

Cone-Beam Computed Tomographic Evaluation of Spontaneously Healed Root Fracture

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Abstract

Introduction: Dental trauma can lead to injuries in teeth and their supporting structures, which occurs most commonly in young patients and varies in severity from enamel fractures to avulsions. Root fractures are relatively uncommon among dental traumas, mostly affecting the permanent dentition. It has been reported that root fractures can undergo healing, whereas pulp necrosis can also occur. **Methods:** In this report, we present a case of the utilization of cone-beam computed tomography (CBCT) in the detection of possible cervical or internal resorption secondary to a mid-horizontal fracture in a 36-year-old male patient. The fractured teeth spontaneously healed and were diagnosed radiographically after 28 years. Initially, conventional radiographs showed fractured fragments with radiolucent lines. Because of possible invasive cervical resorption and doubt over internal resorption in the conventional images, it was decided to examine the teeth with cone-beam computed tomography with three-dimensional reconstructions. **Results:** The images clearly showed the displaced fragments of the root fracture. Despite the appearance in the conventional radiograph, no evidence of cervical or internal resorption was detected in the teeth other than the healed root fracture. **Conclusion:** It was concluded that CBCT images should be obtained for root fractures, especially those in which cervical or internal resorption is suspected from routine conventional radiographs. (*J Endod* 2010;36:1584–1587)

Key Words

cone-beam computed tomography, diagnosis, endodontic problems, healing, management of endodontic problems, root fracture

Traumatic injuries occur more commonly in young patients and vary in severity from enamel fractures to avulsions, which are the cause of emergency treatment in dental practice. Root fractures of permanent teeth can be cited as an example of these kinds of injuries. Horizontal root fractures have a relatively low incidence, ranging from 0.5% to 7% when compared with other dental impact injuries. They are frequently seen in the middle third of the root followed by apical and coronal third fractures; the most affected teeth are the maxillary central incisors of male patients (1–5).

Although root fractures can be generally detected shortly after the injury, they are identified occasionally at subsequent routine dental examinations (1, 6–8). The diagnosis of root fractures is accomplished with clinical and radiographic examination. Clinical examination includes evaluation of the mobility, presence or absence of tenderness and pain to palpation of the soft tissues, and percussion of the teeth and pulp testing. Radiographic examination can establish the diagnosis of root fracture but must be performed carefully. Two or three radiographs taken at various angles may be needed because of the angulation of the fracture. If the x-ray beam does not pass directly through the fracture line, it usually cannot be seen on the radiographs (9–13).

However, in the last decade, with the development of cone-beam computed tomography systems (CBCT), dentoalveolar imaging can be performed with less radiation and greater accuracy (14). In recent studies, it was shown that dental CBCT can be recommended for the assessment root canal systems (15), apical periodontitis (16), and inflammatory root resorptions (17) and has been shown to be useful in the diagnosis and management of these kinds of dentoalveolar trauma patients (13–16, 18). In this report, we aimed to present a case regarding the use of CBCT in the detection of possible cervical or internal resorption secondary to a spontaneous healed mid-horizontal fracture and to discuss the potential use of CBCT in root fractures.

Case Report

A 36-year-old man was referred to our clinic with the chief complaint of pain in the mandibular right second molar. A routine periapical radiograph revealed suspicion of a horizontal root fracture in the maxillary right central incisor (Fig. 1). The patient's medical history was unremarkable, but the dental history revealed that he had been hit in his mouth by his friend's head during a game while he was 8 years old. The patient also stated that his central incisors had displaced palatally, and he had replaced them alone by his hand and did not seek any professional dental care at that time. Although the clinical examination showed palatally displaced teeth and slight discolorations of the central incisors, the patient had no complaints except for the pain in the molar tooth. Vitality testing with solid carbon dioxide (CO₂ ice) and an electric pulp tester (Digitest Parkell, Farmingdale, NY) elicited no response from both the maxillary right and left central incisors. There was no mobility, fistulae, or pain to percussion or palpation. However, in the periapical radiograph, slight radiolucent areas in the fracture line were seen, which were interpreted to be possible resorption areas in the teeth (Fig. 1).

It was decided to obtain CBCT imaging for further evaluation. CBCT analysis was performed in all three dimensions, axial, sagittal, and cross-sectional images, with a 0.4-mm slice thickness (Newtom 3G; Quantitative Radiology SRL, Verona, Italy). The axial images revealed horizontal root fractures of the maxillary right central and left central incisors. Sagittal and cross-sectional views also showed horizontal root fractures in the middle third with pulp obliterations of the teeth. However, there was no evidence of periradicular pathology and no cervical or internal resorption, except

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Figure 1. (a) A panoramic radiograph and (b) periapical radiograph of the patient showing root fractures. Note the arrows showing radiolucent possible resorption area in the fracture line.

for the spontaneously healed root fracture of the incisors (Fig. 2). Three-dimensional reconstructed images also showed the healed fractures in detail (Fig. 3).

Discussion

Traumatic dental injuries are everyday occurrences in children and adolescents (2, 19, 20). Maxillary central incisors are the most vulnerable to injury, sustaining approximately 80% of all dental injuries, followed by the maxillary lateral and the mandibular incisors (21). The literature indicates that many factors may influence the type of healing that occurs for root fractures. For root fractures, the

length of time between the trauma and the treatment, the stage of root development, and any associated signs and symptoms of mobility and pain may influence the type of healing (22).

The healing of root fractures with or without initial treatment is reported to occur in up to 80% of cases, whereas pulp necrosis occurred in 20% (23–25). When the fracture line allows communication with the oral cavity, immobilization is difficult, and microbial contamination of the pulp with subsequent pulpal necrosis is almost inevitable (4, 7).

Root fractures in the apical and middle thirds usually require no immediate treatment, but because of the pathological changes that can occur several years after injuries, long-term follow-up of patients with

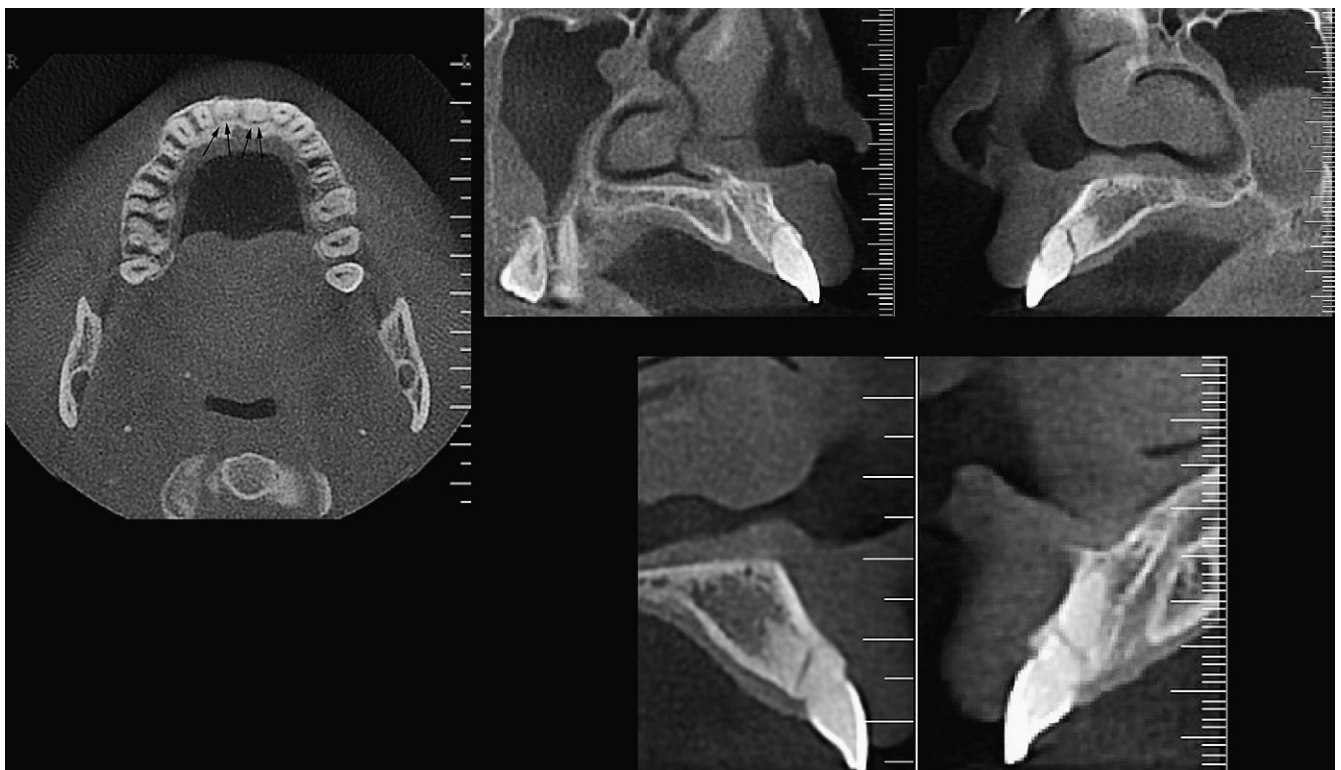


Figure 2. Axial, sagittal, and cross-sectional CBCT images showing a healed root fracture of the incisors without evidence of periradicular pathology or cervical or internal resorption.

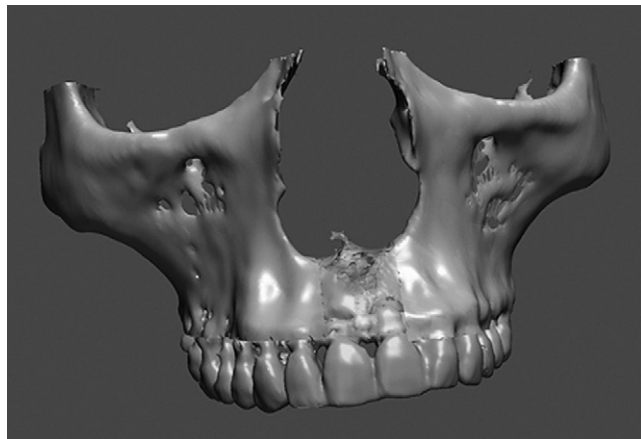


Figure 3. A three-dimensional image of root fractures using volumetric rendering software.

traumatic injuries is very crucial (4, 26–28). Davidovich et al (3) reported such a trauma case, which resulted in invasive cervical resorption 13.5 years after the trauma. In that case, early signs of cervical resorption were missed at 8 years in the follow-up radiographic examinations.

Because periapical radiographs are two-dimensional images of three-dimensional structures, the superimposition of adjacent structures may obscure the visibility of fractures. A three-dimensional imaging protocol should be used in detecting fractures, especially as an only choice for vertical root fractures (12, 29). Youssefzadeh et al (30) reported an *in vivo* study that was conducted with medical computed tomography (MDCT) on the detection of vertical root fractures and found out that MDCT was far better than conventional periapical radiographs. However, the radiation dose, the limited availability, and the increased cost impede its use in dentistry (10, 12, 31).

CBCT produces a cone shaped x-ray beam, and this makes it possible to capture the image in a single shot, rather than capturing slices separately, as in MDCT. The most important advantage of this imaging modality is acquiring comparative images with a much lower radiation dose than MDCT (10–13). In recent studies, it was concluded that CBCT scans are more accurate than periapical radiographs and effective in a safe way to detect both horizontal and vertical root fractures (9, 11, 12, 32). It was also concluded that currently CBCT should be considered when conventional radiographic techniques fail to provide information for diagnosing horizontal root fractures (32).

In our case, vitality testing and the electric pulp tester elicited no response from both the maxillary right and left central incisors. There was no mobility, fistulae, or pain to percussion or palpation. However, in the periapical radiograph, radiolucent areas in the fracture line were seen, which were interpreted as possible cervical or internal resorption in the teeth. Therefore, it was decided to perform CBCT so as not to miss any delayed complications of trauma, like resorptive processes that may lead to tooth loss.

CBCT images showed no sign of pathology in the teeth in our case. Estrela et al (17) reported in a recent study that inflammatory root resorption was determined more accurately and at earlier stages by using CBCT scans than with conventional radiographic images because of the three-dimensional view potential. It was also stated that inflammatory root resorption might be underestimated when evaluated with only periapical radiographs. We suggest obtaining three-dimensional CBCT images for the detection of possible cervical or internal resorption in cases similar to ours.

Although in the present case the initial diagnosis showed that CBCT images were superior in diagnostic efficacy to conventional radiographic images, for follow-up the CBCT images should not necessarily replace conventional methods. CBCT studies cause higher radiation exposures (4–20 times greater). From the standpoint of radiation risk, CBCT appears to have three to seven times the risk of a panoramic examination depending on the area examined, the degree of collimation, and the acquisition software version. Thus, the decision to select an imaging modality for diagnostic purposes, as in this case, should be based on the diagnostic yield expected and in accordance with the ALARA (as low as reasonably achievable) principle (31, 33). In conclusion, from the radiation protection point of view, the diagnostic information of CBCT must improve the treatment results; without such a benefit, this technique should not be recommended.

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