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Restoration of Structurally Broken Maxillary Incisor: A Case Report

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Abstract

Endodontic failures, often attributed to persistent microbial infections and inadequate restorations, pose challenges in preserving natural dentition. This case report presents the inter-disciplinary management of a severely compromised maxillary left central incisor in a 33-year-old female. The tooth, previously subjected to inadequate endodontic treatment, presented with fracture, pus discharge, and persistent apical periodontitis.The multifaceted treatment approach included: endodontic retreatment utilizing metronidazole and calcium hydroxide as intracanal medicaments to combat persistent infection; laser-assisted crown lengthening to establish a 2 mm ferrule, enhancing structural integrity; and restoration with a custom-cast post core, and porcelain-fused-to-metal crown. The post space preparation preserved 5 mm of apical gutta-percha to maintain the apical seal. At the 6-month follow-up, the tooth remained asymptomatic with satisfactory function and aesthetics. This case underscores the potential for salvaging structurally compromised, endodontically challenged teeth through a synergy of advanced techniques. It highlights the importance of thorough disinfection, an adequate ferrule, and well-adapted restorations for endodontic success. It advocates for patient-centered care that prioritizes natural tooth preservation over implant. This report contributes to the evolving paradigm of endodontic outcome

assessment, emphasizes the need for a holistic understanding of tooth biomechanics, microbiology, and restorative principles.

Categories: Dentistry

Keywords: tooth preservation, porcelain-fused-to-metal crown, endodontic failure, custom cast post and core, endodontic retreatment

Introduction

The restoration of endodontically treated teeth is a well-established treatment method with significant clinical success [1-3]. When root canal treatment is adequately carried out, healing of the periapical lesion usually occurs with a gradual reduction and resolution of the radiolucency observed on subsequent examination [1]. Root canal treatment can fail when performed inadequately, but sometimes failure occurs despite high standards [4].

Endodontic failures are often associated with persistent peri-radicular inflammation [5], which is commonly caused by residual microbial infections within the root canal system. Enterococcus faecalis is frequently implicated as the primary microorganism responsible for such persistent infections [6]. The presence of such bacteria in previously treated canals underscores the complexity of achieving and maintaining a sterile environment within the root canal system [5].

In cases of significant coronal tooth structure loss, post-and-core systems are often employed to provide adequate retention for the final restoration [1]. These systems can be prefabricated or custom-made, with each offering distinct advantages in different clinical scenarios [2]. The choice between post systems can significantly impact the long-term prognosis of the restored tooth. Studies have shown that custom cast post-and-cores demonstrate favorable survival rates, particularly in anterior teeth with extensive structural loss [3,4]. The success of any post-and-core system is heavily dependent on the presence of an adequate ferrule, which has been shown to significantly enhance fracture resistance and overall restoration longevity [5]. Properly designed and implemented, post-and-core restorations can effectively distribute occlusal forces and provide a stable foundation for the final crown, ultimately contributing to the successful rehabilitation of endodontically treated teeth.

This case report highlights a challenging instance of endodontic failure in a maxillary incisor. Exploring the biological and procedural factors contributing to this failure, including the role of microbial re-infection andstructural compromise. By presenting this case, the report aims to stress the critical elements in the management of endodontically treated teeth, particularly those at risk of failure. Understanding these factors can inform clinicians' decisions and enhance the longevity and success of endodontic therapies.

Case Presentation

A 33-year-old female reported at the Department of Conservative Dentistry and Endodontics with a complaint of a fractured maxillary left central incisor (tooth #21) accompanied by pus discharge and pain. The patient reported undergoing endodontic treatment on this tooth four years prior, which was not followed by a crown placement. Clinical examination revealed a fractured crown on tooth #21 (Figure *1*). Soft tissue examination showed pus discharge from the sinus tract which was in the buccal attached gingiva in relation to #21 with no extraoral or intraoral swelling. Vertical and horizontal tenderness on percussion was positive, with the patient reporting throbbing pain of sudden onset. A small, leathery mass of reddish-pink color was present in the labial vestibule adjacent of tooth #21, which was also tender on palpation. Radiographic examination revealed tooth #11 appeared endodontically treated tooth. Tooth #21 showed a fractured crown and overextended gutta-percha in the root canal. A periapical radiolucency was evident around the apex of tooth #21 (Figure *2*). Clinical and radiographic evaluation led to the diagnosis of symptomatic previously treated 21 with apical abscess. Endodontic retreatment was recommended for this patient.

FIGURE 1: Preoperative Clinical Picture

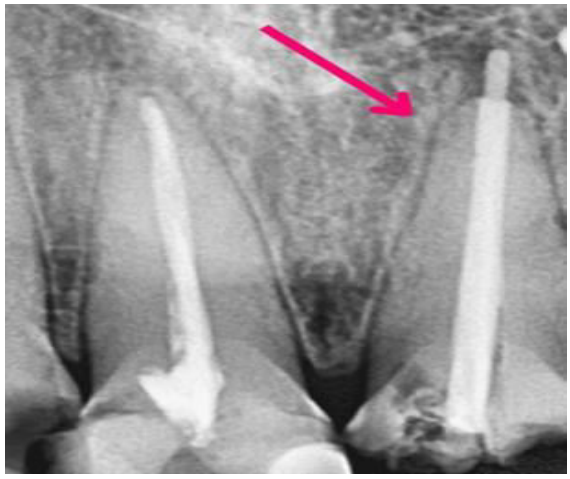

FIGURE 2: Pre-operative Radiograph of tooth number 21

After obtaining informed consent, the patient was prescribed antibiotic of metronidazole 400 mg thrice daily for five days. For pain management, a combination of analgesics (aceclofenac 100 mg with paracetamol 325 mg) was prescribed twice daily for five days. Pus discharge was localized at the apical region of the affected tooth, a draining sinus tract was observed in the same area.

Five days later, during the second visit, the tooth was isolated using a rubber dam with the split dam technique, and the old restorative material from the maxillary left central incisor (tooth #21) was removed.

The overextended gutta-percha was carefully extracted from the canal using Hedstrom files (H-File) of sizes #40 and #45 (DentsplyMaillefer M-Access Hedstrom File) with retraction motions. Periapical radiographs confirmed the thorough removal of obturation material from the root canal walls (Figure *3*).

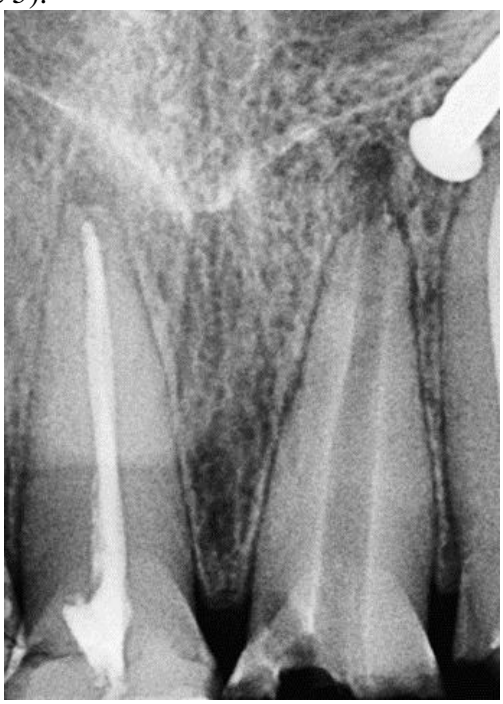

FIGURE 3: Radiographic image of removal of overextended GP

The working length of the canal was determined to be 21 mm using the radiographic method. Biomechanical preparation was carried out using a series of hand files, progressing to a Dentsply Universal ProTaper Finishing Hand File 4 (F4 file finishes the apical preparation in larger canals with a tip diameter of 0.40 mm and a taper of 6%). The crown-down technique was employed for this procedure due to its advantage of minimizing debris extrusion.

The irrigation protocol employed a sequence of irrigants to maximize disinfection and removal of the smear layer. Initially, 17% EDTA (ethylenediaminetetraacetic acid) was used as lubricating agent [7]. This was followed by a saline rinse to neutralize to remove the detached bacteria and helps in debridement. Finally, 2% chlorhexidine was used as the final irrigant due to its broad-spectrum antimicrobial activity and substantivity, providing prolonged antibacterial effects [8]. Irrigation was performed using a 30-gauge closed-end double side vented needle.

An intracanal medicament of metronidazole mixed with calcium hydroxide was placed into the root canal. This was followed by a temporary restoration using Cavit G by 3M ESPE paste was placed in the access cavity to secure the treated tooth. This combination was chosen due to its synergistic antimicrobial effects. Calcium hydroxide is widely used for its alkaline pH, which creates an environment unfavorable for bacterial growth, while metronidazole is particularly effective against anaerobic bacteria commonly found in endodontic infections [8,9]. The patient was scheduled for second appointment seven days later.

During the third visit, the patient showed a cessation of pus discharge, although mild tenderness on percussion persisted. To manage this, the root canal was re-irrigated using a sequence of solutions, a saline rinse followed by 2% chlorhexidine irrigation. An intracanal medicament consisting of metronidazole mixed with calcium hydroxide was placed. A temporary restoration was placed, and the patient was scheduled for a follow-up appointment after seven days for further evaluation.

By the fourth visit, the patient was asymptomatic. Irrigation was carried out using a 30-gauge closed-end double side vented needle, first with 2ml 0.9% normal saline followed by 2ml of 2% chlorhexidine digluconate. The canal was thoroughly cleaned using this irrigation protocol. An intracanal medicament combining metronidazole and calcium hydroxide was then placed. Finally, the access cavity was sealed with a temporary restoration to secure the treated tooth until the next appointment.

Two days later, during the fifth visit, the apical fit of the master gutta-percha cone (6% #40) was verified radiographically. Canal obturation was then performed using the lateral condensation technique. An additional of 6 accessory cones (2% #15) were inserted until no space remained in the canal. An obturation pen (Obtura by Endoking) was used to shear off the excess gutta-percha remaining in the pulp chamber and was condensed with a heated plugger. Following obturation, a temporary restoration was placed in the access cavity to secure the treated tooth.

Given the presence of an adequate band of thick keratinized attached gingiva, a lack of inflammation, and a suitable sulcus depth, a crown lengthening procedure was considered necessary for the maxillary tooth (#21) during the sixth visit. This visit was scheduled with a two-days gap from the fifth visit to allow for any initial post-obturation responses to subside. The area was prepared with 10% povidone-iodine, and local anesthesia (1:80000 lignocaine and adrenaline, brand named LIGNOX 2%A, manufactured by Indoco) was administered via infiltration at the height of the mucco-buccal fold above the apex of the left central incisor.

Using a diode laser (DentsplySirona) [10], laser cauterization was employed to lengthen the crown. Precisely 2 mm of the attached gingiva was marked, and then a laser was used to electrocauterize the gingival tissue effectively. This approach removed the excess tissue and reshaped the gingival margin around the maxillary tooth (#21), enhancing the visibility and

length of the clinical crown. The laser also simultaneously achieved hemostasis, minimizing bleeding and promoting a clean surgical field. The precise control of the laser allowed for gradual and controlled tissue removal, ensuring an optimal 2 mm increase in crown length. The patient was prescribed anti-inflammatory medication and chlorhexidine gluconate (0.12%) rinse at least twice daily for 30 seconds for five days. Following the procedure, the area was allowed to heal for two weeks. During this period, the tissue settled into its new position, providing a stable and extended ferrule for subsequent restorative treatment.

At the seventh visit, after radiographic evaluation, the gutta-percha was removed using a Peeso reamer size #3 (Mani Stainless Steel Peeso Reamers - 32 mm Assorted) for the post space preparation by preserving 5 mm of the gutta-percha apically. The wax impression was made using inlay wax (GC Inlay Wax Medium) and was subsequently sent to the lab for the fabrication of custom-made cast post. After impression making temporary restoration was placed in the access cavity (Figure *4*).

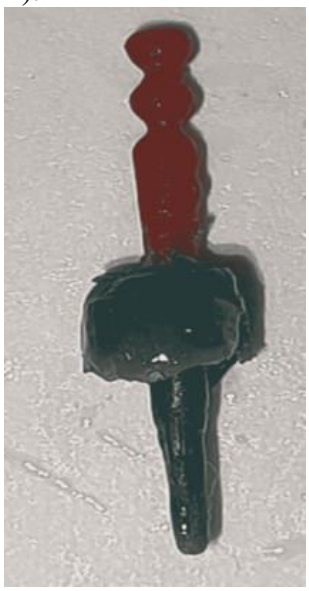

FIGURE 4: Inlay wax impression for metal cast post

The metal cast post was collected from the laboratory after one week and luted at the eighth visit using radiopaque self-cure glass ionomer luting and lining cement (GC Gold Label Glass Ionomer Luting & Lining Type 1) (Figure *5*, and Figure *6*) and the excess cement was removed after drying to ensure clean surface. The final core was prepared using crown preparation burs (Coltene crown preparation kit) followed by a putty and injectable polyvinyl siloxane (PVS)(OrikamNeopure A-silicone Impression Material) impression made for the prosthesis and sent to the laboratory.

FIGURE 5: Metal cast post received from laboratory

FIGURE 6: Luting of metal cast post

The final crown was received after 10 days, on the ninth visit. Its marginal fit, proximal and occlusal contacts and overall aesthetics were assessed and adjusted accordingly (Figure *7*). The crown was subsequently luted permanently with self-adhesive resin luting cement (3M RelyX Luting 2 Kit Resin Luting Cement). The patient was recalled at intervals of one, three and six months (Figure *8*) for follow-up review.

FIGURE 7: Post-operative radiograph of tooth number 21

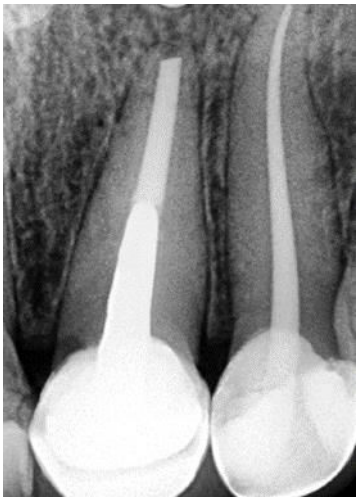

FIGURE 8: Six months follow-up

Discussion

This report highlights the successful use of a multidisciplinary approach to rehabilitate a structurally compromised maxillary incisor. The patient presented with various treatment options, including extraction and implant-supported restoration, but opted for tooth preservation. This case underscores the importance of patient-centered decision-making in treatment planning. The chosen approach of a custom-made cast post followed by a porcelain-fused-to-metal crown was informed by the tooth's history of inadequate endodontic treatment without coronal coverage, which led to significant structural compromise.

This case report underscores the multifactorial nature of endodontic failure and the critical role of comprehensive management in salvaging structurally compromised teeth. The present case of a maxillary incisor with delayed endodontic failure aligns with findings by Siqueira et al. [11], who reported that overextension of filling materials can lead to persistent peri-radicular inflammation. Pus discharge four years post treatment suggests a persistent microbial challenge, often due to Enterococcus faecalis [6]. The decision to not remove gutta-percha on the first day was made to allow for initial drainage and reduction of acute symptoms, following the principle of staged treatment in acute cases.

Mohammadi et al. [8] demonstrated the efficacy of metronidazole and calcium hydroxide against endodontic pathogens, underscoring the need for thorough disinfection in retreatment cases. The use of metronidazole and calcium hydroxide as an intracanal medicament was chosen for its synergistic antimicrobial effects, particularly against anaerobic bacteria often found in persistent infections, as supported by Mohammadi et al. [8,9]. This combination provides both immediate (metronidazole) and sustained (calcium hydroxide) antimicrobial action. The prescription of antibiotics and analgesics was based on the presence of systemic symptoms and to manage pain. While not routinely indicated in all endodontic cases, the acute nature of this case with pus discharge warranted systemic medication as an adjunct to local treatment. Multiple dressings of calcium hydroxide were used to ensure thorough disinfection of the root canal system, especially given the history of persistent infection. This

approach is supported by evidence showing the effectiveness of calcium hydroxide in eliminating resistant microorganisms over time [8].

The lateral condensation technique was chosen for canal obturation instead of warm vertical compaction. While warm vertical compaction can provide excellent three-dimensional filling, especially in complex canal anatomies, the lateral condensation technique was deemed sufficient for this case. This decision was based on the canal's shape and the operator's familiarity with the technique. Moreover, as Peng et al. [12] noted, both techniques can achieve comparable clinical outcomes when properly executed. The lateral condensation technique also offers advantages in controlling the extent of obturation, which was crucial given the previous overextension of gutta-percha.

The decision to use a metal post instead of a fiber post was based on the extensive loss of coronal tooth structure and the need for a custom-fit post in an oval-shaped canal of a maxillary incisor. As noted by Morgano et al. [13], cast posts provide better adaptation to canal anatomy in such cases, potentially offering superior retention and stress distribution. The decision to employ a custom cast post and core-retained crown was crucial. Sorensen et al. [14] noted that loss of coronal tooth structure significantly impacts the survival of endodontically treated teeth. The approach of using a cast post provides better adaptation to canal anatomy than prefabricated posts, especially in ovoid canals such as maxillary incisors, as discussed by Morgano et al. [13]. Moreover, preserving 5 mm of apical gutta-percha ensures an adequate apical seal, as recommended by Mattison et al. [15]. Equally crucial was the crown lengthening procedure using a diode laser to achieve a ferrule height of 2 mm. Libman et al. [16] demonstrated that a minimum of 1.5-2 mm of ferrule can substantially improve the fracture resistance of crowned, endodontically treated teeth. The laser approach allowed for precise soft tissue management without disturbing the underlying bone, preserving the existing dental structures and minimizing invasiveness. This method offers advantages such as reduced bleeding, faster healing, and minimal post-operative discomfort. Hence, diode laser was preferred over conventional surgical techniques.

Coronal leakage is a critical factor in endodontic failure, as highlighted by Ray and Trope [17]. In this case, the absence of a crown following the initial endodontic treatment likely contributed to bacterial reinfection and subsequent treatment failure. The custom-made cast post and core, followed by a well-fitted crown, were chosen to provide an effective coronal seal, reducing the risk of future reinfection.

The 6-month follow-up in this case is promising. However, longer-term studies, such as the 10-year retrospective study by Salehrabi et al. [18], are needed to fully validate the longevity of such complex restorations. This case exemplifies the value of an interdisciplinary approach in managing structurally compromised teeth. Iqbal et al. [19] emphasized interdisciplinary planning, particularly when deciding between endodontic retreatment and other options such as implants.

This case report highlights that even teeth with a history of inadequate endodontic treatment and structural compromise can be successfully rehabilitated. The keys to our success were meticulous retreatment, the strategic use of intracanal medicaments, a well-adapted cast post and core, and the establishment of an adequate ferrule. However, clinicians should remain vigilant. As Vire[20] noted, 60% of endodontically treated teeth failures are due to restorative causes. Therefore, a comprehensive understanding of endodontic, periodontal, and restorative principles is paramount for ensuring long-term success, particularly in anterior teeth where both function and aesthetics are critical. This case serves as a testament to the potential of salvaging severely compromised teeth through evidence-based, interdisciplinary dental care.

Conclusion

This report exemplifies the successful rehabilitation of a severely compromised maxillary incisor, underscoring the power of a multifaceted, patient-centered approach in modern dentistry. By integrating meticulous endodontic retreatment, strategic restorative decisions, and advanced periodontal techniques resulted in the salvage of a tooth that many practitioners might have deemed unsalvageable. Targeted intracanal medicaments, a custom cast post and core, and laser-assisted crown lengthening contributed to a favorable 6-month outcome. This case serves as a reminder that natural dentition can be preserved through evidence-based practices, even with structural compromise and previous endodontic failure. In an era where immediate implant placement often overshadows tooth preservation, this success challenges clinicians in reconsidering the boundaries of what is possible. This calls for a holistic understanding of tooth biomechanics, microbiology, and restorative principles, advocating for an interdisciplinary approach that values natural teeth. This case will inspire practitioners to embrace advanced, collaborative care, pushing the boundaries of tooth preservation and offering patients solutions that honor both function and aesthetics.

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