CASE REPORT

Multidisciplinary Rehabilitation of a Mutilated, Nonvital, Open Apex Tooth with an Indirect Anatomical Fiber Post Reinforcement: A Case Report

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Abstract

Aim and background: The essence of endodontic and restorative dentistry is rooted in preserving the natural dentition, even when a tooth seems beyond salvation. Complex cases with challenging tooth conditions demand a customized, multidisciplinary strategy. Trauma sustained during root development can profoundly disrupt normal apical maturation. The management of an open apex remains a formidable clinical challenge, primarily due to the difficulty in establishing a reliable apical seal and the inherent fragility of the thin radicular walls, which render them highly susceptible to fracture. This case report aims to demonstrate a tailored multidisciplinary approach for salvaging and rehabilitating a severely compromised maxillary central incisor once deemed hopeless.

Case description: This case highlights a clinical scenario where a patient presented with a nonvital, discolored maxillary central incisor complicated by deep cervical caries, grade II mobility, mesiolabial proclination, wide root canal with thin radicular walls, and an open apex—conditions that required a carefully tailored treatment approach. The comprehensive treatment plan included root canal therapy followed by apexification, subsequent root reinforcement with a custom-fabricated indirect anatomic post and full-coverage crown. One year follow-up of the presented case highlights a solution for the clinicians in the management of a condemned tooth, otherwise indicated for extraction to achieve optimal function and esthetics.

Conclusion: A multidisciplinary blend of science and artistry can predictably restore function and esthetics in teeth once deemed beyond repair.

Clinical significance: This case report provides clinical insight into the effectiveness of a strategic interdisciplinary approach in achieving predictable preservation of severely compromised teeth.

Keywords: Apexification, Case report, Indirect anatomical fiber post, Mineral trioxide aggregate, Nonvital tooth, Wide flared root canal.

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Introduction

In routine clinical practice, not all cases adhere strictly to textbook descriptions. Often, the true essence of dentistry lies in thoughtfully moving beyond conventional protocols, where sound scientific principles are seamlessly integrated with clinical acumen to preserve teeth that might otherwise be considered unsalvageable.

Maxillary central incisors are particularly vulnerable to traumatic injuries and are among the most frequently traumatized teeth. When trauma occurs during the phase of physiological root development, it can disrupt normal root maturation and predispose the tooth to pulp necrosis. The resulting immature apex presents several clinical challenges, including thin dentinal walls, large open apices, compromised crown–root ratios, periapical pathology, tooth discoloration, and increased susceptibility to fracture. Endodontic management becomes even more complex when these factors are compounded by deep cervical caries, interdental bone loss, and associated tooth mobility. The absence of an apical constriction in such teeth necessitates alternative treatment strategies beyond conventional root canal therapy. Apexification or root-end closure has traditionally been advocated in these scenarios. While long-term calcium hydroxide apexification has been widely used, its limitations have prompted the adoption of single-step apexification techniques employing biocompatible materials such as mineral trioxide aggregate (MTA).[1]

Widened root canals are frequently encountered in clinical practice and may arise due to over-instrumentation, internal resorption, excessive post space preparation, developmental anomalies, oval canal morphology, or incomplete root development in young patients. These teeth are structurally compromised

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Patient consent statement: A written informed consent was obtained from the patient for the publication of details, which can include photographs and/or videos and/or case history to be published in any printed/online journals.

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Fig. 1: Preoperative photograph

and exhibit reduced resistance to functional masticatory forces, rendering them more prone to fracture.[2]

The conventional management of nonvital anterior teeth with open apices typically involves endodontic treatment followed by definitive coronal restoration and periodic review. However, certain clinical situations—characterized by wide canals, thin and fragile radicular dentin, and reduced periodontal support—pose significant endodontic and restorative challenges. In such cases, preservation of the tooth may be achieved through radicular reinforcement using anatomical fiber posts, which enhance fracture resistance while maintaining biomechanical compatibility with dentin.[3]

This case report highlights a distinctive clinical approach in which a deliberate deviation from routine treatment protocols facilitated the successful preservation of a tooth previously considered hopeless.

Case Description

A 43-year-old male patient reported to the Department of Conservative Dentistry and Endodontics with a discolored and mobile maxillary left central incisor (Fig. 1). History revealed that the patient had suffered trauma at the age of 9 years and occasional purulent swelling. On examination, 21 had a fracture of the incisal one-third and mesiolabial proclination, complicated by deep cervical caries extending below the cementoenamel junction (CEJ), grade II mobility and severe discoloration. The tooth was non-tender to vertical percussion. Radiographic examination revealed an open apex accompanied by periapical radiolucency, widened root canals, thin and fragile radicular walls, and interdental bone loss (Fig. 2). Pulp vitality tests, including thermal and electric pulp testing, demonstrated no responses. Periodontal assessment indicated gingival recession with a probing depth of 4 mm all around the tooth. Correlating clinical and radiographic findings, the provisional diagnosis was necrotic pulp with asymptomatic apical periodontitis of 21.

Treatment Procedure

Rubber dam isolation was performed. Access cavity preparation and working length were established and verified using a periapical radiograph (Fig. 3). A size 80 K-file (Mani, Tochigi, Japan) was loose in the canal and could easily extend beyond the apical limit. Cervical caries was removed, and a composite restoration was done after placing gingival retraction cords, with an 80 K file inside the canal to prevent blockage of the canal by the composite. Thorough canal debridement was carried out with circumferential filing, accompanied by irrigation with 3% sodium hypochlorite (NaOCl)



Fig. 2: Preoperative radiograph



Fig. 3: Working length radiograph

and 17% ethylenediaminetetraacetic acid (EDTA). To facilitate disinfection prior to MTA placement, the canal was dried with sterile paper points. Calcium hydroxide was then introduced as an intracanal medicament, and the access cavity was sealed with

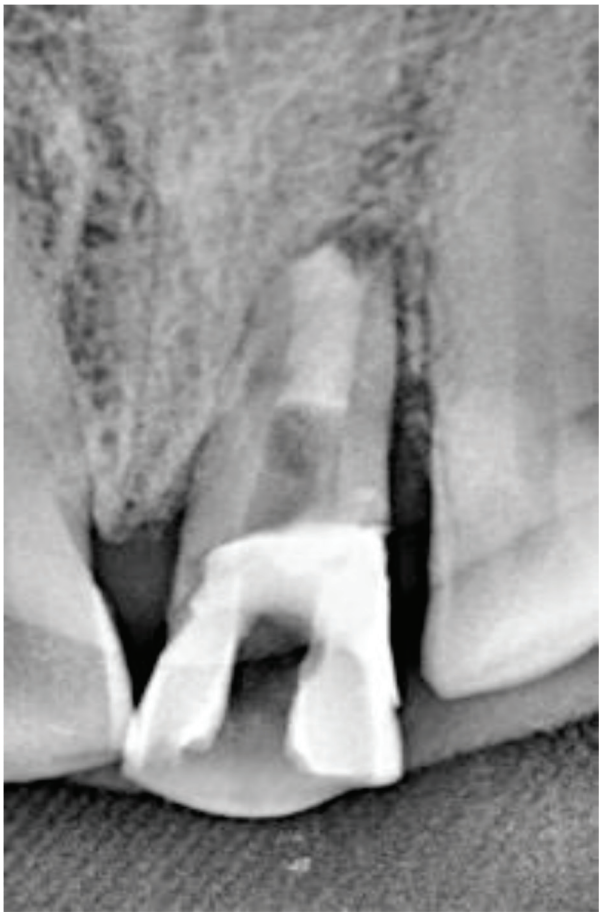


Fig. 4: Mineral trioxide aggregate apexification

a sterile cotton pellet followed by a provisional restoration using intermediate restorative material (IRM). The patient was scheduled to return 1 week later.

At the next appointment, the tooth was reassessed, and calcium hydroxide was removed with 3% NaOCl irrigation and instrumentation. The canal was then dried with paper points. For single-step apexification, MTA Angelus (Angelus, Londrina, Brazil) was mixed with distilled water according to the manufacturer's instructions and subsequently placed at the apex with an MTA carrier and hand plugger. This procedure was repeated until a 5 mm apical barrier of MTA was formed and was confirmed by radiograph (Fig. 4). A wet cotton pellet was left within the canal, and a temporary coronal seal was established with IRM. On the next visit, fabrication of a custom modified fiber post was done. An impression of the radicular space was taken with polyvinyl siloxane by a single-step technique in which light-body impression material was injected into the root canal space, and heavy-body material was loaded in the impression tray and seated in the patient's oral cavity simultaneously. The impression was used to make a model in which the post was custom-made (Fig. 5).

Indirect Anatomic Fiber Post Fabrication

Two glass fiber posts (Denmax International, India), size#1, were selected and tried in the canal of 21 in the model, positioned labially and palatally, to adapt to the wide canal space (Fig. 6). Once the fit

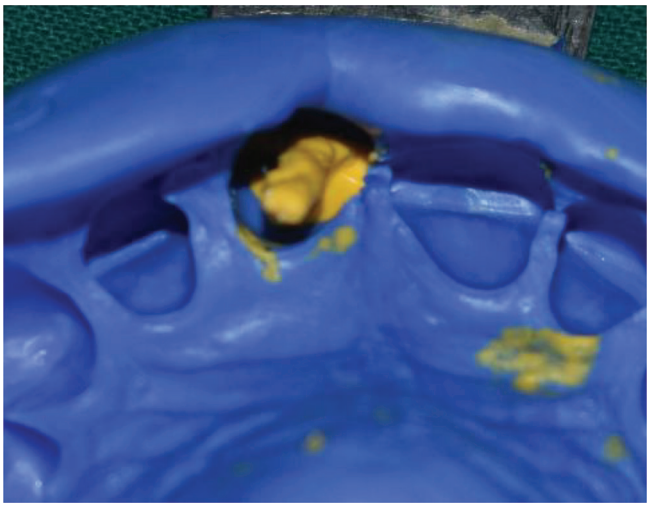


Fig. 5: Post space impression

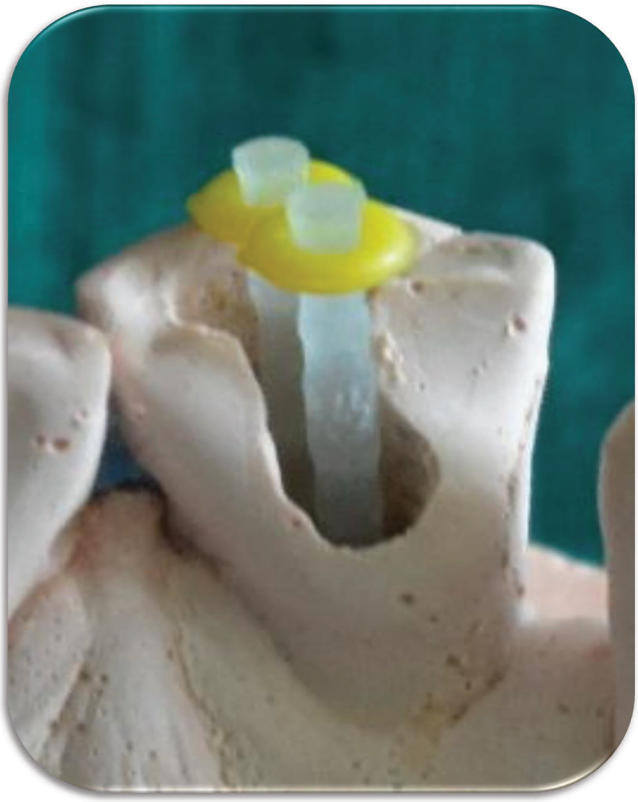


Fig. 6: Two prefabricated glass fiber posts in a cast model

was verified, posts were removed from the canal, and root canal of 21 was coated with separating medium. The post was cleaned with alcohol, and surface treatment was done with a silane coupling agent (Monobond Plus, Ivoclar-Vivadent Schaan, Liechtenstein) for 1 minute (Fig. 7). Nanohybrid composite (Filtek™ Z350 XT; 3M ESPE, St. Paul, MN, USA) was incrementally layered over it, inserted into the canal and light cured for 15 seconds. After the initial set, the post was removed from the canal and was subjected to additional light curing for 20 seconds. The procedure was repeated until a snug fit was obtained (Fig. 8).

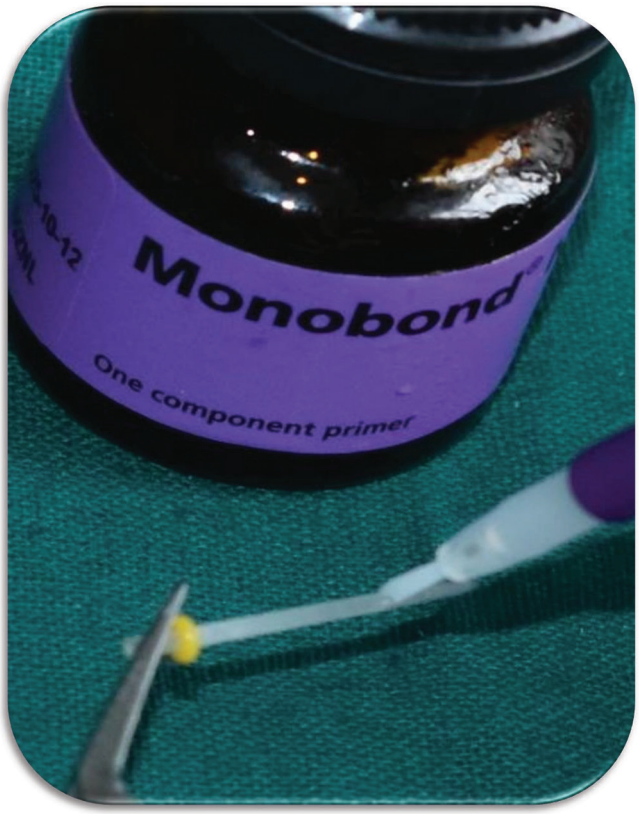


Fig. 7: Silane surface treatment



Fig. 8: Fabricated anatomical fiber post

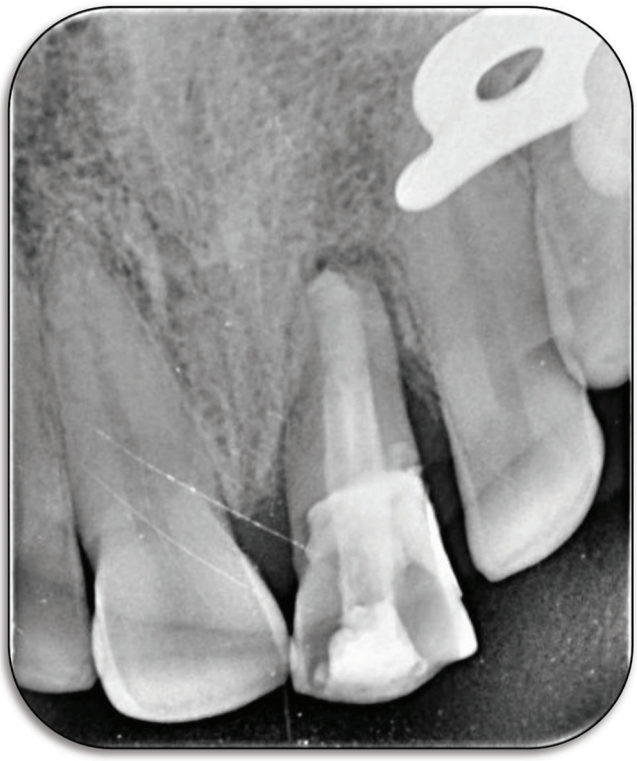


Fig. 9: Post and core bonding



Fig. 10: Tooth preparation for PFM crown

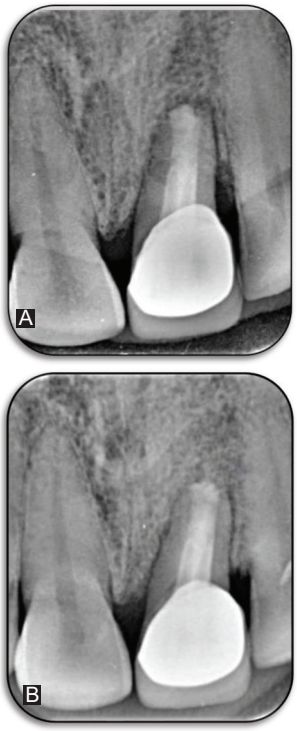
Bonding of Anatomic Post

The root canal and the custom-fabricated anatomic fiber post were rinsed with water and dried with air to remove the applied lubricant gel. The fit of the post in the canal was confirmed. A non-rinse conditioner (ParaBond, Coltene, Altstätten, Switzerland) was applied within the canal for 30 seconds, followed by gentle air-drying for 2 seconds. Subsequently, ParaBond Adhesives A and B (Coltene, Altstätten, Switzerland) were mixed and applied to the canal walls using a microbrush for 30 seconds to ensure uniform coverage. ParaCore dual-cure resin cement (Coltene, Altstätten, Switzerland) was then dispensed into the canal, after which the post was carefully seated to its full depth and light-cured for 40 seconds to achieve complete polymerization (Fig. 9). Tooth preparation for porcelain-fused-to-metal (PFM) crown was done (Fig. 10). An impression was taken with polyvinyl siloxane impression material. A PFM crown with gingival ceramic was fabricated and cemented. The patient was extremely satisfied with the final outcome (Fig. 11).

Three months' follow-up visit showed a substantial reduction in tooth mobility. Six months of radiographic review showed significant improvement in interdental bone formation, which suggested periodontal healing (Fig. 12). No morphological alterations or marginal discolorations were observed clinically, and radiographic evaluation revealed a perfectly adapted anatomic post. The restoration demonstrated both functional integrity and excellent esthetic harmony (Fig. 13).



Fig. 11: Final outcome of restorative procedure



Figs 12A and B: Three months (A) and six months (B) Radiographic outcome

Discussion

Traumatic injuries in the anterior region present formidable clinical challenges due to their esthetic significance and the necessity to achieve a balance between functional restoration and harmonious esthetics. In the present case, the complexity was further compounded by the presence of an open root apex with a wide and weakened canal, deep cervical caries extending into the radicular portion, interdental bone loss leading to mobility and proclination, and pronounced discoloration. These factors collectively emphasized the need to preserve the biological width and maintain optimal periodontal health to ensure long-term success.

Among various surgical and non-surgical treatment modalities for open apex, apexification was deemed appropriate for this case, considering the patient's age and need for immediate rehabilitation. Calcium hydroxide has long been regarded as an effective material



Figs 13A and B: (A) Pre; and (B) Postoperative clinical photographs

for apexification. However, its use is associated with several limitations, including challenges in patient recall management and prolonged treatment duration. Furthermore, extended intracanal dressing with calcium hydroxide has been reported to increase the risk of tooth fracture. In 1990, Morse et al. defined single visit apexification as the non-surgical condensation of a biocompatible material into the apical end of the root canal.

Single step apexification with MTA demonstrates good biocompatibility and produces a superior barrier.[4] This bioactive material is hydrophilic in nature, capable of setting in the presence of moisture, and does not exert any deleterious effects on the structural integrity of the tooth. Moreover, it enhances the fracture resistance of fragile roots.

Replacement and reinforcement of the radicular structure by a material with similar elastic properties will improve the fracture strength of weakened tooth structure. In the present case, a fiber post was selected due to its favorable bonding compatibility with composite resin, its ability to reinforce the root structure, and its elastic modulus closely approximating that of dentin, providing homogeneous stress distribution. These factors collectively help to minimize crack propagation and root fracture.[5] However, when a conventional fiber post is placed within a wide and weaker canal, it often exhibits a poor adaptation to the canal walls, leaving a considerable circumferential gap and inadequate retention. Consequently, a thick cement layer is required to compensate for this discrepancy, which may increase polymerization stress and predispose the restoration to adhesive failure and post-debonding, so we planned an anatomic post.[6] Anatomical shaping of prefabricated fiber posts using composite resin within the root canal allows for precise adaptation while maintaining a minimally invasive approach. This technique optimizes the biomechanical behavior of the tooth, reduces cement volume, and ensures predictable post retention. A study done by Rocha et al. on the effect of anatomical customization of the fiber post on the pushout bond strength showed greater bond strength for anatomical fiber posts than for non-customized posts and permitted a more uniform cement layer.[7] Its monoblock effect lowered stress concentration.[8] All these factors lead to greater clinical longevity. According to Gomes et al., the better performance of this

post is attributed to the hydraulic pressure put on the cement against the dentinal walls, which reduces blister formation and promotes better penetration of resin tags into dentin, resulting in more uniform hybrid layer formation.[9] Silva et al. concluded that relining fiber posts with composite resin could enhance the fracture resistance and decrease the root strain.[10] Nanohybrid composite was chosen for relining the fiber post, as multiple studies have reported that nanohybrid composites possess superior mechanical strength and physical performance compared to their micro-hybrid counterparts. Furthermore, their excellent color stability and polishability render them the preferred material for such restorative techniques.

Direct technique for anatomic fiber post fabrication has disadvantages like time-consuming, technique sensitivity, and the procedure is tedious and clumsy due to the sticky nature of composite resin. So, an indirect technique was employed here, which reduces chair-side time, allows better control of each step, and a higher degree of composite polymerization can be achieved. A dual-cure, glass-reinforced composite resin (ParaCore; Coltene, Altstätten, Switzerland) was utilized for the cementation procedure of this custom-modified post. Since this bonding material system contains a non-rinse conditioner, it eliminates the need for a separate rinsing step, thereby overcoming the challenge of moisture control within the root canal and simplifying the overall clinical protocol. Moreover, it demonstrates reduced technique sensitivity and less dependence on operator skill or canal depth, offering a distinct advantage over conventional multi-step cementation systems, ensuring reliable polymerization even in areas with limited light accessibility. This guarantees an optimum monoblock interface between the post, cement, and crown. A PFM crown was selected to effectively mask severe intrinsic discoloration associated with long-standing pulpal necrosis and trauma. The opaque metal substructure provided predictable shade masking. The metal coping facilitated favorable stress distribution along the post–core–crown complex, while the use of gingival ceramic enhanced cervical esthetics in the presence of periodontal tissue loss. Thus, the PFM restoration contributed to both esthetic rehabilitation and biomechanical stability of the treated tooth.

Three months follow-up visit clinically manifested reduction in tooth mobility, and radiographic evaluation revealed significant improvement in interdental bone level. Six months recall visit showed substantial interdental bone formation suggestive of periodontal healing. Meticulous cervical caries restoration and definitive endodontic treatment contributed to the establishment of a favorable periodontal environment, thereby supporting periodontal healing.

Finally, the satisfactory clinical outcome of the procedure was confirmed by one- year clinical evaluation (Fig. 14). The present report represents a single, highly selected case, and its favorable outcome should not be generalized to all severely compromised open apex teeth. The individualized, multidisciplinary nature of the treatment, together with excellent patient compliance, may have contributed to the observed outcome. Moreover, the 1-year follow-up does not establish long-term prognosis. Further studies involving larger patient populations, standardized treatment protocols, and longer follow-up are required to validate the predictability and generalizability of this approach.

Conclusion

A multidisciplinary, custom-designed treatment plan often holds the key to success in managing complex cases. Such an approach may call for innovative techniques, advanced armamentarium, and novel materials—all grounded in a profound understanding of fundamental dental principles. This integration of science and artistry can transform a tooth once deemed hopeless into one that is functionally restored and esthetically harmonious, epitomizing the pinnacle of clinical excellence.



Fig. 14: One-year follow-up clinical image

Clinical Significance

This case report offers valuable insight into the role of customized interdisciplinary management as a predictable alternative to extraction of teeth in cases of severe structural compromise. It illustrates that even teeth deemed hopeless can be successfully preserved with an optimal functional and esthetic outcome. It reinforces the principle that the true essence of modern dentistry lies in the perpetual preservation of natural dentition through innovation and clinical insight.

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Artificial Intelligence (AI) Disclosure

The authors declare that no AI tools or generative AI technologies were used in the preparation, writing, editing, or development of this manuscript.

Authors' Contribuition

All authors contributed to the conception and design of the case report, clinical management, data collection, literature review, interpretation of clinical and radiographic findings, and preparation and critical revision of the manuscript. All authors reviewed and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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