

Clinical and Histological Findings of Post-Treatment Infection in the Presence of Vertical Root Fracture and Apical Periodontitis: Case Reports

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ABSTRACT

Apical periodontitis and vertical root fracture (VRF) might coexist in the same root, thus representing a diagnostic challenge in endodontics. Diagnosis should be based on detailed clinical examination and precise radiographic interpretation in addition to histological examination, if needed. The histological findings of the case presented showed the possible coexistence of a VRF in the coronal third of the root and signs of apical periodontitis caused by intracanal infection in the apical third of the same root. The presentation of this case underlines the importance of histological examination as a valid complementary diagnostic tool with clinical and radiographic examinations in reaching an accurate diagnosis once the root has been extracted.

Keywords: Apical periodontitis, histological examination, root canal, vertical root fracture

HIGHLIGHTS

- This case report presents an apical periodontitis and vertical root fracture, both coexisting in the same root.
- Clinical and radiographic signs were suggestive for VRF.
- Only histological evaluation was able to show the coexistence of both pathologies in the same affected root.

INTRODUCTION

Vertical root fracture (VRF) is defined as a longitudinal fracture-confined to the root that usually begins in the internal canal wall and extends outward to the root surface (1), buccolingually, or mesiodistally with fractured segments incompletely separated (2). VRF is an undesirable complication that can occur after root canal treatment (3), usually originated from the cervical portion of the

root with extension in an apical direction because of stress induced by forces of mastication (2–4), occlusal contacts, weakened teeth, iatrogenic dental treatment, and root stresses during vertical compaction of gutta-percha (5). During masticatory function, various irritating agents, such as bacteria and debris, may be forced into the fracture site, and an inflammatory process may be consequently induced in the adjacent periodontal tissues (3). The fracture line appears to form an open pathway for irritants and bacterial contamination from the oral cavity and the gingival sulcus and from the canal space to adjacent tissues, resulting in periodontal ligament breakdown and a deep probing defect, alveolar bone loss, and granulation tissue formation (6).

Previous studies highlighted that the VRF is most prevalent in the mandibular molars (7). This may be related to the heavier masticatory forces compared to other tooth types, and to thin or flat roots associated with first molars, in addition to the weakening potential of roots following root canal treatment compared with non-endodontically treated teeth. Anatomical studies showed that the mesial root of first mandibular molars has flat and thin roots with smaller mesiodistal diameter and more susceptible to fracture (8). Pain on biting and a periodontal pocket are pathological signs/symptoms in the majority of cases of VRF (9). VRF in endodontically treated molars has been extensively studied clinically and radiographically; however, only few studies have evaluated histologically VRF in endodontically treated premolars and molars (10). Histological findings showed that buccal root portions (93.8%) were the most frequently affected sites (10).

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The aim of the present case report was to evaluate, through histological analysis, the possible effects of VRF on the root canal space and microbial colonization responsible for both symptoms and the periapical lesion in the mesial root of a mandibular molar.

CASE PRESENTATION

A 59-year-old man was referred to the School of Dentistry, University of Magna Graecia at Catanzaro, Italy for endodontic retreatment of the right mandibular first molar. Clinical examination revealed extensive destruction of the crown, and the tooth was tender to occlusal percussion and palpation of the vestibular margin. A preoperative periapical radiograph showed a short root canal filling in the mesial and distal previously treated roots (Fig. 1a). In the first visit, after rubber dam placement, the remaining carious tissue was completely eliminated, and a resin composite built-up was performed in order to obtain a four-wall access cavity for proper isolation and irrigation (Fig. 1b). Root canal preparation was performed using R25 Reciproc Blue (VDW, Munich, Germany) to remove gutta-percha from all canals and refined with Mtwo tip size 40, taper 0.04 (Sweden & Martina, Padova, Italy) in the distal root canal, whereas mesiobuccal and mesiolingual canals were prepared using Mtwo tip size 30 and taper 0.05. After each instrumentation phase, the canals were irrigated with 5 ml of 5.25% NaOCl (Ogna Laboratori Farmaceutici, Muggiò, Italy) and activated with a passive ultrasonic file (IrriS; VDW) for 20 s. After root canal preparation, a final irrigation was performed with 5 ml of

17% EDTA solution (Ogna Laboratori Farmaceutici) for 2 min in each root canal, and the filling of the root canals was performed by continuous wave of condensation technique (System B; Kerr Endo, USA) and thermoplasticized gutta-percha injection (Ob-tura II, Spartan, USA). An interappointment restorative material (Cavit; 3M Espe, St. Paul, MN, USA) was used to fill the access cavity (Fig. 1c), and in the second visit, a fiber-reinforced composite root canal post (DT Light Post; VDW) was cemented in the distal canal using a three-step dental adhesive system with its activator (Scotchbond Multipurpose; 3M Espe, Seefeld, Germany) and a dual-curable resin composite cement (Virage Dual; Sweden & Martina) photopolymerized for 2 min (Fig. 1d). The tooth was then prepared and temporized with a resin temporary crown.

After 1 year of travel outside Italy, the patient returned without the temporary crown (Fig. 1e). The tooth was painful on percussion and palpation, reporting pain during mastication; there was also one deep probing of 7 mm, extending beyond the physiological 2–3 mm depth and a fracture line of the mesial root localized buccally (Fig. 1f, g). The periapical radiograph showed a widening of the root canal space in the coronal part of the mesial root, suggesting VRF (12) and a small periapical radiolucency in the mesial root (Fig. 1e). These clinical and radiographic signs confirmed the presence of a VRF of the mesial root. The patient was informed and scheduled for root extraction. After a written informed consent to the treatment procedure, the mesial root was extracted after tooth hemisec-



Figure 1. (a) Preoperative periapical radiograph. (b) Intraoperative radiograph of the working length determination. (c) Immediate postoperative radiograph. (d) Radiograph after fiber post placement, build-up, and temporary resin crown cemented. (e) One-year control radiograph showing a periapical radiolucency located on the mesial root. (f) Fracture line of the mesiobuccal root localized buccally. (g) Deep probing defect. (h) Radiograph obtained after hemisection and extraction of the mesial root. (i, l) Extracted root showing a longitudinal vertical root fracture. (m) Six months of follow-up radiograph

tion (Fig. 1h, i, l), and after 1 week, the remaining distal root and the mandibular left second premolar were prepared and temporized with a temporary resin bridge. The treatment was then finalized with a metal-ceramic bridge. A 6-month clinical and radiographic control showed bone and periodontal healing without symptoms (Fig. 1m).

Immediately after extraction, the mesial root was fixed in 10% neutral buffered formalin for 48 h and histologically processed. Briefly, the fractured root was decalcified in a solution of equal parts of 22.5% formic acid and 10% sodium citrate for approximately 3 weeks. Decalcification was evaluated radiographically, and then the specimen was dehydrated in increasing concentrations of ethyl alcohol, clarified in xylene, and embedded in paraffin (melting point 56 °C). The sample was then divided into two parts, and the coronal 7 mm of the root was cut horizontally, whereas the apical 3 mm was cut vertically. A series of approximately 50 slices of 4 µm sections was made, and 1 section out of 3 was stained with hematoxylin and eosin (H&E). Selected slices were stained with Brown and Brenn (B&B). Histological and staining procedures were performed by a single operator (P.S.). All slices were examined through an Olympus CX41 microscope (Olympus Europa SE & Co. KG, Hamburg, Germany), and images of the specimens were subsequently obtained with an Olympus C-5060 digital camera by one experienced examiner (L.G.).

Histologically, a complete fracture was shown in the coronal third of the root extending on the buccolingual plane (H&E stain, Fig. 2a, b). Bacteria aggregated in biofilm were visible in the internal fracture line on both sides of the same slices (B&B stain, Fig. 2c, d). In the middle third, the fracture was visible only in the buccal side (B&B stain, Fig. 3a). Root canals and isthmus seen in the horizontal sections of the middle third of the root showed a good cleaning with few traces of filling material without the presence of bacteria (Fig. 3b, c, d). The vertical sections of the apical 3 mm showed the presence of bacteria and necrotic tissue in the buccal canal (Fig. 4a, b, c, d) and tissues in the main and lateral canals lingually (Fig. 4e, f).

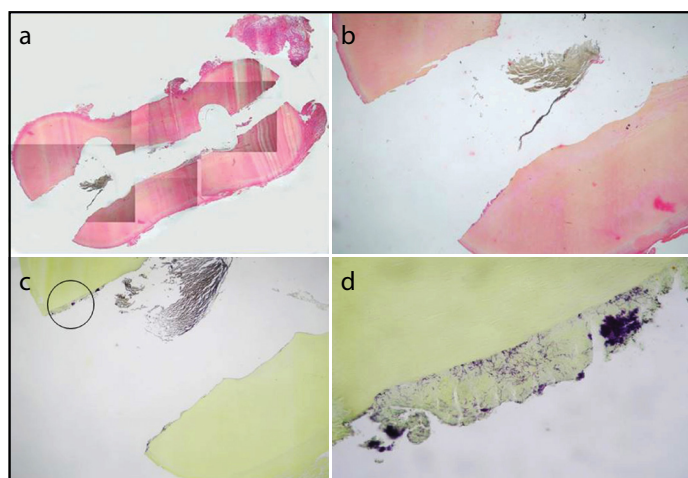


Figure 2. (a) Composite images of the complete buccolingual fracture in the coronal third. (b, c) Fracture line in the buccal view (H&E and B&B stain, 100×). (d) Magnification of the area underlined in c and d showing bacteria along the fracture line (B&B stain, 400×)

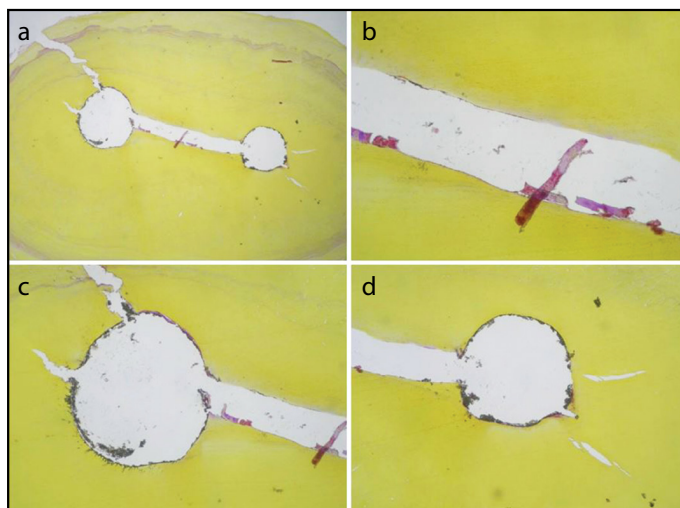


Figure 3. (a) In the middle third, the vertical root fracture is visible only in the buccal side (B&B stain, 40×). (b) Isthmus with traces of filling material and sealer without bacteria (B&B stain, 400×). (c, d) Mesiobuccal and mesiolingual canals in horizontal sections (B&B stain, 100×)

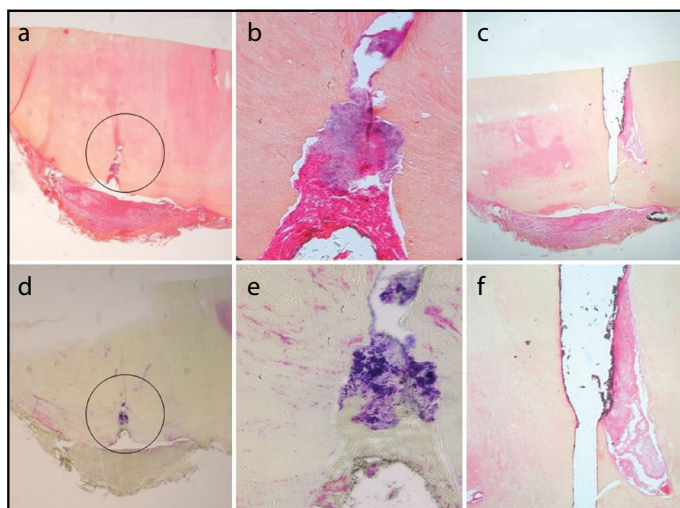


Figure 4. (a, b, c, d) Necrotic tissues and bacteria present in the apical area of the buccal canal (H&E stain, a=40×, b=400× and B&B stain, a=40×, b=400×). (e, f) Lingual canal: tissues in the main and lateral canal (H&E stain, e=40× and B&B stain, f=400×)

DISCUSSION

The differential diagnosis between a VRF and a failed endodontic treatment, or their combination, is a difficult task that may require a supplementary histological analysis in addition to the clinical data and the history of the affected tooth. Mandibular molars and maxillary premolars were found to have more VRF than any other tooth (10–11), and this could lead to an erroneous diagnosis of VRF instead of apical periodontitis. Often, VRF clinical signs and symptoms as well as radiographic features are similar to those associated with non-healing root canal treatments (4). The diagnosis of a VRF usually is confirmed by the observation of a fracture line, by elevation of an explorative surgical flap and a deep probing >5 mm (12), as standard radiographs have the disadvantage to be 2D images. Today, only three-dimensional cone beam computed tomography images can be used to distinguish the VRF with a

high degree of accuracy, but its use is not so widespread yet in all private dental clinics (13).

Owing to the non-restorability of the case showed in the present report, the hemisection of the affected mesial root followed by its extraction was suggested to allow the preservation of the remaining tooth structure and the maintenance of a severely compromised tooth (14). Functional pain when chewing or after percussion/pressure associated to a periapical radiolucency in an endodontically treated tooth has been considered a clinical evidence of apical periodontitis or root fracture or both (15). Interestingly, the histological procedures applied to the extracted mesial root of the present clinical case showed that apical periodontitis and VRF might coexist separately in the same root. The simultaneous coexistence of both clinical scenarios is mainly justified by the weakening of the coronal and radicular tooth structure, making it susceptible for the root fracture (16) and the apical anatomical challenge of the tooth involved, making it difficult to be cleaned.

Owing to the anatomical complexity of the root canal space (17), studies investigating the amount of bacteria remaining in the root canal after instrumentation have reported a poor debridement and an inadequate disinfection of the root canal system (18). Therefore, inadequate debridement and disinfection of the apical portion of the root resulted in the clinical signs and symptoms in addition to histological findings presented in this case, whereas, the coronal and middle thirds of the canal showed no evidence for micro-organisms. In fact, the histological findings of the present study have highlighted and confirmed the signs of VRF in the coronal third of the root, whereas signs of apical periodontitis predominated in the apical third of the root, thus demonstrating the coexistence of both pathologies in the same affected root.

CONCLUSION

Apical periodontitis and VRF coexisting in the same root represent a diagnostic challenge for the clinician that should be based on not only clinical and radiographic examinations but also, when it is possible, careful histological examination.

Disclosures

Conflict of interest: The authors declare that there is no conflict of interest.

Informed consent: Written informed consent was obtained from the patient for the publication of the case report and the accompanying images.

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