applied actively, air-thinned to evaporate solvents, and light-cured according to manufacturer recommendations. This move is essential to attain successful hybridization of dentin and an increase in bond strength.

Luting was done with a dual-cure resin cement to achieve maximum polymerization, especially in the deeper regions of the pulp chamber where light penetration is minimal. The restoration was firmly seated under regulated pressure, and initial tack-curing was carried out for a few seconds to help in removing excess cement. Polymerization was then done on various sides to produce a regular polymerization.

The excess cement was taken away carefully, and occlusion was assessed by the use of articulating paper. The restoration had the correct seating, the optimum proximal contacts, and the harmonious occlusion without premature contacts (Figure 10a, 10b), hence ensuring the functional stability and reducing the risk of postoperative complications.

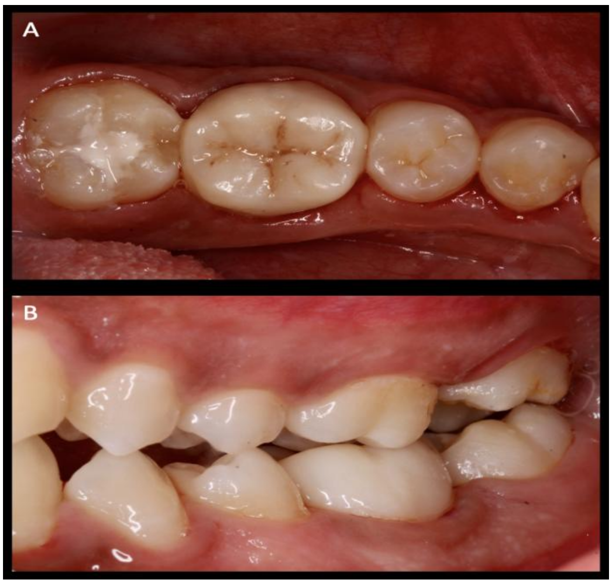

Figure 10. Clinical view after cementation of the endocrown: (a) Post-cementation occlusal view; (b) Occlusal relationship (bite).

3. Outcome

An intraoral periapical radiograph (Figure 11) was performed to determine whether the endocrown had

adapted satisfactorily. At follow-up, the patient was asymptomatic, and her percussion and palpation showed no tenderness.
The immediate post-obturation and follow-up radiographic comparison is presented in Figures 12a and 12b. Radiographic assessment showed a decrease in periapical radiolucency, which is an indication of continuous healing (Figure 12b). The restoration had acceptable functional and esthetic performance, and stable occlusion without clinical complications.

Figure 11. Post-cementation intraoral periapical radiograph showing satisfactory adaptation of the endocrown.

Figure 12. Radiographic comparison: (a) Immediate post-obturation radiograph; (b) Post-cementation radiograph at one-month follow-up showing reduction in periapical radiolucency and evidence of healing.

4. Discussion

The restoration of endodontically treated teeth (ETT) with extensive coronal destruction remains a complicated clinical challenge, especially in cases where the remaining tooth structure is inadequate to supply an adequate ferrule. The ferrule effect has been regularly recognized as a paramount factor in the fracture resistance and prognosis in the long term; nevertheless, in severely compromised teeth, the attainment of a ferrule can often necessitate further removal of healthy tooth structure or lengthening of the surgical crown, which may negatively impact on the periodontal support and overall prognosis [17-20]. In these situations, other restorative approaches that focus on preserving tooth structure are necessary.
Traditionally, post-core restorations have been employed to retain coronal restorations in ETT. But modern experience shows, that the intraradicular posts do not support the tooth, but merely fulfil a retentive role [33]. In addition, preparation of post space causes loss of radicular dentin, which contributes to increased susceptibility to root fracture, especially when subjected to functional and parafunctional loading conditions [5-8]. Both clinical and biomechanical research have found that the failure modes that are related to post-core systems are in most cases catastrophic and non-restorable, and thus, these systems should not be routinely used in structurally compromised teeth.The beginning of endocrowns signifies a paradigm shift to biomimetic and minimally invasive restorative dentistry [34]. Endocrowns are based on the pulp chamber to provide macromechanical retention and adhesive bonding to provide micromechanical and chemical retention, thus, eliminating the need to place post [13-16, 35]. The strategy maintains radicular dentin and minimizes the chances of developing iatrogenic weakening of the root. In addition, monoblock concept realised by adhesive cementation enables the tooth, luting agent and restoration to act as a single biomechanical unit, increasing the stress distribution and minimising interfacial failures [21-23]. Favourable survival rates of endocrowns, ranging between approximately 81% and 98% have been reported in systematic reviews and meta-analyses and particularly high success rates have been reported in molars due to their pulp chamber and increased bonding surface area [17-20]. Comparative studies have also shown that endocrowns are as fracture resistant as or more so than conventional post core crowns, provided that adhesive protocols are followed to the letter. Moreover, the failure modes in endocrowns tend to be positive (restorable) rather than disastrous root fractures experienced with post systems. Finite element analysis has been useful biomechanically in shedding light on stress patterns distributions. It has been demonstrated that endocrowns can evenly distribute the occlusal stresses along the cervical area and along the internal walls of the pulp chamber, thus reducing the stress concentration in the root structure [21-23]. Conversely, post core systems are likely to focus stresses at the post dentin interface and apical areas, which predispose the tooth to root fracture. The butt-joint margin design that is employed in the endocrowns also contributes to the positive stress distribution by transmitting compressive forces on the long axis of the tooth. The choice of material is a key factor which determines clinical success. Ceramics, such as Dentsply Tessera™, based on lithium disilicate have become widely accepted due to their high flexural strength (approximately 350-400 MPa), fracture toughness and excellent bonding ability [24-27]. These materials have shown to have an optimum balance between strength and elasticity thus being able to absorb and distribute functional stresses without transmitting excessive forces to the underlying tooth structure. The importance of advanced CAD/CAM ceramics and hybrid materials in enhancing fracture resistance and marginal adaptation, but long-term clinical data are limited, have also been highlighted by recent studies. Introduction of CAD/CAM technology

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has made the endocrown restorations more precise and predictable. Digital workflows enable accurate margin delineation, controlled occlusal morphology, and improved internal fit, thereby reducing marginal discrepancies and enhancing longevity [28-31]. The chairside systems like the CEREC enable the fabrication of the restorations to be produced with reduced chairside time but with high levels of accuracy. Research has shown that endocrowns produced by CAD/CAM technology have better marginal adaptation and internal fit than other types of endocrowns produced by alternative methods. The success of endocrowns has been significantly influenced by adhesive cementation, which directly affects retention, marginal integrity and stress distribution. The hydrofluoric acid etching and silane application complement each other as they promote interlocking at the micromechanical level and chemical bonding between the ceramic and resin cement [24,26]. Dual-cure resin cements assure sufficient polymerization even in deeper parts of the pulp chamber, where light penetration is low. The adhesive interface is important in order to attain the monoblock effect and to discourage debonding or marginal leakage.In the current case, the subgingival margins could be shifted to a more convenient supragingival location with the use of deep margin elevation (DME), thus making isolation and adhesive procedures more accessible. DME has been shown to improve marginal adaptation and bonding efficacy while avoiding the need for more invasive procedures such as crown lengthening [24,25]. When done properly, it does not negatively influence the health of the periodontium and helps to achieve better clinical results.The biological point of view is that the one-month interval between obturation and definitive restoration provided an opportunity to examine periapical healing, which is a significant factor to consider in the cases with apical pathology. The noted decrease in periapical radiolucency is the sign that the healing process has begun and is a good indicator of the success of the endodontic treatment. Intracanal medicament and bioceramic sealer of obturation further added to the microbial control and biological sealing, which is needed to facilitate the periapical repair.Although the benefits of endocrowns are many, some drawbacks have to be considered. Case selection is also critical since endocrowns are not necessarily appropriate in teeth with inadequate depth of pulp chamber, low bonding surface area, or poor occlusal profile, such as heavy bruxism [20,23]. Also, despite the encouraging short- to medium-term outcomes, long-term clinical profiles, especially of new CAD/CAM materials, are undergoing development. The skills of the operator, the compliance with adhesive policies, and the management of the occlusal are also important factors in clinical success.

The positive effect of the case observed can be explained by the correct choice of the case, compliance with the principles of biomimetic, careful endodontic, and adhesive procedures, and a precise CAD/CAM workflow. The results are in line with the growing body of evidence that has been in support of the use of endocrowns as a predictable and conservative alternative to traditional postcore restorations in structurally compromised endodontically treated molars.

5. Conclusion

The biomimetic rehabilitation of a structurally compromised endodontically treated mandibular first molar using a CAD/CAM-fabricated endocrown showed good clinical and radiographic results in the limitations of this case report. Use of an endocrown made possible preservation of the remaining tooth structure, elimination of the post space preparation, and creation of a monoblock effect via adhesive bonding, thus leading to improved biomechanical performance. The incorporation of a digital workflow with the CEREC supported the accurate fabrication, maximum marginal adaptation, and efficient delivery of treatment. Also, deep margin elevation was used to help manage the subgingival margins, increasing the isolation and bonding predictability. The observed decrease in periapical radiolucency after endodontic therapy, as well as satisfactory functional and occlusal outcomes after restoration, are indicative of the importance of proper case selection, adherence to adhesive protocols and a multidisciplinary approach consisting of a combination of endodontic and restorative principles. Endocrowns are a predictable and conservative alternative to the traditional post-core restorations on the structurally compromised posterior teeth. Nonetheless, clinical research studies in the long-term will be needed to further establish their durability and performance in various materials and clinical conditions.

References

1. Dartora NR, de Conto Ferreira MB, Moris IC, Brazão EH, Spazin AO, Sousa-Neto MD, Silva-Sousa YT, Gomes EA. Effect of intracoronal depth of teeth restored with endocrowns on fracture resistance: in vitro and 3-dimensional finite element analysis. Journal of endodontics. 2018 Jul 1;44(7):1179-85.
2. Govare N, Contrepois M. Endocrowns: A systematic review. The Journal of prosthetic dentistry. 2020 Mar 1;123(3):411-8.
3. Al-Dabbagh RA. Survival and success of endocrowns: A systematic review and meta-analysis. The Journal of prosthetic dentistry. 2021 Mar 1;125(3):415-e1.
4. Thomas RM, Kelly A, Tagiyeva N, Kanagasingam S. Comparing endocrown restorations on permanent molars and premolars: a systematic review and meta-analysis. British dental journal. 2020 Nov 12:1-9.
5. Papalexopoulos D, Samartzi TK, Sarafianou A. A thorough analysis of the endocrown restoration: a

literature review. The journal of contemporary dental practice. 2021;22(4):422-6.

6. Dogui H, Abdelmalek F, Amor A, Douki N. Endocrown: An alternative approach for restoring endodontically treated molars with large coronal destruction. Case reports in dentistry. 2018;2018(1):1581952.
7. Tzimas K, Tsiafitsa M, Gerasimou P, Tsitrou E. Endocrown restorations for extensively damaged posterior teeth: clinical performance of three cases. Restorative dentistry & endodontics. 2018 Aug 22;43(4):e38.
8. Belleflamme MM, Geerts SO, Louwette MM, Grenade CF, Vanheusden AJ, Mainjot AK. No post-no core approach to restore severely damaged posterior teeth: An up to 10-year retrospective study of documented endocrown cases. Journal of Dentistry. 2017 Aug 1;63:1-7.
9. Tribst JP, Dal Piva AM, Madruga CF, Valera MC, Borges AL, Bresciani E, de Melo RM. Endocrown restorations: Influence of dental remnant and restorative material on stress distribution. Dental Materials. 2018 Oct 1;34(10):1466-73.
10. Eskitaşçioğlu M, Küçük O, Eskitaşçioğlu G, Eraslan O, Belli S. The effect of different materials and techniques on stress distribution in CAD/CAM endocrowns. Strength of Materials. 2020 Sep;52(5):812-9.
11. Zarone F, Sorrentino R, Apicella D, Valentino B, Ferrari M, Aversa R, Apicella A. Evaluation of the biomechanical behavior of maxillary central incisors restored by means of endocrowns compared to a natural tooth: a 3D static linear finite elements analysis. Dental materials. 2006 Nov 1;22(11):1035-44.
12. Gresnigt MM, Braeckmans A, van der Made SA, Naves LZ. Partial anterior indirect restorations in cases with dentin exposure. International Journal of Esthetic Dentistry. 2021 Dec 1;16(4).
13. Weiser F, Behr M. Self-adhesive resin cements: a clinical review. Journal of Prosthodontics. 2015 Feb;24(2):100-8.
14. Rocca GT, Krejci I. Crown and post-free adhesive restorations for endodontically treated posterior teeth: from direct composite to endocrowns. Eur J Esthet Dent. 2013 Jun 1;8(2):156-79.
15. Mangoush E, Lassila L, Vallittu PK, Garoushi S. Shear-bond strength and optical properties of short fiber-reinforced CAD/CAM composite blocks. European Journal of Oral Sciences. 2021 Oct;129(5):e12815.
16. Fabian Fonzar R, Goracci C, Carrabba M, Louca C, Ferrari M, Vichi A. Influence of Acid Concentration and Etching Time on Composite Cement Adhesion to Lithium-silicate Glass Ceramics. Journal of Adhesive Dentistry. 2020 Mar 1;22(2).
17. Yuen JJ, Saw ZK, Chua HS, Beh YH. Clinical behavior and survival of CAD-CAM resin nanoceramic and polymer interpenetrating ceramic network material restorations on endodontically treated teeth: A systematic review and meta-analysis. The Journal of Prosthetic Dentistry. 2025 Jun 1;133(6):1437-e1.
18. Otto T. Computer-aided direct all-ceramic crowns: preliminary 1-year results of a prospective clinical study. International Journal of Periodontics and Restorative Dentistry. 2004 Oct 1;24:446-55.
19. Chang CY, Kuo JS, Lin YS, Chang YH. Fracture resistance and failure modes of CEREC endo-crowns and conventional post and core-supported CEREC crowns. Journal of Dental Sciences. 2009 Sep 1;4(3):110-7.
20. Zheng Z, Wang H, Mo J, Ling Z, Zeng Y, Zhang Y, Wang J, Yan W. Effect of virtual cement space and restorative materials on the adaptation of CAD-CAM endocrowns. BMC Oral health. 2022 Dec 9;22(1):580.
21. Saad W, Saleh AR, Almaslamani M. Evaluation of Internal Adaptation of Different CAD/CAM Endocrown Materials: A Comparative Microcomputed Tomography Study. Ceramics. 2025 Mar 31;8(2):33.
22. Taha AI, Saad AE. Clinical and radiographic outcomes of endocrowns fabricated from two different CAD-CAM materials versus stainless steel crowns in restoring first permanent molars in children: a randomized clinical trial. BMC Oral Health. 2025 Jul 8;25(1):1127.
23. Dinçtürk B A, Garoushi S, Alp C K, PK V, MB Ü, Lassila L. Fracture resistance of endocrowns made from different CAD/CAM materials after prolonged fatigue aging. Clinical Oral Investigations. 2025 Feb 22;29(3):149.
24. Taha AI, Saad AE. An in vitro evaluation of tensile strength of molar endocrown milled from various computer aided design and manufacturing materials. Scientific Reports. 2024 Oct 23;14(1):24952.
25. Binaljadm TM. Effect of Pulp Chamber Depth and Base Material on Fracture Resistance of CAD/CAM Endocrown. Journal of International Dental and Medical Research. 2025;18(1):77-82.
26. Kontakou Zoniou A, Tzimas K, Pappa E, Rahiotis C. Clinical Performance of Endocrowns in Molars: A Scoping Review. Medicina. 2025 Aug 30;61(9):1562.
27. Dudley J, Farook TH. Measuring the marginal gap of pre-cemented all-metal single crowns: A systematic review of in vitro studies. Dentistry Journal. 2025 May 2;13(5):204.
28. Ayata M, Oktay EK, Albayrak H, Çakar M, Özcan M. Evaluation of the clinical performance of endocrown and overlay restorations: A 4-year retrospective study. Journal of Dentistry. 2025 Sep 1;160:105874.
29. Fraga S, Balbinot GD, Quadros BG, Rodrigues SB, Foggi CC, Collares FM. Mechanical behavior of endocrown vs. post-and-crown: a systematic review and meta-regression analysis. Brazilian Dental Journal. 2025;36:e25-6632.
30. Bindl A, Mormann WH. Clinical evaluation of adhesively placed Cerec endo-crowns after 2 years-preliminary results. Journal of Adhesive Dentistry. 1999 Jan 1;1:255-66.

31. Jebali C, Riahi Z, Ayadi L, Hadyaoui D, Harzallah B, Cherif M. Endocrown: An Alternative Approach for Restoring Endodontically Treated Molars. Sch J Dent Sci. 2025 Apr;3:24-31.
32. Wejden BA, Yosra G, Elhouda LN, Zohra N, Dalenda H, Jilani S, Mounir C, Belhassan H. Digital Workflow Optimization for Endocrown Restorations on Root-Treated Teeth. Sch J Dent Sci. 2024 Nov;9:119-25.
33. de Morais DC, Butler S, Santos MJ. Current insights on fiber posts: A narrative review of laboratory and clinical studies. Dentistry Journal. 2023 Oct 10;11(10):236.
34. Reis A, Feitosa VP, Chibinski AC, Favoreto MW, Gutierrez MF, Loguercio AD. Biomimetic Restorative Dentistry: an evidence-based discussion of common myths. Journal of Applied Oral Science. 2024 Oct 25;32:e20240271.
35. Cardoso JA, Almeida PJ, Negrão R, Oliveira JV, Venuti P, Taveira T, Sezinando A. Clinical guidelines for posterior restorations based on Coverage, Adhesion, Resistance, Esthetics, and Subgingival management. The CARES concept: Part I-partial adhesive restorations. Int J Esthet Dent. 2023 Jul 18;18(3):244-65.