Different Representations of Vertical Root Fractures Detected by Cone-Beam Volumetric Tomography: A Case Series Report

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Abstract

Introduction: Vertical root fractures (VRFs) pose a clinical dilemma and a challenge to clinicians. Definitive diagnosis is often complicated by the lack of consistent signs and symptoms and the low sensitivity of conventional radiographs in the detection of VRFs. New radiographic imaging systems have recently become available for use in dentistry. Among these new imaging technologies is cone-beam volumetric tomography (CBVT). CBVT technology allows the precise visualization and evaluation of teeth with VRFs. The use of CBVT has great potential as a diagnostic tool to assist in the detection of VRFs. **Methods:** Seven cases are presented to demonstrate the use of CBVT in detection of VRFs in endodontically treated teeth. **Results:** Five specific findings on CBVT exam were consistent with confirmed VRFs. **Conclusions:** As demonstrated in this case series, CBVT can provide valuable additional diagnostic information in the detection of VRFs and may help prevent unnecessary treatment. *(J Endod 2012;38:1435–1442)*

Key Words

CBVT, cone beam CT, vertical root fracture

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Vertical root fractures (VRFs) pose a clinical dilemma and a challenge to clinicians (1). Definitive diagnosis is often complicated by the lack of consistent signs and symptoms and the low sensitivity of conventional radiographs in the detection of VRFs (2). Dental history (especially previous root canal treatment), presence of localized pain or swelling, an isolated deep periodontal pocket, and the radiographic appearance of a characteristic lateral root surface radiolucency are all consistent but not pathognomonic for VRFs. Because of the difficulty in reaching an accurate diagnosis, exploratory surgery and/or extraction are often recommended treatment options.

New radiographic imaging systems have recently become available for use in dentistry. Among these new imaging technologies are medical computed tomography (CT), cone-beam volumetric tomography (CBVT), and magnetic resonance imaging (MRI). In 2000, the U.S Food and Drug Administration approved the first CBVT unit for dental use in the United States (3). As of 2007, there were at least 12 cone-beam systems specifically designed for dental use. Cone-beam technology uses a cone-shaped beam of radiation to acquire a digital volume that is used for 3-dimensional (3D) reconstruction and visualization of the target area. CBVT systems are available in different fields of view (FOVs): CBVT limited (dental) or medium and full (ortho or facial) CBVT. The limited CBVT ranges in diameter from 40–100 mm, whereas the FOV of full CBVT ranges from 100–200 mm. The voxel size is generally smaller for the limited version (0.076 mm) versus for medium and large FOVs (0.1–0.2 mm and 0.3–0.4 mm, respectively), thus offering higher resolution and potentially greater utility for endodontic applications (4–9).

CBVT technology allows the precise visualization and evaluation of teeth with VRFs. The detection of VRFs by CBVT has already been demonstrated by previous studies (10–14). CBVT has great potential to become a valuable diagnostic and treatment planning tool in the modern endodontic practice. CBVT imaging has been a routine part of our diagnostic evaluation for all retreatment and surgery consultations since approximately January 2010, unless it was possible to reach a definitive conclusion regarding the etiology and prognosis for the tooth after initial clinical exam and 2-dimensional (2D) imaging. The Kodak 9000 3D (Carestream Dental LLC, Atlanta, GA) with limited FOV was the system used in the following cases. The intent of the following case series report is to demonstrate the different typical representations of VRFs detected by CBVT.

Case 1

A 33-year-old woman was referred for consultation and treatment of tooth #30, with a chief complaint of the following: "My tooth hurts to biting. My dentist told me I might need my root canal redone." Dental history revealed that root canal therapy on tooth #30 was completed approximately 10 years ago. The patient's medical history was noncontributory. The tooth was tender to percussion, palpation, and biting. Periodontal probing depths were 2–3 mm, and there was no evidence of swelling or sinus tract. A periapical radiograph of #30 showed periradicular radiolucency in relation to the mesiobuccal (MB) root (Fig. 1*A*). A widened periodontal ligament space on the distal root was noted on the radiograph. The CBVT imaging demonstrated MB bone loss at mid-root level in the axial and coronal views and 3D reconstruction (Fig. 1*B*, *D*, and *F*). A diagnosis of previously treated tooth with symptomatic apical periodontitis was reached. A VRF of the MB root was established as the etiology of treatment failure, and the tooth was scheduled for extraction and

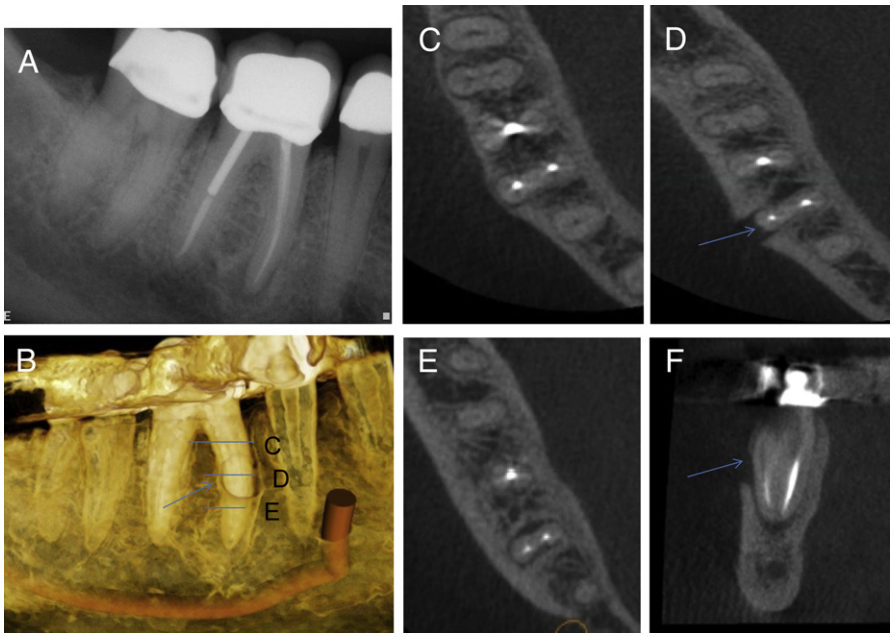

Figure 1. (*A*) Periapical radiograph of tooth #30. (*B*) 3D reconstructed view demonstrating the mid-root buccal defect (*arrow*). Lines correspond to the axial section views (*C–E*). Note axial view demonstrating the mid-root buccal bone loss (*arrow*) in (*D*). (*F*) Coronal view demonstrating the mid-root buccal bone loss (*arrow*).

socket preservation. A VRF was confirmed by buccal flap reflection before extraction of tooth #30 (Fig. 2*A* and *B*).

Case 2

A 56-year-old woman was referred for consultation and treatment of tooth #12, with a chief complaint of the following: "I feel pressure in my tooth. When I put my finger on my gums it is sore. It never felt good even after the root canal was done." Dental history revealed that root canal therapy on tooth #12 was completed approximately 3 years ago. The patient's medical history was noncontributory. Tooth #12 was tender to palpation. Periodontal probing depths were 2–3 mm, and there was no evidence of swelling or sinus tract. A periapical radiograph and the sagittal CBVT view of #12 revealed a widened periodontal ligament space (Fig. 3*A*). The CBVT imaging demonstrated intact buccal bone in the coronal one-third of the buccal root as well as buccal bone loss at the mid-root to the apex level in the axial and coronal views and 3D reconstructed view (Fig. 3*B–E*). A diagnosis of a previously treated tooth with symptomatic apical periodontitis was reached. A VRF of the buccal root was determined, and the tooth was scheduled for extraction and socket preservation. A VRF was confirmed by buccal flap reflection before extraction of tooth #12. The buccal root fracture of tooth #12 can be identified in Figure 3*F*.

Case 3

A 36-year-old man was referred for consultation and treatment of tooth #8, with a chief complaint of the following: "My front tooth hurts when it touches my lower teeth. I have a bad taste sometimes."

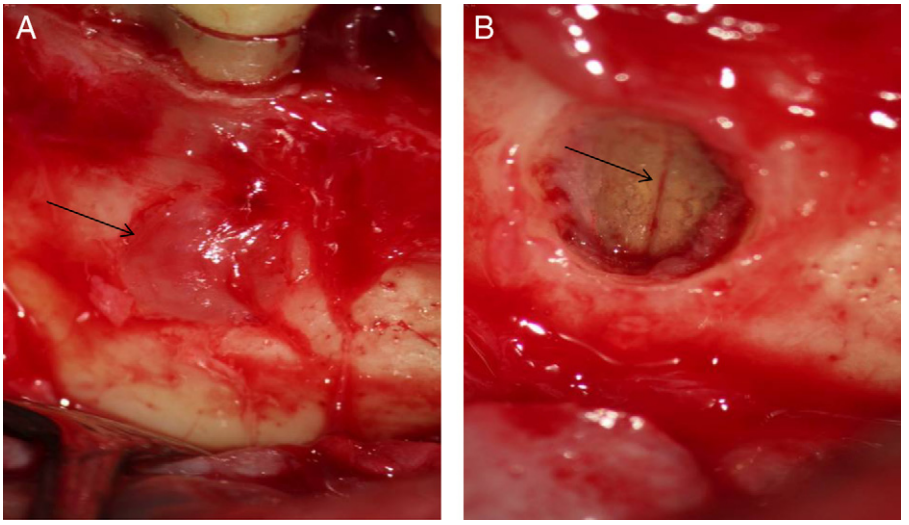

Figure 2. (*A*) Surgical exploration and confirmation of VRF. Note the granulation tissue at mid-root level (*arrow*) coinciding with CBVT images B, D, and F in Figure 1. (*B*) Surgical degranulation of the defect demonstrating the VRF in the mesial root (*arrow*).