Case Reports in Maxillary Posterior Teeth by Guided Endodontic Access

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Abstract

The localization of partial or completed root canal obliteration is a challenging task in endodontic practice. Recently, guided endodontics has become an alternative solution for those cases. Although this technique has already been used clinically in managing anterior teeth, in this report, we describe 3 complex clinical scenarios of calcified root canals of 1 molar and 2 premolars using guided endodontics. The clinical cases reported here show that technological evolutions should make guided endodontic procedures more widespread because their execution is relatively fast and safe even in the case of the upper molar. Additionally, 12-month clinical follow-up visits showed the effectiveness of the guided endodontic procedures. *(J Endod 2019;45:214–218)*

Key Words

Case reports, clinical follow-up, guided endodontics, root canal obliteration

Significance

Although guided endodontics has already been used clinically in managing anterior teeth, this report describes 3 complex clinical calcified root canals of a molar and 2 premolars and, after 24-month clinical follow-up visits, shows its effectiveness.

Partial or total pulp canal calcification is a common finding in permanent teeth and is often associated with caries, aging, traumatic injuries, and systemic conditions (1–4). The pulp chamber and the root canal space are obliterated by mineralized tissue deposition (2–5).

In these cases, the localization and negotiation of the root canal are challenging tasks in endodontic practice (6–10). These procedures may lead to iatrogenic failure and poor prognosis (11). If conventional endodontic treatment is impossible or impractical, surgical intervention or extraction and replantation are alternative approaches for teeth with calcified root canal systems (12–14).

Recently, with the improvement of tomographic imaging techniques associated with virtual planning, a new method called "guided endodontics" was introduced to access and treat calcified canals (15–18). An *ex vivo* study showed the high precision of this technique (15), which has already been used in the clinic to manage anterior teeth (15, 19). Additionally, the effectiveness of guided endodontics in treating a calcified molar was recently demonstrated (20).

In this report, we describe the endodontic treatment of 1 molar and 2 premolars with extremely calcified canals using the guided endodontics technique. To reach the remaining apical root canal system (RCS), the tomographic images associated with the guided endodontics technique were used. This study aimed to show the effectiveness of these technical procedures for solving complex clinical calcified root canals in cases in which conventional endodontic treatment does not allow access to the apical foramen. Moreover, follow-up visits were performed to confirm the healing of previous periapical lesions.

Materials and Methods

Case Reports

Case 1. In April 2016, a 47-year-old female patient presented with the need for endodontic treatment in the first left upper molar because of the presence of acute symptomatology. Clinical examination revealed the presence of percussion sensitivity and a negative response to thermal and electrical tests. The periapical radiograph revealed an

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obliterated pulp chamber and possible calcification of the buccal canals. Both palatal and mesiobuccal canals were located and instrumented under an endodontic microscope.

Cone-beam computed tomographic (CBCT) imaging (I-Cat Classic; Kavo Ind, Saguaçu, Joinville/SC) was performed to map the extent of the obliteration and to identify the remaining root canal. The absence of the second mesiobuccal root canal was observed. The length of the distobuccal canal was approximately 14.43 mm. The calcification was approximately 11.26 mm from the buccal cusp. Therefore, 3.17 mm of the remaining root canal needed to be reached and operated on.

Case 2. A 65-year-old female patient was referred to a private clinic with a history of pain in the second left upper premolar. Previously, an endodontist tried unsuccessfully to access the root canal orifices. The patient reported a history of parafunctional habits and was using a night guard for grinding. The tooth presented fracture of the palatal cusp, great coronal wear, and percussion sensitivity. Thermal and electrical sensitivity tests were negative. Radiographic examination showed root canal obliteration as well as a possible iatrogenic communication on the mesial face that was created during surgical access. CBCT imaging confirmed pulp obliteration. The root canal was initiated at 13.46 mm from the buccal cusp, with approximately 7.00 mm of its length remaining to be reached and operated on.

Case 3. A 45-year-old female patient was referred for endodontic treatment of the second right upper premolar. The tooth presented apical periodontitis and positive sensitivity to percussion and palpation tests. Radiographic examination showed an extremely calcified root canal associated with periapical radiolucency. First, an experienced endodontist used the dental microscope and was unsuccessful in accessing the root canal orifices; the patient was then referred for CBCT examination. The data showed 2 severely calcified root canals that converged in a single foramen in the apical third. The length of the calcifications were approximately 16 mm and 17 mm in the palatal and buccal root canals, respectively.

Building the Endodontic Guide

The 3-dimensional (3D) documentation was obtained by CBCT imaging (I-Cat Classic) and a TRIOS Color Pod intraoral scanner (3Shape A/S, Copenhagen, Denmark). Two study models were created based on those images. Afterward, the models were aligned and exported to virtual planning software (Simplant 15.0 Pro; Materialise, Brussels, Belgium). The diameter of the drill used to access the root canal was determined according to the radicular width obtained by the CBCT examination.

A virtual copy of the selected access drill was superimposed on the CBCT-acquired image in a position that allowed access to the remaining apical root canal. The position of the drill was verified in 3 dimensions in the axial, sagittal, and coronal sections to ensure that the tip of the instrument reached the space of the remaining apical root canal. The anchorage guides were defined. By stabilizing the guide, the safety and efficiency of the technique were improved because the probable displacement of the guide during the clinical procedure could be anticipated. A virtual guide was then conceived using coDiagnosticX software (Dental Wings GmbH, Chemnitz, Germany). This model was exported as an STL file and sent to a 3D printer (Objet Eden 260 V, Material: MED610; Stratasys Ltd, Minneapolis, MN), which fabricated the respective guide.

Clinical Procedures

Clinical procedures were performed under local anesthesia. The guides were positioned on the teeth and adjusted; the positioning of the drill in the mouth was checked. Afterward, the guides were fixed through the stabilization of guided pins milled by a drill with a diameter of 1.3 mm (Neodent Drill for Tempimplamts, Ref: 103179; JJGC Industria E Comercio De Materiais Dentarios SA, Curitiba, PR, Brazil) using the X-SMART IQ engine (Dentsply Maillefer, Ballaigues, Switzerland) at a speed of 350 RPM and a torque of 5 N-cm (Ref: 102110, JJGC Industria E Comercio De Materiais Dentarios SA). The procedures were performed with copious irrigation of saline. A driver located in the guide positioned precisely on the coronary access cavity of the tooth allowed the stabilization of the selected drill.

A drill with a diameter of 1.1 mm (Neodent Drill for Tempimplamts, Ref: 103.044, JJGC Industria E Comercio De Materiais Dentarios SA) was used to access the buccal root of the maxillary molar. This drill was coupled to an X-SMART IQ motor (Dentsply Maillefer), which was operated at 350 RPM and 5 N-cm torque in short, apical pressure movements under irrigation of saline to a length of 11.5 mm. To access the premolar root canals, a drill with a diameter of 1.3 mm was used (Neodent Drill for Tempimplamts, Ref: 103179) under the same condition used previously. After that step, the guides were removed, and absolute isolation of the operative field was performed. The working length was determined by an apex locator (Raypex 5; VDW, Munich, Germany), introducing a #10 K-file (VDW) into the canal. The chemical mechanical preparation was performed using ProTaper nickel-titanium files (ProTaper Next, Dentsply Maillefer) under constant irrigation with sodium hypochlorite (5.25%) until an X3 instrument reached the working length. The RCS was filled using a gutta-percha cone (Dentsply Maillefer) associated with endodontic cement (Pulp Canal Sealer; Kerr, Orange, CA). All cases were resolved in 1 session.

Clinical Follow-up

The patients were clinically and radiographically evaluated at 15 days and 6 and 12 months after the initial procedures.

Results

At the 15-day follow-up visit, all of the patients were asymptomatic and were referred for prosthetic rehabilitation. After 6 months, periapical tissue mineralization was observed in cases 1 and 3, which presented previous periradicular lesions, and in case 2, which presented the absence of periapical thickening. Complete healing was observed after the 12-month follow-up visit (Figs. 1*A–J*, 2*A–G*, and 3*A–J*).

Discussion

The use of endodontic microscopy and ultrasonic tips to access obliterated root canals has allowed clinical success rates of approximately 74% (7). Recently, to increase such rates and at the same time provide more technical security in accessing the calcified root canals, a new technique, namely, guided endodontics, was proposed (15, 16). This technique can facilitate the endodontic treatment of calcified root canals even by inexperienced operators, providing maximum conservation of the coronal and radicular tooth structure along with a reduced risk of root perforations within a short time (16).

In this study, we present 3 clinical endodontic treatments performed *in vivo* using the guided endodontic technique as described elsewhere (16). The first clinical case addresses the treatment of a first left upper molar. The second shows the endodontic treatment of a second right upper premolar with an indication for endodontic treatment for prosthetic reasons after an experienced endodontist unsuccessfully attempted to access and locate the root canals. The third case focuses on the endodontic treatment of a second right upper premolar with

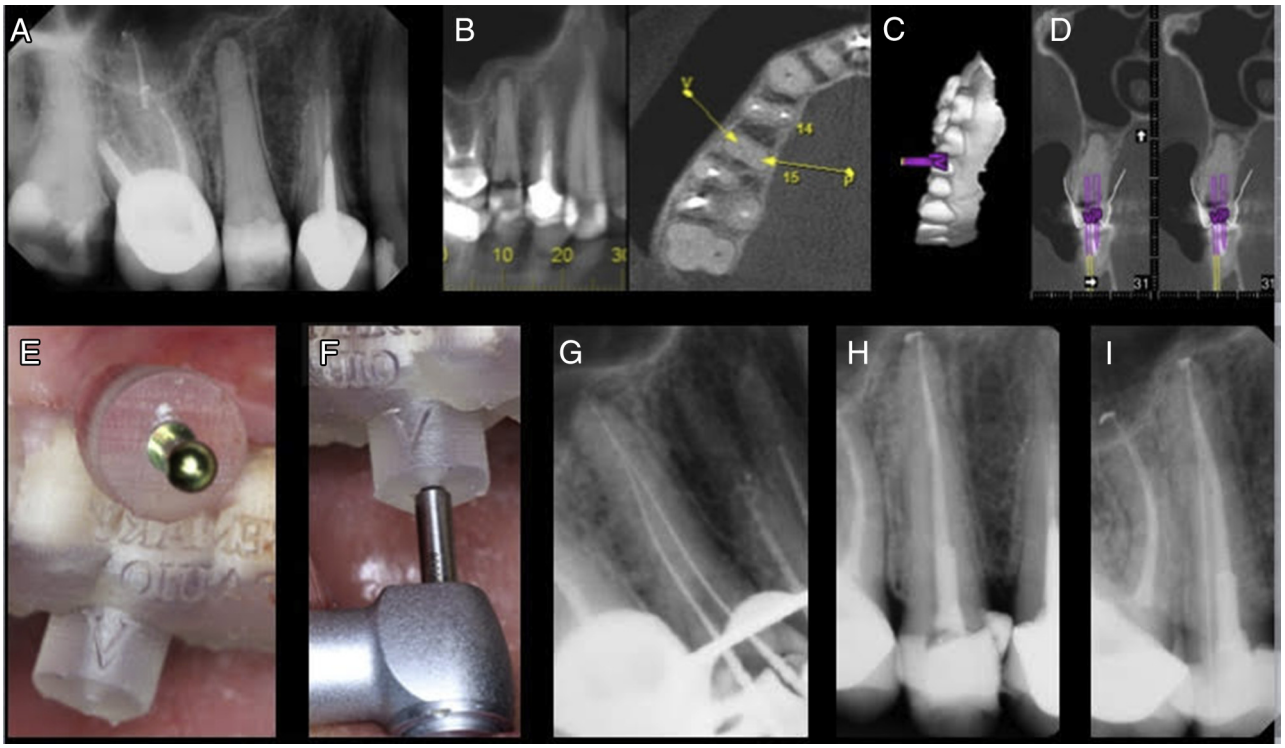

Figure 1. (*A*) Radiographic examination of the first upper molar. (*B*) A CBCT image showing partial and completed obliterations of the distal and mesial vestibular root canals. (*C*) A 3D model of the oral cavity. (*D*) 3D root canal planning. (*E*) The prototyped surgical guide. (*F*) Perforations performed for guide fixation. (*G*) The bur positioned in the 3D template. (*H*) Canal patency. (*I*) Radiography at the 6-month follow-up. (*J*) Radiography at the 1-year follow-up.

radiographically detectable apical periodontitis and sensitivity to percussion and palpation tests.

The use of guided endodontics was proposed after failure of the dental microscope and ultrasonic tips to access partially obliterated root canals. In the clinical cases of root canal obliteration, such as those presented herein, the use of guided endodontics may be essential to reach the remaining RCS. Additionally, guided endodontics removes the need for multiple radiographic shots during RCS localization and access and improves the predictability of the outcomes (16).

In most reported cases (15–19), guided endodontics is used to treat more extensive and straighter roots, such as those of the central incisors; however, we performed this technique in the molar and premolars because it was impossible to reach the remaining canals with conventional localization techniques. Technical failure is frequently associated with a dubious prognosis when searching for obliterated root canals (21). Moreover, according to some researchers (21), complications may be aggravated because of the presence of pulp nodules.

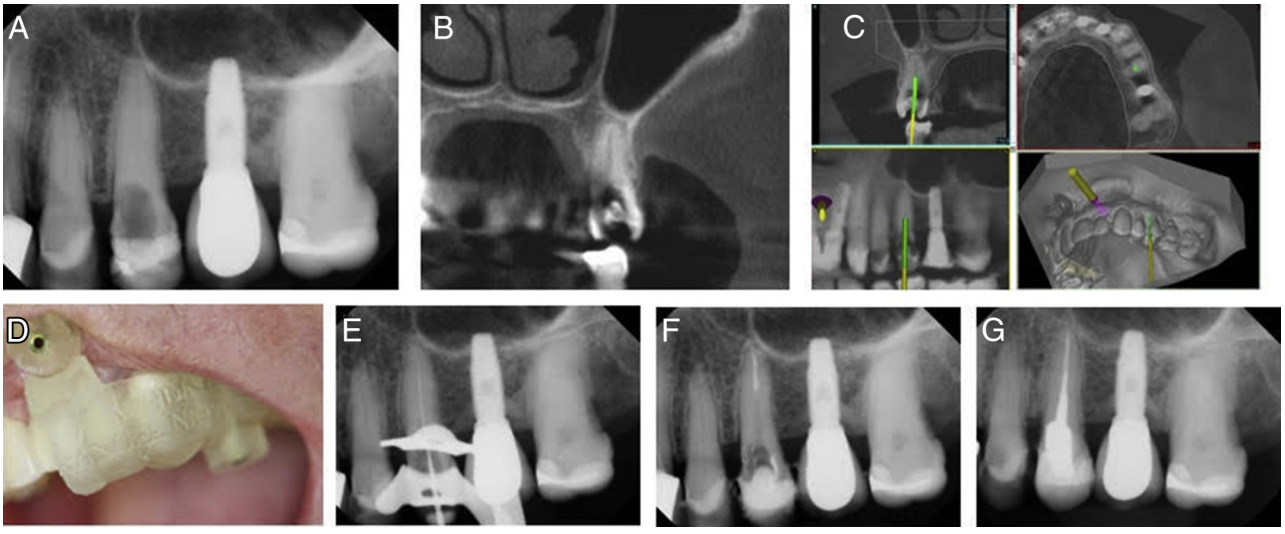

Figure 2. (*A*) Radiographic examination of the second upper premolar. (*B*) A CBCT image showing partial obliteration of the root canal. (*C*) A 3D model of the oral cavity and 3D root canal planning. (*D*) The prototyped surgical guide. (*E*) canal patency. (*F*) The final radiograph. (*G*) The radiograph at the 1-year follow-up.

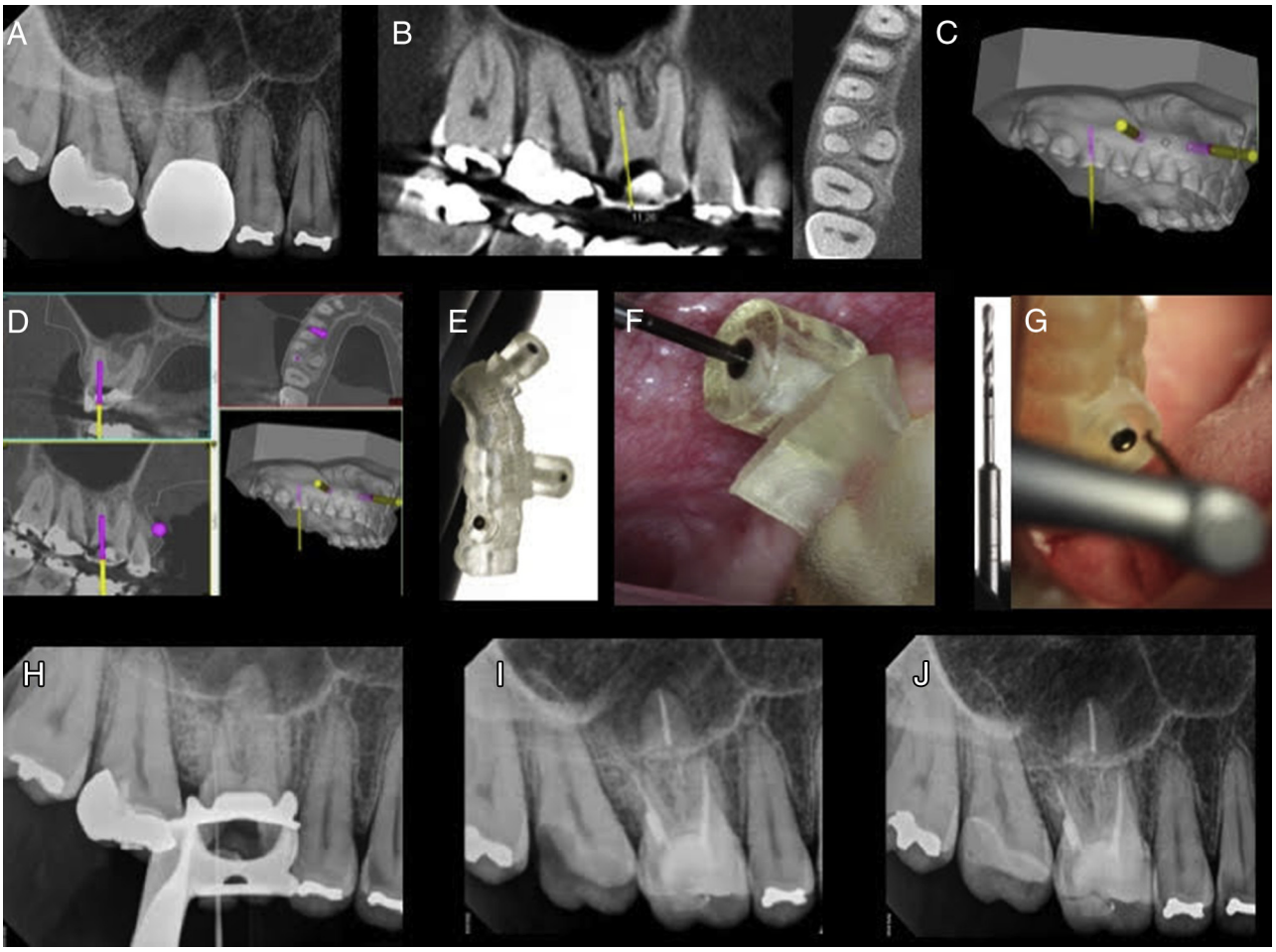

Figure 3. (*A*) Radiographic examination of the second upper premolar. (*B*) A CBCT image showing partial obliteration of the root canal and apical periodontitis. (*C*) A 3D model of the oral cavity. (*D*) 3D root canal planning. (*E*) Perforations performed for guide fixation. (*F*) The bur positioned in the 3D template. (*G*) Canal patency. (*H*) The final radiograph. (*I*) The radiograph at the 6-month follow-up. (*J*) The radiograph at the 1-year follow-up.

In the first report, it was observed that even in the case of an upper molar with considerable calcification along the root canal, more than two thirds of its length, it was possible to access the remaining 3 mm without deviation and with selective dentin wear. It was shown that after the use of guided access in a premolar with great coronal iatrogenic destruction, the remaining RCS at 13.46 mm from the buccal cusp was reached without great dentin wear. The guide for root canal access in a premolar with an extensive periradicular lesion was also used, presenting 2 severely calcified root canals that converge in a single foramen. In the next 12 months of follow-up visits, the clinical effectiveness was radiographically demonstrated by new bone deposition.

It is well-known that even with the use of the dental microscope in the negotiation of extremely calcified root canals, there is a high risk of deviation, perforation, or at least overpreparation of the root canal (22). The cases reported here reinforce what was observed by previous guided endodontics reports (15, 16), showing that this new endodontic tool facilitates access to the remaining root canal that is unobstructed below the calcified region, even in the case of an upper molar. Additionally, the technology used in guided endodontics, such as the equipment, tomography, and prosthetic laboratory, does not prohibit treatment because this technology is accessible worldwide.

It should be noted that guided endodontics is achieved by the use of planning software (coDiagnosticX) in tandem with the fusion of CBCT and intraoral scanning. The combination of these technologies has allowed planning of the ideal methods to access highly calcified root canals. This planning culminates in the preparation of an orientation guide using a 3D printer. It is also worth noting the importance of the use of washers, which provide adequate stabilization of the guide (15).

In recent years, the use of scanning techniques in dentistry has increased, and it is believed that the combination of CBCT and 3D prints to obtain information will become standard in dental planning in the future (16). The clinical case reports presented here unequivocally show that such technological evolution should make guided endodontic procedures more accessible and widespread, even among less experienced operators. Although extremely detailed planning is required, the execution of the technique is relatively fast and safe, substantially reducing the occurrence of iatrogenic failures and increasing the success rates of endodontic treatment.

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