A New Approach for Minimally Invasive Access to Severely Calcified Anterior Teeth Using the Guided Endodontics Technique

Sônia T.O. Lara-Mendes, DDS, MS, PhD, * *Camila de Freitas M. Barbosa, DDS,*† *Vinícius C. Machado, DDS, MS,*‡ *and Caroline C. Santa-Rosa, DDS, MS, PhD*§

Abstract

This article describes an endodontic treatment technique performed through a new minimally invasive approach that leads to no tooth damage at the incisal edge and uses cone-beam computed tomographic (CBCT) imaging and 3-dimensional guides. A 26-year-old patient presented with pain in the anterior region of the maxilla and reported having suffered dental trauma 13 years prior. Radiographic examination exhibited no visible root canal on tooth # 9 with a slight thickening in the apical periodontal ligament space. Pulp sensitivity tests produced no response, whereas the percussion test responded positively. CBCT imaging revealed a visible canal space limited to the apical 2-mm section of the root. Guided endodontic access was planned after intraoral scanning of the tooth surface to be used with the CBCT scan. A virtual model was created with the aid of virtual implant software for the surgical access planning in such a way as not to damage the incisal edge of the tooth. The resulting guides were printed. With guides in position over the rubber dam, a mechanical-chemical preparation was performed in the root as soon as the canal was located. Intracanal medication was left for 14 days, after which the root canal was filled gutta-percha and the access cavity sealed. Follow-up was performed 1 year after completion of the treatment. The patient was asymptomatic with periapical tissue within normal limits. The guided endodontic therapy optimized the treatment, having provided a conservative access with no tooth damage at the incisal edge in a safe and predictable way despite the presence of a severely calcified root canal. *(J Endod 2018;■:1–5)*

Key Words

Calcification, cone-beam computed tomography, endodontic access, intraoral scanning, tooth damage

Significance

The guided endodontic technique was used for locating and accessing canals in a calcified maxillary incisor in an attempt to minimize dental structure removal. Such an approach is also known as a minimally invasive access.

The combined use of cone-beam computed tomographic (CBCT) imaging and intraoral scanning of the target area allows the manufacturing of access guides that are extremely helpful in locating severely calcified root canals in highly complex cases, for which guided endodontic access is recommended (1–3). Guided access through root calcifications in anterior teeth has been previously performed and reported in the literature with favorable and predictable results (4, 5). The planned and guided access to calcified roots may help to preserve dental structure and avoid accidents such as deviations and perforations. This may lead to an improved long-term prognosis (3).

Except for minor modifications, traditional designs of root canal treatment of the endodontic cavity for different types of teeth have remained unchanged throughout decades (6). They promote a controlled removal of tooth structure while obtaining proper access to root canal entrances. By overcoming the access challenge, the operator will benefit from facilitated cleaning, shaping, and filling of the root canal system while avoiding procedural errors during treatment (6, 7). Some authors (8, 9) have recently changed the endodontic cavity design to minimize the removal of tooth structure. The conservative endodontic cavity concept emphasizes the preservation of dental structure, including pericervical dentin (8, 10, 11), which leads to an enhanced fracture strength under functional loads (12).

In previous studies in which guided endodontics was used to treat severely calcified anterior teeth by minimally invasive approaches, the incisal edges of teeth were always compromised by the access (3, 4, 13, 14). Aimed at avoiding major losses to such a relevant dental structure, the present case report proposes a modified endodontic access as an attempt to minimize incisal edge compromise.

Case Report

A 26-year-old patient presented with symptoms in the region of the maxillary central incisors. The patient reported a history of dental trauma in the anterior maxilla region 13 years before. A radiograph of the area revealed that tooth #9 had a completely calcified pulp chamber and root canal (Fig. 1*A*).

From the *Department of Endodontics, Faculty of Dentistry, Universidade de Itaúna, Itaúna, Minas Gerais, Brazil; †Department of Endodontics, Faculty of Dentistry, Faculdade São Leopoldo Mandic de Campinas, Campinas, São Paulo, Brazil; ‡Department of Radiology, Faculty of Dentistry, Faculdade São Leopoldo Mandic de Belo Horizonte, Belo Horizonte, Minas Gerais, Brazil; and §Department of Restorative Dentistry, Faculty of Dentistry, Universidade Federal de Minas Gerais, Belo Horizonte, MG, Brazil.

Address requests for reprints to Dr Sônia T.O. Lara-Mendes, Department of Endodontics, Universidade de Itaúna, Rodovia MG 431 - Km 45, Trevo Itaúna/Pará de Minas, 35.680-142 Itaúna, MG, Brazil. E-mail address: soniamendes@hotmail.com

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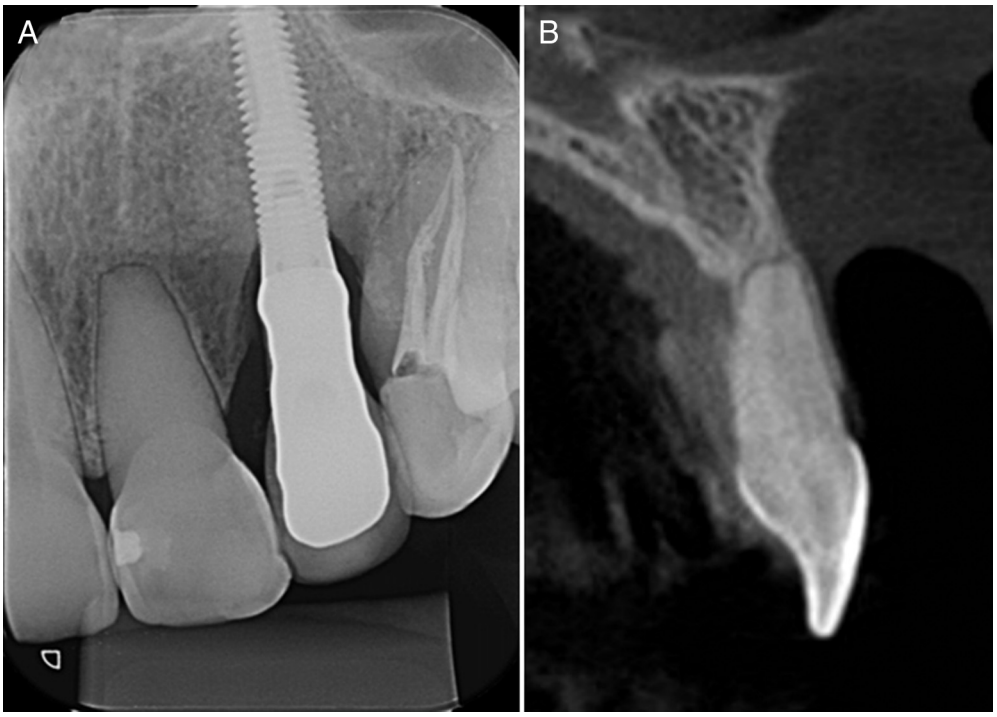

Figure 1. (*A*) A preoperative radiograph showing both the pulp chamber and the root canal completely calcified. (*B*) Sagittal reconstruction showing that only the last 2 mm were visible in the apical third of the root.

At the clinical examination, the tooth failed to respond to the thermal and electrical tests, but the patient reported pain to percussion, which suggests a diagnosis of initial acute apical periodontitis. Endodontic therapy with guided endodontic access as an initial strategy was the proposed treatment. This led the team to call for guided endodontic therapy and a minimally invasive access as the incisal treatment strategy.

A high-resolution CBCT scan was performed with the following settings: 0.12-mm voxel, gray scale, 14 bits, 26.9-second x-ray exposure, 120 kV, and 37 mA (iCAT; Imaging Sciences International, Hatfield, PA). A plastic lip retractor for soft tissue CBCT imaging was used as described by Januário et al (15) to allow for a more detailed view of the dentogingival unit. An apical radiolucent area was observed in the left maxillary central incisor, coinciding with the pain described by the patient. The canal space was only visible in the apical 2 mm of the root (Fig. 1*B*). In light of these findings, the patient signed an informed consent form and was scheduled for a guided endodontic access procedure. In order to guide a clean access through the extent of 11.79 mm of calcified material, a computer-aided design/computer-aided manufacturing approach was suggested. The following steps were taken to create a 3-dimennsional (3D)-printed template. Using the R700 Desktop Scanner (3Shape, Warren, NJ), an intraoral impression was converted into a 3D stereolithography file and then uploaded to virtual implant planning software (Simplant Version 11; Materialise Dental–Technologielaan, Leuven, Belgium). The CBCT image was added to this software, and both the CBCT scan and the surface scan were matched based on the radiographically visible structures. Then, the patient's soft and hard tissues were highlighted with the use of the soft tissue CBCT technique (15). The Simplant software was set to design 2 drills to be used for each guide. The first one was solely aimed at marking the access through enamel using the FG 1014 HL (KG Sorensen, Cotia, SP, Brazil). The second planning helped to design the template for the drill that would be used for guided endodontic access (Neodent Drill for Tempimplants, Ref: 103179; JJGC Ind e Comércio de Materiais Dentários SA, Curitiba, Brazil), with a total length of 20 mm, a 12-mm working length, and a 1.3-mm diameter; the drill was virtually superimposed on the root canal calcification. This virtual drill was angled to avoid the incisal edge of the tooth and to lead the course in such a way as to reach the visible lumen of the root canal (Fig. 2*A*). By means of the previously described position of the drill, the software automatically created a virtual template by applying its designer tool. Aiming at a precise transfer of the virtual plan to the surgical procedure, 2 clamp pins were simulated for stabilization purposes after the correct placement of the printed template on the patient's teeth. A guiding sleeve (with a 3.0-mm external diameter, a 1.4-mm internal diameter, and 8-mm length) was also virtually customized and incorporated into the planning process to access the root and clamp sites (Fig. 2*B*). The template generated was exported as a stereolithography file and sent to a 3D printer (Objet Eden 260 V, Material: FullCure 720; Stratasys Ltd, Minneapolis, MN). The previously mentioned sleeve (Ref: 102110; JJGC Ind e Comércio de Materiais Dentários SA) was integrated into the printed template to guide the drill during the orifice preparation and clamp fixation sites.

The first access guide to the tooth enamel was fixed and positioned under local anesthesia. A mark was placed through the template sleeve to indicate the exact region of the endodontic access cavity. Enamel was removed in this area using a diamond drill until the dentin was exposed. Subsequent to this, the first guide was removed, and a second dentin access guide was positioned and fixed to the patient's upper arch. We used the same bone cutting drill to perform the guided access through the calcified portion of the canal at a speed of 1200 rpm. The template was removed, and the rubber dam was placed. We observed a minimally invasive access opening that preserved the incisal edge of the tooth (Fig. 3*A*). We were able to introduce a K-type #10 file (Dentsply Sirona Endodontics, Ballaigues, Switzerland) into the canal to the working length (Fig. 3*B*). At this stage, an electronic foramen locator (RomiApex