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Guided Endodontic Treatment for Calcified Central Incisor with Discoloration, a Conservative Approach Preserving Incisal Edge: A Case Report

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Pulp canal obliteration (PCO) in calcified teeth presents a challenge for endodontic treatment, especially when accompanied by discoloration. Guided endodontic access (GEA) has emerged as an advanced method for root canal therapy (RCT) in such cases. This case report describes the successful treatment of a calcified maxillary central incisor with discoloration using GEA. A 32-year-old female with a history of dental trauma presented with discoloration in the left maxillary central incisor that did not respond to external bleaching. Clinical examination revealed a pulpless infected canal with asymptomatic apical periodontitis. Cone-beam computed tomography (CBCT) and intraoral scanning were utilized to create a three dimensional (3D) template, enabling minimally invasive access preparation through the palatal aspect. The RCT was performed in a single visit, followed by tooth whitening using hydrogen peroxide. At 18 months follow-up, the tooth was asymptomatic, and the apical lesion was healed. GEA offers a predictable and conservative approach, preserving tooth structure and providing enhanced long-term prognosis for teeth with calcified canals and discoloration.

Keywords: Cone-beam Computed Tomography; Dental Pulp Calcification; Endodontics; Guided Endodontics; Internal Bleaching; Minimally Invasive Access

Introduction

Pulp canal obliteration (PCO) is associated with dental trauma, excessive orthodontic interventions, iatrogenic dental treatment [1] physiological aging of the tooth, or regenerative endodontic treatments [2]. Endodontic treatment in a tooth demonstrating PCO without symptoms or periapical pathosis is discussible [3]. As obtaining an aesthetic outcome in teeth with PCO is challenging [4], intentional RCT may be required before internal bleaching in cases with discoloration that doesn't respond to external bleaching [4]. According to the American Association of Endodontists, RCT in these cases is extremely challenging, with the possibility of complications or failures [5]. Therefore, to manage PCO cases, the concept of *Guided Endodontics* was introduced [6]. In this method, the cone-beam computed tomography (CBCT) (NewTom Vgi, Verona, Italy) image was matched with digital data acquisition of intra-oral scanning (IOS). Then, a three-dimensional (3D) template is designed and printed for the planning of minimally invasive endodontic access preparation.

The guided endodontic approach can successfully locate canals in calcified anterior and posterior teeth with fewer complications such as transportation, perforation, and dentin loss to meet the biologic aims of endodontic treatments: chemo-mechanical preparation and 3D obturation [7-12].

The purpose of this case report is to explain a new approach to the guided endodontic treatment of an anterior calcified tooth before internal bleaching with a more conservative approach to preserve the incisal edge.

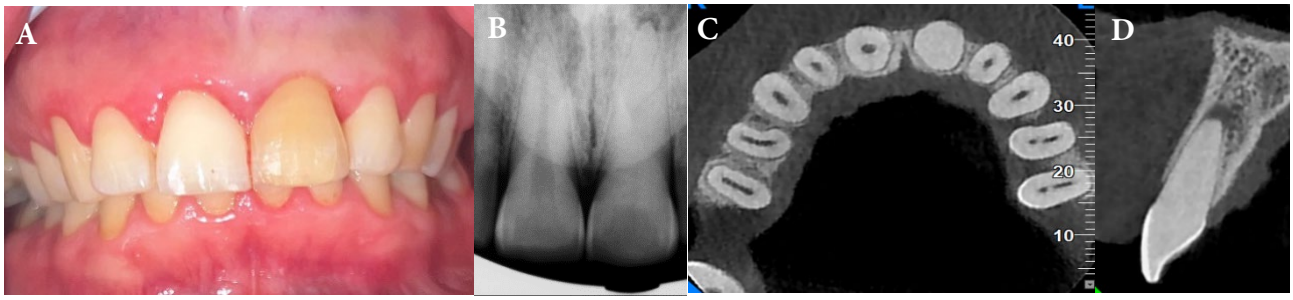

Figure 1. *A*) The photograph shows discoloration in the maxillary left central incisor; *B*) Periapical radiograph shows pulp canal calcification and a periapical lesion; *C*) CBCT image, the axial reconstruction shows pulp canal obliteration in the cervical third; *D*) CBCT image, the sagittal reconstruction shows pulp canal obliteration in cervical and middle thirds

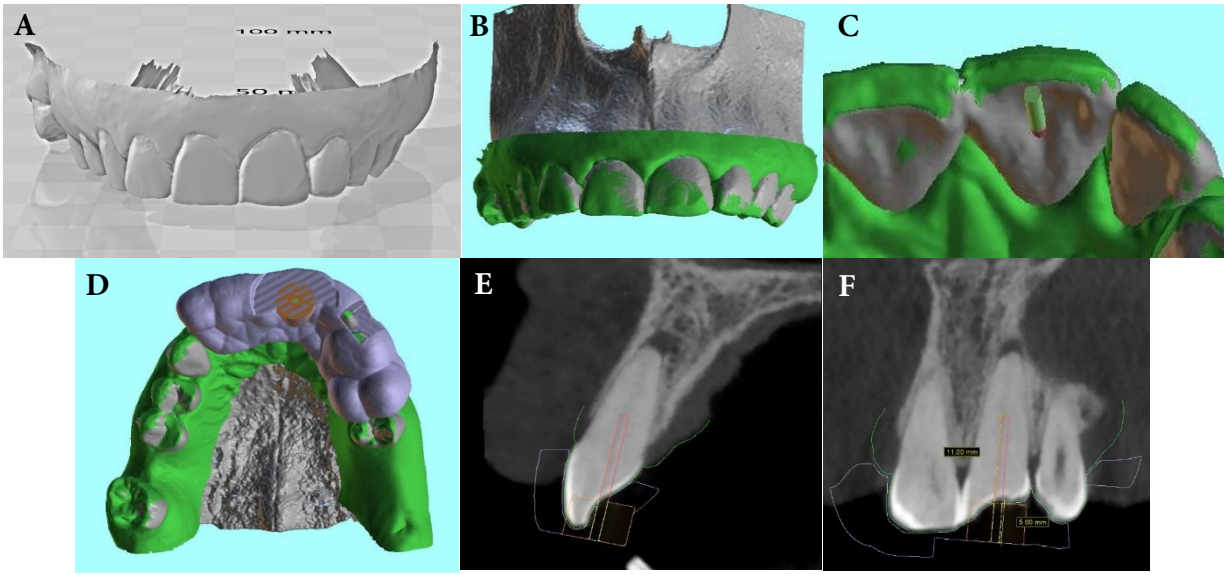

Figure 2. *A*) Intraoral scan of maxillary arch; *B*) Superimposition of intraoral scan on the CBCT image; *C*) Virtual planning of the path of the drill insertion; *D*) The virtual 3D template; *E* and *F*) Axial and frontal view of the virtual planning of the guided endodontic template in CBCT images

Case Presentation

A 32-year-old female was referred to the Department of Endodontics, complaining of discoloration in the left maxillary central incisor that had not responded to external bleaching one year ago. She had a history of dental trauma 10 years ago. Her medical history was non-contributory. The patient was classified as ASA I. The clinical examination showed discoloration in the left maxillary central incisor (Figure 1A). The tooth didn't respond to the pulp sensibility tests, there was no symptom in percussion and palpation. Mobility and probing depth were normal. An initial periapical radiographic examination of teeth showed pulp canal calcification and rarefaction in the periapical area (Figure 1B). The tooth was diagnosed as pulpless infected canal and asymptomatic periodontitis.

High-resolution CBCT images with 100-micron voxel size, 110 kV, and 6 cm × 6 cm field of view (NewTom Vgi, Verona, Italy) were acquired. CBCT images showed obliteration in the coronal and middle thirds (15 mm) of the canal and the only patent canal segment was the apical portion 6 mm above the apex (Figure 1C). Also, a periapical lesion with a diameter of 2 mm diameter was noticed (Figure 1D).

Once the patient was clarified about the treatment approach, informed consent was obtained. An intra-oral scan (Trios, 3Shape, Copenhagen, Denmark) was conducted and exported to Bluesky software (Figure 2A) for virtual endodontic guide planning. The CBCT image and standard tessellation language (STL) file of intra-oral scanning (IOS) were superimposed (Figure 2B). The virtual drill, 0.8 mm in diameter and 16 mm in length was aligned into the root canal system through a conventional palatal access. The virtual drill was oriented to prevent damage to the tooth's incisal edge and to direct the path of the sleeve to the visible lumen of the root canal (Figure 2C, D). The drill's position was evaluated in three dimensions, then the planned template was exported to a 3D printer (Dentafab, Istanbul, Turkey) as an STL file. To access the root, a virtual customized guiding sleeve with

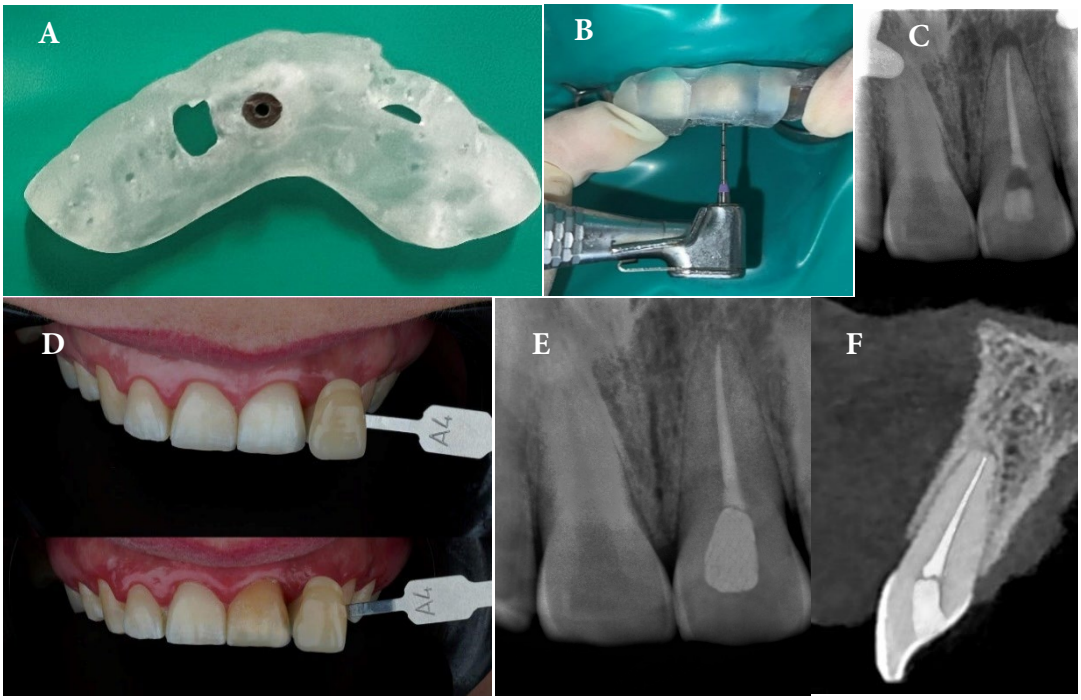

Figure 3. *A*) The printed resin template; *B*) The template was adapted to the maxillary teeth and stabilized manually to avoid vertical movement during drill insertion; *C*) Peri-apical radiograph after obturation; *D*) Photograph of the tooth before and after internal bleaching; *E* and *F*) Peri-apical radiograph and CBCT image of left central incisor after 18 months of follow-up, respectively

dimensions of 5 mm in length, 3 mm in external diameter, and 1 mm in internal diameter was also used (Figure 2 E, F). It was merged into the template to serve as a drill guide during the orifice shaping and planning process to access the canal.

The template was placed on the anterior teeth, and the stability and accordance of the template were checked. The tooth was isolated with the split dam technique (Figure 3B). The access guide was fixed and positioned under local anesthesia with lidocaine and 1/100000 epinephrine (Persocaine; Daroupakhsh, Tehran, Iran) with an infiltration technique. Via the template sleeve, a mark was made to show the precise location of the endodontic access cavity. First, a hole in the enamel of the access area was prepared by a round diamond bur (Meisinger, Düsseldorf, Germany) with a high-speed hand-piece (NSK, Tokyo, Japan), then the template was placed, and mounce bur #1 (Meisinger, Germany) was used with a low-speed handpiece (NSK, Japan) to penetrate the canal through a correct direction. In this way, we could perform a minimally invasive access cavity that kept the incisal edge of the tooth intact.

Drilling was performed with saline irrigation. After drilling 10 mm inside the tooth, a K-file #10 was placed in the canal, and the direction of the prepared hole was checked with periapical radiographs with different horizontal angulations, then drilling resumed 16 mm into the tooth. A K-file #10 was used to negotiate the canal, and the apex locator (Morita, Tokyo, Japan) was applied to determine the working length which was confirmed by peri-apical radiography. A glide path was prepared with manual K-file #15. Passive ultrasonic (Woodpecker, Guangxi, China) with a solution of 2.5% NaOCl was used for root canal irrigation. Cleaning and shaping were performed by RaCe rotary files up to size 25, 4% (FKG Dentaire, La Chaux de Fonds, Switzerland). A paper cone was used to dry the root canal and the root canal was obturated using gutta-percha cones (Meta-Biomed, Cheongju City, Korea) and AH-26 sealer (Dentsply Maillefer, Ballaigues, Switzerland) by cold lateral condensation method (Figure 3C).

The tooth remained isolated by a rubber dam and the gingiva was protected by cream. Then obturation material was cut 2 mm below the CEJ. to prevent penetration of the bleaching agent from the pulp chamber into the root canal and cervical periodontal tissues, the orifice was sealed with glass ionomer with a thickness of 2 mm. 35% Hydrogen peroxide gel (Opalescent Endo; Jordan, UT, Ultradent, USA) was applied in the pulp chamber, then the access cavity was sealed with Cavit (3M ESPE, St Paul, USA).

The bleaching gel should be changed every 3-4 days [13] until the satisfying color was obtained. After three days the color was corrected, the bleaching gel was removed and the cavity was sealed with Cavit (Figure 3D). For optimal bonding, the patient was referred to the restorative department two weeks after bleaching gel removal [14]. After 18 months of follow-up ,the tooth was asymptomatic and the lesion was healed (Figure 3 E, F).

Discussion

This paper emphasizes the advantage of treatment of patients with PCO using new technologies like CBCT and guided endodontics.

CBCT imaging is a helpful tool for identifying root canal anatomy, detecting periapical diseases, recognizing vertical root fractures, planning surgical procedures, and estimating the degree of canal obliteration [15]. According to the statement of the American Association of Endodontists and the American Academy of Oral and Maxillofacial Radiography (AAE/AAOMR) on the application of CBCT imaging in endodontics, CBCT is recommended for locating calcified root canals [16].

Holcomb and Gregory's investigation, reported the prevalence of partial or complete canal calcification to be 4% for incisors [17], and these teeth also have a 7%–27% probability of developing a periapical lesion [18]. There have been reports of a poor prognosis for RCT in teeth that don't succeed during instrumentation [19]. Despite the radiographic image of a calcified tooth that shows the tooth without any pulp canal space, histologically, pulp space containing pulp tissue is found in the majority of them [20]. So guided endodontics makes RCT more predictable for clinicians to perform and helps them minimize iatrogenic consequences, which enhances the prognosis [9].

PCO itself is not considered an endodontic disease, it may occur as a healing sign [21]. The RCT is only indicated in the presence of acute symptoms and apical periodontitis or when PCO complicates the execution of treatment and deteriorates prognosis [18]. According to the AAE, PCO is considered to be an endodontic case with a high degree of difficulty which should be considered for referral [22]. With the use of microscopes and ultrasonic tips, skilled endodontists were able to complete RCT in cases of PCO with an 80% success rate [23]. Even when employed by general practitioners or inexperienced dentists, successful RCTs became significantly more common using the guided endodontic method [7]. This technique can help perform RCT in teeth with calcified canals without a dental microscope [24]. There is virtually minimal risk of perforation, ledge formation, and missed calcified canal with this procedure, regardless of the degree of calcification, unless there are errors in design or insufficient stability in the guide [15, 25].

The report by Krastl *et al.* [8] and the study by Zehnder *et al.* [6], as well as numerous other studies [26-29], explain how conservative access cavity preparation is feasible if it's created parallel to the tooth's long axis through the incisal edge. This method is not without its drawbacks; some areas of the tooth may remain untouched during mechanical shaping, and any residual pulp tissue that remains in the pulp chamber and pulp horns maintains the risk of discoloration in the future [30]. Involvement of the incisal edge makes esthetic results compromised [31]. Lara-Mendes *et al.* [31] reported modified endodontic access that doesn't invade the incisal edge and showed that it is possible to prepare access up on the singulom in guided endodontics. In this report, to preserve the tooth structure and save the incisal edge, and perform a minimally invasive RCT, the guided access preparation was modified, so the access was prepared on the conventional area instead of the incisal edge.

Guided access is a reliable and predictable method that enhances both the short-term and long-term outcomes [26] since it enables more conservative approaches and maintaining tooth structure.

Conclusions

This case report explains RCT with an endodontic guide for a heavily calcified central incisor of the maxilla in which the access was modified to preserve the incisal edge. The long-term prognosis can be enhanced by this conservative technique. To improve the success rate and reduce iatrogenic accidents, this case study recommends using CBCT and an endodontic guide while treating calcified canals.

Conflict of Interest: 'None declared'.

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