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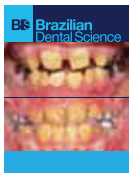

CASE REPORT

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Diagnosis of a horizontal root fracture during retreatment of a maxillary canine utilizing an electronic apex locator and monitoring with CBCT: a case report

Diagnóstico de fratura horizontal durante retratamento de um canino superior com auxílio de localizador apical e tomografia de feixe cônico (Cone Beam): relato de caso

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ABSTRACT

Introduction: The aim of this case report is to demonstrate the retreatment of a maxillary canine diagnosed with a horizontal root fracture utilizing an electronic apex locator and monitored with cone beam computed tomography. **Case Report:** A 35 year old African American male was referred for root canal retreatment of a maxillary right canine prior to prosthetic rehabilitation. Following removal of gutta percha, an apex locator was utilized to determine the length of the root canal. After a more comprehensive dental history, the patient confirmed a previously unreported history of dental trauma at this time, leading to the suspicion of a horizontal root fracture. Clinical microscopy detected a connective tissue in the apical third of the root canal and multiple periapical and occlusal radiographs enhanced visualization of a horizontal root fracture. The coronal segment was filled with an MTA apical plug and the apical segment remained stable. A recall after 1.5 years was performed with CBCT, which showed no apical radiolucency. **Discussion:** The present case report reinforces the precept that detailed dental history and careful observation of radiographs are critical factors for obtaining an accurate diagnosis. Fundamental adjuncts, such as microscopy, apex locators and CBCT imaging, can potentially aid in the diagnosis and the subsequent treatment plan of horizontal root fracture.

KEYWORDS

Cone-beam computed tomography; Apex locator Cuspid; Radiography; horizontal root fracture.

RESUMO

Introdução: O objetivo deste estudo foi mostrar o passo-a-passo do diagnóstico de uma fratura horizontal durante um retratamento, utilizando o localizador apical e a tomografia de feixe cônico como auxiliares do diagnóstico clínico. **Relato de caso:** Um paciente de 35 anos do gênero masculino afro-americano foi encaminhado com necessidade de retratamento no canino superior direito para posterior reabilitação protética. Seguida da remoção da guta-percha, foi utilizado o localizador apical para determinar o comprimento real do dente. Após uma melhor investigação sobre a história dental do paciente, o paciente confirmou uma história de trauma dental até então não comentada durante a anamnese, levando a suspeita de fratura horizontal no comprimento onde o localizador marcava a posição 0,0. Com o microscópio clínico detectou-se a presença de tecido granulomatoso no terço apical e, através de múltiplas radiografias periapical e uma oclusal foi possível visualizar a fratura horizontal. O segmento coronário instrumentado foi selado com um plug de MTA e, mantido o segmento apical sem tratamento. A proservação após um ano e meio foi realizada com CBCT, não presentando quaisquer alterações periapicais. **Discussão:** O presente relato de caso reforça ainda mais a necessidade de uma anamnese e história dental detalhada e cuidadosa observação radiográfica como fatores críticos para um diagnóstico preciso. Ferramentas auxiliares, como o microscópio, localizador apical e tomografia podem adicionar ao diagnóstico e consequentemente ao planejamento de fraturas horizontais.

PALAVRAS-CHAVE

Tomografia computadorizada de feixe cônico; Localizador apical; Dente canino; Radiografia; Fratura radicular horizontal.

INTRODUCTION

Root fractures, defined as fractures involving dentin, cementum, and pulp, comprise only 0.5-7% of all dental injuries, and the age group between 10-20 years old are the most likely to be affected. Horizontal root fractures are chiefly observed in the maxillary anterior region, however are not commonly observed in canines [1,2]. The prognosis of horizontal root fracture depends on the extent of the fracture, location, and type of trauma involving the coronal segment [3]. Most fractures occur in the middle third, followed by fractures in the apical and cervical thirds, with the latter having the least favorable prognosis [4,5]. The prognosis of the tooth involved in trauma can also be influenced by other factors, including patient's age, stage of root growth, mobility of the coronal segment, and dislocation of the segments and communication to the oral cavity [1].

According to the type of lesion and anatomical and functional characteristics, healing can take place by interposition of calcified tissue, interposition of connective tissue, or interposition of bone tissue. The way in which these lesions heal depends on the health of the pulp, dentin, cementum, and alveolar bone and the degree of dislocation of the fragments [6].

Differential diagnosis based on clinical and radiographic examination is needed when dental trauma occurs. Clinical management includes evaluation of pulp testing, periodontal probing, mobility, and soft tissue palpation and percussion. Intraoral radiography is widely used to detect root fracture [7]. Multiple periapical and occlusal radiographs are often required to confirm root fracture. 3-D images have been recently used to avoid distortion and diagnostic errors observed in conventional radiographs. Likewise, tomographs are used for differential diagnoses of horizontal root fractures [8,9]. Another adjunct commonly used during endodontic treatment is the apex locator. When coronal and apical segments are totally separated, this device is accurate and acceptable clinical tool in the detection of horizontal root fractures [10,11].

The following case report describes the retreatment of a maxillary canine by using apex locator, conventional, and occlusal radiographs during a one-and-a-half year follow-up with cone beam computed tomography.

CASE REPORT

A healthy 35-year-old male Afro-American was referred, on March 20, 2009, to the Endodontics Division at the State University of Campinas, Brazil – to receive root canal retreatment of the maxillary right canine prior to prosthetic rehabilitation. The patient was asymptomatic and reported no history of trauma. From this point on, he was not questioned about the absence of his anterior teeth (11, 12 and 21).

The apparent tooth length was estimated to be the length of the gutta-percha inserted in previous treatment (approximately 23 mm) (Figure 1A). The gutta-percha was completely removed from the root canal by using #3 and #2 Gates-Glidden burs (VDW, Germany), manual K-files (CCcord/VDW, Germany), Hedstrom files (Dentsply, Maillefer, Switzerland) and Hero 20.06 files (MicroMega, France) utilizing the operating microscope. The root canal was irrigated with a syringe (27-gauge needle) containing 2 mL of 2% chlorhexidine gel in 1% Natrosol (Endogel, Essencial Pharma, Itapetininga, SP, Brazil) before the use of each instrument and then immediately rinsed with 4 mL of saline solution. Multiple attempts to instrument the entire length of the root canal were unsuccessful. When the file reached the 23 mm length, the apex locator (Novapex, Forum Technologies, Israel) always showed a zero reading. Some bleeding and presence of connective tissue were observed with the

microscope. The most probable diagnosis was root canal perforation during the first attempt to treat this upper canine. The root canal was filled with calcium hydroxide, 2% chlorhexidine gel and iodoform. A series of periapical radiographs were taken and showed extrusion of medication beyond the lamina dura (Figure 1B).

The patient was questioned again about his dental history and the absence of his anterior teeth. He reported an automobile accident five years earlier. This led to the suspicion of a horizontal root fracture.

At the next appointment, an occlusal radiograph confirmed an apical fracture (Figure 1C). The working length was determined to be the apical extent of the coronal segment, where the apex locator indicated a zero reading.

After medication removal and reinstrumentation, a final rinse with EDTA 17% was performed for 3 min, renewing the solution every min. Next, an apical plug with white MTA (Angelus, Londrina, PR, Brazil) was placed into the apical 3 mm of the coronal segment and then backfilled with Cavit (3M, Manaus, AM, Brazil) and composite (Z250/3M, Manaus, AM, Brazil) (Figure 1D).

We opted to follow up the treatment with CBCT because the fracture line could not be clearly seen with conventional radiographs, and because of the questionable prognosis of the canine, which would serve as an abutment for a fixed prosthetic rehabilitation.

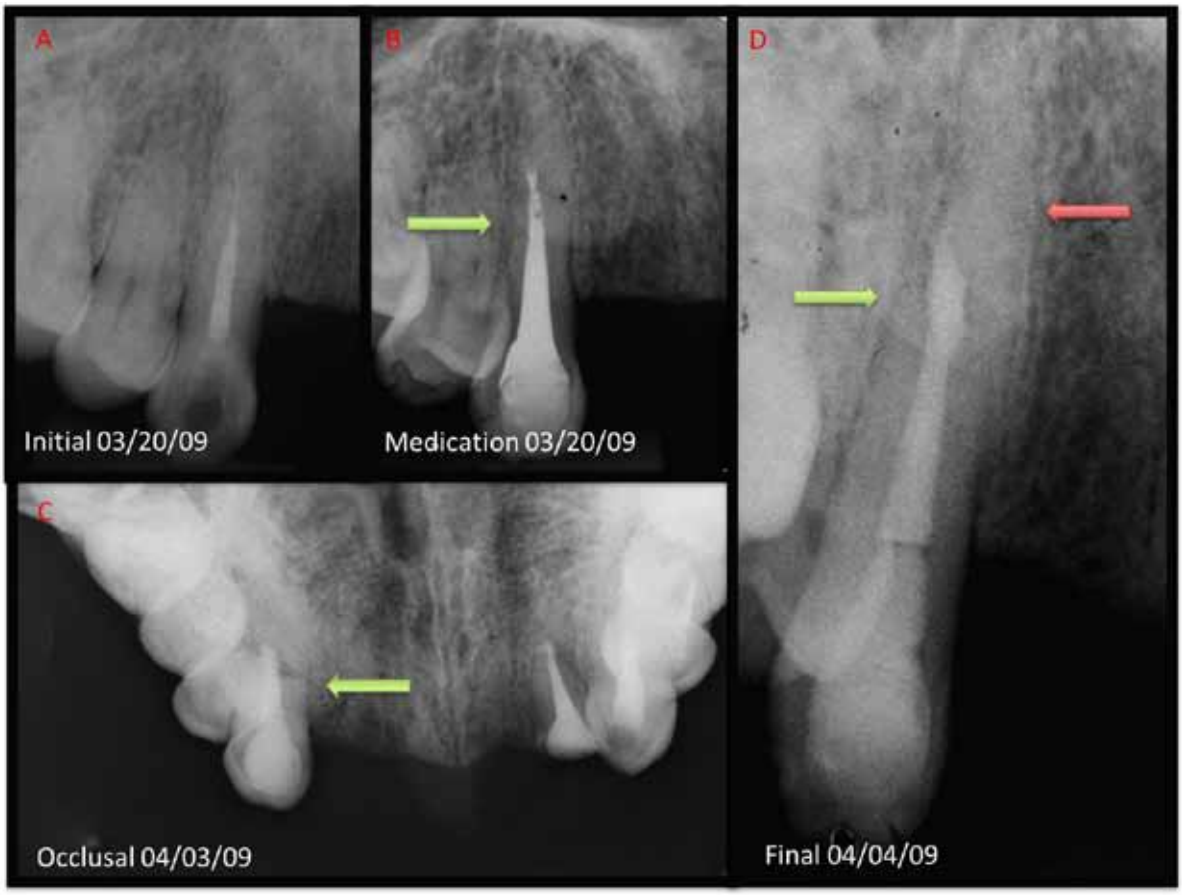

Figure 1 – Radiographs of maxillary canine during retreatment. A - Initial radiograph illustrating root filling short of the radiographic apex; B/C - Intermit lamina dura in the coronal segment with medication overfilling and stable apical segment (green arrows); D - Obturation with MTA, backfill with Cavit® and coronal sealing with composite. Note dislocation of coronal segment and intermit lamina dura (red arrow), as well as apical segment with intermit lamina dura and absence of apical radiolucency.

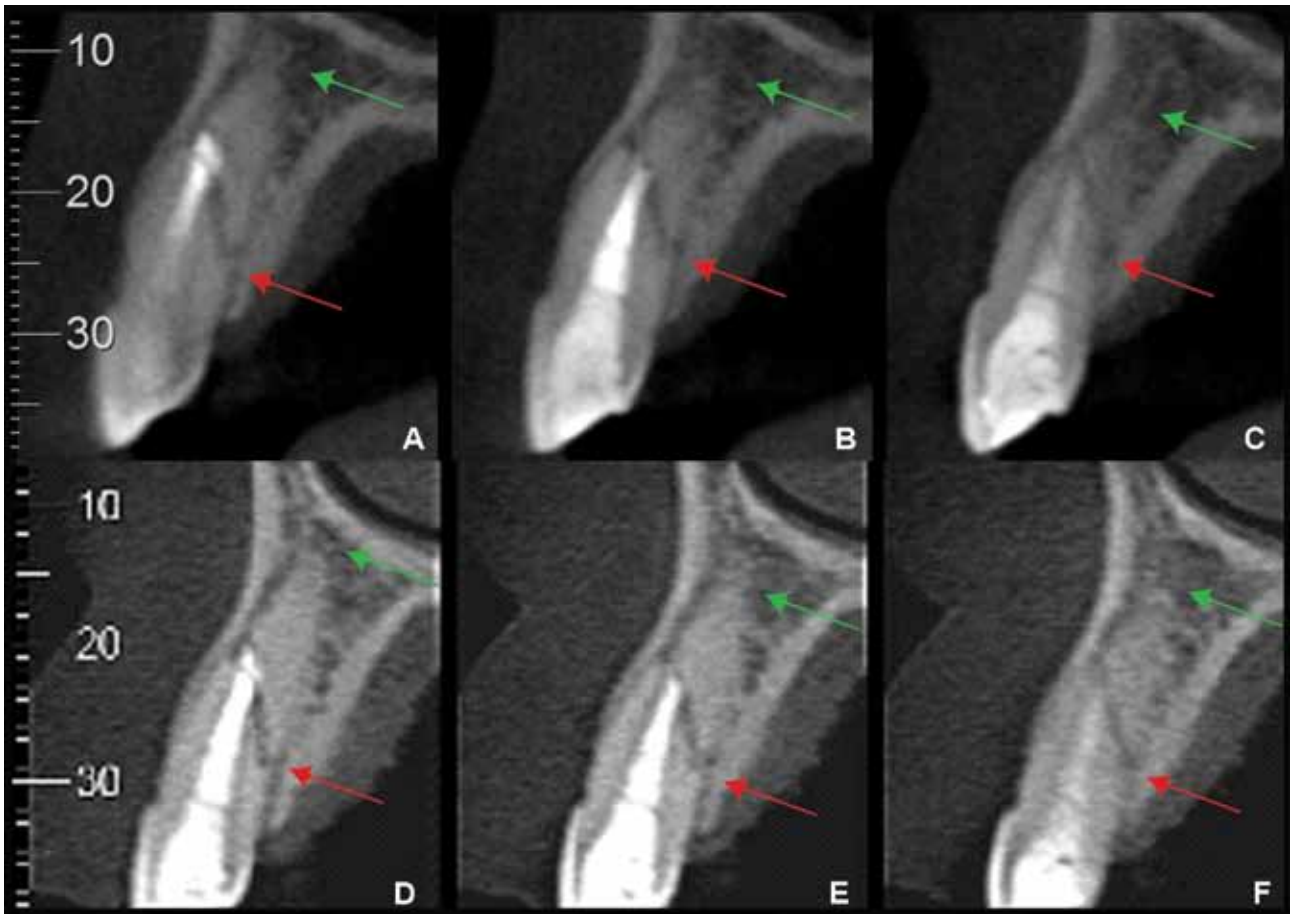

Figure 2 – A, B, C - CBCT after 5 months following retreatment (September 17, 2009) – sagittal slices. Stable coronal segment without any lesion in the fracture line (red arrows) and stable apical segment with no periapical radiolucency (green arrows). D,F,G – CBCT after 1.5 years (September 4, 2010) – sagittal slices. Same characteristics of the 5 month follow-up. Stable coronal segment without any disease in the fracture line (red arrows), and stable apical segment stable with no periapical lesion (green arrows).

The first follow-up was held on September 17, 2009, with CBCT (i-Cat Vision/ Imaging Sciences-Kavo) because the periapical radiograph showed no fracture line. By observing the sagittal slices (Figures 2A, B, C), no pathological changes were detected in either coronal or apical segment, with both cortices remaining intact and no segment removal being required. The patient reported no tenderness to percussion or palpation, and no sinus tracts or swelling

The second follow-up was held on September 4, 2010, and CBCT (i-Cat Vision/ Imaging Sciences-Kavo) was used again to detect any pathologic change. Oblique slices (Figures 2D, E, F) showed that the root canal filling was intact and no radiologic change in the radiolucent line separating the segments. Clinically, the patient reported no sign and symptom that could indicate failure.

No radiolucency in the apical segment was observed radiographically. As the patient was referred for fabrication of a new prosthesis, tomographs were taken to confirm the fracture and to assess the bone structure surrounding this tooth. The bone structure was determined to be insufficient to serve as an abutment for a fixed prosthesis. The patient chose to pursue oral rehabilitation with a removable prosthesis considering his economic situation.

CASE REPORT

Root fractures are complications arising from dental trauma, often caused by sports activities, violence, malocclusion or automobile accidents [1]. However, horizontal root fractures appear to be rare, occurring in 0.2-7% of dental trauma [1,12,13]. It is possible that the coronal segment may lose vitality, while the apical segment retains vitality. In the present report, horizontal root fracture in the maxillary canine and avulsion of central and lateral incisors had been caused by an automobile accident.

In the case of horizontal root fractures, the success rate reported in the literature ranges from 54% to 77% [3]. In general, the apical segment never remains intact (with pulp vitality or without infection) after endodontic treatment in the coronal segment [4]. Considering this, no apical segment treatment was conducted and the follow-ups confirmed that it was not necessary to perform instrumentation or remove the segment third.

The process of healing after dental trauma, particularly the horizontal root fracture, begins at the sites of pulp and periodontium involving the tooth segments. Healing occurs by hard tissue formation or interposition of connective tissue between the tooth segments if no infection is observed [1]. The healing of root fracture is related to the stage of root formation and extent of the injury. The frequency of pulp necrosis following root fractures is higher in teeth with closed apices than those with open apices [14]. Also, trauma severity and displacement of the coronal segment are factors that influence the healing process [13]. Although Andreasen and Hjörting-Hassen [12] state that the fracture site has no influence on the prognosis, we believe the contrary as other factors can influence the treatment outcome (patient's age, stage of root growth, mobility of the coronal segment, diastasis of the segments, and communication to the oral cavity). Moreover, rehabilitation may become extremely difficult when fracture line occurs in the cervical third.

Our initial misdiagnosis was partially due to the unreported history of trauma at the initial visit. Retreatment was recommended without signs of periapical disease because we did not know the historical details of the previous endodontic treatment and because of the extensive nature of the prosthetic rehabilitation. Horizontal root fracture was confirmed after gutta percha removal with the aid of an apex locator. Goldberg et al. [11] observed high accuracy rates in the fracture detection, using electronic apex locators, even in cases that the segments are not completely separated.

Complete clinical and radiographic examination is essential in the diagnosis and treatment of dental trauma. The guideline by the International Association of Dental Traumatology suggests that clinical and radiographic examinations should be followed by pulp tests and care instructions.

Intraoral radiography has been widely used because of its low cost and high resolution. A radiolucent line between the segments and discontinuity of the periodontal ligament space are the main predictors for diagnosis of horizontal root fracture [15]. In our case, we had difficulty in observing the fracture line in the periapical radiograph. The first signs of discontinuity appeared during the retreatment session when the apex locator was used. The patient did not report dental trauma in his dental history, and the segments were overlapped in the radiograph images. The fracture line separating both segments was noticed only by means of occlusal radiography.

The apex locator was used to localize both apical constriction and, in this case, the apical extent of the coronal segment. This device was the key to identify horizontal root fracture in the maxillary canine as its accuracy ranges from 60 to 80% for partially separated segments and from 93.5% to 100% for completely separated segments [10,11].

A more thorough investigation of the dental history may have led to a suspicion of a horizontal root fracture, at which time a CBCT may have been utilized. According to the AAE and AAOMR joint position statements, the use of CBCT should be limited to complex endodontic treatments or conditions such as diagnosis and management of dentoalveolar trauma especially root fractures, luxation and/or displacement of teeth, and alveolar fractures [16].

The effective radiation dose is known to be higher than that of periapical radiographs. Therefore, the AAE and AAOMR statements[17] recommend using the smallest possible field of view (FOV), the smallest voxel size, the lowest mA setting, and the shortest exposure time in conjunction with a pulsed exposure mode of acquisition.

In order to better monitor and treatment plan this case, a CBCT was performed to obtain an optimal diagnosis as the multiple-angled periapical radiograph showed neither fracture line nor possible periapical lesions. A long-term follow-up with CBCT was performed again as its high resolution and low distortion can show signs of failure during the re-treatment as well as the apical segment stability. In fact, this is an important adjunct which can aid during diagnosis and follow-ups.

It is important to perform a long-term follow up of the patient when considering dental trauma, since complications can occur years later. Although the present case was monitored for a small period of time, we found that despite the previous treatment received because of the trauma, the patient came to our department for retreatment and after one year no pathologic chances in either segments were observed and the canal filling was also intact.

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