



# Diagnosis of Vertical Root Fractures in Restored Endodontically Treated Teeth: A Time-dependent Retrospective Cohort Study

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## Abstract

**Introduction:** The purpose of this study was to examine different patient- and treatment-related factors associated with the time of presentation of vertical root fractures (VRFs) in endodontically treated teeth restored with crowns. **Methods:** One hundred ninety-seven root-filled, crowned teeth with no post and suspected of VRFs were included in the study. Patient details with relevance to endodontic treatment and clinical signs/symptoms were documented, and radiographs were taken. A diagnosis of a VRF was confirmed after surgical flap elevation. Frequency distributions were determined, and statistical analyses were performed using Pearson chi-square analysis, Fisher exact test, cross tabulation, Pearson correlation, and multiple logistic regression. **Results:** Mandibular molars (34%) and maxillary premolars (22.8%) were the most frequently affected teeth. The postoperative time to the diagnosis of a VRF was 4.35 ( $\pm 1.96$ ) years. Female patients, posterior teeth, overfilled canals, and patients older than 40 years were associated with the presentation of VRFs within 5 years of the postoperative period. Clinical findings most frequently observed were pain on percussion (60%), pain on palpation (62%), presence of a deep narrow pocket (81%), and sinus tract/swelling (67%). "Halo"-type radiolucency (48.7%) was the most common radiographic feature related to VRFs. **Conclusions:** Pain on palpation/percussion, deep narrow pocket, sinus tract, and halo-type radiolucency are characteristic features of VRFs. Posterior teeth, overfilled canals, female patients, and older patients (>40 years) presenting with the previously described clinical features in endodontically treated teeth restored with crowns are more likely to present with VRFs within 5 years postoperatively. (*J Endod* 2016;42:1175–1180)

## Key Words

Crown, overfilled canals, post, root canal treatment, vertical root fracture

A vertical root fracture (VRF) is defined as a complete or incomplete, longitudinally oriented fracture of the root, which is usually directed in the buccolingual plane. This fracture usually initiates in the tooth root and may extend coronally (1). In most instances, a VRF leads to tooth extraction (2). Clinical surveys and follow-up studies of endodontically treated teeth suggest a variable prevalence of 3.69% (3), 4.3% (4), 11% (5), 13.4% (6), and 20% (7) for VRFs. A recent retrospective clinical study that examined the 10-year survival of endodontically treated teeth observed root fractures in 6% of the extracted teeth (8). These inconsistencies in the reported prevalence of VRFs may be attributed to several risk factors, ambiguous clinical presentations, and challenges involved in the diagnosis.

Several predisposing factors have been known to increase the predilection of root-filled teeth to VRFs. The morphology of the root (9), root canal anatomy (10), amount of remaining dentin (9), and age changes in dentin (11) were also suggested to increase the predilection of VRFs in root-filled teeth. In addition, iatrogenic causes such as the degree of dentin removed during operative procedures or root canal preparation (12), dentinal defects induced during instrumentation and obturation procedures (13), and post space preparation (9) were also suggested as predisposing factors. It has also been suggested that endodontically treated abutment teeth are at high risk for fracture (2). Previous clinical studies have examined different diagnostic and clinical parameters associated with VRFs; nevertheless, the diagnostic accuracy of clinical and radiographic features of VRFs in root-filled teeth is still uncertain (14).

## Significance

This study highlights the average time taken for the clinical presentation of VRFs in endodontically treated teeth restored with crowns and without posts. It looks at the association between the length of obturation and VRFs and describes the characteristic clinical and radiographic features of VRFs in endodontically treated teeth restored with crowns and without posts.

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Typically, a VRF has been suggested to be a fatigue failure in an endodontically treated tooth (9, 15). A VRF may be initiated during root canal therapy or restorative treatment; yet, it is usually diagnosed years after the completion of treatment, when significant degrees of bone loss have already occurred (16). Nonetheless, only a few clinical studies have investigated the postoperative time to the diagnosis of VRFs in crowned endodontically treated teeth. Schwarz et al (17) evaluated 32 endodontically treated and crowned teeth with VRFs and reported an average of 7.8 years. Fuss et al (16) and Morfis (3) reported 1 to 5 years and 3 years postoperatively, respectively; however posts were present in more than 50% of these cases. The purpose of the current retrospective study was to determine the postoperative period taken for the confirmative diagnosis of VRFs and to examine the related clinical and diagnostic features of VRFs in crowned endodontically treated teeth restored with a crown and no post.

### Materials and Methods

The Institutional Ethical Review Board of the Dr. MGR Educational and Research Institute University, Chennai, India, approved the study. Patients with previously endodontically treated teeth presenting with signs and/or symptoms of VRFs in the university dental hospital and 2 private dental surgeries between 2009 and 2015 were assessed for this study. Informed consent was obtained from all the patients, and a documentation form was prepared. The collection of patient-/tooth-related data included the age, sex, tooth type, history of root canal treatment (primary or retreatment), date and technique of root canal obturation, and details of the postendodontic restoration. The history and treatment-related details were obtained from the case records of the dentist who had performed the root canal treatment.

Radiographs were taken using a paralleling cone technique, and findings were recorded. Radiographic assessment was performed based on Tamse et al's classification (18). The recorded radiographic features were categorized as follows:

1. *Normal periapical region*: No periapical rarefaction detected
2. *Periapical radiolucency*: Radiolucency/rarefaction located in the periapical region of the affected tooth and extending to less than 2 mm of the root coronally
3. *Isolated perilateral radiolucency*: Radiolucency/rarefaction limited to the lateral aspect of the affected root, without involving the coronal or apical regions
4. *"Halo" radiolucency* (Fig. 1): A periradicular rarefaction/radiolucency observed on the lateral aspect of the affected root, which extended apically and to the opposite side of the root
5. *Periodontal radiolucency*: A lateral radiolucency/rarefaction observed extending from the crestal bone to the apical (mesial, distal, or both) aspect of the root but did not involve the periapical area
6. *Vertical bone loss*: Interproximal angular bone loss exists in the mesial or distal side or both sides of the root
7. *Furcation radiolucency*: Radiolucency/rarefaction observed in the furcation area only
8. *Uniform widening of the periodontal ligament space*

The presenting clinical features recorded were pain on palpation; pain on percussion; presence of sinus tract/swelling; and presence of a buccal or lingual deep, narrow periodontal pocket. A diagnosis of a VRF was confirmed after surgical flap elevation (Fig. 2) using a microscope. A surgical flap was elevated for 294 teeth, with VRFs being identified in 289 teeth (97.6%). Under local anesthesia, a mucoperiosteal flap was elevated, and granulation tissue in the areas of bone dehiscence or fenestration was removed. The



**Figure 1.** A periapical radiograph showing "halo"-type radiolucency around the root suggestive of a VRF.

exposed root surface was examined under a microscope to confirm the presence of a VRF. A total of 289 extracted root-filled teeth with VRFs were evaluated for this study. Teeth that were not crowned ( $n = 14$ ), underwent retreatment ( $n = 26$ ), received a post and core restoration ( $n = 16$ ), served as an abutment ( $n = 35$ ), and third molars ( $n = 1$ ) were excluded from the study, leaving 197 teeth for the analysis.

### Statistical Methods

The data were combined, and statistical analysis was performed using the Statistical Package for the Social Sciences software, version 18.0 (SPSS Inc, Chicago, IL). The frequency distributions of all the parameters were obtained. In order to determine the association between various parameters, Pearson chi-square analysis, Fisher exact test, and cross tabulation were carried out for various combinations of parameters as follows: postoperative time before extraction versus apical extent of root canal filling, tooth type, radiographic presentation, and sex. To analyze the correlation between age of the patients and the postoperative time before extraction, Pearson correlation was conducted. To determine the influence of various factors on the postoperative



**Figure 2.** A clinical photograph confirming the diagnosis of a VRF after surgical flap elevation.

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