CASE REPORT

ENDODONTIC TREATMENT OF TEETH WITH POST-TRAUMA ROOT CALCIFICATION: CASE REPORT

TRATAMENTO ENDODÔNTICO DE DENTE COM CALCIFICAÇÃO RADICULAR PÓS-TRAUMA: RELATO DE CASO CLÍNICO

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ABSTRACT

The calcification of the root canal is a process that may occur after a dental trauma or slowly develop due to physiological dental aging. It is characterized by hard tissue deposition on both the pulp chamber and the root canal. Periapical radiography and computed tomography can be used to diagnose this condition. In some cases, it may be associated with pulp necrosis and the presence of periapical injury, and the treatment may be considered to be quite complex. This case report addresses the endodontic treatment of the upper left central incisor, symptomatic, with root canal obliteration and pulp necrosis as a sequela of dental trauma. After all the tests, chronic apical periodontitis was diagnosed, and conventional endodontic treatment was proposed. The most significant difficulty faced was when locating the root canal's entrance. Numerous radiographs were carried out to avoid deviations. The opening of the root canal could only be found at the end of the middle third, so treatment could proceed by using the crown-down technique and intracanal medication based on calcium hydroxide during the sessions. When the patient was asymptomatic, the root canal has been filled. The accomplishment of the technique was successful, and after finishing the case, there was remission of symptoms. After a six-month follow-up period and three years, the healing of the periapical tissues was observed.

Keywords: Dental pulp calcification, dental trauma, pulp necrosis, periapical diseases.

RESUMO

A calcificação do canal radicular é um processo que pode ocorrer posteriormente a um traumatismo dentário ou que pode se desenvolver lentamente em decorrência do envelhecimento dentário fisiológico. É caracterizada pela deposição de tecido duro tanto na câmara pulpar como no canal radicular. Essa condição pode ser diagnosticada através de radiografias periapicais e tomografia computadorizada. Em alguns casos, pode estar associada à necrose pulpar e presença de lesão periapical, e o tratamento pode ser considerado bastante complexo. Este relato de caso clínico aborda o tratamento endodôntico do elemento 21, sintomático, com obliteração do canal radicular e necrose pulpar como sequela de um traumatismo dentário. Após a realização de todos os exames, foi dado o diagnóstico de periodontite apical crônica, sendo proposto o tratamento endodôntico convencional. A maior dificuldade encontrada foi a localização da entrada do canal radicular. Inúmeras radiografias foram realizadas a fim de evitar desvios. Somente ao final do terço médio foi possível localizar a entrada do canal radicular e dar prosseguimento ao tratamento, utilizando a técnica coroa-ápice e medicação intracanal à base de hidróxido de cálcio durante as sessões. Foi possível realizar a obturação do canal radicular quando a paciente se mostrou assintomática. Obteve-se sucesso na realização da técnica, e, após a conclusão do caso, foi possível observar remissão dos sintomas. Após um período de acompanhamento de 6 meses e, posteriormente, de 3 anos, foi possível observar cicatrização dos tecidos periapicais.

Palavras-chave: Calcificação da polpa dentária, traumatismo dentário, necrose pulpar, doenças periapicais.

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INTRODUCTION

The apposition of hard tissue throughout the root canal's walls is a slow process, usually associated with physiological aging. In response to tooth wear and stimulation, localized hard tissue deposition occurs in both the pulp chamber and the root canal. Nevertheless, partial or total calcification of the pulp may also be associated with caries, traumatic injuries, and systemic conditions(1).

The development of root canal calcification depends on two main factors: the patient's age and the type of injury the tooth has suffered(1). Non-physiological calcification of the root canal happens through the deposition of tertiary dentin in response to a stimulus or trauma. This dentine has an irregular shape, and the amount to be formed will depend on the calcification rate (1).

The precise mechanism of root canal obliteration is unknown, but it is believed to be related to damage to the neurovascular supply of the pulp at the time of trauma(2). Calcification of the pulp chamber leads to the dental crown's darkening, loss of translucency, and yellowish appearance(3). This condition may be clinically visible three months after the trauma, but in most cases, it is not diagnosed within one year(4).

After root canal obliteration and depending on the degree of alteration, pulp necrosis can be a late complication(1, 5). The incidence of pulp necrosis in calcified teeth has been increasing over time and its development is related to teeth that suffered severe trauma and teeth that had complete root formation at the time of trauma(3).

In these cases, the location and negotiation of the root canal become a significant challenge in the endodontic practice(6). These procedures may lead to iatrogenic failures and poor prognoses(7). Thus, it is necessary to create good case planning and elaborate a proper treatment plan to obtain a better prognosis. This work aims to describe a clinical case concerning the endodontic treatment of a tooth with root canal calcification, which presented pulp necrosis and periapical injury after a dental trauma.

CASE REPORT

A 27-year-old female patient, Caucasian, without any systemic health changes, attended the dentist appointment at the Dental School of the Federal University of Rio Grande do Sul, reporting slight discomfort in the upper left central incisor with complaining about the color change of this tooth.

During anamnesis, the patient reported having suffered trauma to the anterior region of the face during a basketball game 14 years prior to the appointment. At that time, she sought dental care in which no dental intervention was deemed necessary. Two years after the event, during a routine dental appointment, an x-ray of the upper left central incisor was performed, and the need for endodontic intervention was verified. The attempt to locate the root canal was unsuccessful, and the tooth received a restoration with glass ionomer cement and composite resin.

During the clinical examination, it was found that the dental crown of the upper left central incisor presented a direct restoration in composite resin on the palatine face. The tooth did not have any wear and root exposure. Periodontal tissue was healthy, with no outbreaks of inflammation or infection. There was no intra or extraoral edema, nor fistula. Also, both upper left and right central incisor presented a slight color change. The crown of the upper left lateral incisor was healthy, with no signs of alterations.

A periapical x-ray of diagnosis was carried out, in which severe calcification of the root canal of both teeth was observed. Nonetheless, periapical alterations were observed only in the upper left central incisor. The upper left lateral incisor revealed hard blade integrity, as shown in Figure 1. Moreover, the patient had already undergone a computed tomography of this area, confirming the radiographic findings in Figure 2.

During the clinical examination, all tests were done on both teeth. Both elements responded positively to horizontal and vertical percussion and apical palpation tests. Under relative isolation, the sensitivity test was performed with Endo Ice (Maquira, Maringá, Paraná, Brazil) and obtained a negative response from the two teeth.

After all the tests, chronic apical periodontitis was diagnosed regarding the upper left central incisor, and the treatment plan was established. We chose to perform the endodontic treatment conventionally, even considering the limitations and risks of the technique. The patient was informed of the proposed treatment and the prognosis of the case; subsequently, the free informed consent was signed.

In the second appointment, endodontic treatment was initiated. Initially, the restoration of composite resin was removed using 1014 diamond burr (KG Sorensen, Cotia, São Paulo, Brazil). Afterward, absolute isolation of the operative field was performed with a folding arch, rubber sheet, and rubber dam clamp #211 (Golgran, São Caetano do Sul, São Paulo, Brazil). We tried locating the root canal's entrance with Endodontic Heine Probe (Golgran, São Caetano do Sul, São Paulo, Brazil) and files type K 08 and 10 (Maillefer, Dentsply, Petrópolis, Rio de Janeiro, Brazil), unfortunately without success.

Subsequently, we used a spherical carbide bur, LN drill (Maillefer, Dentsply, Petrópolis, Rio de Janeiro, Brazil), with a long neck in low rotation to wear the cervical and middle thirds. Throughout this process, various periapical radiographs were carried out to guarantee that the drill was inside the canal and was not generating deviations (Figure 5).

Figure 1 - *Diagnostic radiography*

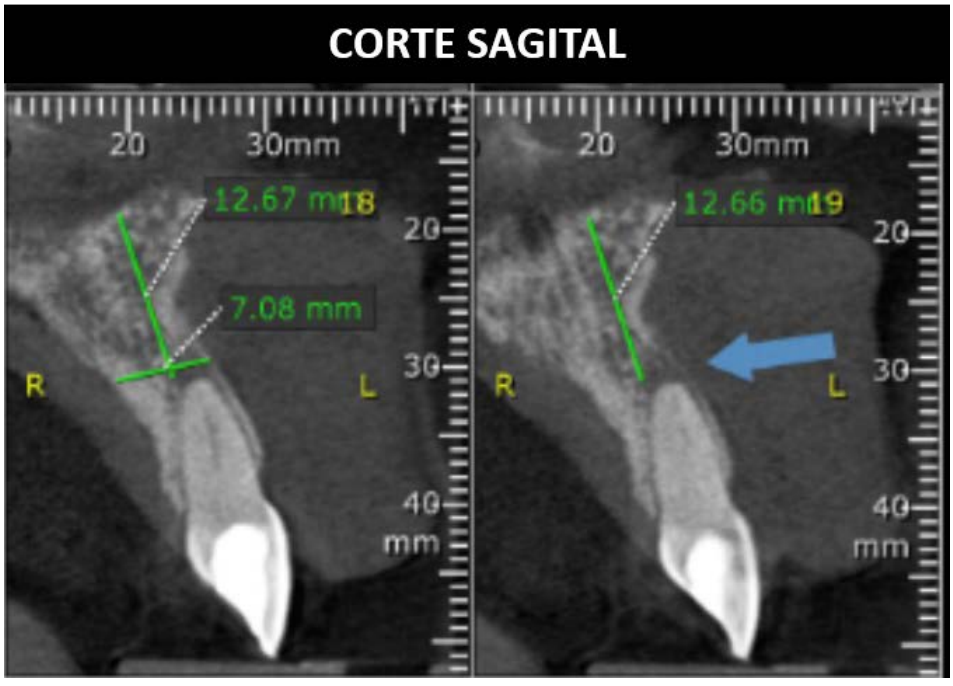

Figure 2 - *Computed tomography, sagittal view*

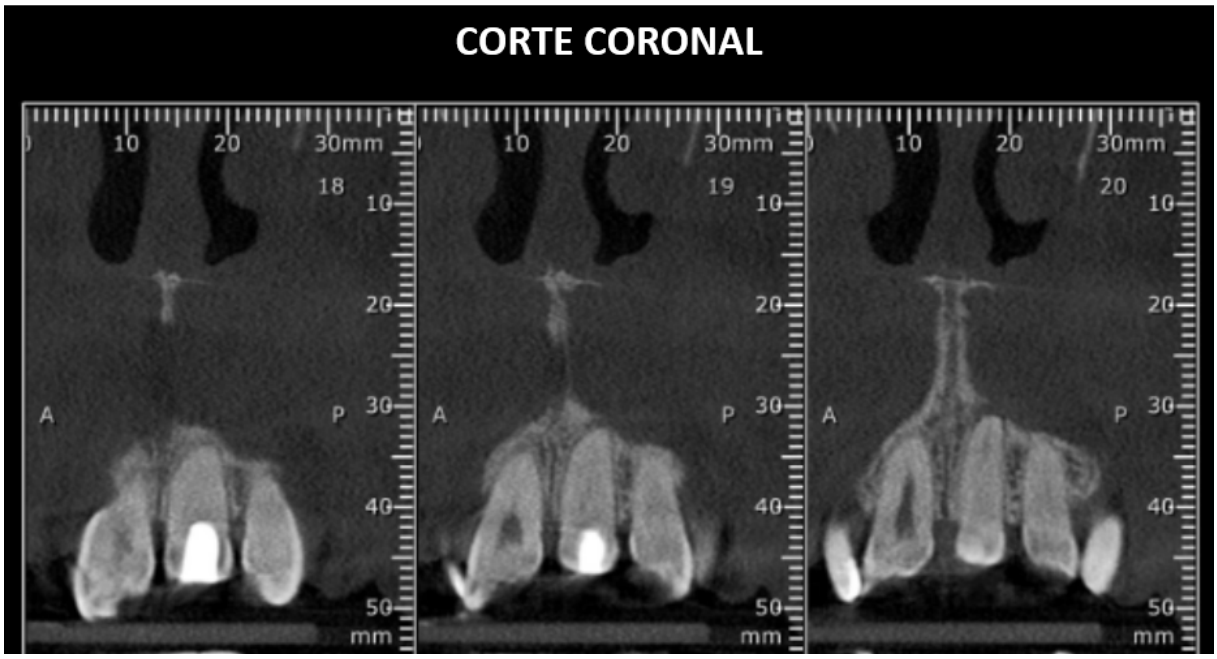

Figure 3 - *Computed tomography, coronal view*

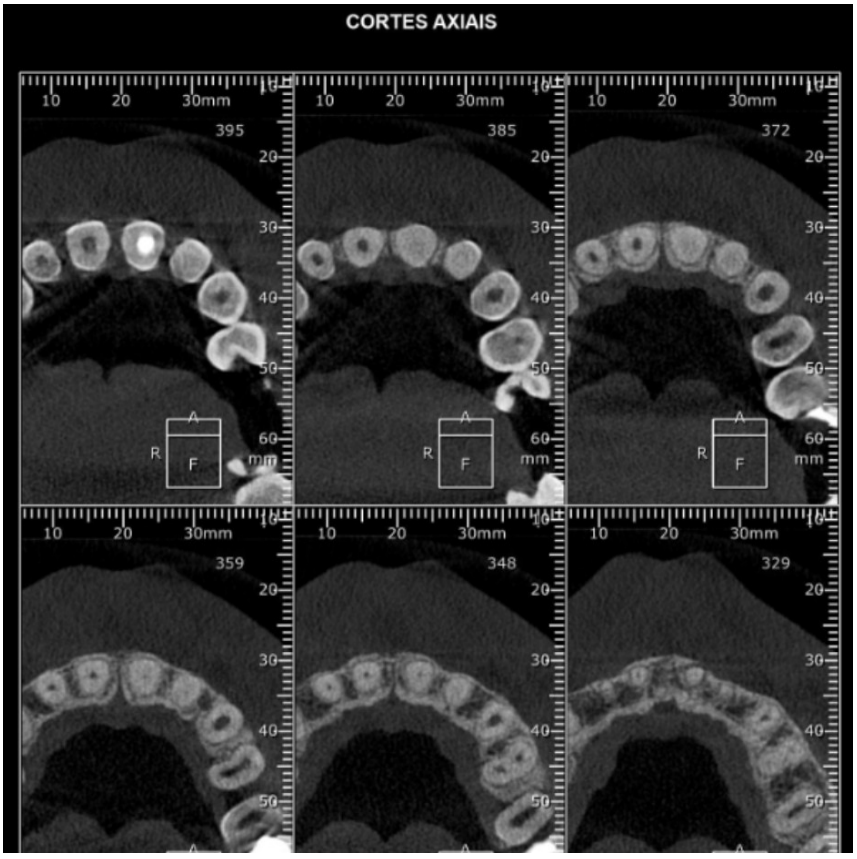

Figure 4 - *Computed tomography, axial view*

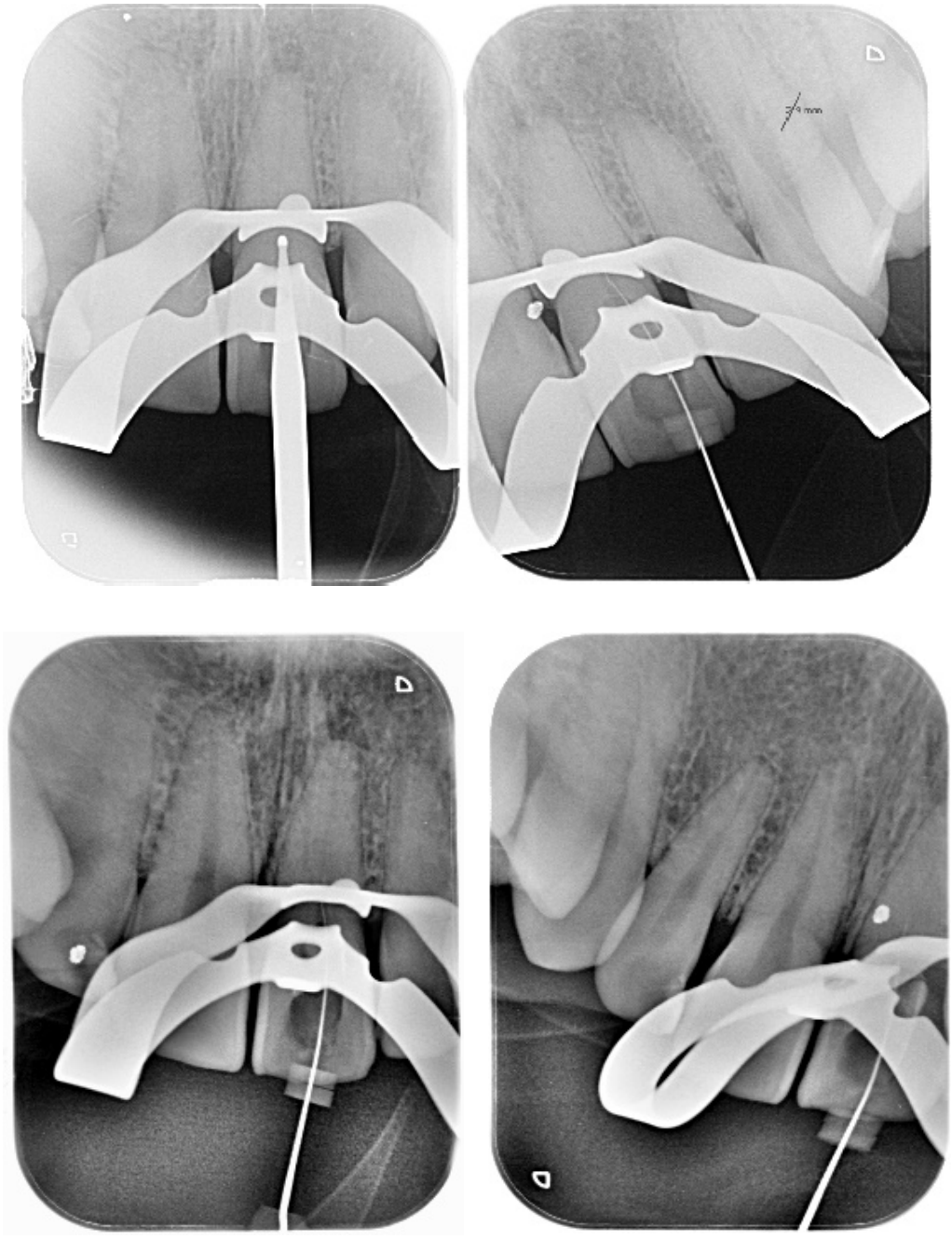

Figure 5 - *Periapical radiographs evidencing the location of the root canal entrance with no deviations.*

At the end of the middle third, the root canal entrance was detected, and a file type K08 was used to make the exploration. Orthoradial, mesiorradial, and distoradial periapical radiographs were performed with file K08 in position and could confirm the location of the root canal (Figure 6).

The irrigation process was performed with a disposable 27G needle (Injex, Ourinhos, São Paulo, Brazil), attached to the disposable plastic syringe with sodium hypochlorite 2.5% (Farmácia Marcela, Porto Alegre, Rio Grande do Sul State, Brazil). By the end of the appointment, a cotton ball with tricresolformalin (Biodinâmica, Ibiporã, Paraná, Brazil) was placed at the entrance of the root canal, and the tooth was sealed with temporary sealer material (Cavitec; Caitech, São José dos Pinhais, Paraná, Brazil), followed by glass ionomer cement (MaxxionR; FGM, Joinville, Santa Catarina, Brazil). The occlusal adjustment was performed, and the patient was instructed on possible postoperative discomfort.

In the third appointment, absolute isolation of the operative field was performed, followed by the removal of the crown's sealing and cotton ball with intracanal medication. The same irrigation and

aspiration processes. The measure of root canal length was performed with apical locator Propex Pixi (Dentsply, Petrópolis, Rio de Janeiro, Brasil), confirmed with periapical radiography, and the working length (WL) was defined at 21 mm, with an incisal lip as a reference. The root canal was enlarged with K-type filed (Maillefer, Dentsply, Petrópolis, Rio de Janeiro, Brazil) #8, #10, and #15 throughout the tooth's length (WL + 1 mm). The canal was irrigated with 2 mL of sodium hypochlorite solution 2.5% at each instrument change.

Afterward, the mechanical chemical preparation of the root canal was carried out with Wave One Gold (Maillefer, Dentsply, Petrópolis, Rio de Janeiro, Brazil), Small (20.07), Primary (25.07), Medium (35.06), and Large (45.05) reciprocating files. After completion of the preparation, the *smear layer with 17% EDTA* (Farmácia Marcela, Porto Alegre, Rio Grande do Sul, Brazil) was removed during three minutes, followed by irrigation with saline solution (Farmácia Marcela, Porto Alegre, Rio Grande do Sul, Brazil) and drying the canal with absorbent paper cones #45.

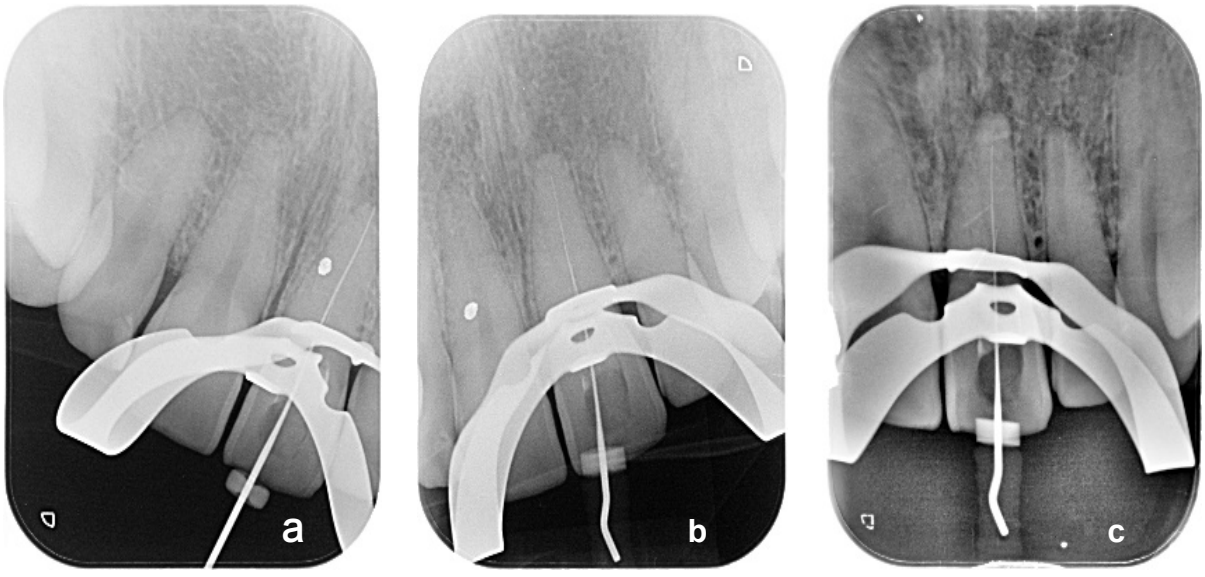

Figure 6 - *Radiographs at different horizontal angles to confirm the absence of root canal deviation. Mesiorradial (a), orthoradial (b), and distoradial (c) radiography.*

Due to the presence of periapical injury, we chose to use intracanal medication based on calcium hydroxide (UltraCal®XS; Ultradent Products, Inc, Indaiatuba, São Paulo, Brazil) (Figure 7a). The tooth was sealed with a cotton ball, temporary sealer, and glass ionomer cement (MaxxionR; FGM, Joinville, Santa Catarina State, Brazil).

After 34 days, the appointment happened to fill the canal. Sealing and intracanal medication were removed through successive irrigations with sodium hypochlorite 2.5% under absolute isolation. The central cone #45 (Figure 7b) was tested, and root canal filling was carried out with gutta-percha points and epoxy resin cement (AH Plus; Dentsply, Petrópolis, Rio de Janeiro, Brazil) with the Tagger Hybrid Technique (Figure 7c). The root canal entrance was sealed with temporary shutter cement, followed by direct restoration in composite resin.

After the conclusion of the endodontic treatment, the patient was referred to another department of the Dental School of UFRGS to perform the definitive restoration and whitening of the tooth. After 15 days of the filling appointment, all tests were redone in the upper left central and lateral incisors. Both responded negatively to horizontal and vertical percussion tests and apical typing test. Besides that, the patient reported no longer feeling any discomfort. Thus, it was decided not to carry out any endodontic intervention in the upper left lateral incisor and to monitor the case clinically and radiographically.

After six months, the patient returned to the clinical and radiographic control of the upper left central incisor and to evaluate the situation of the upper left lateral incisor. After clinical tests of horizontal and vertical percussion and apical palpation, the patient did not feel discomfort in the tooth submitted to endodontic treatment nor in the upper left lateral incisor. On radiographic examination, regression of the periapical lesion was observed, with the re-establishment of the periodontal space and the hard blade in the apical region of upper left central incisor (Figure 8a).

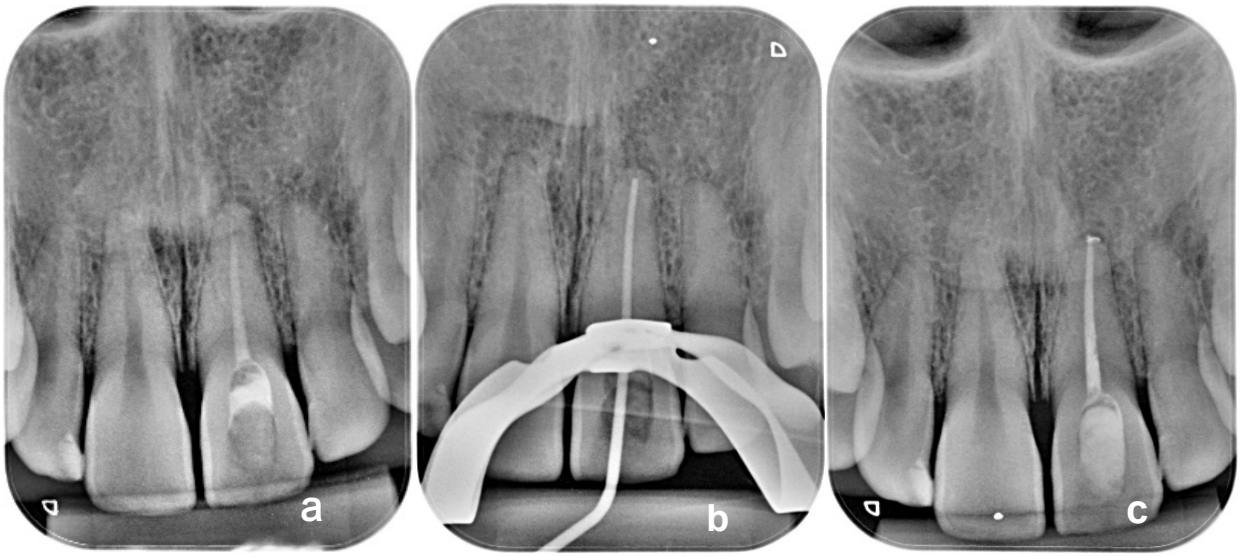

Figure 7 - *Periapical radiography evidencing the presence of intracanal medication (a), cone test radiograph (b), and final radiography (c).*

Figure 8 - *Proservation radiography: six months after endodontic treatment (a) and three years after endodontic treatment (b).*

In a new follow-up appointment, three years after the completion of endodontic treatment, it was possible to observe treatment success since there was no painful symptomatology in percussion and palpitation tests. Radiographically, repair of the periapical region was identified (Figure 8b).

DISCUSSION

The diagnosis of teeth with pulp calcification is essential for the development of a proper treatment plan, so, radiographic and clinical examinations, followed by percussion and sensitivity tests, are required. After trauma, affected teeth do not always react to sensitivity tests (4). This lack of response can be reversible; after a few weeks, the test may begin to display its results (8). Additionally, in many cases, the degree of atresia of the pulp chamber due to a previous trauma may be of such magnitude that there is virtually no more pulp tissue in this region. In cases like this, the thermal stimulus cannot reach these nerve fibers, and the obtaining of false-negative results is quite frequent. In this sense, in the presence of root canal obliteration, it is accepted that pulp sensitivity tests are unreliable (3,9). In the case report described above, this approach was adopted for the upper left lateral incisor, since after the endodontic intervention in the upper left central incisor the painful clinical signs and symptoms ceased, not demonstrating the need for endodontic intervention.

Moreover, the complete obliteration of the pulp in the radiographic image does not necessarily mean the absence of space in the pulp canal. In the majority of the cases, there is a pulp space and root pulp, but the sensitivity of radiographs is too low to allow its image to be captured (10). A study by Kuyk and Walton measured the diameter of the canal of 36 teeth on radiographs and then compared it with the actual measurements of the canals obtained through histological sections. They found out that, histologically, all root thirds had canal light, although many regions did not present a canal on a radiograph (11). Complete radiographic obliteration does not necessarily mean the absence of root canal space, given that, in most cases, a pulp canal space is indeed present. This study confirmed previous findings by Patersson and Mitchel, who observed that some form of the patent canal usually persists (10).

The advance in digital radiographs, including cone beam computed tomography, has the potential to help diagnose and plan this kind of treatment. Three-dimensional images allow a better view of traumatized teeth and eliminate overlaps. Many studies reveal the improvement of the diagnosis capacity with computed tomography compared to conventional intraoral radiography (12). In this case, computed tomography was used as an additional resource for elaborating the treatment plan. This way, we measured the calcification level of the root canal, in which there was a more significant presence of root lumen.

Root canal treatment in these cases should only be initiated if the tooth that presents symptoms or radiographic signs of periapical disease (13). According to the endodontic guide of cases of challenging access by the American Association of Endodontists (AAE), this kind of treatment is considered highly difficult. In such cases, reaching a predictable prognosis is challenging, even for a more experienced professional. Additionally, a study by Kiefner et al. revealed that the time it takes an endodontics specialist to locate obliterated root canals can range from 15 minutes to an hour using a clinical microscope. If this feature is not used, time increases further (13). As for this case, it was necessary to have an appointment of almost two hours for the location of the root canal to be successfully achieved. Beside to a careful wear of the root dentin, transoperative radiographs with different horizontal incidences were performed to better visualize any deviation of the original root canal trajectory.

The negotiation of calcified canals is a significant challenge (14). Cvek *et al.* found that the most crucial number of irreversible instrument fractures occurred in obliterated root canals (15). Typically, small-caliber files are required to achieve patency; however, these files do not have the necessary stiffness to cross restricted spaces and end up fracturing when used with force. An alternative is to obtain patency by alternating Kerr #08 and #10 with smooth vertical pressure movements, replacing them with new instruments before fatigue occurs. Moreover, it is recommended to use the crown-down technique (16). As a general rule, the pulp calcification process occurs in a corono-apical direction, thus, once the cervical third canal is located, the instruments tend to progress more efficiently and advance toward the end of the canal (17).

Another very recurrent risk in the endodontic treatment of calcified canals is perforation. To avoid perforation, various radiographic shots should be made at different horizontal angles to maintain alignment and ideal direction of the root canal (18).

A study performed by Schindler and Gullickson suggested that at the moment a canal is not located, apical surgery is recommended (19). Parendodontic surgery of apical surgery is seen as a good option for the treatment of calcified canals, as it offers a direct approach to the root apex (20). However, root canal localization may continue to be challenging even after root cutting (17). As for the case described

above, the patient was informed of all of the possible risks, that the prognostic was doubtful and that, in case the treatment failed, surgical approach would be necessary.

Pulp canal obliteration produces a clinical scenario in which canals should be located in more apic parts of progressively narrow roots due to dentin, caries, orthodontics, systemic disease, or trauma (17). Besides, it accounts for up to 75% of perforations during the attempt to locate and negotiate calcified canals (21). Aiming to reduce these risks, a study by van der Meer *et al.* revealed that it is possible to perform the digital planning of the endodontic treatment of calcified teeth based on cone beam computed tomography and intraoral scans(22). Through these scans, endodontic guides are created through prototyped manufacturing to direct the drill to the root canal. Similarly, case reports describing the use of 3D printed guides to access a calcified upper incisor and a lower molar support the clinical usefulness of the technique (23).

In recent years, guided endodontics has been employed to conduct endodontic treatment of calcified teeth, remove fiberglass pins, teeth with anomalies, and periapical surgeries (25). This technique has the advantage of direct access to root canal light in calcified teeth, surpassing the mineralized area with minimal deviation. Some authors reported that guided endodontics maintains a more significant dental structure, regardless of operator experience, compared to conventional access (26).

Nevertheless, guided endodontics presents some limitations. For example, access is performed with a giant diameter drill (1.3 mm) which can cause in certain situations, as in the case of teeth with mesiodistal flattening, an excessive wear, weakening the root remnant and compromising the survival of the treated tooth. In addition, its use is indicated in straight canals or the straight sections of curved canals and the difficulty accessing posterior teeth is due to the dimensions of the endodontic guide and the drill used for access(26).

Lastly, the cost of cone-beam computed tomography and guide making can be considered a limiting technique factor. In this case, it was chosen not to perform the guided endodontics due to the high cost since the patient could not afford the guide's expenses.

CONCLUSION

Endodontic treatments of traumatized teeth may be quite complex, especially when there is partial or total root canal obliteration due to trauma. Based on periapical radiographs in different angles, computed tomography, and patient treatment adherence, as well as the knowledge of the inherent risks to this type of approach, conventional endodontic treatment should be recommended. After a follow-up period of six months and, later, three years, there was remission of symptoms and healing of periapical tissues after treatment of upper left central incisor with a partially calcified canal and presence of periapical lesions.

The authors declare no conflict of interest.

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