Revista ARACÊ
ISSN: 2358-2472

USE OF GUIDED ENDODONTICS IN TREATING TEETH WITH PULP OBLITERATION DUE TO CALCIFICATION AND THE RELEVANCE OF CLINICAL SCRUTINY IN DECISION MAKING: A CLINICAL CASE REPORT

https://doi.org/10.56238/arev7n5-109

Date of submission: 06/04/2025 **Date of publication:** 06/05/2025

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ABSTRACT

Endodontic treatment of teeth with pulp canal obliteration (PCO) represents a procedure of higher complexity, as it requires the professional to have precise control over access

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ISSN: 2358-2472

direction, considering that essential references are lost. This difficulty becomes even more critical when the PCO extends to the apical third of the tooth. In such cases, a relatively recent alternative emerges as a viable option that facilitates and provides greater control over the procedure: guided endodontics. In this process, surgical guides are designed using scans of the arch and high-resolution tomography scans and then printed to integrate perfectly with high-precision sleeve and drill systems. This allows pulp obliteration to be bypassed up to the portion of the canal with preserved anatomy. However, this procedure cannot be performed without a specialist's parallel supervision, as minor trajectory deviations can result in root perforations. This clinical case report illustrates a scenario in which the guided procedure was interrupted by the specialist's decision. Upon evaluating the depth already cleared and the image of the obstruction, the specialist considered the possibility of a deviation in the trajectory, although this was not observed radiographically. Therefore, he requested a new high-resolution tomography, which confirmed the deviation of the trajectory from the palatine, although it remained parallel to the root canal. Thus, the professional opted for a traditional approach, aided by the operating microscope, and achieved a successful treatment. In conclusion, a situation is demonstrated that, although not frequently reported, shows the vital importance of carefully monitoring the entire clinical step-by-step by the specialist.

Keywords: Guided endodontics. Calcified teeth. Cone beam computed tomography. Intra-oral scanning.

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ISSN: 2358-2472

INTRODUCTION

Pulp canal obliteration (PCO) is frequently observed after dental trauma and, in many cases, represents a favorable outcome, indicating the maintenance of pulp vitality (1,2). It is estimated that approximately 4% to 24% of traumatized permanent teeth have PCO, which is characterized radiographically by the reduction of the pulp space and, clinically, by the change in the color of the dental crown due to the deposition of tertiary dentin, in addition to the reduced or absent response to thermal sensitivity tests (3,4). Initially, treatment involves periodic clinical and radiographic monitoring. However, in some cases, the development of a periapical lesion may be observed due to pulp necrosis and subsequent periapical lesion, making endodontic treatment necessary (2,3,5,6). The prevalence of pulp necrosis in PCO varies between studies between 7% and 36.4% (4,7).

Endodontic treatment of teeth with obliterated canals represents a significant challenge in endodontic practice, mainly due to the difficulty in locating the root canal, which increases the risk of deviations, perforations, and other intraoperative accidents (2,3,5,7). In this context, guided access has been adopted as a promising strategy in more difficult cases (8–12). The technique requires the integration of intraoral scanning and cone beam computed tomography, allowing virtual planning based on the anatomy of the dental canal. Among the main advantages are greater safety in locating canals, greater tooth structure preservation, and reduced clinical time (8).

A systematic review demonstrated that, among 45 studies included, only two (4.44%) reported accidents or failures in using endodontic guides (11). Failures may be attributed to the lack of bone fixation of the guide, imprecise superimposition of images, or inadequate seating of the guide during the procedure (13). Despite technological advances, it is important to emphasize that this approach does not replace the need for careful clinical judgment and technical skill on the part of the professional to manage intraoperative complications, even with the use of the guide.

Despite the benefits already described, few studies still address clinical difficulties that may occur during guided access, such as trajectory deviations or anatomical limitations that hinder the procedure's predictability. Most research focuses on demonstrating the technique's technical feasibility and high success rates. However, reports that discuss its limitations, challenges during execution, and ways to resolve them are rare (13). Therefore, clinical cases that describe these situations are important to broaden the understanding of possible complications and help improve the techniques and protocols used.

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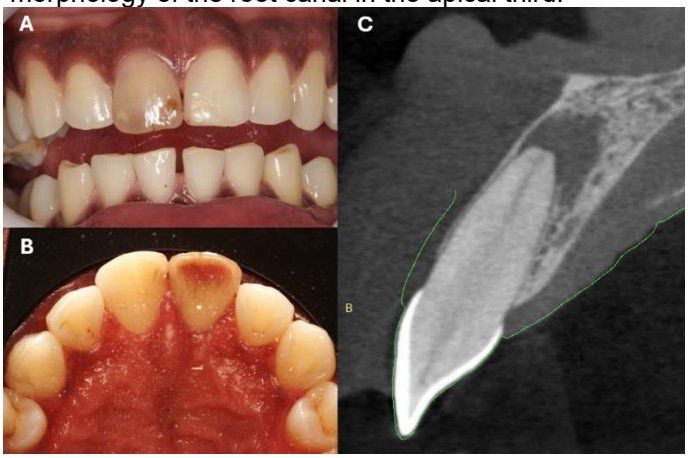
Given this scenario, the objective of the present study is to report, through a clinical case report, possible causes of failures during guided access and the importance of clinical judgment for managing a trajectory deviation in PCO.

CASE REPORT

A 34-year-old male patient with a history of dental trauma that occurred 15 years ago sought care at the School of Dentistry of the State University of Rio de Janeiro in 2022, complaining of darkening of the upper right central incisor. Clinical and radiographic evaluation revealed crown discoloration, severe PCO, negative response to the thermal test, absence of pain to percussion, and presence of a periapical lesion, with a periapical index (PAI) of 4, confirming the need for endodontic treatment. Adjacent teeth showed normal responses to thermal and percussion tests. An informed consent form was obtained previously. Figure 1 (A and B) shows the initial clinical aspect of the tooth, buccal and palatal, respectively.

Given the severe PCO and the anticipated difficulty in locating the canal, it was decided to perform guided access. Initially, the impression was taken, and subsequently, the model was scanned with the CEREC Omnicam system (Dentsply Sirona, Bensheim, Germany). Virtual planning was performed using the Blue-Sky Plan 4 software, which allowed the superimposition of the files obtained through scanning (STL format) and cone beam computed tomography (CBCT, DICOM format), providing a three-dimensional representation of the pulp anatomy. Figure 1C demonstrates the radiolucent image corresponding to the periapical lesion, the pulp obliteration affecting the root's coronal and medium thirds, and the apical third's preserved anatomy.

Figure 1. Clinical aspect from buccal (A) and palatal (B) views. Microtomography shows the proximal aspect of the tooth and the visible morphology of the root canal in the apical third.



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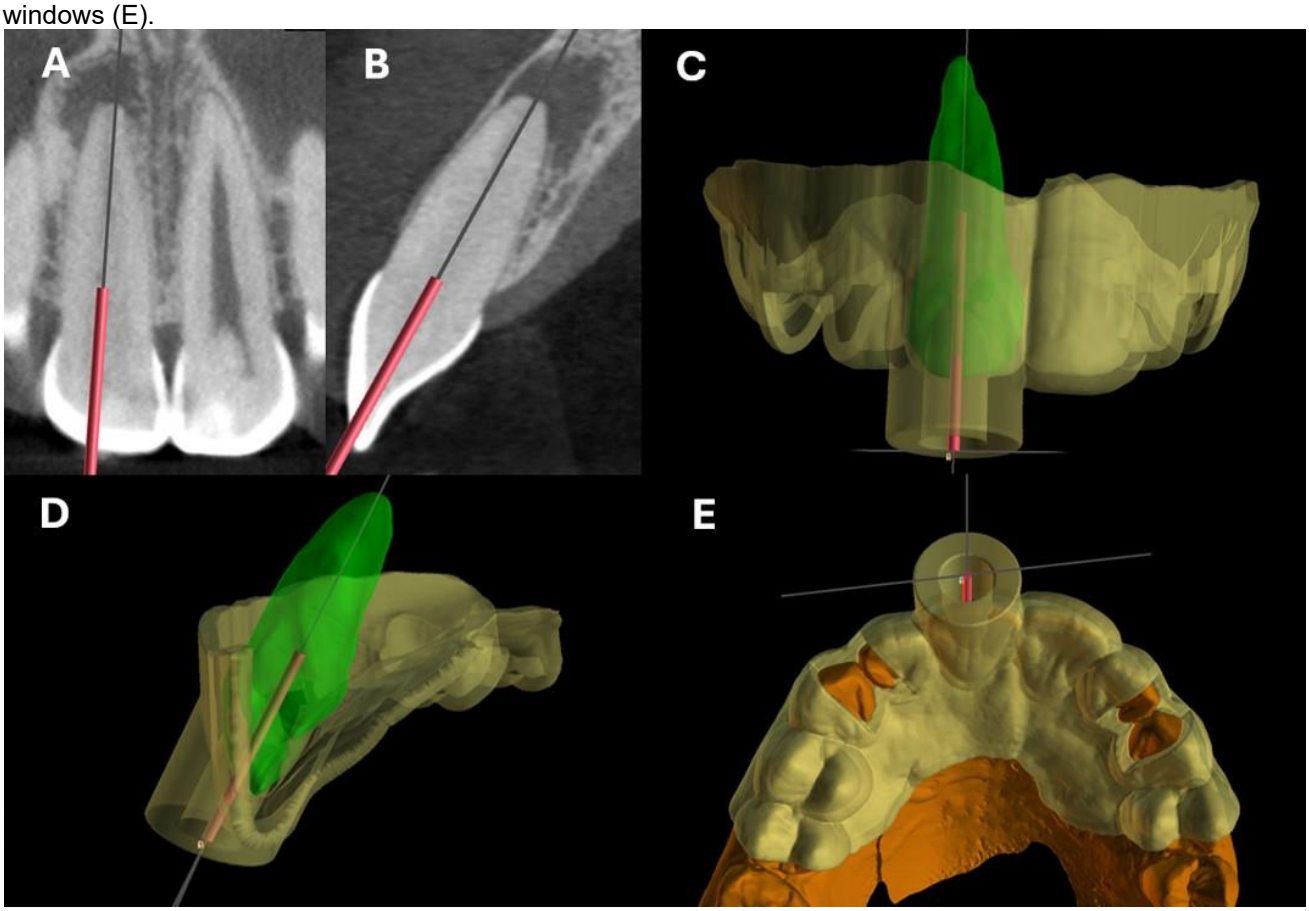
Based on this reconstruction, a straight path was traced from the visible light of the root canal (Figures 2A, 2B, 2C and 2D). A virtual copy of the diamond point (Endo Guide Kit, Mukai EFF Dental Components, California, USA), measuring 23 mm in height by 1.2 mm in diameter, was used for planning, superimposed on the images considering the working length of 27 mm. The endodontic guide was designed with incisal windows, allowing verification of the seating in the mouth (Figure 2E), with the sleeve measuring 5 mm in height and 1.3 mm in diameter. The final design was exported as an STL file and printed on a 3D printer (Creality Halot-one, 3D Lab, Betin, MG, Brazil) using Prizma 3D Bio Guide resin (Makertech, Tatuí, SP, Brazil).

Figure 2. Planning the positioning of the access axis to the canal in buccal (A) and lateral (B) views. Guide designing through a buccal (C) and lateral (D) views. Occlusal view of the guide's virtual design with incisal windows (E).



After printing the guide, it was tested in the mouth to ensure its stability and the reliability of complete seating and three-dimensional positioning through the incisal windows (Figure 3A). Then, the sleeve was inserted, and the starting point for drilling was marked with a fine pencil (Figure 3B and 3C) to allow the start of the enamel access with a 1014HL

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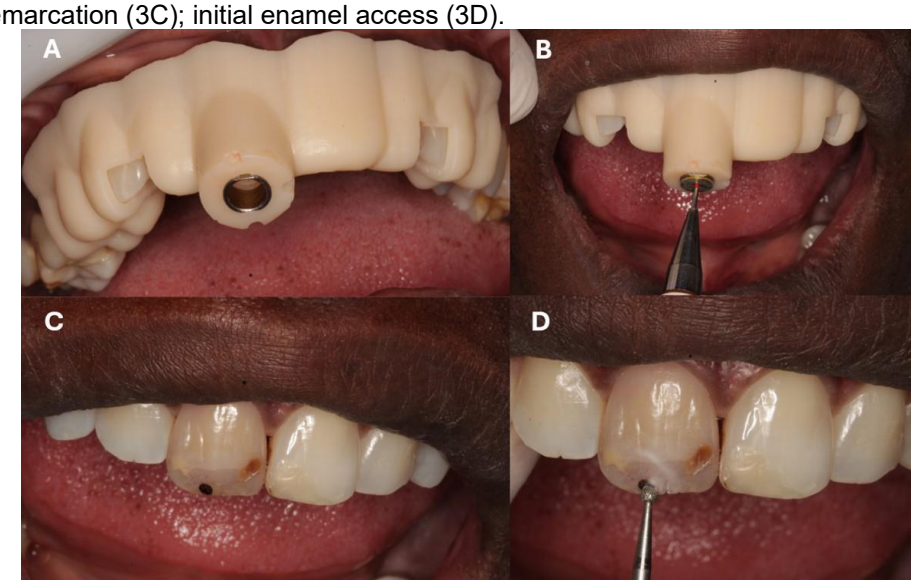
diamond point (Microdont, São Paulo, SP, Brazil), avoiding any slippage or deviation of the system's calibrated drill (Figure 3D).

Figure 3. Testing the printed guide in position (3A); marking the initial point of access with a fine pencil (3B); initial access demarcation (3C); initial enamel access (3D).



After making a stabilizing niche for the manufacturer's sequence of drills, progressive wear began in back-and-forth movements and the exchange of drills and sleeves until the root canal was reached and conventional instrumentation was allowed, following the manufacturer's instructions. Digital periapical radiographs were taken throughout the procedure to monitor the progress of access. Although the images suggested the correct path, the canal was not located with the No. 6 K-file (Dentsply Maillefer, Tulsa, OK, USA). Figure 4A shows access through the standardized sleeve. Figure 4B demonstrates the attempt to locate the root canal. Given the persistent difficulty in locating the canal, path deviation was suspected. For clarification, a new high resolution computed tomography scan was requested.

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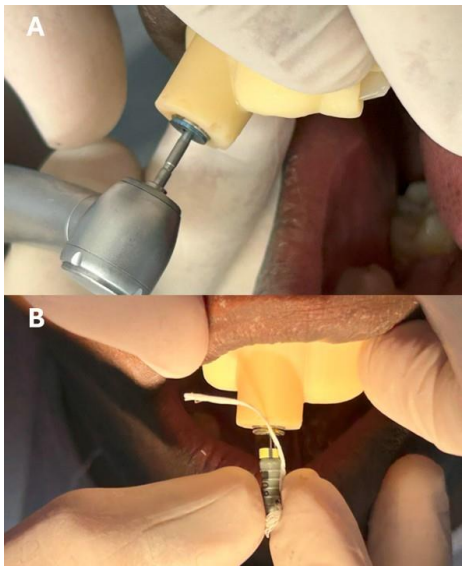
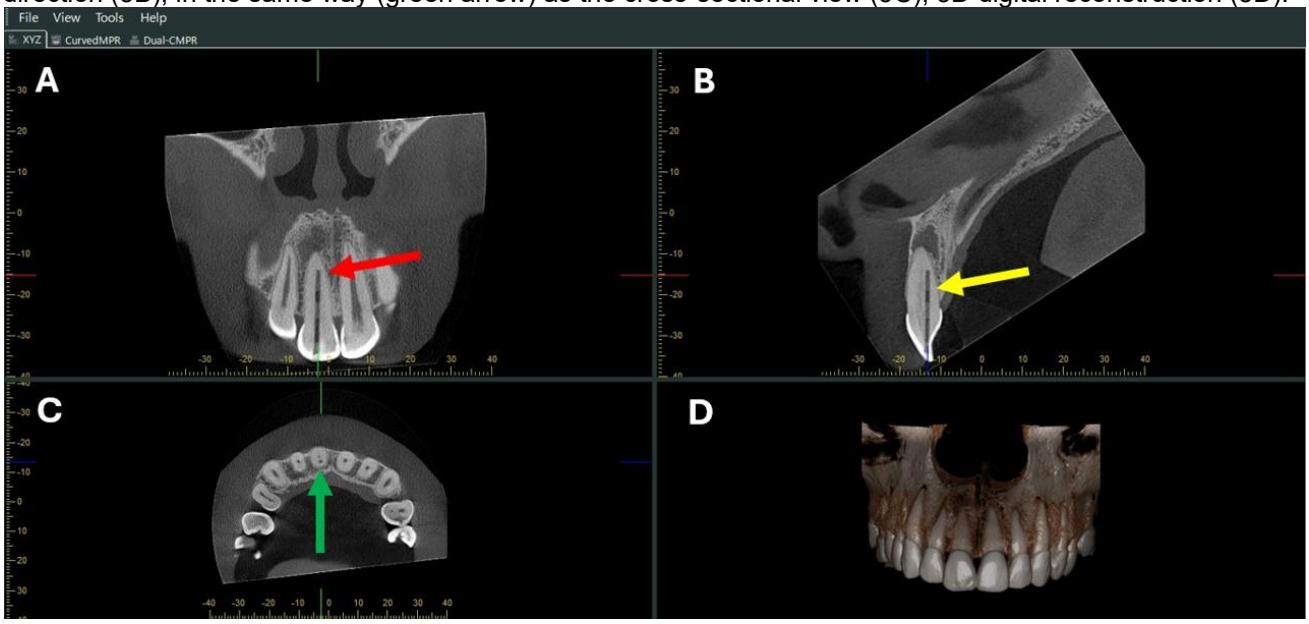
Figure 4. Initial enamel access through the first sleeve (4A); attempt to catheterize the root canal with a No. 6 K-file (4B).



The second tomography confirmed the suspicion, revealing a deviation in the canal path in the buccal-palatal direction (Figure 5). The patient was informed about the existence of the deviation, and it was jointly decided to undergo treatment without using the guide.

Figure 5. Second tomography: buccal view demonstrating (red arrow) absence of proximal deviation and correct angulation (5A); lateral view showing (yellow arrow) deviation from the canal path in buccal-palatal direction (5B); in the same way (green arrow) as the cross-sectional view (5C); 3D digital reconstruction (5D).



Thus, after local anesthesia and absolute isolation, conventional endodontic access was performed with high-speed HL1014 diamond burs (KG Sorensen - Serra, ES, Brazil) in order to allow, with the aid of a unique MC 12 model (DFV Comercial e Industrial LTDA,

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Valença, RJ, Brazil), the use of TRA24D ultrasonic inserts (Dental Trinks, São Paulo, SP, Brazil) and the use of K-files #06 (Dentsply Maillefer, Tulsa, OK, USA), to locate the entrance of the calcified canal in the cervical third.

Once the root canal was identified, it was partially explored up to its middle third to allow a mechanized R Pilot™ file (Dentsply Sirona, Ballaigues, Switzerland), driven in reciprocating mode, to be used along the entire length of the canal, confirmed by means of electronic root canal length, to perform the glide path. Then, the canal was modeled with the Reciproc R40™ file (Dentsply Sirona – Ballaigues, Switzerland). At the same time, the apical enlargement was complemented with manual files up to LK#55 in the CT and manual stepped setbacks up to LK#80. The irrigating solution was 2.5% sodium hypochlorite (Asfer Indústria Química LTDA, São Caetano do Sul, SP, Brazil) throughout the chemical-mechanical preparation. After the final aspiration, the root canal was filled with 17% EDTA solution for five minutes, and the solution was agitated for 30 seconds using a UDS-E piezoelectric ultrasound (Woodpecker, Guangxi, China), using a TRA31T ultrasonic insert (Dental Trinks, São Paulo, SP, Brazil) for this purpose. The root canal was washed with a 2.5% NaOCl solution (Asfer Indústria Química LTDA, São Caetano do Sul, SP, Brazil). The root canal was dried with #50 absorbent paper points (DiaDent, Burnaby, Canada) and then filled with a paste based on calcium hydroxide (Biodinâmica, Ibiporã, PR, Brazil), PMCC (Biodinâmica, Ibiporã, PR, Brazil) and glycerin (LBS Indústria Farmacêutica LTDA, São Caetano do Sul, SP, Brazil), in a 1:1 ratio, for seven days.

After this period, a new consultation was held, and after anesthesia and absolute isolation, the procedures for filling the canal were performed. The hybrid Tagger technique was used, employing gutta-percha cones (Dentsply Sirona) and Sealer Plus cement (MK Life, São Geraldo, PA, Brazil). Finally, the tooth was restored with composite resin (Filtek Z 350 XT, 3M Oral Care, St. Paul, MN, USA). The patient has been followed up periodically, presenting satisfactory clinical and radiographic signs of lesion remission (Figure 6).

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Figure 6. Final radiographic aspect of the tooth after completed root canal treatment.

DISCUSSION

Guided access has shown to be a promising approach in treating teeth with PCO, offering greater predictability in the location of the root canal and minimizing risks such as deviations and perforations (8–12). However, as observed in the reported case, strict monitoring by the specialist is essential to avoid unexpected complications and achieve successful treatment. Even with the increased use of guided access, complications in its use are still poorly documented. A recent systematic review included 45 studies and only 2 (4.44%) reported failures in the technique (11). This low failure rate may be related to underreporting of complications.

A recent study demonstrated that in cases of PCO involving the apical third, the risk of deviations and perforations increases by up to 15 times (14). Performing radiographs to gradually monitor the evolution of access is one of the most important procedures to avoid any deviation from the trajectory at the beginning of the process (12).

The case reported here represents a situation in which professional experience and careful monitoring were crucial to avoid perforation since there was no proximal deviation or inclination of the trajectory perceptible in a frontal view, as obtained by periapical radiographs. The professional considered it relevant that he was already in the advanced depth of the access and had not yet managed to catheterize the root canal, even though it was visible radiographically in the apical third, at a depth that should have already been reached. As a precaution, he requested a new high-resolution tomography scan to dispel doubts (13-15). As he suspected, the guided access had created parallel access to the canal, displaced lingually. Thus, he could correct the trajectory using the traditional

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methodology combined with an operating microscope for greater precision, ultimately completing the endodontic treatment.

Defining the exact cause (or causes) that led to the positioning of the deviated access to the palate is very difficult, but some possibilities can be considered. Fonseca Tavares et al. (2022) highlighted that guide rings smaller than 8 mm allow greater instability of guided access. In the present study, the ring used was 5 mm, which may have contributed to the decentralization of the instrument.

Another aspect that can be listed is that a printed guide without bone fixation was chosen, which, according to some authors, would allow (13) greater stabilization of the guide during the procedures. However, it is worth highlighting that no instability in the guide was observed during the procedure and that the windows designed in the guide allowed good adaptation control.

One aspect also highlighted in some articles is that due to the adjustment to the access path through the guide, the incisal edge is often affected to allow a straight line (7,16,17). The professional responsible for the design of the guide must be rigorous during planning and advise the patient about this occurrence. Any deviation, however small, to avoid incisal wear can result in a deviation with disastrous consequences at the apical level.

CONCLUSION

Despite the indisputable benefits of guided access in cases of pulp canal obliteration, technical limitations may compromise the planned path. The reported case highlights the importance of clinical judgment and professional experience in recognizing and managing failures and modifying the approach when necessary. Integrating technology, clinical skills, and experience is essential for success in complex situations.

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ISSN: 2358-2472

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