



Influence of Limited Mouth Opening on Guided Endodontic Access and Its Clinical Management: A Case Report

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Abstract

This case report presents the innovative application of ultrasonic points combined with a graphite-marked endodontic guide in a case of restricted vertical space. A 71-year-old female patient with root canal obliteration in the second left mandibular molar was referred for treatment. The patient was experiencing spontaneous pain. Using data from cone-beam computed tomography and surface scans, a virtual 3D guide was developed and positioned. As the patient presented limited interocclusal space, black graphite was inserted through the drill path to mark the pathway. The guide was withdrawn, shorter ultrasonic points were inserted 2 mm into the marked dentin, and this process was repeated until the root canals were localized. The root canals were subsequently shaped and filled. The guide drill path effectively served as a reference for ultrasonic points, enabling successful localization of the root canals. Graphite-marked guide path facilitated access to obliterated root canals in the presence of limited interocclusal space.

Keywords: Root Canal Obliteration; Guided Endodontics; Ultrasonic Points; Clinical Follow-up

Introduction

Since 2016, Guided Endodontics has been a novel and intriguing approach that utilizes cone-beam computed tomography (CBCT), digital impression systems, three-dimensional printing technology, template designing, software, and dynamic navigation, attempting to manage several endodontic challenges, and delivering more predictable treatments [1-6]. Localization and negotiation of the root canals are especially difficult in partial or total pulp canal obliteration (PCO) [7-9]. Despite the clinical difficulties associated to cases involving complex scenarios of calcification in molars, the use of guided endodontics has been demonstrated as a viable and reliable treatment alternative [1].

Patients with severe limitations in mouth opening may represent an even greater challenge for clinicians. Limited mouth opening, lack of visibility, as well as thinner dentin walls of the posterior teeth, result in a risk of root perforation. The

inclination of the teeth and the presence of root curvature make the localization of calcified canals in molars a risky procedure [1, 9-11]. In these situations, the use of guided endodontics would be even more crucial for gaining access to the root canals. However, limited mouth opening may prevent the insertion of the guide and the contra-angle drill set into the patient's mouth.

Recent advancements, such as intracoronal [11] and sleeveless guides [12], have been introduced to address these limitations in posterior teeth. The aim of this case report is to show a promising technique for managing calcified root canal of a molar in a patient with critical interocclusal space restriction.

Case Report

A 71-year-old female patient was referred for endodontic treatment of the symptomatic second left mandibular molar. The patient had limited mouth opening measuring about 32 mm. Clinical examination revealed sensitivity to percussion and



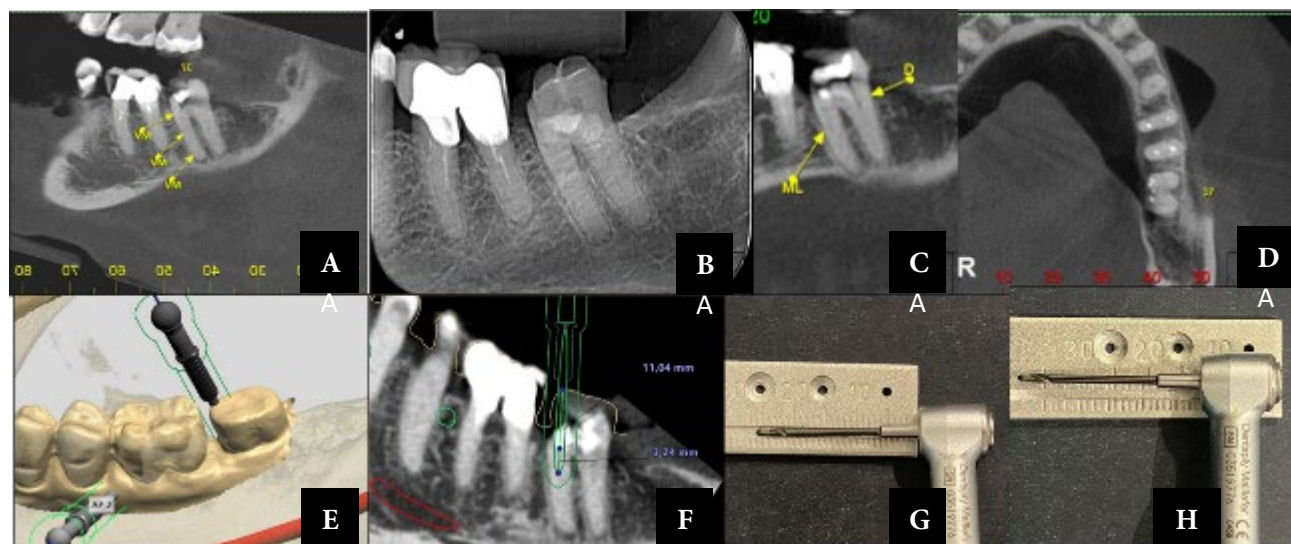


Figure 1. A) Radiographic presentation of the second left lower molar needing root canal treatment. All root canals, mesial and distal, are seemingly obliterated; B) The invested longitudinal view of the CBCT image shows the mesiobuccal canal; C) The longitudinal view of the mesiolingual canal; D) The axial view of the CBCT image exposes the region; E) Surface scan with virtual drill path and surgical pins; F) Virtual drill path and the pulp canal obliteration (PCO)'s measure; G) The length of the drill (35 mm) when attached to the dental handpiece; H) The size of the set: the drill (35 mm) attached to the dental handpiece (Dentsply X-Smart)

great coronal destruction. The periapical radiograph revealed severe pulp calcification of the mesial and distal root canals (Fig. 1A). Discrete periapical thickening was observed. However, after coronal access, the distal root canal was immediately located.

Diagnostic imaging

Cone-beam computed tomography (iCAT; Imaging Sciences International, Hatfield, PA; field of view: 56 mm × 56 mm, voxel size: 0.2 mm) was obtained to map the extent of obliteration and identify the remaining mesial root canals (Fig. 1B-1D). The length of both mesial canals was approximately 19.5 mm. The distance from the buccal cusp to the beginning of the calcification was approximately 11.04 mm (Fig. 1F). The calcified segment measured approximately 3.24 mm in length, necessitating precise access to the remaining apical segment of the canals. (Fig. 1F). The patient was informed of treatment options, and a guided endodontic technique was suggested as the most suitable approach. The patient agreed to the treatment plan and signed the informed consent form.

Endodontic guide fabrication

The 3D documentation was obtained by CBCT (iCAT; Imaging Sciences International, Hatfield, PA; field of view: 56 mm × 56 mm, voxel size: 0.2 mm) and a TRIOS Color Pod intraoral scanner (3Shape A/S, Copenhagen, Denmark), as previously described [3]. Briefly, two study models were created based on those images. Then, 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 canals was determined according to the radicular width obtained by the CBCT exam.

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 segment of the root canals. The drill positions were verified in three dimensions in the axial, sagittal, and coronal sections to ensure that the instrument tip reached the space of the apical segment of the root canal. The anchorage guides were defined. By stabilizing the guide, the safety and efficiency of the technique were improved, as the probable displacement of the guide during the clinical procedure could be anticipated. A virtual guide was then designed using CODIAGNOSTIX software (Dental Wings GmbH, Chemnitz, Germany). This model was exported as an STL file and printed by a 3D printer (Objet Eden 260 V; Material: MED610; Stratasys, Minneapolis, MN, USA), which manufactured the respective guide.

Clinical procedure

Under local anesthesia using 2% lidocaine with 1:100000 epinephrine (Alphacaine, DFL, Rio de Janeiro, Brazil) and endodontic microscopy, the guide was positioned on the patient's teeth. As the patient presented limited interocclusal space, the drill (Steco) attached to the handpiece could not be accommodated, as shown in Fig. 2A. Hence, a 0.9 mm black

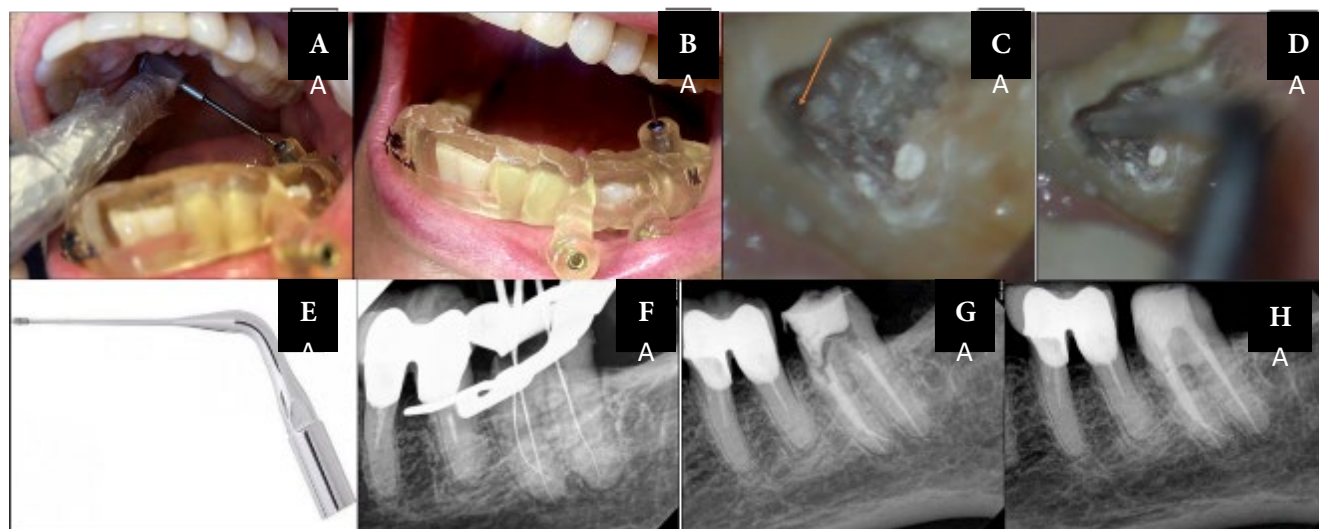


Figure 2. A) The adjusted tooth-supported guide shows the small interocclusal space that makes the drill useless; B) Black graphite 0.9 mm was inserted through the drill path, pressing dentin to mark the pathway; C) Marked dentin by black graphite; D) Ultrasonic tip probing into the marked dentin; E) Ultrasonic point with a diameter of 0.6 mm, length of 17.5 mm, and diamond tip of 1.0 mm; F) The working length from mesiobuccal, mesiolingual, and distal canals; G) The X-rays of the filled root canals; H) and at the 6-month follow-up

graphite was inserted through the drill path, pressing dentin to mark the pathway (Fig. 2B & 2C). After withdrawing the guide, ultrasonic points with a diameter of 0.6 mm, diamond point of 1.0 mm, and total length of 17.5 mm (Finder Helse ultrasonic Capelli e Fabris Ind Com, Santa Rosa de Viterbo, SP, Brazil) were inserted 2 mm into the marked dentin (Fig. 2D & 2E). Next, the guide was repositioned, the dentin was marked by black graphite, and the guide was withdrawn. The ultrasonic point was used again, and the root canal was located. Coronal reconstruction and isolation of the operative field were performed. The working length was established by an apex locator (Raypex 5; VDW, Munich, Germany) (Fig. 2F). The chemomechanical preparation was performed using Protaper nickel-titanium files (Protaper Next; Dentsply, Ballaigues, Suisse) under constant irrigation with 5.25% sodium hypochlorite until an X3 instrument reached the working length. The root canals were filled using gutta-percha cones (Dentsply, Ballaigues, Suisse) along with an endodontic zinc oxide eugenol sealer (Pulp Canal Sealer; Kerr, Kraemer Blvd., CA, USA) (Fig. 2G). The case was treated in a single session.

Follow-Up

At the 15-day follow-up, the patient reported no symptoms and was referred for prosthetic rehabilitation. A 6-month evaluation confirmed clinical and radiographic success (Fig. 2H), with the patient remaining asymptomatic.

This case report has been written according to Preferred Reporting Items for Case reports in Endodontics 2020 guidelines (Fig. 3) [13].

Discussion

The concept of guided endodontics was first described by Krastl *et al.* [2]. Since then, it has been applied with a high success rate, mainly in the anterior region since it requires space for the guide, bur, and handpiece [5, 6, 14, 15]. Moreover, several studies have reported success in treating molars [1, 11, 12, 16, 17]. Nevertheless, in patients presenting with limited interocclusal space, practitioners sometimes find it challenging to clean and shape root canals, especially in molars. To our knowledge, this was the first work to develop a technique that overcomes the limitation of mouth opening when using guided endodontics.

Mouth opening is an essential indication of the functionality of the temporomandibular joint [18], interfering with different oral procedures, including the use of endodontic guides. There is no consensus about the measurement of mouth opening, although it is widely studied. Several studies define the distance between incisal edges of central incisors, not including or including overbite [19]. Hence, studies have found a maximum mouth opening range between 40 and 60 mm [18], observing significant differences when comparing men and women [20].

Moreover, when a clinical study evaluated the average opening ratio in the molar area to the extent of opening in the incisor area, it was observed that a vertical dimension opening of 1 mm between central incisors resulted in 0.73 mm of occlusal clearance between first molars [21]. Hence, a 40-mm vertical dimension opening in the incisor area resulted in an approximately similar opening between canines and a reduced opening between first molars at about 29.2 mm.

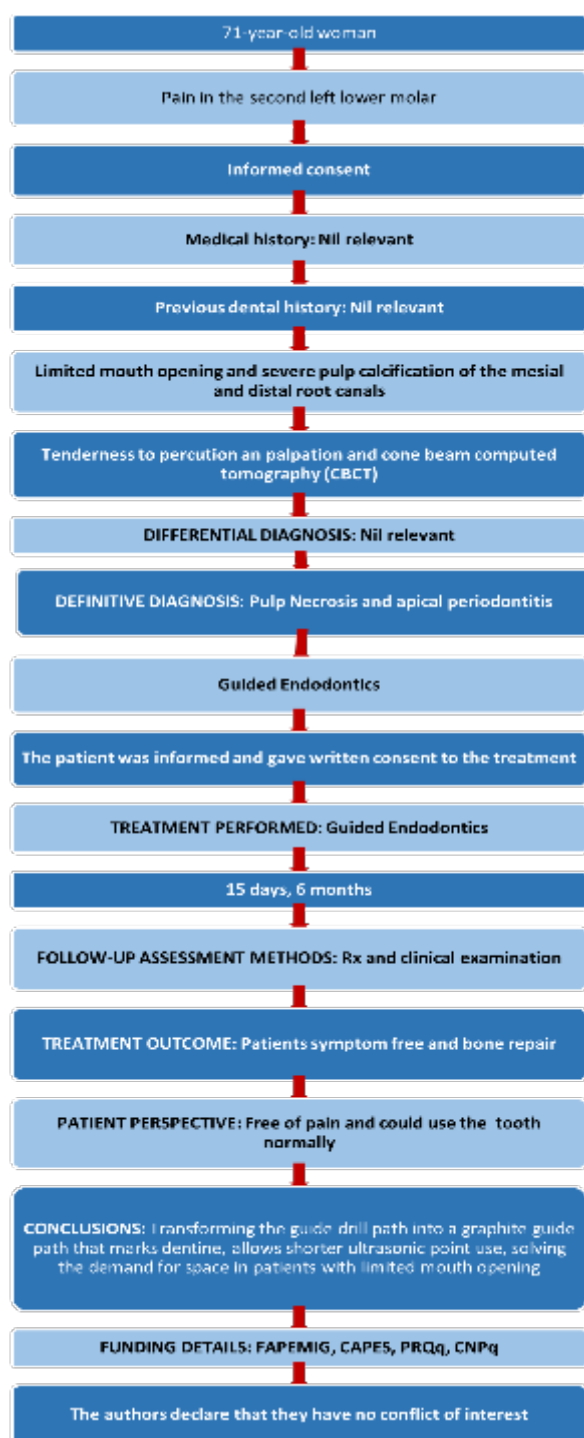


Figure 3. PRICE 2020 flowchart. From: Ref. [12]. For further details visit: <http://pride-endodonticguidelines.org/price/>

In order to create an accurate endodontic guide, several steps such as planning, designing, and printing should be done meticulously, especially for tooth-supported guides, which accommodate the guide, bur, and handpiece. The thickness of the guide is about 2 to 3.5 mm to avoid fracture or distortion. A

sleeve with its height depending on the recommended diameter of the drill (which is 1.3 mm or less) is placed over the guide [8]. For a height of about 5-7 mm, a sleeve with 1.1 mm of the inner diameter of the metal is recommended to reduce the apical and coronal deviation of the drill [22].

Steco® provides special endo-guide burs for endodontics; offering drills with 35 mm and 42 mm lengths, with the former being the most frequently used. The 35 mm drill coupled to the Dentsply handpiece measures about 26 mm from the handpiece (Fig. 1G). In this case report, the distance from the buccal cusp to the remaining segment of the root canal was 14.28 mm (Fig. 1F). Seven millimeters of sleeve is placed over the buccal cusp, implying the necessity to have a length of 19.83 mm of drill to reach the remaining segments of the root canal. Solely considering these parameters, the drill attached to the handpiece (26.0 mm) can pass through PCO, reaching the remaining root canal.

In this case report, we aimed to discuss the treatment of a patient presenting limited mouth opening. A relatively sizeable interocclusal space is needed when following the proposed concept of a guide [3, 6]. In this case, the patient's mouth opening was about 32 mm, which theoretically corresponds to 23.3 mm in the molar area, as described by another study [21]. As seen in Fig. 2, the endodontic guide fits well. At the same time, the drill attached to the handpiece (Fig. 1H), cannot be coupled into the sleeve because it is bigger than the oral space (Fig. 2A). Short drills [1] were suggested in the presence of limited interocclusal space, but as shown in this case report, almost all active parts of the drill must reach the remaining segment of the root canal. The other option would be planned angulated access for the drill, but it depends on canal angulation and is challenging in multi-rooted teeth.

As such, we used an adjusted guide as a pilot to black graphite that passes through the sleeve in the drill path to mark dentin (Fig. 2B & 2C). Afterwards, 17.5 mm ultrasonic points with a diamond point of 1.0 mm were used to reach 2 mm into the marked dentin (Fig. 2D & 2E). The guide was repositioned, the dentin was marked again, the ultrasonic point was used, and the root canal was located. The ultrasonic points reached a point beyond the PCO into the root canal system with careful precision. Subsequently, this case was successfully managed after traditional endodontic procedures were performed.

Conclusion

As stated in the literature, guided endodontic treatment is a reliable alternative when treating calcified canals, improving its accuracy and predictable outcomes [23]. The case report shows

an alternative use of guided endodontics to deal with limited interocclusal space that exacerbates in the posterior region. This restriction was surpassed by transforming the guide drill path into a graphite guide path that marks dentin and allows the use of shorter ultrasonic points, resolving the demand for space. This new guided endodontics approach was revealed to be safe and may be a suitable solution to similar cases of PCO in molars. Further research and clinical validation are warranted to refine and expand the applications of this approach.

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Conflict of interest

None.

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Authors' contributions

Methodology: GM, LM, VM, WT, AS. Formal analysis and investigation: GM, LM, KT, VM, WT, AS. Writing review and editing: GM, LM, WT, AS. Supervision: GM, WT, AS. All authors read and approved the final manuscript.

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