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CASE REPORT

Impact of Multiple Individualized Guides on the Management of Obliterated Root Canals in a Maxillary First Molar: A Case Report

Helder Fernandes de OLIVEIRA, Bruna Ribeiro GOBBI, Alline Soares VAZ, Iussif MAMEDE-NETO, Orlando Aguirre GUEDES

Department of Endodontics, Evangelical University of Anápolis, Faculty of Dentistry, Anápolis, Brazil

ABSTRACT

This report evaluated the impact of using multiple individualized endodontic access guides in the management of obliterated root canals in maxillary molars. A 70-year-old female patient presented with pain in the upper left first molar. Intraoral examination revealed an extensive resin composite restoration, with no signs of tooth mobility or marginal periodontal disease. The clinical diagnosis was symptomatic apical periodontitis. Cone beam computed tomography (CBCT) revealed a hypodense area in the mesiobuccal and palatal (P) roots, associated with signs of apical periodontitis and obliterations in the cervical and middle thirds of the first MB (MB1), second MB (MB2) and P canals. Due to the high risk of perforation, a guided approach to the canals was selected. Multiple guides were designed using digital planning software, combining CBCT images with intraoral scanning. Access cavities were created using a 25 mm long, 1.0 mm diameter surgical bur. After gaining access, the canals were instrumented, medicated with calcium hydroxide for 15 days, and obturated. Twelve months post-treatment, the patient remained asymptomatic, and the clinical results were considered satisfactory.

Keywords: Apical periodontitis, cone beam computed tomography, guided endodontics, pulp canal obliteration

HIGHLIGHTS

- Multiple individualized endodontic guides enabled accurate access to obliterated root canals in maxillary molar, minimizing procedural errors such as perforations and canal deviations.
- The combination of cone beam computed tomography (CBCT) and intraoral scanning allowed for the digital planning and 3D printing of customized guides, improving the safety and predictability of the treatment.
- The guided approach resulted in effective disinfection, canal obturation, and resolution of apical periodontitis, with the patient remaining asymptomatic 12 months post-treatment.

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Address for correspondence:
Helder Fernandes de Oliveira
Department of Endodontics, Evangelical University of Anápolis, Faculty of Dentistry, Anápolis, Brazil
E-mail: helfo22@gmail.com

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INTRODUCTION

Control of endodontic infection, achieved through adequate cleaning and disinfection of the root canal system, is a critical factor in the success of endodontic treatment (1). However, several challenges can compromise the effectiveness of antimicrobial strategies (2). Root canal obliteration (RCO) is characterized by the deposition of mineralized tissue along the root canal, often resulting from physiological aging or trauma responses (3–5). When signs of apical periodontitis are present, endodontic treatment becomes necessary (3).

Conventional management of this condition is challenging, as operative errors such as deviations from the canal trajectory, excessive wear, and perforations may occur, jeopardizing the prognosis (4, 6, 7). In this context, the development of endodontic guides (EG) has significantly advanced the planning and treatment of severely obliterated root canals, especially in cases involving periapical lesions.

The use of EG allows for more precise access, reducing errors and operative difficulties, and achieving more satisfactory results in less time

compared to conventional techniques (6). Studies suggest that this technique is safe and predictable, particularly in treating obliterated canals in anterior teeth (4–6). Recent advances have extended its application to posterior regions, such as maxillary molars, where obliterated canals are common (5, 7).

However, protocols for using multiple individualized guides for each obliterated canal in maxillary molars are still limited. The aim of this report was to evaluate the impact of multiple individualized endodontic access guides in the management of a maxillary molar with obliterated root canals and associated apical periodontitis.

CASE REPORT

This case report has been written according to Preferred Reporting Items for Case reports in Endodontics (PRICE) 2020 guidelines (8).

A 70-year-old female patient presented to the dental office complaining of pain in the region of the upper left first molar. During the medical history review, she did not report any systemic conditions. Intraoral examination revealed an extensive resin composite restoration, with no signs of tooth mobility or marginal periodontal disease. The tooth was sensitive to both vertical and horizontal percussion tests, as well as to periapical palpation. The cold thermal test was negative (Endo-Frost; Roeko, Langeman, Germany).

The initial periapical radiograph showed an extensive restoration, slight widening of the periodontal ligament space at the palatal root, and obliteration in the mesiobuccal (MB1) and palatal (P) canals (Fig. 1a). Cone beam computed tomography (CBCT) images (PreXion 3D Inc., San Mateo, USA) with a voxel size of 0.10 mm were obtained for a more detailed evaluation. The tomographic images revealed a circumscribed periapical hypodense area in the mesiobuccal (MB) and palatal (P) roots, with signs of apical periodontitis and obliterations in the cervical and middle thirds of the first MB (MB1), second MB (MB2), and P canals (Fig. 1b, c). Additionally, expansion and disruption of the buccal cortex of the maxillary sinus floor were observed in the periapex of the palatal root (Fig. 1b). The absence of response to the cold thermal test indicated pulp necrosis, and based on clinical and radiographic findings, a diagnosis of symptomatic apical periodontitis was established. Informed consent was obtained from the patient, both verbally and in writing. Endodontic treatment was indicated, and due to the inability to locate the MB1, P, and distobuccal (DB) canals under 20x magnification with a dental microscope (Zeiss OPMI PICO; Carl Zeiss Meditec AG, Jena, Germany), a guided approach was chosen to reduce the risk of procedural errors. Patient consent was obtained.

Two 3D-printed guides were fabricated to access the obliterated canals (MB1, MB2, DB, and P). The process involved intraoral scanning of the upper arch using a 3Shape Trios intraoral scanner (3Shape, Copenhagen, Denmark), generating an STL (stereolithography) file. The CBCT images were combined with the STL file in 3D planning software (CoDiagnostiX version 9.2, Dental Wings, Montreal, Canada) to plan the drill trajectory (Fixation Pin, Straumann, Carnaxide, Portugal), with a length of 25 mm and a diameter of 1.0 mm, targeting the middle third of the DB and P canals (Fig. 2a) and MB1 and MB2 canals (Fig. 2b). The guides were designed with 3.0 mm of resin material (Sheraprint Model Plus UV, Shera, Lemford, Germany) to ensure dimensional stability, supported by the tooth and extending to the region of the upper left second molar. Metal sleeves with an internal diameter of 1.2 mm and a length of 7.5 mm were inserted into the guide holes. 3D printing was performed using a Moonray DLP 3D-Printer (Sprintray, Los Angeles) (Fig. 3a, b).

Before the procedure, the guides were tested in the mouth to ensure proper fit and accuracy (Fig. 4). After administering local anesthesia, coronal access was initiated using a 1012 HL diamond round bur (KG Sorensen, Barueri, SP, Brazil) at high speed with water cooling to remove enamel, guided by the

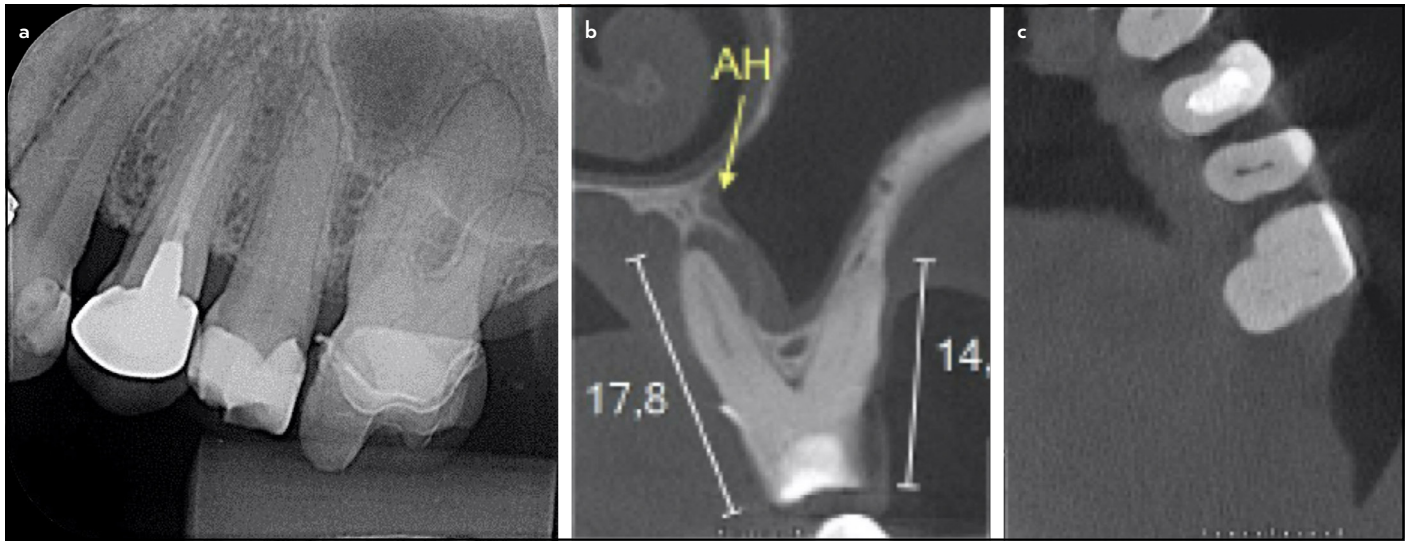

Figure 1. (a) Periapical radiograph showing PCO in the root canals, extensive restoration and slight widening of the periodontal ligament space in the palatal root of the upper left first molar; (b) Sagittal CBCT view showing hypodense area in the mesiobuccal and palatal roots; (c) Axial section confirming the presence of PCO.

PCO: Pulp canal obliteration, CBCT: Cone beam computed tomography.

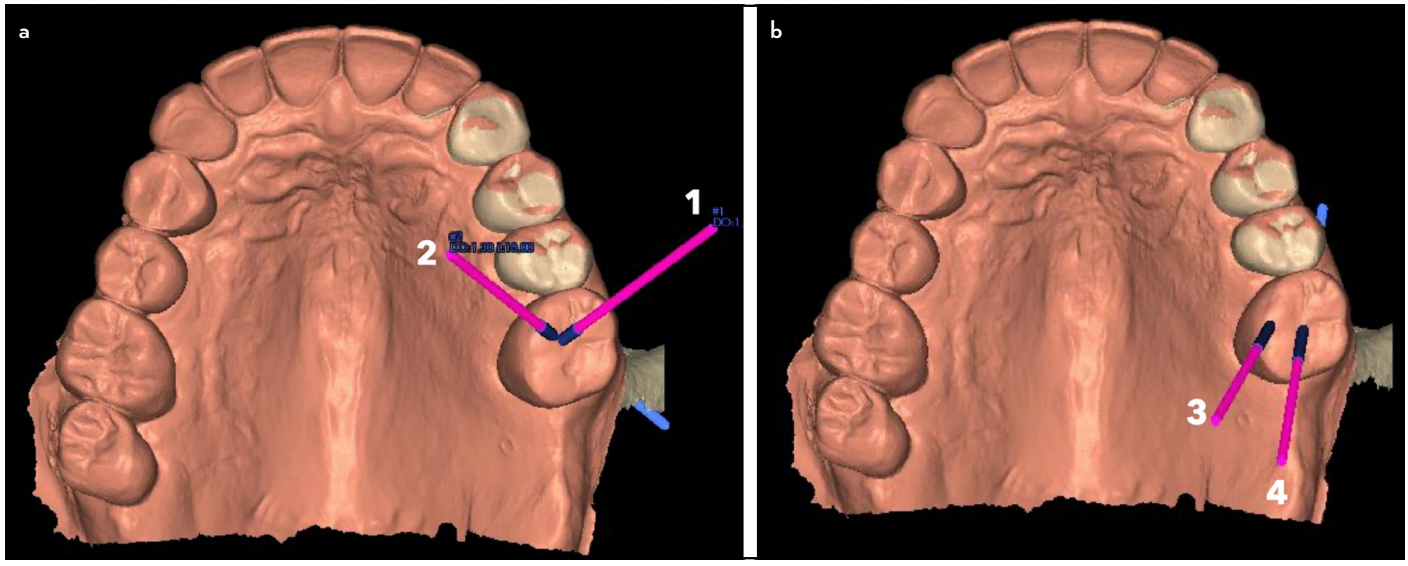

Figure 2. Guided model designed for planning. (a) Drills numbered 1 and 2 for P and DB canals; (b) Drills numbered 3 and 4 for MB1 and MB2 canals. P: Palatal, DB: Distobuccal, MB: Mesiobuccal.

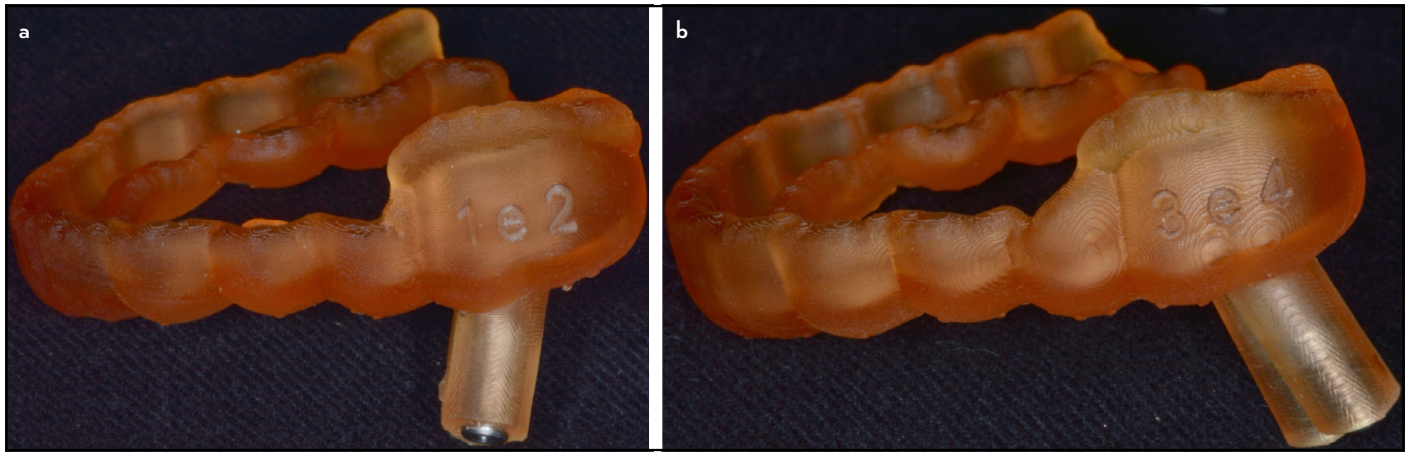

Figure 3. 3D printed guides, numbered according to the root canal orifices.

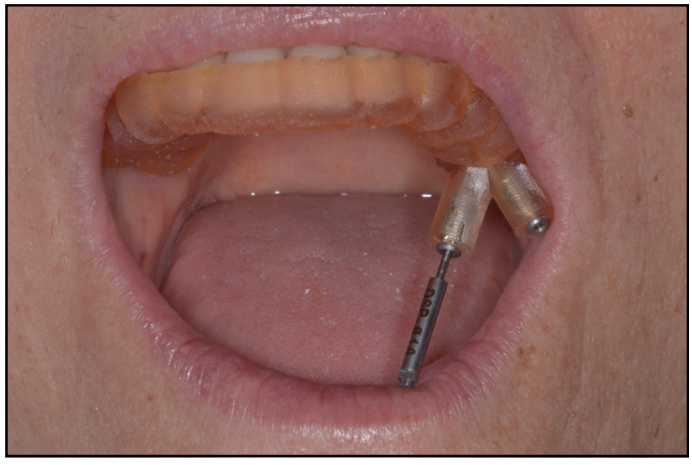

Figure 4. Guide positioned in the mouth to check the fit and adaptation to the support structures.

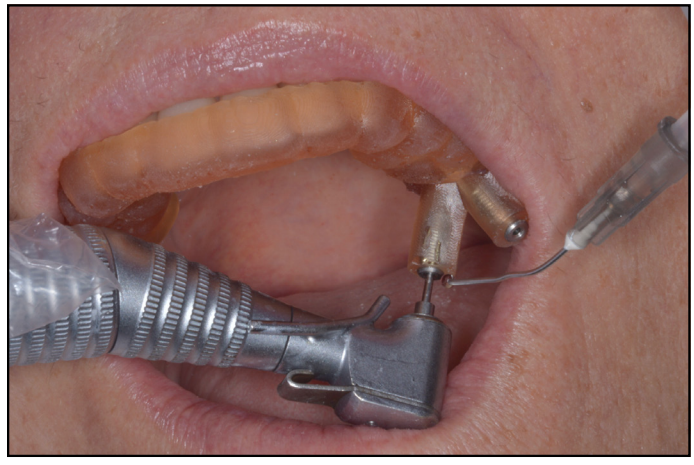

Figure 5. Guide in position during the beginning of the access cavity, using a surgical drill driven under constant irrigation with saline solution.

positioning of the guide and markings made with graphite tips. With the guide in place, a 1.0 mm diameter, 25 mm long surgical drill was used with a X-Smart Plus endodontic motor (Dentsply Maillefer, Ballaigues, Switzerland) at 4 N torque and 950 rpm, with constant saline irrigation (Fig. 5). This process was repeated for each metal sleeve in the guide holes. After guide removal, the tooth was isolated with a rubber dam, and the canals were explored using a #10 K-file (Dentsply Sirona

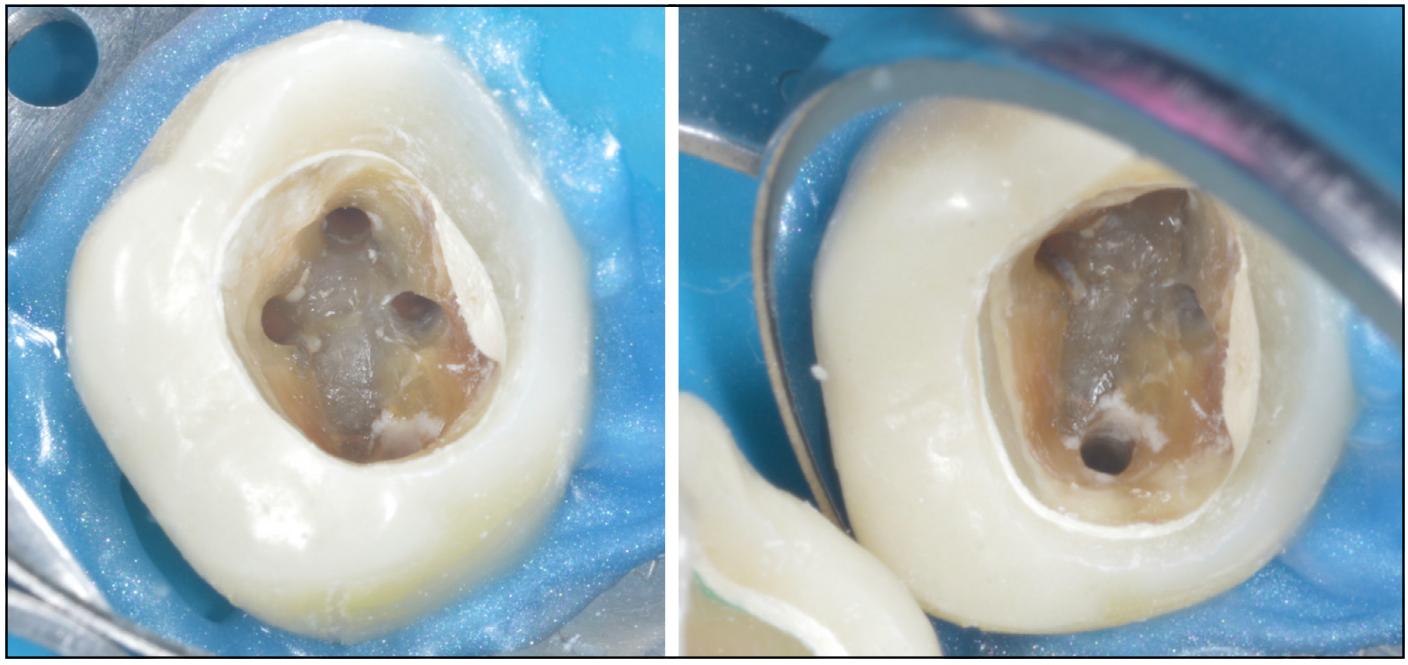

Figure 6. Occlusal view after instrumentation of the root canals, showing the prepared canals.

Figure 7. Clinical aspect of the restoration. (a) Frontal and (b) occlusal view. (c) Final periapical radiograph after coronal restoration.

Endodontics, Ballaigues, Switzerland). Working length was determined using measurements from the CBCT images and confirmed with an electronic apex locator (Propex Pixi, Dentsply-Maillefer, Ballaigues, Switzerland) and periapical radiographs.

The root canals were instrumented with the WaveOne Gold system (Dentsply-Maillefer, Ballaigues, Switzerland) up to a #35.06 file, using 2.5% sodium hypochlorite as the irrigant (Fitofarma, Goiânia, Brazil) and 17% EDTA (Fitofarma, Goiânia, Brazil) to remove the smear layer (Fig. 6). The canals were medicated with calcium hydroxide (Ultracal, Ultradent, Indaiatuba, Brazil) for 15 days, and the access cavity was temporarily sealed with flowable bulk-fill composite (Opus, FGM, Joinville, Brazil). Two weeks later, the canals were obturated using the lateral compaction technique with gutta-percha cones (Odous De Deus, Belo Horizonte) and bioceramic sealer (BioRoot RCS, Septodont, Pomerode, Brazil). The tooth was restored after cleaning the access cavity (Fig. 7a). A periapical radiograph confirmed the success of the guided approach (Fig. 7b). After 12 months of follow-up, the patient remained asymptomatic, with no tenderness on percussion.

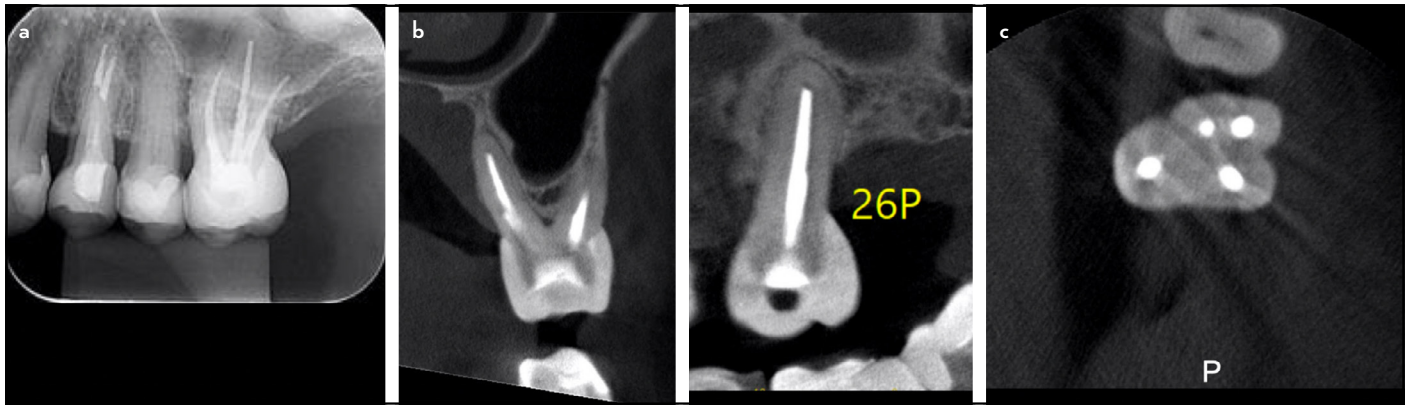

Figure 8. Twelve-year-follow up. (a) Periapical radiograph showing apical repair and maintenance of the coronal restoration in the maxillary left first molar; (b) Coronal and sagital views showing apical healing of the palatal root; (c) Axial section confirming the presence of the four previously filled canals.

DISCUSSION

The endodontic treatment of obliterated root canals in maxillary molars with apical periodontitis has long represented a significant clinical challenge, with limited evidence of success and predictability using conventional access techniques alone (3). The introduction of new methods, materials, and the use of CBCT has brought substantial advances in the management of calcified canals, leading to more successful and higher-quality treatments (6, 9, 10).

Despite these advancements, the interpretation of tomographic images and the creation of a mental guide for conventional coronal access remain technical challenges for many clinicians (9, 11, 12). Guided endodontics, utilizing custom guides, has emerged as a solution to improve precision and safety in such cases, reducing the risks of deviations, transportation, and root perforations (6, 7).

In the case presented, a guided endodontic approach was selected due to the presence of obliterations in the MB1, MB2 and P canals, identified in CBCT images and confirmed during the initial examination under optical magnification. While the use of the dental operating microscope combined with specific ultrasonic tips offers benefits in locating obliterated canals, the process is often time-consuming and technically challenging (9). According to Lang et al. (4), even when canals are successfully located, excessive removal of dentine, particularly in the cervical third, can weaken the tooth structure, compromising the long-term prognosis. Although guided endodontics also requires time for planning and guide fabrication, it can reduce chairside time during the actual procedure, potentially improving clinical efficiency.

When treating obliterated canals, the primary goal should be to locate the canal system using conventional approaches (1), with invasive procedures such as surgery considered only as a last resort. The literature emphasizes that when endodontic treatment or retreatment is a viable option for treating periapical lesions, surgery should not replace conservative management (13, 14). However, in molars with multiple obliterated canals, as in the present case, guided endodontics offers a valuable alternative, though established protocols for this specific clinical scenario remain limited (5, 7, 12, 15).

In this case, the combination of high-resolution CBCT images with 3D models enabled the precise planning of endodontic guides. The superimposition of CBCT data with the digital intraoral model provided a three-dimensional view of the obliterated canals, facilitating the design of guides for the MB, DB, and P canals. A critical consideration was the selection of the appropriate diameter of surgical drill. Drills with a 1.3 mm diameter, commonly used in other studies (4, 6, 7, 16, 17), were deemed unsuitable for the dimensions of the roots in this upper molar case. Instead, a drill with a length of 25 mm and a diameter of 1.0 mm was selected, ensuring precise access to the DB and P canals (Fig. 2a) and MB1 and MB2 canals (Fig. 2b). This customization was essential for the success of the treatment, allowing safe and effective canal access.

Despite the advantages of individualized endodontic guides, certain limitations must be considered when applied to molars. One major challenge is the restricted interocclusal space, which may limit the positioning of the guide and the angulation of the bur during access cavity preparation (18). Additionally, the use of these guides may hinder the ability to achieve absolute isolation of the operative field with a rubber dam, which is essential for contamination control during endodontic procedures (19). These factors should be evaluated on a case-by-case basis to determine the feasibility of guided endodontics in posterior teeth.

The use of the WaveOne Gold system, combined with appropriate irrigant, proved effective in cleaning and shaping the root canals. After 12 months of follow-up, the patient remained asymptomatic, and periapical radiographs showed resolution of the periapical lesion. However, given the initial diagnosis based on CBCT, long-term follow-up using three-dimensional imaging was essential to accurately assess periapical healing, particularly in the palatal root, which was presented in this case. A twelve-year follow-up examination, including both periapical radiographs and CBCT, confirmed the repair of the periapical area, demonstrating radiographic evidence of bone regeneration and the absence of clinical symptoms (Fig. 8). These findings reinforce the reliability of guided endodontics in the management of obliterated canals and highlight the importance of CBCT in assessing periapical healing in complex cases.

CONCLUSION

The use of customized endodontic guides was essential for the successful endodontic treatment of a maxillary molar with obliterated root canals and symptomatic apical periodontitis. The integration of advanced technologies, such as high-resolution CBCT and 3D modeling, combined with meticulous planning, enabled safe and precise access to the obliterated canals, leading to the resolution of the periapical lesion and the absence of symptoms during follow-up.

Disclosures

Ethics Committee Approval: This is a single case report, and therefore ethics committee approval was not required in accordance with institutional policies.

Informed Consent: Written informed consent was obtained from the patient for the publication of the case report and the accompanying images.

Conflict of Interest Statement: The authors have no conflicts of interest to declare.

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