

# Guided Endodontic Access of Calcified Anterior Teeth



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## Abstract

Pulp canal calcification is characterized by the deposition of calcified tissue along the canal walls. As a result, the root canal space can become partially or completely obliterated. Recently, “guided endodontics” has been reported as an alternative solution in cases of partial or completed canal obliteration. Although this technique can enhance minimally invasive access to the calcified canal, it has been shown that the incisal surfaces are often removed during the access of anterior teeth. This report describes 2 cases of guided endodontics using conventional palatal access in calcified anterior teeth and discusses the applicability of this approach in cases of pulp canal calcification with apical periodontitis and acute symptoms. The method demonstrated high reliability and permitted proper root canal disinfection expeditiously, without the unnecessary removal of enamel and dentin in the incisal surface. (*J Endod* 2018;44:1195–1199)

## Key Words

Apical periodontitis, dental trauma, guided endodontics, opening access, pulp canal calcification

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**P**ulp canal calcification (PCC), also known as pulp canal obliteration or calcific metamorphosis, is characterized by the deposition of calcified tissue along the canal walls.

As a result, the root canal space can become partially or completely obliterated. PCC cases are associated with luxation injuries after dental trauma (1, 2). Other causes of PCC are a pulpal response to injuries such as invasive pulp therapy procedures (3), extended carious lesions (4), abfractions, and restorations (5). The use of orthodontic forces may also induce PCC because of interference in the blood supply (6). Moreover, in elderly patients, the deposition of secondary dentin may also severely reduce the root canal space (7, 8).

An incidence of 4% of partial or total obliteration of the pulp spaces of anterior teeth was reported by Holcomb and Gregory (9) in servicemen. In cases of traumatized permanent teeth, this incidence is increased to 22% (10). Pulp necrosis has been reported in 1%–16.5% of PCC cases (11), and the development of apical periodontitis has been estimated at 7.3%–24% of cases after 4 years of trauma (2). There is a consensus in the literature that the root canal treatment of teeth presenting with PCC is only indicated in the presence of acute symptoms or apical periodontitis (1, 2, 9–15). In these cases, even the most experienced clinicians can encounter difficulties in achieving the goals of endodontic treatment. Root perforation and canal deviations have been reported as common complications after the treatment of PCC cases, which may ultimately result in tooth loss (16, 17).

Recently, “guided endodontics” has been reported as an alternative solution in cases of partial or completed canal obliteration (18, 19). Special software (coDiagnostix; Dental Wings Inc, Montreal, Canada) aligned with cone-beam computed tomographic (CBCT) imaging and a digital impression 3-dimensional (3D) scan allows virtual planning of the canal access cavity. Subsequently, a 3D template can be produced to guide the drill into the calcified root canal (20). Although this technique can enhance minimally invasive access to the calcified canal, it has been shown that the incisal edge is often removed during the access of anterior teeth to allow for straight-line access parallel to the long axis of the tooth for the drill (18–20). To avoid this, a modification in the template was proposed to permit standard access preparation for maxillary anterior teeth, which is located in the exact center of the palatal surface of the crown buccolingually and incisogingivally.

These reports aimed to describe 2 cases of guided endodontics programmed with conventional palatal access in anterior teeth and to discuss the applicability of this approach in cases of PCC with apical periodontitis and acute symptoms.

## Case Report 1

A 43-year-old female patient was referred to a private clinic with a history of pain in the maxillary right central incisor. The patient had a history of dental trauma that occurred 25 years earlier. The tooth was discolored and yellow, and it presented

## Significance

Guided endodontics often causes incisal edge removal in anterior teeth. Guided endodontics programmed with conventional palatal access showed high reliability and permitted root canal disinfection expeditiously.

## Case Report/Clinical Techniques

tenderness to percussion. Thermal and electrical sensitivity tests were negative. Radiographic examination showed a severely calcified root canal. The presence of apical periodontitis was confirmed by the CBCT scan. However, root canal space could only be identified in the apical third with 3D imaging. After analysis and discussion with the patient, guided endodontics was chosen as the most appropriate treatment approach.

A conventional opening access was initiated with a high-speed diamond round bur. The enamel in the palatal surface was removed until the dentin was reached. Then, a silicon impression was taken, and a gypsum dental model was created and scanned (3Shape R700 Scanner; Holmens Kanal, Copenhagen, Denmark). Both CBCT imaging and model scans were aligned and processed with SimPlant (Version 11; Materialise Dental, Leuven, Belgium). A virtual copy of a drill with a diameter of 1.3 mm and a length of 20 mm (Neodent Drill for Tempimplants, Ref: 103179; JJGC Ind e Comércio de Materiais Dentários SA, Curitiba, Brazil) was superimposed onto the scans in a position that allowed its access to the identified root system within the apical one third of the tooth. An effort was made to perform a conventional palatal cavity access and prevent unnecessary incisal dentin wear (Fig. 1). The position of the drill was checked in 3 dimensions. Subsequently, the 3D template was exported as an STL file and sent to a 3D printer (Objet Eden 260 V with Fullcure 720 material; Stratasys Ltd, Minneapolis, MN) as described elsewhere (20).

The template fit and bur position were checked in the mouth. The bur was coupled to a low-speed handpiece set to 10,000 rpm. Drilling was performed with pumping movements to penetrate through the calcified part of the root canal under copious irrigation with saline. After each 2-mm apical advance, radiographs in 2 different angulations were taken to confirm the correct position of the bur. The patent apical root canal was reached, and a rubber dam was placed. A #15 K-file was introduced, and the root canal length was electronically (Root Z X2; J Morita Mfg Corp, Fushimi-ku, Kyoto, Japan) and radiographically confirmed (Fig. 2).

The tooth was instrumented with the 30.01 and 30.05 rotary NiTi Logic System (Easy Equipamentos Odontológicos, Belo Hori-

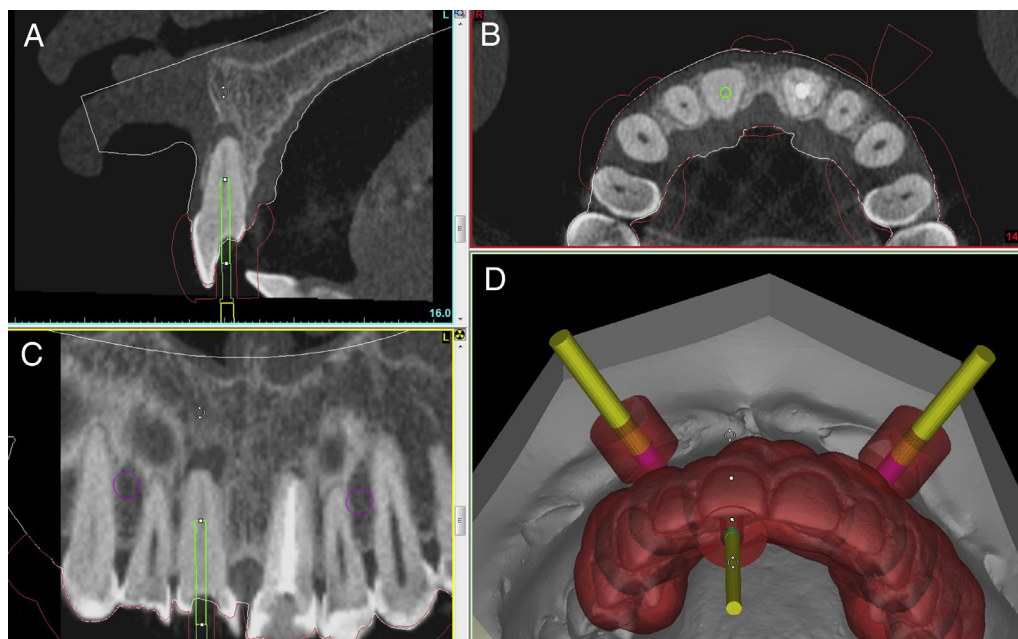
zonte, MG, Brazil) and irrigated with 2.5% sodium hypochlorite. Irrigation was agitated with the XP-endo Finisher (FKG Dentaire, La Chaux-de-Fonds Switzerland) for 60 seconds. After drying the root canal, obturation was performed with Tagger's hybrid technique (21) and AH Plus Sealer (Dentsply DeTrey GmbH, Konstanz, Germany). The access cavity was cleaned and sealed with glass ionomer cement and composite resin. At the 15-day follow-up, the tooth was asymptomatic.

### Case Report 2

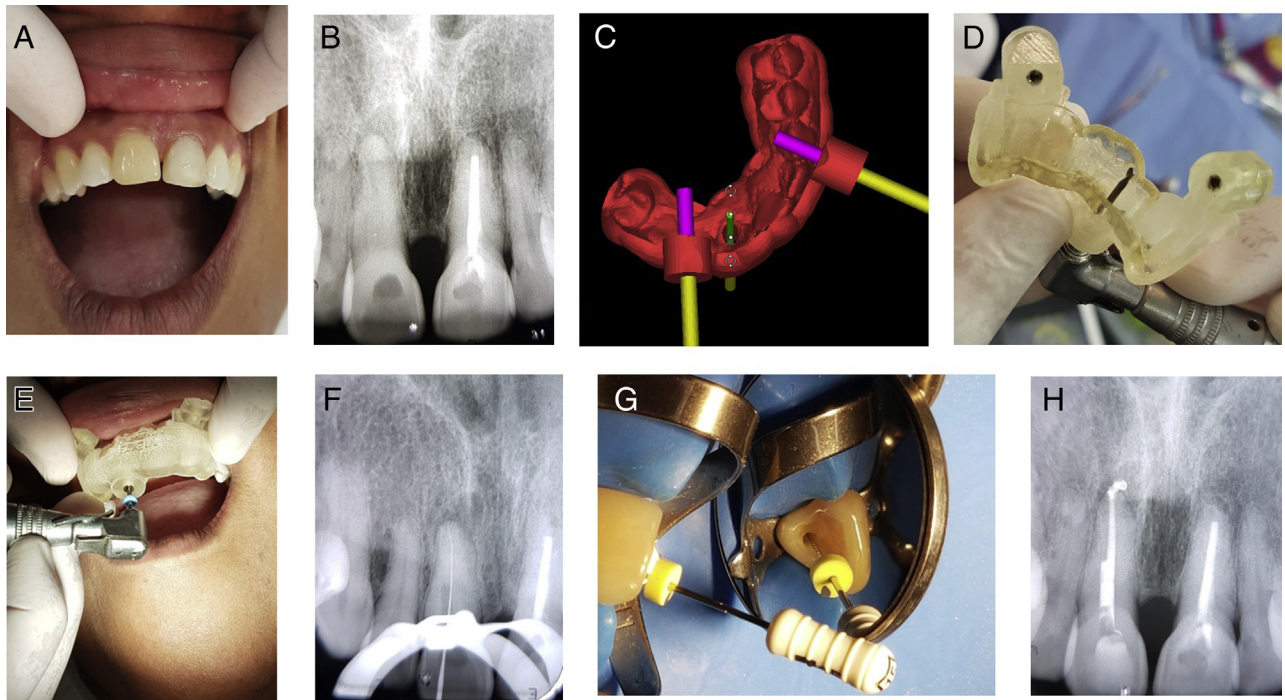
A 24-year-old female patient was referred for endodontic treatment of the maxillary right central incisor. The tooth presented with radiographic apical periodontitis and was sensitive to percussion and palpation tests. An unsuccessful attempt to access the patent canal was made by another endodontist. The patient had a history of car accident trauma and teeth luxation in childhood. The maxillary left central and lateral incisors also presented PCC but were completely asymptomatic and had no evidence of apical periodontitis; thus, endodontic treatment was not indicated. The patient was informed about the choices of treatment for the right central incisor, and guided endodontics was considered as the most appropriate treatment approach.

Because previous palatal access had already been made, the patient was referred for a CBCT examination, which confirmed the presence of severe canal calcification and apical periodontitis. As previously described, the 3D template was built taking into account the traditional palatal access. The scans were aligned and processed, and the bur could gain access to the apical visible root canal (Fig. 3).

After checking the adjustment of the template, the access was made with a low-speed handpiece set to 10,000 rpm. Care was taken to irrigate the drilling action with saline and avoid microcracks. Intraoperative radiographs were taken with different angulations to check the correct bur position. The patent canal was reached with a #10 K-file, and the working length was confirmed (Fig. 4). This step takes on average 5 to 10 minutes.



**Figure 1.** A CBCT image of the right maxillary central incisor with severe PCC and apical periodontitis. (A–C) Virtual planning of guided endodontics. (D) The model scan aligned to the 3D template and the virtual copy of the drill.



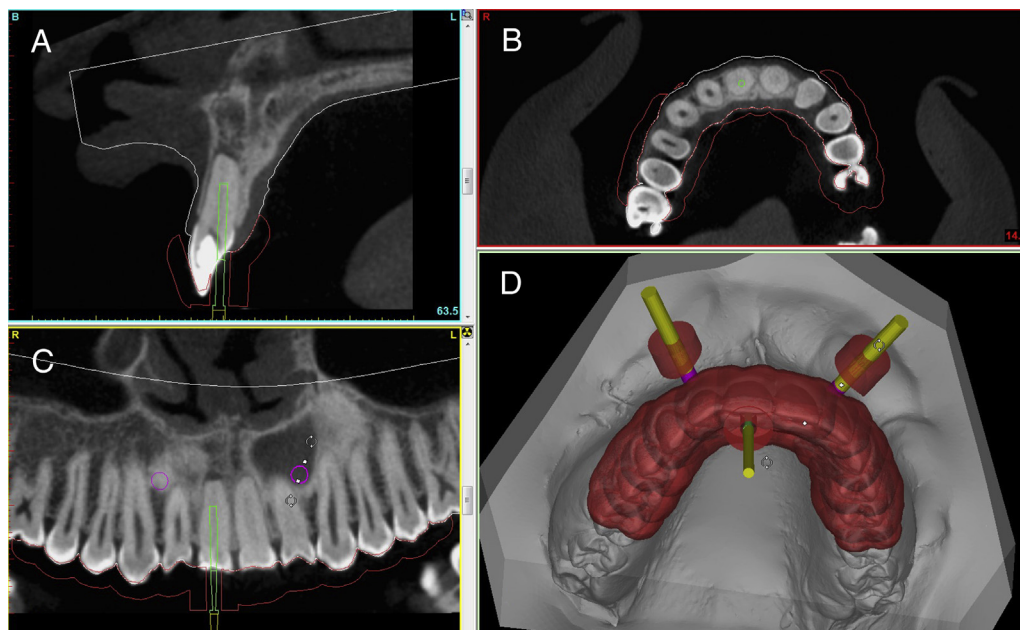
**Figure 2.** (A) The right maxillary central incisor discolored and yellowish. (B) Radiographic examination showing severe PCC. (C and D) The virtual and real bur positioned in the 3D template. (E) The template positioned in the mouth and guided dentin drilling. (F and G) Checking of the root canal length and (H) the final radiograph.

The tooth was instrumented with the 30.01, 25.06, 30.05, and 40.05 rotary NiTi Logic System (Easy Equipamentos Odontológicos) and irrigated with 2.5% sodium hypochlorite. Irrigation was agitated with the XP-endo Finisher for 60 seconds and antimicrobial photodynamic therapy was performed (22). After drying the root canal, obturation was performed with Tagger's hybrid technique (21) and AH Plus Sealer. The access cavity was cleaned and sealed with glass ion-

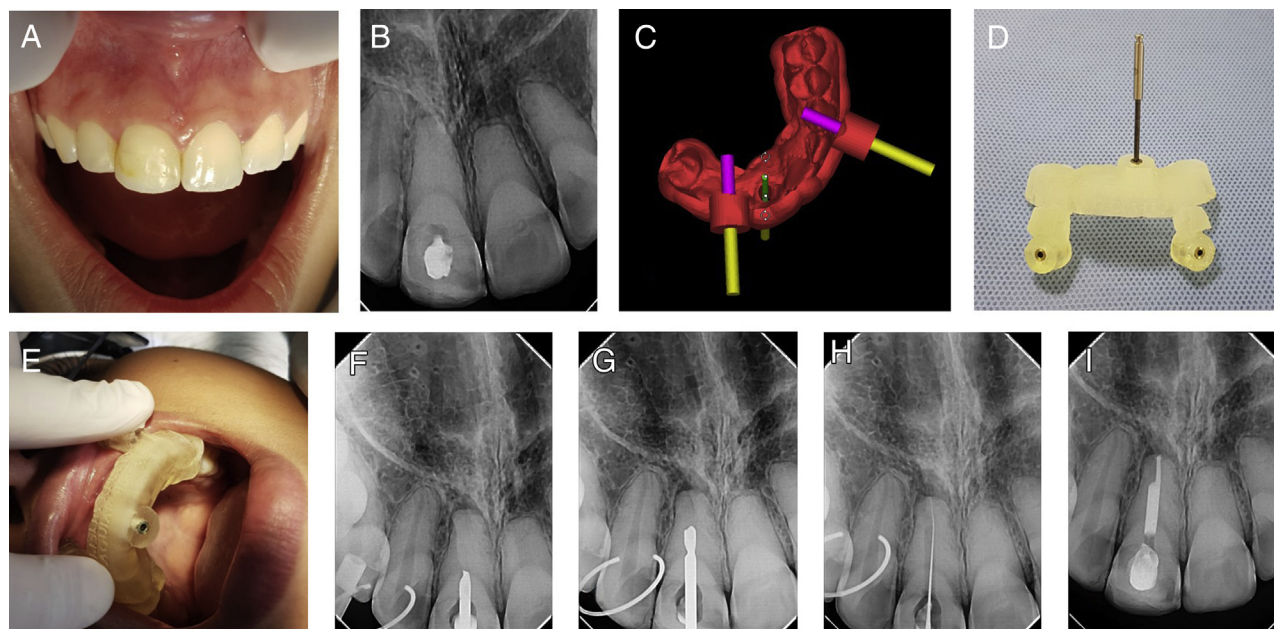
omer cement and composite resin. The tooth was completely asymptomatic after 30 days.

### Discussion

Severe pulp canal calcification is a challenge in cases of apical periodontitis. Although it has been established that the most



**Figure 3.** A CBCT image of the right maxillary central incisor with severe PCC and apical periodontitis. (A–C) Virtual planning of guided endodontics. (D) The model scan aligned to the 3D template and the virtual copy of the drill.



**Figure 4.** (A) The right maxillary central incisor discolored and yellowish. (B) Radiographic examination showing severe PCC. (C and D) The virtual and real bur positioned in the 3D template. (E) Template fit checking in the mouth. (F and G) Transoperative radiographs of guided dentin drilling. (H) Canal patency. (I) The final radiograph.

experienced endodontists can attain high levels of success in such cases, the risk of perforation and tooth loss should be considered. Guided endodontics provided us with a very reliable method to gain access to patent canals even in severely obstructed canals (18, 19). Moreover, in mandibular incisors, this technique proved to be very efficient with the aid of thinner burs (20). However, until now, cases presented open access with incisal edge removal in the anterior teeth. Our objective was to gain access to the traditional palatal surface opening, which was shown to be entirely possible.

The development of oral scans provided benefits in the precision of models. Direct oral scanning delivers a faster and more reliable copy of the teeth, which is paramount for success in cases that demand high sensitivity. However, even when direct oral scanning is not possible, the technique can still be performed. As in the cases presented in this report, an impression with silicon was made. The high-quality model obtained was then scanned in a radiologic center so that the template could be constructed.

The bur diameter in the cases presented (1.3 mm) generated a high wear of dentin. In fact, because of the large diameter, care was taken to irrigate the bur copiously. This avoided unnecessary attrition and microcracks during dentin drilling. The back and forward movement with gradual advances helped to prevent extensive loads and forces into the dentinal walls. Notably, even with the large diameter of the bur (compared with conventional endodontic instruments), it was possible to reach the patent canal without unnecessary wear of the incisal borders of the teeth. The canals were promptly reached with #10 or #15 K-files in most cases treated by our group until now.

The time of the entire procedure must be taken into consideration. Within a few minutes, patency could be achieved. Without this guidance, even the most experienced clinicians should be cautious and take several radiographs to ensure the correct insertion position of the instrument used to achieve the canal (16).

The reduction in the number of radiographs with this approach is also a benefit and compensates for the radiation received by the patient in CBCT scanning because the latter would be considered as a possible

drawback of this technique (20). However, we strongly recommend intraoperative radiographs in at least 2 angulations to certify that the bur does not deviate from its path (16).

Conventional root canal treatment and apical surgery are alternative treatment options in PCC cases. Although experienced clinicians can achieve high levels of success with conventional root canal treatment in calcified canals, 3 factors must be considered: it is time-consuming, there is a risk of perforations or excessive tooth substance removal, and there is excessive patient exposition to x-rays (16). Apical surgery is a more invasive and discomfortable approach to the patient; however, it must be considered as the treatment of choice in cases of PCC in which a straight line to the patent canal cannot be achieved by the bur with guided endodontics as in cases of severely curved canals.

## Conclusions

The conventional opening access programming of guided endodontics in cases of PCC in anterior teeth with apical periodontitis has been shown to be very reliable and permits proper root canal disinfection expeditiously. An improvement in the technique is on the way. Prototype burs with smaller diameters and different lengths are being tested and will soon be in production. This will allow access to calcified canals in longer teeth such as canines and avoid the risk of enormous dentin wear or perforation in thinner teeth such as mandibular incisors. Efforts must be made to improve the technique and allow its use in the treatment of curved canals and posterior teeth, the guidance of retreatment of selective canals, and the removal of fiber posts.

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*The authors deny any conflicts of interest related to this study.*

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## Erratum



Erratum to Clinical Outcome of Non-Surgical Root Canal Treatment Using a Single-cone Technique with Endosequence Bioceramic Sealer: A Retrospective Analysis [Journal of Endodontics 44 (2018) 941–945]

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