True vertical tooth root fracture: Case report and review

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Abstract
It is important for the clinician not only to gather as much information about a case as possible, but also to be able to correctly interpret the data to arrive at an accurate diagnosis. Occasionally, a case presents with symptoms that might be suggestive of a condition; however, the final diagnosis may be totally different. This paper reports on an interesting case of a true vertical root fracture, in an intact maxillary molar in a 55-year-old man. The case was misdiagnosed and treated as a periodontal defect for over two months. The paper discusses the various causes and diagnostic dilemmas of root fractures.

Keywords: Misdiagnosis; periodontal defects; vertical root fracture

Introduction
“The eyes fail to see what the mind doesn’t know.” Thus, for a clinician it is not only the accumulation and conglomeration of various signs and symptoms that are important, but also the association of those with the presenting symptoms and correct interpretation of the data available, to arrive at an accurate diagnosis. Correct diagnosis plays a pivotal role in the success of any treatment. Dental/oro facial pain being a very diverse phenomenon and involving interplay of various neuronal responses, requires a thorough knowledge of various etiological factors of pain to institute proper treatment. One of the not so common causes of dental pain is root fracture.

Root fractures in permanent teeth are either in the form of transverse intra-alveolar root fractures, generally seen in the anterior teeth, secondary to any trauma; or, vertical root fractures (VRF) which occur both in anterior as well as posterior teeth, secondary to traumatic occlusion or iatrogenic procedures. Most often VRF are encountered in endodontically treated teeth. However, it may occasionally occur in intact teeth as well. The prevalence of VRF in endodontically treated teeth is much higher than in non-endodontically treated, restored or intact teeth. In most cases of VRF associated with the non-endodontically treated teeth, the fractures are usually the apical extension of a fractured coronal superstructure. This can be in the form of a split tooth, secondary to traumatic occlusal forces or restorations, causing a wedging force extending apically to involve the roots. Few cases of true vertical fractures have also been reported in which the fractured tooth was intact without any restorative or endodontic intervention.

True VRF is defined as a longitudinal fracture confined to the root that usually initiates on the internal canal wall and extends outwards onto the root surface. We report here an interesting case of a true VRF in a 55-year-old man in whom, it was misdiagnosed as a case of local periodontal disease for over 2 months, till his pain became severe and characteristically presented with symptoms of acute pulpitis. The case is presented for its unusual presentation; the diagnostic challenges such root fractures pose; and, various causative and contributing factors associated with this clinical entity.

Case Report
A 55-year-old man reported to the department of dental surgery with the complaint of a severe, sharp shooting pain, which radiated to the temporal and the auricular region on the left side, in the upper left maxillary quadrant since the night before. Detailed history taking revealed that the patient had pain in the region for over 2 months. Initially the pain was of dull aching type, which increased on mastication. The pain gradually kept on increasing in intensity till it became very severe at night. The patient gave no history of trauma or any other dental intervention on the affected side. Patient’s dental records showed that he was being treated for the same complaint with a diagnosis of chronic periodontitis, which of course did not give him any relief in pain.

On clinical examination, all the teeth in the left posterior
quadrant appeared normal. Oral hygiene was satisfactory. Surprisingly, he had very little attrition and most of his posterior teeth had sharp and prominent cuspal inclines. Teeth #15 and 25 were showing 90° rotation. Tooth #26 was extremely tender, both, on percussion and on palpation. The tooth showed no carious involvement or restoration. His orthopantamograph revealed a hazy radiolucency on the cervical 1/3rd of the mesio-buccal root [Figure 1]. Considering the patient’s history, which was suggestive of acute pulpitis; severe tenderness on percussion and palpation in #26; and, radiographic finding of hazy radiolucency around Mesiobuccal (MB) root of #26, a clinical diagnosis of VRF was made. An intraoral periapical radiograph was advised for clarity, which confirmed the vertical split of mesio-buccal root of #26 [Figure 2]. The patient was informed about the treatment options; either extraction of the whole tooth or endodontic treatment of the tooth followed by extraction of the fractured MB root (radisection) and, final restoration with a full crown. The patient opted for the first treatment option as he had already suffered severe pain over a length of time and wanted quick and permanent relief from his pain.

Hence, extraction of #26 was done under local anesthesia, taking utmost care to prevent the displacement of the fragments. The whole tooth was extracted except the fractured mesial segment of the mesiobuccal root, which was carefully teased out of the socket [Figures 3-5]. Post extraction six weeks later, impressions were made for prosthodontic rehabilitation. The plaster model of upper arch is shown in Figure 6 to document rotated second premolars and relatively lesser attrition of cuspal inclines.

**Discussion**

Incomplete fractures of teeth, as a clinical entity, can pose a challenge to the diagnostic skills of an inexperienced clinician due to the varied clinical symptoms, and also because their symptoms often resemble those of periodontal disease conditions. Often, they manifest as diffuse oro-facial pain of long duration. Brynjulfsen et al. found that sometimes
the diagnosis of such teeth may be delayed for as long as a year and longer the duration, more diffuse is the pain. In the present case, the pain continued for over 2 months’ period, before it was diagnosed as an incomplete fracture involving the root.

Vertical root fractures are generally seen in teeth with either coronal restorations or in endodontically treated roots. They occur more often in older patients, which may be related to increased number of restorations and endodontic treatments with age, resulting in weakening of the tooth structure.[9,10] Also with ageing, due to high concentration of minerals, the teeth do get more brittle and may fracture when a high and sudden load is brought upon it.[11] It has been reported that mandibular molars account for 26.7% of all posterior tooth fractures.[12] Among the posterior teeth fractures in the mandibular arch, premolars account for 12%, while molars account for 88%; in the maxillary arch, both molars and premolars are reported to be equally susceptible to fractures (51 and 49%, respectively).

Causes of vertical root fractures associated with endodontically treated teeth are as follows:[2,3,10,11]
- Vigorous and injudicious instrumentation of narrow canals.
- Excessive force during obturation, specially lateral condensation.
- Wedging effects of endodontic posts.
- Corrosion and expansion of posts.
- Immediate full coverage crown not provided after root canal treatment.
- Pathologic fractures secondary to periodontal lesions.
- Abutment teeth with unfavorable forces.

Causes of vertical root fractures associated with coronal restorations are as follows:[2,10,13]
- Excessive removal of tooth structure during cavity preparation, causing weakening of the cusps.

The present case was found to be very interesting and unique, as it did not present with any commonly listed causes of root fractures, such as previous restorations or endodontic treatments. Such true VRFs in non-endodontically treated teeth have been reported earlier by Wei and Ju,[4] Yang et al.,[5] Yeh[6] and Chan et al.,[14] surprisingly, all in Chinese population. The exact cause of these fractures is still unknown,[15] though Yang et al.[5] suggested that these fracture might have been related to special diet pattern or chewing habits in Chinese people. Yeh[6] proposed that VRFs might result from an excessive, repetitive and heavy masticatory stress and referred to these fractures as ‘fatigue root fractures’. Cameron[9] postulated that such fractures in the posterior teeth could be due to the ‘nut cracker effect’. When the jaws are closed, the teeth that are close to the point of fulcrum i. e, nearer Temporomandibular joint (TMJ), would exert more forces as compared to those that were more anterior. Therefore, it is the posterior teeth, which bear the brunt of the increased occlusal forces. According to Chan et al.,[6] of all the vertical root fractures, 40% occurred in non-endodontically treated (intact) teeth, and of those, 84% were in molars. For endodontically treated teeth, the incidence of VRF in mandibular 1st molars was twice as much as maxillary 1st molars. Vertical root fractures are rare in non-endodontically treated anterior teeth. It was also found that the fractures occurred more often in thin, flat root, with smaller mesio-distal diameters such as in the mesio-buccal roots of maxillary molars (as in the reported case), and the mesial root of mandibular molars.

Grippo[16] suggested that there are many mechanical loading factors, which affect the teeth like the magnitude, frequency,
direction, location, and duration of forces. The stress induced on the tooth structure may therefore result in different patterns of fracture, depending also on the biologic or anatomical conditions of the crown, root, or the supporting bone. He proposed that for non-endodontically treated teeth, possibly excessive and repetitive masticatory force exerted vertically on attrited surfaces may concentrate the stresses at weaker apical areas. Cracks or fatigue may then initiate coronal propagation of this fracture.

These hypotheses combined explain the possible causes of VRF in the present case. Though, the patient was a 55-year-old man, his dentition showed minimal attrition and very steep cuspal inclines. Both his maxillary premolars were rotated. It is possible that due to rotated premolars, there was an uneven load distribution during mastication, resulting in excessive occlusal stresses on the maxillary first molars. Molars, being closer to TMJ, got subjected to heavy, repetitive occlusal forces, resulting in fatigue fracture of the thin ribbon shaped MB root. The fracture was found to be in the bucco-palatal plane dividing the MB root into mesial and distal segments.

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