CASE REPORT

Combined Effect of Mineral Trioxide Aggregate and Customized Glass Fiber Post in Nonsurgical Endodontic Retreatment Teeth at Esthetic Zone: A Case Report

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Abstract

Background and aim: Choice of the most suitable obturation materials and post–core systems for endodontically treated teeth (ETT) is challenging and should be performed by understanding their areas of applications, advantages, amount and characteristics of remaining tooth structure, and esthetic needs.

Case description: The use of mineral trioxide aggregate (MTA) with customized glass fiber post in nonsurgical ETT retreatment of single-rooted teeth is recommended to treat apical root pathosis with open apexes. A combination of those materials can provide impressive results in the anterior esthetic zone and in the presence of immature and wide canals.

Conclusion: This report demonstrated the use of MTA and customized glass fiber posts for nonsurgical root canal (RC) retreatment of maxillary anterior teeth for a young male patient.

Clinical significance: This technique is simple, effective, less invasive, and suitable for apical apexification and to restore wider ETT canals.

Keywords: Customized fiber post, Fiber-reinforced composite, Mineral trioxide aggregate, Open apex, Periapical pathosis.

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Introduction

The biocompatibility of MTA was authorized for endodontic use by the U.S. Food and Drug Administration in 1998.[1] MTA has been shown to support promising tissue healings categorized by the absence of severe redness, the existence of a fibrous capsule, and the production of mineralized repair tissue.[2] Later on, some researchers added definite components to progress the easiness of management and inset possessions of MTA in order to create MTA-based apexification. Materials of such products presently on the market are ProRoot Endo Sealer® (Dentsply, Tulsa, OK, USA), Endo-CPMSealer®, and MTA Fillapex® (Angelus, Londrina, PR, Brazil).[3]

Rehabilitation of dental structures lost by trauma or caries requires adequate planning based on the clinical situation. The restoration of ETT and severely damaged teeth has been a concern of the clinicians,[4] and the researchers still seek the most adequate technique and material to restore these teeth. After ET, a proper restorative technique is necessary to ensure coronal seal[5,6] and protection of residual teeth structure[7] which have lost two or more walls and need to be restored with posts to increase retention and stability of final restoration.[8,9]

When radiographic examination shows a radiolucent area in the periapical region of maxillary incisors, healing in this area will be developed after retreatment.[10] Kim and Ahn showed an 88.4% of cumulative survival rate after 11 years of follow-up of nonsurgical root canal treatment (RCT) for maxillary anterior teeth; it was higher in males[11] and it was 85.6% for all anterior teeth and 77.3% for teeth with periapical pathosis, but those percentages of success were lesser in males.[12] In addition to that, the survival rate of prefabricated fiber posts in the maxillary anterior teeth was 88%.[13]

Posts have been suggested to strengthen weak ETT against intraoral forces by transmitting torquing forces within the radicular dentin to supportive tissue along their roots.[14] Different types are available in the markets, such as prefabricated metal posts, casted posts, prefabricated colored composites, and all ceramic posts. Prefabricated glass fiber post has been widely used and shows a relative success rate because[15] their properties are similar to those of dentin.[16] They are more esthetic, less expensive, and invasive than metal posts and core systems.[5,9] Also, they are cylindrical and have a standardized diameter in accordance with the system. The manufacturers recommend the use of these posts in cases where there is a sufficient coronal tooth structure remaining.[17]

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Due to the uneven and wider RC space and fragile dentinal walls, custom-made posts are preferred over prefabricated posts. Customized glass fiber posts that are well adjusted into the root walls and have mechanical properties similar to those of dentin may be the suitable treatment for severely compromised ETT.[18] Chair-side customized fiber post by relining it with direct, light-cured composite resin mimics the canal anatomy. It also provides superior retention and esthetics.[19,20] In order to restore the teeth with fragile root, a customized post plays an important role and has gained a favorable prognosis.[5,6,9]

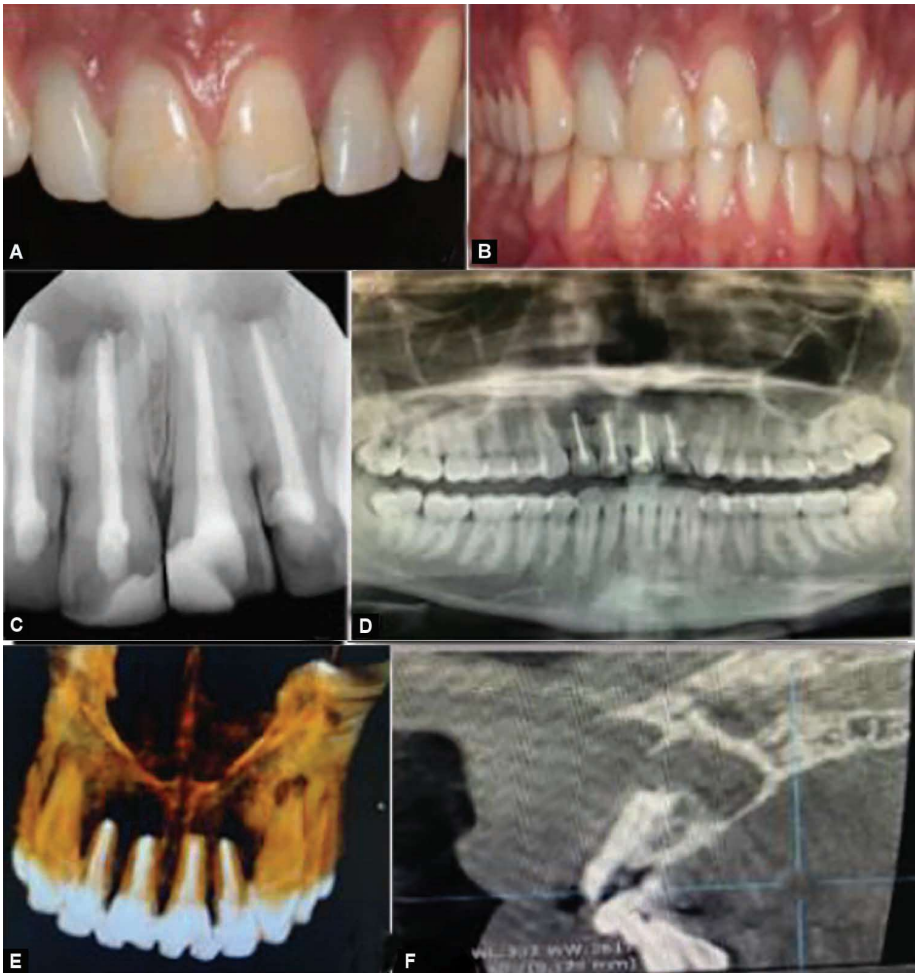
There is a growing demand for highly esthetic restoration from patients and clinicians. Consequently, the use of all-ceramic crowns and esthetic post and core materials is increased.[21] Significant improvements in dental restorative materials and technology, such as computer-aided design and computer-aided manufacturing (CAD/CAM) and lithium disilicate glass-ceramic (LDGC) (IPS e.max Press), have produced esthetic, affordable, efficient, and predictable restorations.[22–24] Many studies demonstrated long-term color stability of using (IPS e.max Press) crowns among different staining beverages such as Khat and Shammah as it is used daily among patients in different societies, especially among Saudis in Jazan province.[25–28]

Treatments with failed ETT and persistent preapical lesions in maxillary anterior teeth were reported earlier without emphasizing a particular retreatment protocol. This case report demonstrates the use of MTA with a customized fiber post with nonsurgical endodontic retreatment for a young male patient who complained of recurrent swelling at the apex of the maxillary incisors teeth, then crowning of those teeth with LDGC after 9 months of follow-up and healing of the preapical lesions.

Case Description

The technique demonstrated, in this case, was advised by the authors for patient treatment in the Specialized Dental Center, Ministry of Health, Jazan, Saudi Arabia in January 2022. A single, 25-year-old, Saudi male, university student was presented to Saudi Board Residency Clinics. He was referred from a secondary hospital for extraction of teeth # 11,12 and replace with an implant. His chief complaint was restoration of his front teeth, pus secretion from the front gums, and the presence of movement of his upper frontal teeth. The history of chief complaint started 6 months ago. He had done a previous RCT for maxillary anterior teeth and composite restoration 14 years ago. Also, the patient mentioned that he received apical surgery related to teeth # 12,11,21, and 22 7 years ago.

His extraoral findings revealed a normal appearance. The intraoral soft tissue colors, tongue, teeth relations, and other



Figs 1A to F: Preoperative views (A, maxillary frontal; B, both arches during maximum intercuspation); Radiographic views (C, periapical; D, orthopantomogram; E, frontal CBCT; F, lateral CBCT)

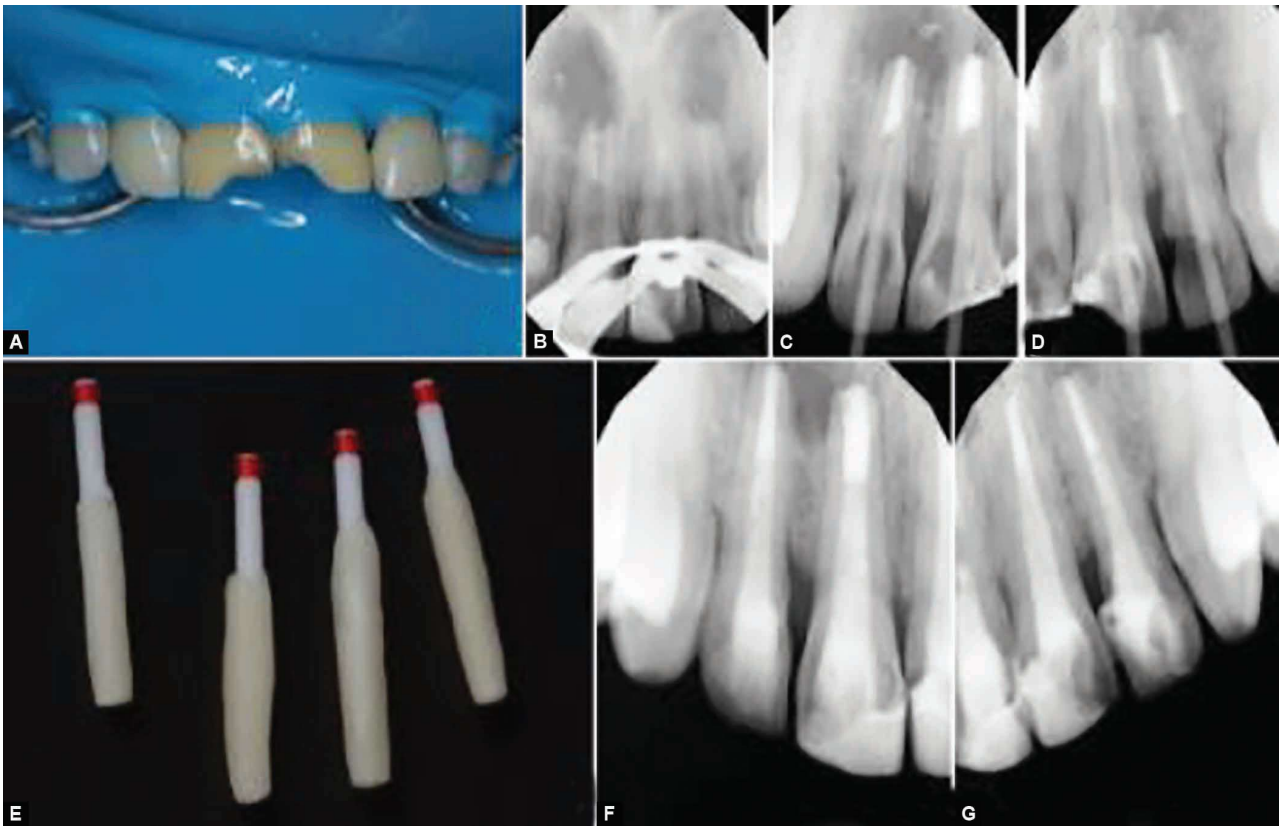
structures were within normal. Discolored maxillary laterals and central incisors with fluctuant and discolored gingiva (Figs 1A and B). The endodontic assessment for central and lateral maxillary incisors showed mobility grades I and II, respectively, fluctuated buccal bone during palpation, presence of fistula with pus discharge at the midline, negative response to sensitivity test, and tenderness to percussion. The panoramic radiographic shows bilateral apical abscess in relation to previous RC of teeth 12,11 and 21,22, the periapical X-ray confirmed those findings, and the left abscess was larger than the one on the right side (Figs 1C and D). The frontal and lateral cone-beam computed tomography (CBCT) showed the size and dimensions (diameter of 1 mm on the left side and 1.5 mm on the right side) of the chronic apical abscess (Figs 1E and F).

After data interpretations, the pulpal diagnosis was present of unhealed previous ETT in relation to maxillary teeth 12,11,21,22 with chronic apical abscess associated with poor apical seals, and open as well as wide apexes of the mentioned teeth. The selected treatment plan was nonsurgical retreatments of the existing ETT for teeth # 12,11,21, and 22, then follow-up (3 months and longer) to reevaluate the apical pathosis, mobility, and bone fluctuant of the affected teeth. After that, a customized glass fiber post and core followed by an LDGC (IPS e.max Press) crown will be considered. In case of failure (persisting of the radiolucent area in the X-ray and recurrent swelling over the affected teeth) of this treatment, the choice of apical surgery of the existing ETT for the involved teeth will be considered. The treatment options were agreed upon by the patient.

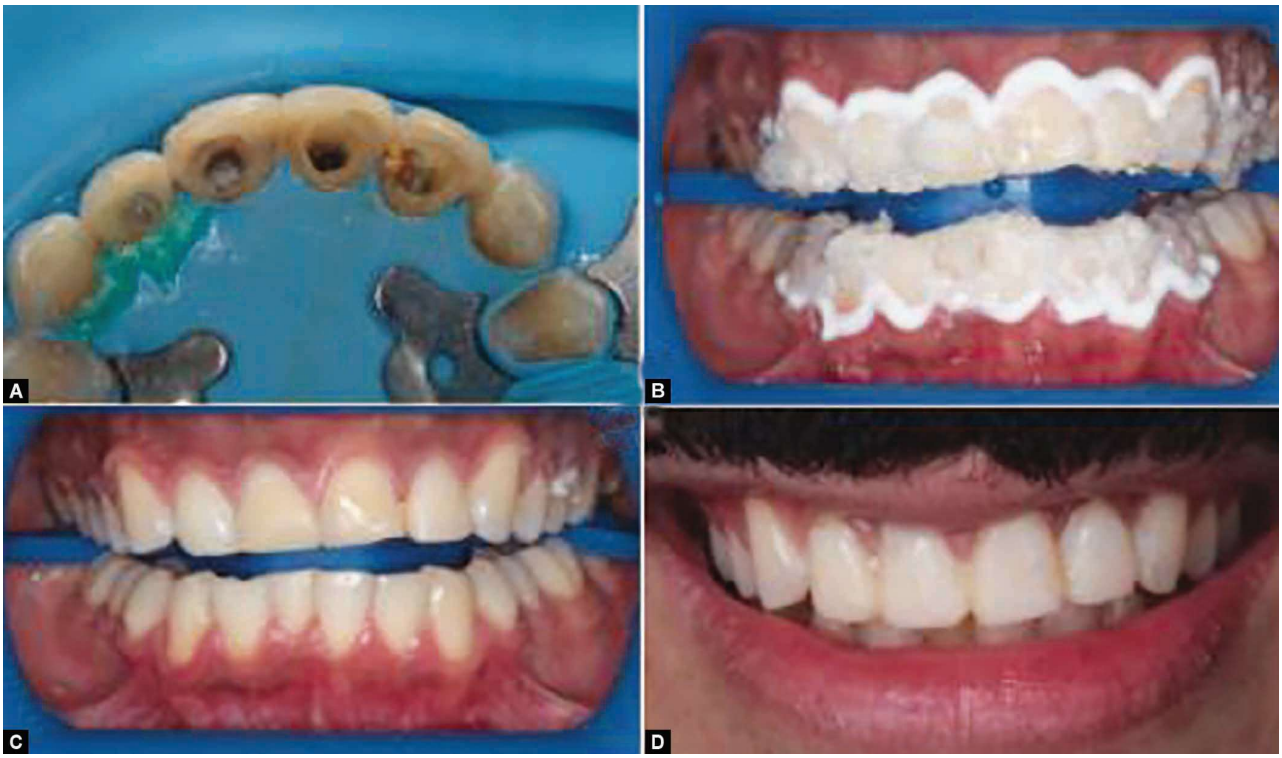
The treatment was started with local anesthesia and isolation with a rubber dam for the working area (Fig. 2A), access cavities were gained by diamond bur, gutta-perchas were detached with the assistance of ProTaper retreatment files (Dentsply Maillefer, Ballaigues, Switzerland) and a 60 size H-file (Mani Inc, Japan) through the help of solvent. A periapical X-ray was reserved to guarantee the whole elimination of the gutta-percha from the canal (Fig. 2B).

To avoid injuring the periapical tissue, the working length was set 2 mm below the apex. A K-file of size no. 90–120 (Mani Inc, Japan) was used to instrument the RC, and 3% sodium hypochlorite was used for irrigation. The final irrigation was done with a 2% chlorhexidine (Ultradent UltraCal XS, South Jordan, UT) to disinfect the canals. The canals were then dried with paper points. Then RC patency was obtained with size 90 K-file (Dentsply, Sirona, USA) using Endosolv E (Septodont) and working lengths were established to be 21 mm for teeth 12,22 and 22.5 mm for teeth 11,21 with electronic apex locator (Dental Root ZX, Morita Corporation, Japan). Then, the retreated RCs were shaped using Mtwo technique (Sweden and Martina, Italy) (basic sequence: 10.04/15.05/20.06/25.06) and preparations were completed with manual instruments in the apical zone with 0.5–1 mm from the apical foramen. The canals were closed before the recall appointment.

The patient was recalled after 14 days. During this appointment, the affected teeth were found to be asymptomatic. MTA (MTA CEM, Nexobio Co, Korea) was mixed through distilled water offered by the producer and injected into the canal by means of an amalgam carrier. Predesignated pluggers were utilized to condense MTA into



Figs 2A to G: (A) Isolation with rubber dam; (B) After removal of gutta-percha; (C and D) MTA at the apexes; (E) Customized glass fiber posts; (F and G) Cemented customized post in RC of teeth 12,11,21,22



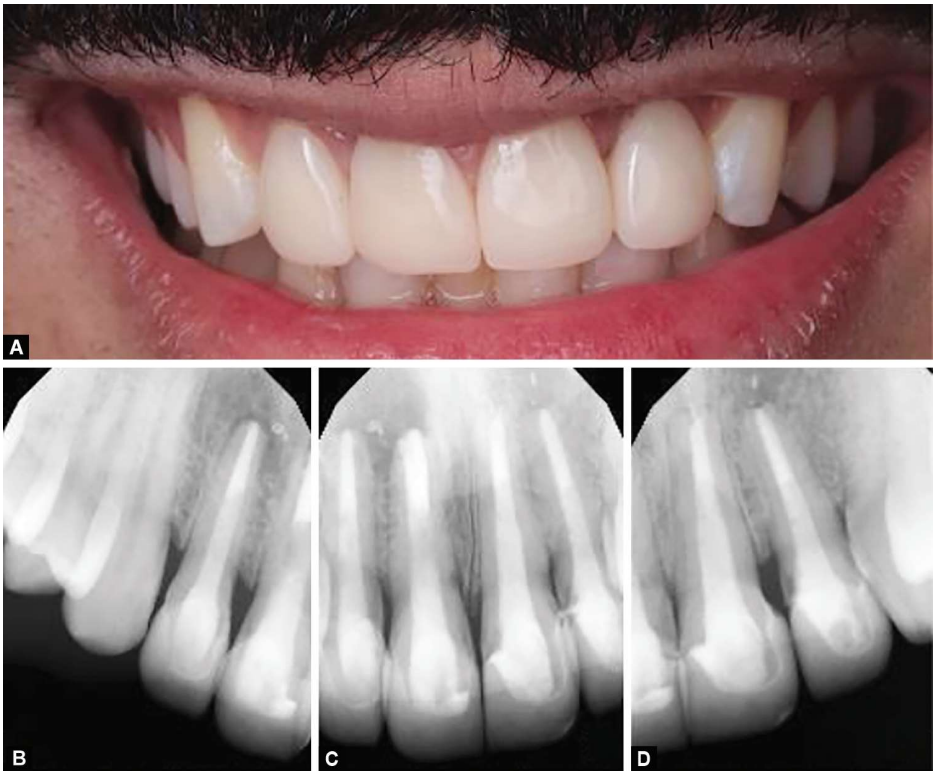
Figs 3A to D: (A) Internal bleaching after rubber dam isolation; (B) During external bleaching; (C) After bleaching and composite build-up of teeth; (D) With provisional crowns

the canals, developing a 7- and 8-mm plug for central and lateral incisors, respectively. After examining the apical blockage of the MTA with a radiograph (Figs 3C and D), moist pieces of cotton were injected into the RCs to hydrate the substance. The patient had been informed to attend after 24 hours, and the setting of MTAs was tested for maturation before beginning the restoration. The RCs were cleansed of any physical traces of MTAs by applying a microbrush and 17% ethylenediaminetetraacetic acid (Canal Plus, Septodont). A brief rinsing with normal saline followed by rinsing with 1% sodium hypochlorite was achieved to eliminate any remaining ethylenediaminetetraacetic acid and organic trash. Glass fiber posts with 1.5 mm diameter (Figs 2C and D) (ParaPost Fiber White, Choltene Whaledent) were treated by applying a 40% hydrogen peroxide (Opalescence, Ultradent) for 1 minute. Then, the posts were coated with a layer of uncured composite resin (Te-Econom Plus, Ivoclar Vivadent) and sited within the RCs spaces to permit the modification of the composite to the canal boundary before light-curing for 20 seconds. Following the initial curing, the customized fiber post was taken from the RC areas (Fig. 2E), and the paper barrier was unpeeled off to accept other curing for 60 seconds of the apical one-half out of the canal, in close proximity to the light curing unit. After that, the customized fiber post was reinserted to make sure for boundaries adaptation.

In arrangement for cementation, the intraradicular dentin was handled for 15 seconds employing a 37% phosphoric acid (Eco-Etch, Ivoclar Vivadent, Germany) followed by 15 seconds rinsing through water and drying per air and dry paper points. For rewetting, the dentin, 0.12% chlorhexidine solution (Clinica) was employed for 30 seconds, and after that additional solution was drained by means of a cotton pellet and dry paper points. An adhesive system mixed of primer and adhesive resin (Adper single bond 2–3M) was applied by means of a microbrush by actively brushing the dentin walls for 20 seconds followed by air drying for 10–15 seconds to volatilize the solvent. The adhesive was light-cured for a minute in the presence of a wide fiber post to permit the circulation of light to the extent of the RC zone. Dual cure adhesive resin cement was generously inserted in the RC area by a lentulospiral (size 40, Mani Inc, Japan). The customized fiber post was implanted, and additional cement was cleaned by applying a microbrush following which light curing was taken out for 60 seconds. A direct composite filling (Te-Econom Plus, Ivovlar Vivadent, Germany) was finalized above the customized fiber post, and radiographs were taken for final assessment (Figs 2F and G).

After 2 weeks, bleaching of teeth # 12,11,21, and 22 was performed. Isolation of the working area with a rubber dam, removal of composite restorations from the pulp orifices, and defected coronal restorations. Then, removal of gutta-percha from the pulpal champers of the involved teeth (Fig. 3A). In-office internal and external bleaching with 35% opalescence endo hydrogen peroxide was performed into the pulpal champers and onto the whole clinical crowns of RCT teeth numbers 12,11,21,22 (Figs 3B and C). The bleaching gel was activated by means of a power bleaching system for 15 minutes. The etching gel was separated with calcium hydroxide as a carrier for the bleaching gel, and the steps were reproduced one more time. Afterward, the teeth were initially prepared and provisional crowns constrictions and cementations were performed (Fig. 3D).

The patient 9 months after was satisfied with the esthetic result and the resolution of the sinus tract. Also, the periapical radiographs showed improvements and healing of the preapical area as well as the presence of an apical apexification (Fig. 4). The teeth preparations were accomplished following the guidelines and principles for tooth



Figs 4A to D: (A) Provisional crowns after 6 months; (B to D) Periapical X-rays of bonded final prosthesis after 1 year

reduction of full ceramic restoration, then one step-double mixed of the maxillary final impression with additional silicon (Virtual, Ivoclar Vivadent, Lichtenstein) with two retraction cord technique was used (knitted, size 0 and 00 with hemostatic agent). Fabrication of full coverage crowns for maxillary teeth (12,11,21,22) by LDGC IPS e.Press (HT ingot, and MO ingot, Germany) and following the manufacturer's instructions were carried out. The subsequent steps were followed during the cementation of the crowns. The intaglio surfaces of the restorations were treated with 9.5% hydrofluoric acid (IPS Ceramic Etching Gel, Ivoclar Vivadent, Germany) rinsed, and dried, then a silane coupling agent (Silane, Ultradent, South Jordan, Utah, USA) was applied to this surface for 60 seconds and air-dried. After that, the preparations were treated with a total-etch technique 35% phosphoric acid for 90 seconds, rinsed and dried, then a bonding agent system, Adper Prompt L-Pop (3M ESPE, St. Paul, MN, USA) self-etching adhesive system was applied to the preparations for 20 seconds and air-thinned. A dual-cure resin cement, Unicem ApliCap Resin Cement (3M ESPE, Germany) was then applied to the intaglio surface of each restoration. The overall excess of resin cement was separated, and the restorations were entirely light-cured on each accessible side. Lastly, removal of the excess cement was achieved with scalers. The patient was recalled after 3, 6, and 12 months for radiographical and clinical follow-up. The patient functioned well and was satisfied with the esthetics and well-being of this treatment (Fig. 5).

Discussion

Retreatments of previous ETT failure with preapical lesions in maxillary anterior teeth were reported earlier without emphasizing a particular protocol. This case report demonstrated using of an MTA in a combination with a customized fiber post with nonsurgical RC retreatments for young male patient who complained of recurrent swelling at the apex of the maxillary central and lateral incisors teeth, then crowning of those teeth with LDGC (IPS e.max Press) crowns with 9 months of follow-up.

The absence of an apical stop may cause some difficulty during obturation and achieving a good apical seal. So, those teeth usually had a thin wall and are more prone to fracture. Apexification with MTA is the preferred treatment because it creates a calcific barrier at the apex, allowing root filling to take place in a more favorable environment.[29] This technique with apical plug and pulp regeneration endodontic treatment are reliable treatments for nonvital immature teeth. The radiographic outcomes are comparable between the immature teeth subjected to MTA apexification versus those subjected to revascularization.[30] In addition, recent systematic reviews issued by Khandelwal et al. and Chopra et al. on different studies showed significant healing of periapical lesions after using sealers that contain MTAs.[31,32] Also, a case report published by Jain et al. describes using of MTA for the nonsurgical management of a large periapical lesion involving teeth #12,13,14 in a 20-year-old female patient who came with a chief complaint of swelling and pus discharge. ET was done, then clinical and radiographic reevaluations at 2, 6, and 12 months revealed progressing bone healing.[33] Similar findings were shown in the present case.

As compared to rigid metal posts and/or ceramic posts, the glass fiber posts are white and translucent, radiopaque which is more favorable for esthetic demand for all ceramic crowns. It has a modulus of elasticity, mechanical behavior, and physical properties much closer to dentin in contrast to higher values to a metal post which increases the fracture resistance of the tooth.[34,35] This also

Figs 5A to D: Postoperative views of maxillary and mandibular arches with cemented LDGC crowns

will allow for a better distribution of occlusal forces and reduce substantially if compared with harder materials and the risk of vertical root fracture.[36,37] A previous case report used prefabricated fiber posts,[38,39] which showed a high success rate after a certain period, whereas other cases applied cast post[10,14]; both types of posts resulted in a long survival rate.

The direct and indirect customized glass fiber posts showed a high success rate after a long period of time.[18,40,41] Customized glass fiber posts are well adjusted into the RC, minimize the cement material spaces, and have mechanical properties comparable to those of dentin could be an appropriate treatment for severely compromised ETT. Its fabrication is a simple technique, providing an increased volume of fibers into the RC space, and an adequate polymerization of the post–core system. This technique can be considered effective, causes uneven stress distribution between the post and remaining radicular dentinal, and is less invasive. Also, it reduces the chances of shrinkage and gap formation between radicular dentin and post if a greater amount of resin cement is used and it provides strength and support to the final restoration.[15,40–42]

In addition, Gutiérrez et al. observed no significant differences were found in fracture resistance between prefabricated and CAD/CAM glass fiber posts or between metal cast posts and customized glass fiber, although the latter demonstrated higher fracture resistance than the prefabricated glass fiber posts.[43] But a laboratory study carried out by Bosso et al. investigated different types of posts including a customized glass fiber post, they concluded that conventional posts showed high-stress concentration at the root and customized glass fiber posts showed more favorable biomechanical behavior.[44] While a previous review published by Piovesan et al.[45] said that the mean overall survival estimate for fiber post was 90.2 (±3.7) months. Other studies presented high survival rates after the 97-month follow-up period.[10,45]

For esthetic reasons, usually LDGC e.max Press crowns are preferred due to their high biocompatibility, optical, mechanical, easy manufacturing, and low cost in comparison to other all ceramic types. Also, such type of prosthesis is recommended in the esthetic areas and highly advised for patients with social habits such as hot and cold drinks, khat chewing, and using miswaks.[22–28,45]

The present case report on retreatment of existing open wide canals with periapical pathosis with successful recovery of periapical hard tissues without surgery and bone removal signifies the importance of selection of case with appropriate technique for achieving good results and patient satisfaction. This simple technique boosted the patient's self-confidence due to the resulted excellent esthetic. In addition, minimal cost and time required were added advantages.

Conclusion

The healing of the periapical tissues is crucial to the success of ETT. MTA is innovative in the management of teeth with an immature apex. This report demonstrated the use of MTA and customized glass fiber post for nonsurgical retreatment of an extensive periradicular lesion of maxillary anterior teeth with clinical and radiological characteristics of a pathosis. Nine months later, the lesion was completely healed, indicating the apical barrier formation of the discolored maxillary incisors with an immature apex under comprehensive cleaning and disinfection procedures. The radiographic outcomes of this protocol (use of MTA and customized glass fiber composite) showed good revascularization and regenerative retreatment with good apical seals. Such a combination is simple, effective, less invasive, and suitable for restoring wider and open ETT canals.

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