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# GUIDED ENDODONTICS IN A TOOTH AFFECTED BY CALCIFIC

# ENDODONTIA GUIADA EM DENTE ACOMETIDO POR METAMORFOSE CÁLCICA

# ENDODONCIA GUIADA EN UN DIENTE AFECTADO POR METAMORFOSIS CÁLCICA

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## ABSTRACT

Endodontic treatment is a procedure that involves a series of techniques, including mechanical instrumentation, chemical debridement, and obturation of the root canal system, with the aim of maintaining and/or restoring the health of the affected tooth and surrounding tissues. Among the challenges faced in endodontic practice, pulp calcification is a relevant condition, characterized by the deposition of calcified tissue on the walls of the pulp tissue, resulting in partial or total obliteration of the root canal. This study aimed to report a case involving treatment with Guided Endodontics of tooth 12 affected by calcific metamorphosis. The patient was referred to COESP College due to obliteration of the canal of tooth 12. Thus, cone beam computed tomography was requested and a guide was made for treatment with endoguide. The report demonstrates that Guided Endodontics can be an effective alternative for accessing teeth affected by calcific metamorphosis, due to the performance of a more precise access, avoiding excessive wear or iatrogenic damage, facilitating cleaning and shaping of the root canal, and contributing to a good prognosis.

**Keywords:** Endodontics. Tooth Calcification. Dental Pulp Calcification. Tooth Injuries. Case Reports.

## RESUMO

O tratamento endodôntico é um procedimento que envolve uma série de técnicas, incluindo a instrumentação mecânica, desbridamento químico e obturação do sistema de canais radiculares, com o objetivo de manter e/ou restaurar a saúde do dente afetado e dos tecidos ao redor da raiz. Entre os desafios enfrentados na prática endodôntica, a calcificação pulpar é uma condição relevante, caracterizada pela deposição de tecido

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calcificado nas paredes do tecido pulpar, resultando na obliteração parcial ou total do canal radicular. Este trabalho objetivou relatar um caso envolvendo o tratamento com Endodontia Guiada do dente 12 acometido pela metamorfose cálcica. O paciente veio encaminhado para a Faculdade COESP devido a obliteração do canal do dente 12. Dessa forma, foi solicitada a tomografia computadorizada de feixe cônico e confecção do guia para tratamento com endoguide. O relato demonstra que a Endodontia Guiada pode ser uma alternativa efetiva para o acesso de dentes acometidos pela metamorfose cálcica, devido à realização de um acesso mais preciso, evitando desgastes excessivos ou iatrogenias, facilitando a limpeza e modelagem do canal radicular e contribuindo para um bom prognóstico.

**Palavras-chave:** Endodontia. Calcificação dentária. Calcificação da Polpa Dentária. Traumatismos dentários. Relato de Caso.

## RESUMEN

El tratamiento endodóntico es un procedimiento que implica una serie de técnicas, incluida la instrumentación mecánica, el desbridamiento químico y la obturación del sistema de conductos radiculares, con el objetivo de mantener y/o restaurar la salud del diente afectado y los tejidos circundantes. Entre los desafíos enfrentados en la práctica endodóntica, la calcificación pulpar es una condición relevante, caracterizada por la deposición de tejido calcificado en las paredes del tejido pulpar, lo que resulta en la obliteración parcial o total del conducto radicular. Este estudio tuvo como objetivo informar un caso que involucra el tratamiento con Endodoncia Guiada del diente 12 afectado por la metamorfosis cálcica. El paciente fue remitido a la Facultad COESP debido a la obliteración del conducto del diente 12. Por lo tanto, se solicitó una tomografía computarizada de haz cónico y se realizó una guía para el tratamiento con endoguía. El informe demuestra que la Endodoncia Guiada puede ser una alternativa efectiva para acceder a los dientes afectados por la metamorfosis cálcica, debido a la realización de un acceso más preciso, evitando el desgaste excesivo o el daño iatrogénico, facilitando la limpieza y modelado del conducto radicular y contribuyendo a un buen pronóstico.

**Palabras clave:** Endodoncia. Calcificación de Dientes. Calcificaciones de la Pulpa Dental. Traumatismos de los Dientes. Informes de Casos.

## INTRODUCTION

Endodontic treatment is a procedure characterized by the combination of mechanical instrumentation, chemical debridement and filling of the root canal system (SCR) aiming at the maintenance and/or restoration of the health of the dental element and periradicular tissue. In order to achieve a good result with the treatment, it is essential that the therapy is carried out in well-planned stages that promote the complete and adequate disinfection of the root canal, eliminating the bacteria previously present and creating an unfavorable environment for its survival (Bourreau et al., 2020; Santos et al., 2020).

Currently, endodontic treatment has shown a high success rate, in some cases, over 97%. To this end, a thorough knowledge of the morphology of the root canal system associated with a careful preoperative evaluation and good planning are essential prerequisites for ensuring better results (Fezai; Al-Salehi, 2019; Bourreau et al., 2020). However, some more complex and challenging situations, such as anatomical variations of the SCR, accentuated curvature of the root, difficult access to the canals, and calcification of the pulp cavity, may require more advanced management skills, knowledge, and technical experience on the part of the professional for successful treatment (Shah; Chong, 2018; Essam et al., 2021).

Among the complex scenarios found in Endodontics, a highlight should be given to teeth with pulp calcification. Pulp calcification (CP), or calcium metamorphosis, is characterized by the deposition of calcified tissue in the walls of the pulp cavity, resulting in a partially or fully obliterated canal. Its development basically depends on two main factors: the age of the individual and the type of injury that the dental element has suffered. Thus, the main causes of PC are pulp responses to carious lesions, use of excessive orthodontic forces, apposition of secondary dentin, especially in the elderly, and, especially, dental trauma (Bastos; Cortes, 2018; Tavares et al., 2018).

According to the American Association of Endodontics, endodontic therapy of teeth with pulp calcification presents a high level of difficulty, and can be a great challenge even for the most experienced endodontists (AAE, 2005; Tavares et al., 2020). In this context, seeking to improve the access and location of root canals, "Guided Endodontics" emerges as a new therapeutic approach in the treatment of root canals with calcium metamorphosis. In guided endodontic therapy, computed tomography of the tooth is performed in order to assess the morphology of the canal and allow the virtual planning of a guide for the access drill, which will be printed on a three-dimensional (3D) printer (Moreno-Rabié et al., 2019; Connert; Weiger; Krastl, 2022).

Due to the high degree of difficulty in performing the access, achieving patency and performing the proper modeling and cleaning of a tooth element with calcium metamorphosis, guided endodontics has been chosen to obtain a more accurate access and preparation during endodontic treatment (Moreno-Rabié et al., 2019). Thus, this study aims to report a case involving the endodontic treatment of tooth 12 affected by calcium metamorphosis through guided endodontics.

## CASE REPORT

A male patient arrived at a private practice in the city of João Pessoa, with an aesthetic complaint due to a fracture in the palatal region of tooth 12. Radiographic examination revealed obliteration in the root canal.

During the anamnesis, he reported that he suffered dental trauma while playing soccer at the age of 12, which in addition to the fracture of the elements, also generated mobility in elements 11 and 12. After stabilizing the teeth over the days, only the aesthetic restoration of the affected teeth was made. Based on this, the investigation was initiated through imaging exams. Cone-beam computed tomography (CBCT) was requested with axial, sagittal and coronal sections, with 0.3 mm/0.3 mm sections to study tooth 12 in more detail (Figure 1).

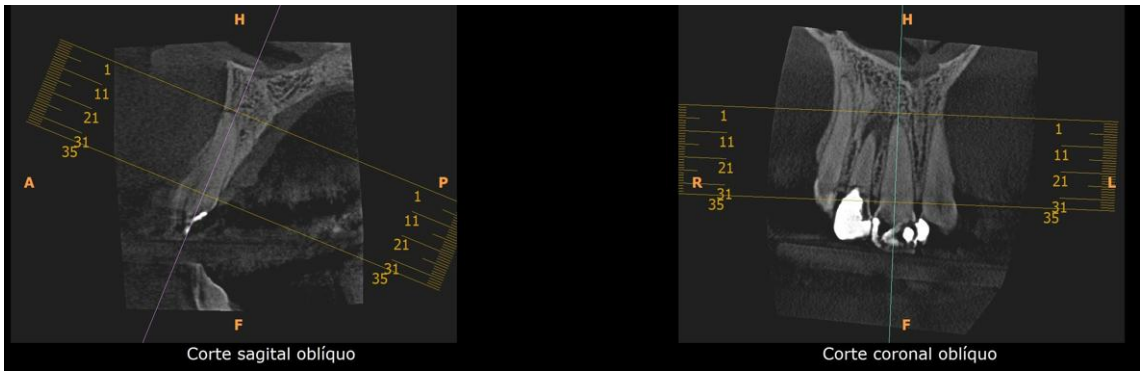


**FIGURE 1:** Tomography for planning

In addition to the fracture of the aesthetic restoration and the obliteration of the root canal, the presence of a carious lesion in the cervical region of tooth 12 was also observed (Figure 2), requiring a surgical procedure to reposition the tissues and later restore the region. After the restoration of the element in the cervical region and reconstruction of the tooth (Figure 3), and an attempt to access the tooth, where it was unsuccessful (Figure 4), the patient was referred to the endodontic specialization clinic of the COESP Faculty to begin endodontic treatment of the affected tooth.

**FIGURE 2:** Cervical carious lesion
**FIGURE 3:** Restoration and synthesis
**FIGURE 4:** Initiation of treatment

At the COESP College, the patient was dressed and instructed to rinse with 10mL of 0.12% chlorhexidine (Colgate, New York, USA) for one minute, and then the initial consultation was performed. After filling out the electronic medical record and signing the free and informed consent form (ICF), an anamnesis was initiated, where the involvement by calcium metamorphosis was diagnosed and the proposed treatment was the "endoguide" guided endodontics to be able to access the canal and later be able to perform the endodontic treatment.

Thus, a new CBCT was requested (Figure 5) and a guide was made to access the only canal present in the tooth.

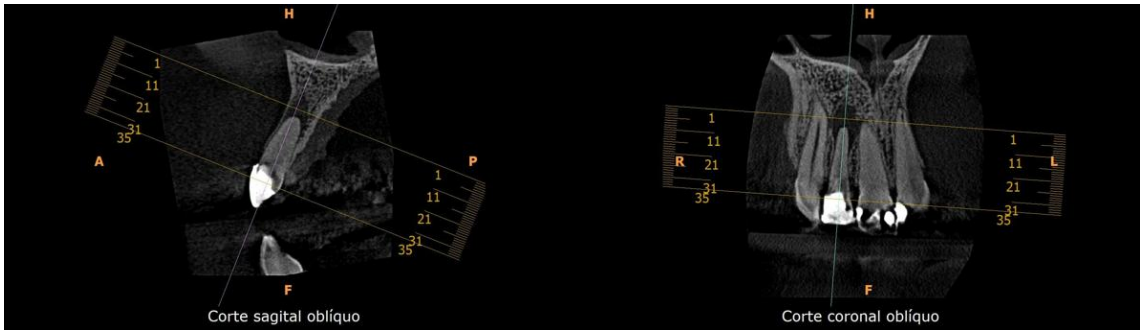


**FIGURE 5:** CT scan for making the guide

After infiltrative anesthesia was performed in the vestibular region using 4 tubes of 4% articaine and 1:1000 epinephrine (DFL, Jacarepaguá, Rio de Janeiro) using the technique of Anterior Superior Alveolar Nerve Block of the 1st and 2nd quadrant, due to the fixation of the guide being performed between teeth 13 and 23 and in the palate, infiltrative anesthesia was performed only in the region of tooth 12, where the clamp was positioned. The guide was fixed in the buccal region, in the region of teeth 13 and 23 to provide greater stability during access (Figure 6). After the first stage, a periapical X-ray was performed

(Figure 7).  to analyze whether the guide was well positioned and the cutter was following the correct path and thus, the preparation of the element up to the middle third of the dental element was completed with the cutter.

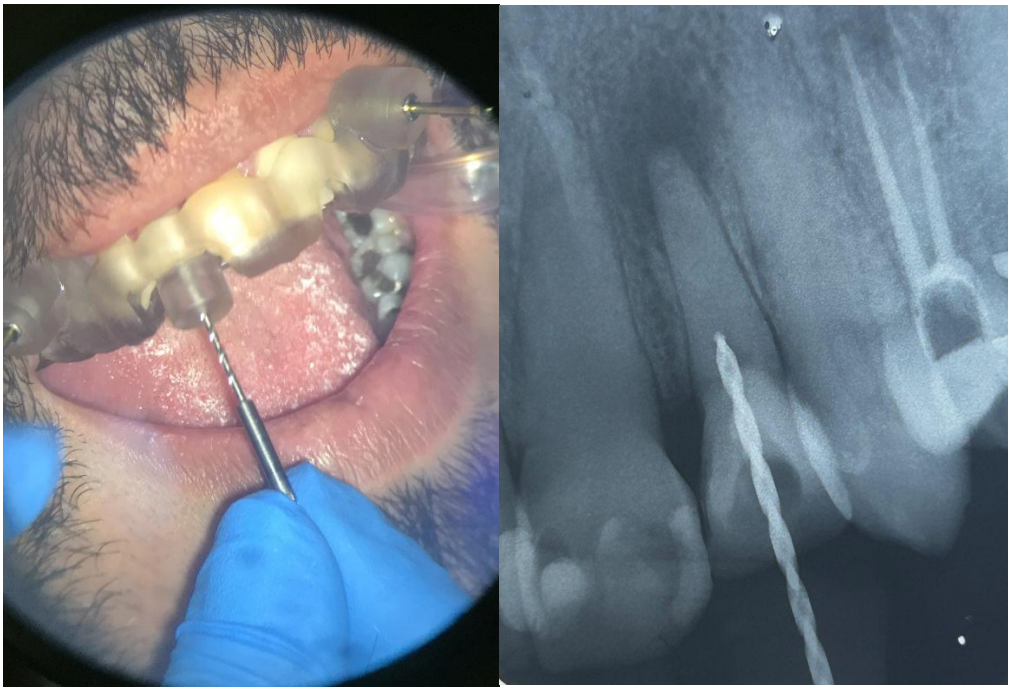

**FIGURE 6:** Fixation of the guide by buccal
**FIGURE 7:** Periapical X-ray of the cutter path in the groove

Soon after the removal of the guide, absolute isolation was performed at a distance, using staple No. 206 (SSWhite, Rio de Janeiro – RJ, Brazil) on tooth 13 with rubber dam (Madeitex, São José dos Campos-SP, Brazil), Ostiby arch (Maquira, Maringá – PR, Brazil) the sheet was adapted on teeth 12 and 13 already with the clamp (Figure 8),  and for a better seal and to avoid contact of the irrigating solution with the oral environment, saliva infiltration and microorganisms, a 'top dam' gingival barrier (FGM, Joinville -SC, Brazil) was used around the already isolated tooth.

**FIGURE 8:** Adapted absolute isolation

After abundant irrigation with 2.5% sodium hypochlorite (Naocl) (Brilux, Paulista, Pernambuco), using a 5mL disposable syringe (Descarpack, São Paulo-SP, Brazil), and an intracanal needle (Injex, São Paulo-SP, Brazil), exploration was initiated with a 25mm c-pilot 6 file (VDW, Munich, Germany) (Figure 9) and electronic dentistry was performed with the apical foraminal locator Romiapex A-15 (Romidan, São Paulo, Brazil). Reaching the patency length (CP), an initial preparation was performed with a 6, 8 and 10 c-pilot file (VDW, Munich, Germany) to perform the glide path and then start the mechanical instrumentation. The first file used in the PC was the Small file, from the Wave One Gold system (Dentsply Maillefer, Ballaigues, Switzerland) (Figure 10) and in the blanking length (CO), which corresponds to the CP-1mm, the XP-Endo Shaper file (FKG Dentaire, La Chauxde-Fonds, Switzerland) was used (Figure 11).

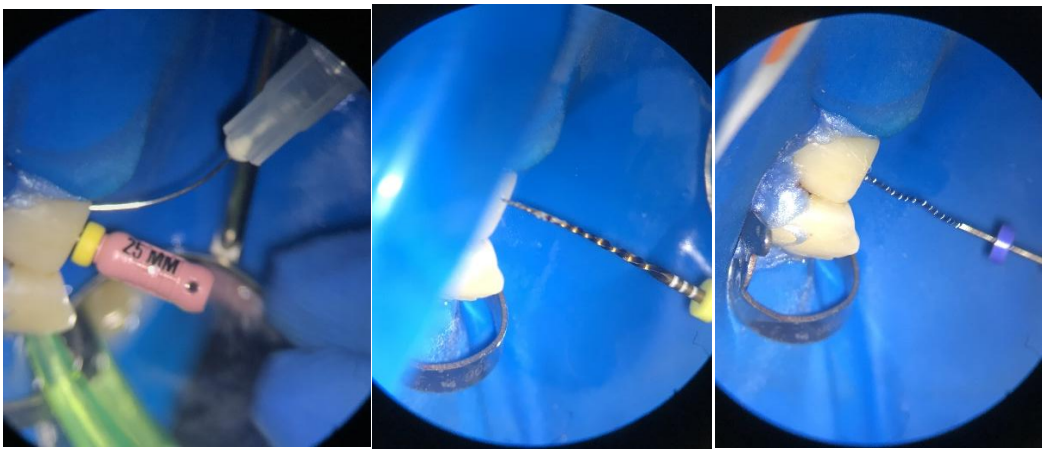


**FIGURE 9:** Explosion with C-pilot file.
**FIGURE 10:** Preparation with the Wave One Gold system.
**FIGURE 11:** Preparation with XP-Endo Shaper system.

After preparing the channel with the mechanized instruments, the irrigating solution (Naocl 2.5%) (Brilux, Paulista, Pernambuco) was stirred with the XP-Endo Finisher file (FKG Dentaire, La Chauxde-Fonds, Switzerland), (Figure 12) configured at 800rpm/1N rotation, with 3 cycles of 20 seconds, followed by passive ultrasonic irrigation (PUI) using the E1 Irrisonic insert (Helse,  São Paulo, Brazil) with the same irrigating solution and in 3 cycles of 20 seconds and we proceeded to the gutta-percha cone test. (Figure 13).

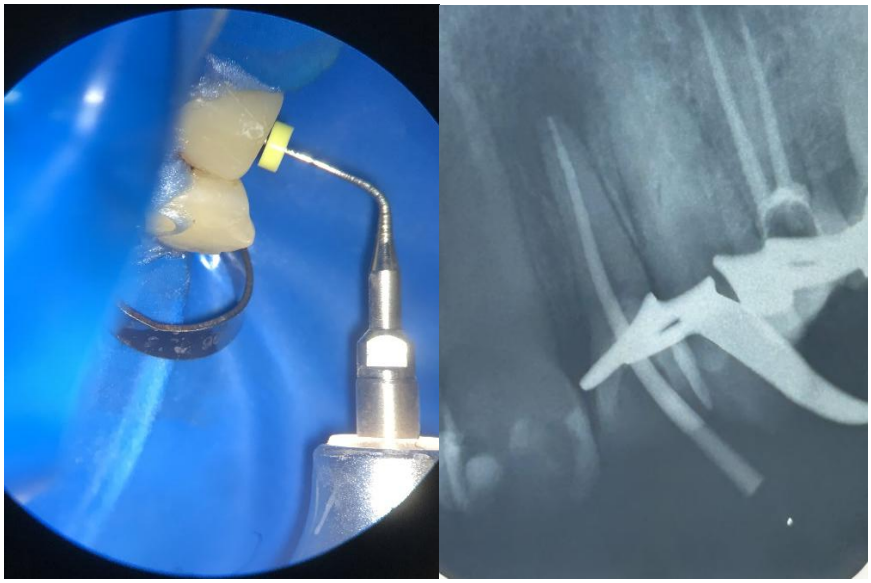

**FIGURE 12:** Irrigation protocol - PUI
**FIGURE 13:** Gutta-percha cone test

The F5 gutta-percha cone of the Protaper system (Dentsply Maillefer, Ballaigues, Switzerland) was selected in the OC (Figure 14) due to a better adaptation in the root canal and was complemented with FF accessory cone (Dentsply Maillefer, Ballaigues, Switzerland) to seal the spaces present in the cervical and middle regions.

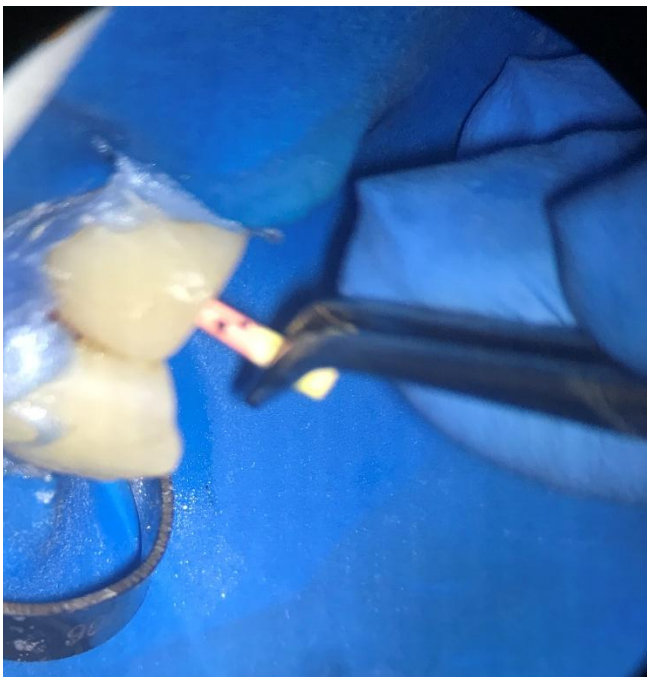

**FIGURE 14:** Filling with F5 Protaper cone

After the selection of the cones, the channel was irrigated with a 10mL flask of sterile distilled water (Santec, Ribeirão Preto - SP, Brazil) and the use of 17% EDTA (Biodinâmica, Ibiporã, Paraná, Brazil) was performed to remove the *smear layer*. 3 cycles of 20 seconds of solution agitation were performed with XP-Endo Finsher (FKG Dentaire, La Chauxde-Fonds, Switzerland) and followed by 3 more cycles of 20 seconds of PUI using the E1 Irrisonic insert (Helse, São Paulo, Brazil). The canal was dried with an absorbent paper cone compatible with the F5 Protaper cone (Dentsply Maillefer, Ballaigues, Switzerland) and filled with AH Plus Jet resinous endodontic cement (Dentsply Maillefer, Ballaigues, Switzerland), (Figure 15). After insertion of the main cone (F5), the accessories were inserted using a type C digital spacer (Dentsply Maillefer, Ballaigues, Switzerland), (Figure 16) and finally the lateral condensation technique was performed and the gutta-percha cut was performed below the cement-lime junction. (Figure 17).

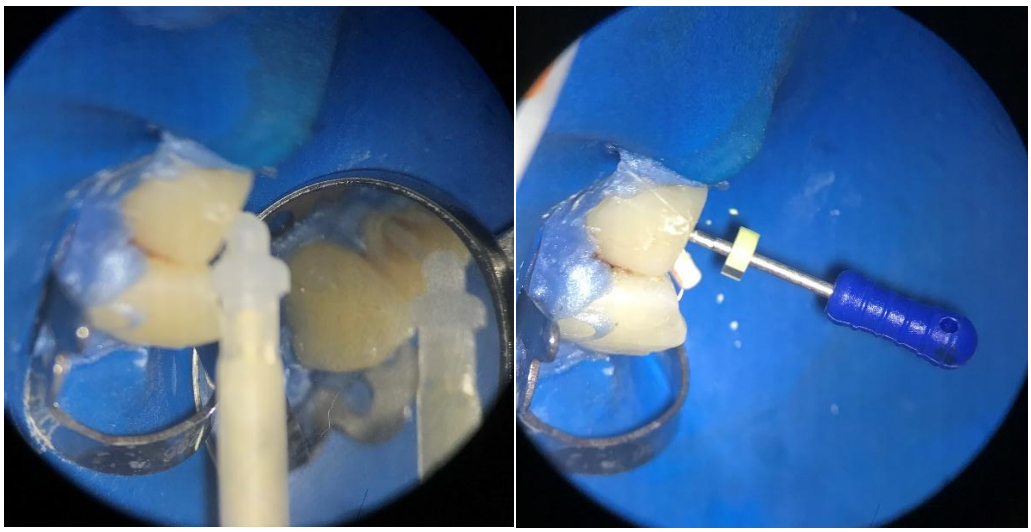

**FIGURE 15:** Filling cement insert – AH Plus Jet
**FIGURE 16:** Using the Type-C Digital Spacer

**FIGURE 17:** End-periapical X-ray

The pulp cavity was cleaned with sterile cotton and alcohol, and sterile isotape (TDV, Testo Central, Pomerode, Santa Catarina, Brazil) was inserted, sealed with Riva Light Cure (SDI, Victoria, Australia), and the patient returned to the index finger to perform definitive restoration and will be followed up to observe the regression of the present periapical lesion.

## DISCUSSION

The use of cone beam computed tomography (CBCT) in endodontics has been growing rapidly worldwide. This reality derives mainly from the ability of CBCT to provide a three-dimensional radiographic evaluation of dental elements and their adjacent structures. With the information provided by tomography, it is possible to identify, locate and analyze teeth with differentiated anatomy, fractures, root resorption and periapical pathologies.

Thus, CBCT is able to increase diagnostic accuracy and decision-making reliability for complex endodontic treatment (Patel et al., 2019; Chogle et al., 2020).

According to the recommendations of the American Association of Endodontists (AAE), CBCT is the modality of choice in the endodontic treatment of root canals with complex morphology, being indicated, for example, in the identification and location of calcified root canals (AAE, 2015). Pulp calcification or calcium metamorphosis is characterized by the formation of mineralized hard tissue in the pulp cavity space or in the pulp/dentin interface, and is often associated with a history of trauma, orthodontic treatment, dental caries, unsatisfactory restorations, or aging (Connert; Weiger; Krastl, 2022; Keles; Keskin; Versiani, 2022).

In the present report, the male patient presented to the dental clinic with an aesthetic complaint in element 12 and a history of trauma to the upper incisors at 12 years of age during a soccer game. According to the study by Oliveira et al. (2022), men are the most affected by dental trauma, a fact mainly related to the greater participation and exposure of this gender in contact sports activities. In relation to the affected elements, several studies state that the central and upper lateral incisors are the elements most affected by traumatic injuries, as the anterosuperior region is the most exposed at the time of trauma (Rocha et al., 2019; Tewari et al., 2020; Silva; Valencia; Vasconcelos, 2021; Oliveira et al., 2022)

A point to be emphasized in this case is that pulp calcification was only detected many years after the trauma episode and through a routine radiographic examination, since the element did not present any painful symptoms. According to Connert, Weiger, and Krastl (2022), the calcification process is usually asymptomatic and is noticed incidentally during an X-ray examination or indicated by a yellowish tooth coloration. In addition, root canal calcification is a typical late sequelae of dental trauma, which is the main etiology of pulp obliterations (Chaves et al., 2022; Connert; Weiger; Krastl, 2022).

Closure of the canal system can be accomplished by obliterating the pulp space within 6 months to 1 year of trauma. This phenomenon is well known and occurs frequently, and is also known simply as "pulp obliteration", but more appropriately it would be "Pulp Calcium Metamorphosis", the name most commonly used in the literature on the subject (Consolaro; Bernardini, 2007). According to the American Association of Endodontics (2005), the endodontic treatment of a tooth with pulp calcification has a high level of complexity. Thus, endodontic therapy should only be performed in cases of discomfort or signs and symptoms of periradicular pathology, such as in cases of apical periodontitis (Lara-Mendes et al., 2018; Connert; Weiger; Krastl, 2022).

Although the patient in this case did not present painful symptoms, there was clinical and radiographic evidence of the presence of an asymptomatic periapical lesion, and therefore endodontic treatment was indicated to resolve the infection.

In the context of endodontic treatment in teeth with calcium metamorphosis, the location and preparation of the root canal represent a challenge for the professional. Due to partial or total obliteration of the canal lumen, some procedural errors may occur, such as excessive enlargement of the access cavity, iatrogenic perforation, file fracture, and root canal deviation, which prevent the clinician from reaching the working length (Pujol et al., 2021; Connert; Weiger; Krastl, 2022).

In view of all the challenges involved in endodontic therapy of teeth with calcium metamorphosis, new techniques have been developed in order to increase the accuracy of the planning and execution of endodontic treatment. Among these techniques, guided endodontics deserves to be highlighted. This procedure aims to overcome the difficulties involved in the access of these elements, allowing a more precise location of the root canals. In addition, guided access provides greater preservation of tooth structure and prevention of deviations and perforations (Pujol et al., 2021; Tavares et al., 2022).

Guided endodontic access or "endoguide" consists of the association of CBCT, digital scanning, 3D models and access drills designed with the objective of properly accessing the calcified canals. To perform this technique, at first, a CBCT of the dental element and a scan of the adjacent dental arch or a plaster model of the region are performed. Subsequently, the images are worked on in software for the construction of an access guide and special drills. Only after these steps, the guide is printed on a 3D printer for the procedure to be started (Patriota et al., 2020; Ribeiro et al., 2020). Thus, taking into account the steps described, the present case followed all the steps mentioned above, agreeing with what is recommended by the literature.

According to studies, guided endodontic access has been shown to be a promising technique for the endodontic treatment of teeth with calcified canals, being considered safe, precise, direct, predictable and fast, because, despite having a greater number of steps, it reduces work time (Lara-Mendes et al., 2018; Moreno-Rabié et al., 2019; Connert; Weiger; Krastl, 2022; Tavares et al., 2022). In addition, according to the findings of Connert et al. (2019) and Loureiro et al. (2020), guided access has been presented as a minimally invasive method because it causes less loss of substance and preserves a greater volume of dental tissue when compared

In the context of chemical-mechanical preparation, the instrumentation of calcified channels also becomes a great challenge, and it is often necessary to use small-caliber

files with smooth movements to reach the patency length and achieve conduit enlargement (Chaves et al., 2022). In this case, due to the tooth having a more atresied canal, after performing the guided access, it was decided to use small diameter files for gradual expansion of the canal light, such as the C-Pilot files of the special series, the Small, of the Wave One Gold system, and the XP Endo Shaper.

Like any technique and procedure, guided endodontic access may have some limitations and disadvantages, according to the literature. One of the main limitations reported would be the use of drills with a larger diameter, which could lead to microfractures in the roots or make it impossible to use them in teeth with narrower roots. Another issue would be that drills would also make it difficult to use them in curved channels or posterior teeth (Moreno-Rabié et al., 2019; Patriota et al., 2020). However, several studies have already demonstrated its effectiveness in curved canals and teeth located in regions with limited mouth opening, such as molars. In addition, due to the reduction in the diameter of the drills used, the technique is already used in teeth with fine roots, such as the mandibular incisors (Connert et al., 2018; Maia et al., 2020; Navabi; Mohammadi, 2022; Santiago et al., 2022).

Other disadvantages reported would be the longer time to perform the technique and the increase in cost due to the use of high technology. However, some studies point out that the average time for the planning and design stages of the model takes around 9.4 minutes. In addition, despite the increase in planning time, there is a considerable reduction in the clinical time to perform the access. In relation to the high cost, it would be offset by the reduction of the risks of iatrogenic errors that would lead to higher costs if they occurred (Connert et al., 2018; Connert et al., 2019; Moreno-Rabié et al., 2019; Patriota et al., 2020).

In summary, the case presented presented satisfactory immediate results with a good prognosis, corroborating similar studies that performed the guided endodontic access technique in maxillary incisors (Tavares et al., 2018; Lara-Mendes et al., 2018; Torres et al., 2019; Loureiro et al., 2021). However, long-term follow-up is still necessary to verify the success of endodontic treatment.

## CONCLUSION

The case report demonstrates that guided endodontics can emerge as an effective option in the treatment of teeth affected by calcium metamorphosis, as well as a valuable strategy to address obstructed canals. This approach allows for more controlled and precise access, minimizing the need for excessive removal of tooth structure or the occurrence of

iatrogenies. In addition, it facilitates the execution of the stages of cleaning and shaping the root canal, thus contributing to a favorable prognosis.

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