CASE REPORT

Endodontic Management of Mandibular First Premolar with Type IV Root Canal: A Case Report

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Abstract

Thorough knowledge of the root canal morphology, appropriate assessment of the pulp chamber floor, and critical interpretation of radiographs are foundation for successful root canal therapy. Mandibular premolars have earned the reputation for having an aberrant anatomy, making them one of the most difficult teeth to manage endodontically. Therefore, clinician should be aware of the configuration of the pulp system as the incidence of having two roots in these teeth is quite rare. These two case reports present the clinical management of mandibular first premolar having two roots bifurcated at the mid-root level.

Keywords: Abnormal morphology, Mandibular first premolar, Root canal morphology, Root canal therapy.

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Introduction

The main objective of endodontic treatment is thorough cleaning and shaping of the canal followed by three-dimensional obturation of the root canal space together with fluid tight seal of the apical foramen. Therefore, a vital prerequisite for management to all or any dental procedure is to gain a clear understanding of the human tooth internal anatomy. Root canal splitting present within the middle and apical root canal sections may go unnoticed, is more difficult to manage, and may affect the cyclic fatigue of endodontic instruments.[1] Therefore, a clinician must be aware of the complexity and variations of the root canal system. Also, the knowledge and a spotlight to typical and atypical anatomy will be a critical factor in determining the success of endodontic therapy.

Slowey[2] has suggested that the mandibular premolars may present the great difficulty of all teeth to perform successful endodontic treatment. A study conducted in 1955 at the University of Washington assessed the failure rate of nonsurgical root canal treatment in all teeth;[3] according to it, the mandibular first premolar had the highest failure rate of 11.45%.[3,4] The incidence of having two or more root canals in the mandibular first premolar was reported to be as low as 2.7% and as high as 62.5%.[5]

Scott and Turner[6] described the accessory root of mandibular first premolar as Tome's root and observed ethnic differences in the root morphology. They found that the incidence of accessory roots in the Australian and sub-Saharan African populations was highest (>25%). Sert and Bayirli[7] reported sex differences in root canal morphology and reported higher incidence (44%) of accessory roots and canals in females as compared to males (34%).

The case reports describe the successful diagnosis and treatment of mandibular first premolar with a type V Vertucci's classification and type IV Weine's classification with the help of CBCT.

Case Descriptions

Case 1

A 52-year-old male patient reported to the department of conservative dentistry and endodontics with chief complaint of pain in the lower left back region since 1 week. Patient's medical history was noncontributory. Oral examination revealed distoproximal decay along with attrition in relation to #34. The tooth was tender on percussion. The buccal and lingual mucosa was normal. There was no intra or extraoral swelling/sinus present. The pulp sensibility test showed negative result. The periodontal health was normal. Radiographic examination (orthopantomogram) revealed distoproximal radiolucency approaching to pulp along with widening of the periodontal ligament space (Fig. 1). Also, periapical radiographic examination revealed there was a sudden disappearance of pulpal space radiolucency in middle third of the root (Fig. 2). Cone-beam computed tomography was performed for better understanding of the root morphology (Fig. 3). Based on clinical and radiographic evidences, a diagnosis of pulpal necrosis was made and root canal treatment was initiated.

The tooth was anaesthetized by using a 2% solution of lignocaine hydrochloride containing 1:80000 adrenaline, under rubber dam isolation. Access preparation was prepared using Endo Access bur (Dentsply Maillefer, Ballaigues, Switzerland) in the left mandibular first premolar and was modified by coronal flaring till the level of bifurcation with Gates Glidden drills. Careful manual exploration with the 10 K file was done and the working length was measured with the electronic apex locator and confirmed radiographically (Fig. 4).

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Fig. 1: Orthopantomogram shows distoproximal radiolucency (Case 1)

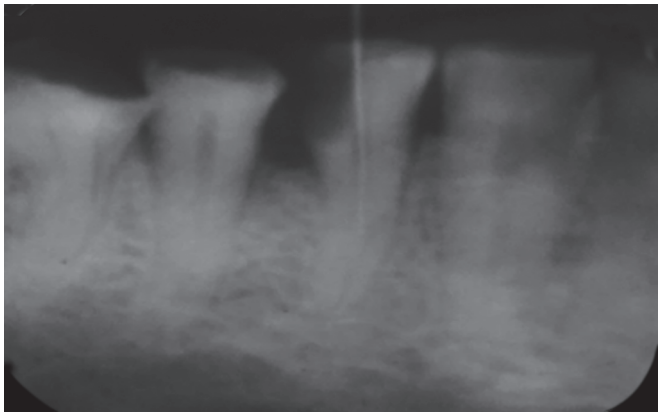


Fig. 2: Intraoral periapical radiograph of irt 34 (Case 1)

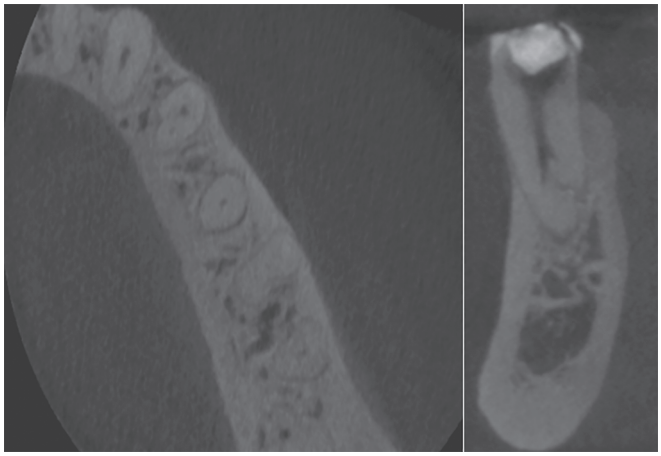


Fig. 3: Cone-beam computed tomography shows root morphology (Case 1)

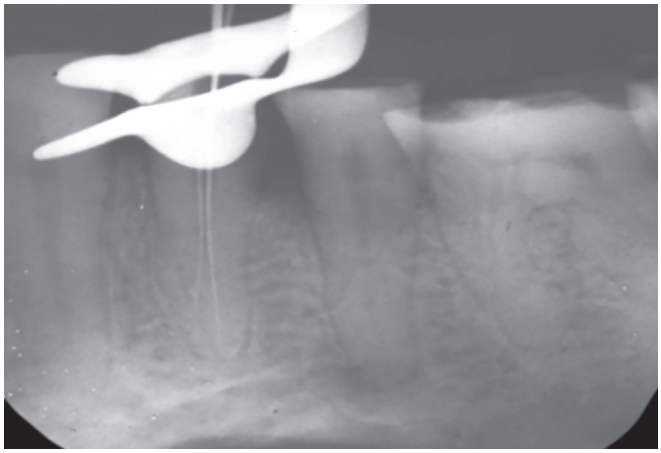


Fig. 4: Working length determination (Case 1)

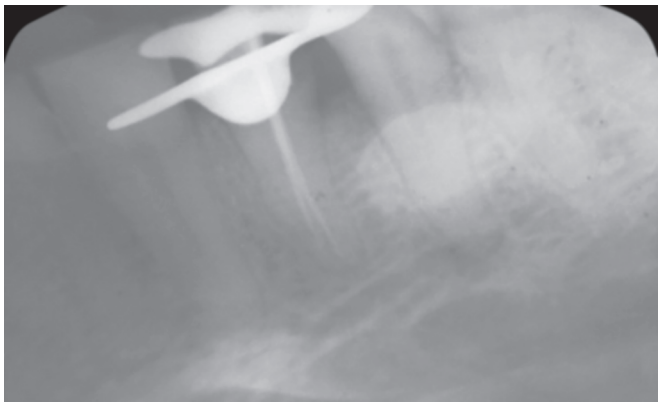


Fig. 5: Master cone radiograph (Case 1)

Both the canals were prepared using the hand K-file till no 20 followed by the Hyflex CM file (Coltene Endo) till 20.04. During biomechanical preparation, the canals were lubricated with glyde (Dentsply) and irrigation was done with the help of 2.5% NaOCl and saline. The calcium hydroxide dressing were placed in the canals for 1 week and temporary restoration was placed.

After 1 week, when patient was asymptomatic, canals were dried using paper points. The canals were coated with AH plus sealer and obturated to the level of bifurcation and rest of the canal was obturated with guttapercha with the warm vertical compaction technique and the tooth was then restored with composite resin (Figs 5 and 6).

Case 2

A 35-year-old male patient reported to the department of conservative dentistry and endodontics with chief complaint of pain in the lower left back region since 2 weeks. Patient's medical history was noncontributory. Oral examination revealed occlusal decay in relation to #34. The tooth was tender on percussion. The buccal and lingual mucosa was normal. There was no intra or extraoral swelling/sinus present. The patient was nonresponsive to the pulp sensibility test. The intraoral periapical radiograph revealed radiolucency involving pulp and root bifurcation in the middle third was seen along with periapical pathology (Fig. 7). The diagnosis of pulpal necrosis along with apical periodontitis was made and root canal treatment was initiated. Cone-beam computed tomography (Fig. 8) was performed for better understanding of the root morphology.

The tooth was anesthetized using a 2% solution of lignocaine hydrochloride containing 1:80000 adrenaline. Under rubber dam isolation, access preparation was prepared using Endo Access bur (Dentsply Maillefer, Ballaigues, Switzerland) in the left mandibular first premolar. It was modified by coronal flaring till the level of bifurcation. With the help of magnifying loupe and a sharp DG 16 explorer, the canal orifices were located. After obtaining the canal patency, a #10 K file (Dentsply, Maillefer) was precurved and inserted in a distolingual direction to traverse the canal bifurcation

into the second root. Working length (Fig. 9) was measured with the electronic apex locator and confirmed with radiograph. Both the canals were prepared using the hand K-file till no. 20 followed by the Hyflex CM file (Coltene Endo) till 25.04. During chemomechanical preparation, the canals were lubricated with glyde (Dentsply) and irrigated with 2.5% NaOCl and saline. The calcium hydroxide dressing was placed in the canals for 1 week and sealed with temporary restoration.

In the second appointment, the canals were coated with the AH plus sealer and obturated to the level of bifurcation. The rest of the canal was obturated with guttapercha in the lateral compaction and the tooth was restored with composite resin (Figs 10 and 11).

Discussion

Anatomical variations, such as extracanals and roots, should always be considered when treating teeth endodontically. To recognize the aberrant anatomy requires thorough knowledge of the root canal morphology, critical interpretation of the diagnostic aids, and appropriate assessment of the pulp chamber floor and most importantly the operative skills of the clinician. Peters et al.[8] reported that the original geometry of canal, before shaping and cleaning procedures, had more influence on the changes that occurred during preparation, than the instrumentation technique itself. The root canal morphology of the mandibular first premolar can be difficult to clean and shape.[9] Ingle[10] described the shape of the canal as ovoid at the cervical level, round or ovoid at the mid-root level, and round in the apical third. However, it is apparent that the root canal system of the mandibular first premolar is not regular in shape and that many variations can exist.

The case report presented here refers to the management of endodontic challenge of mandibular first premolar having two roots which are bifurcated at the mid-root level.

The root canals of teeth are complex and they may divide and rejoin, taking various pathways to the apex. Weine[11] categorized the root canal system into four basic types. Vertucci[5] in his studies found numerous complex root canal systems and identified eight pulp canal configurations. Slowey[2] has shown that when the root canal shadow suddenly stops in the radicular region on radiograph, bifurcation or trifurcation of the canal at that point should be suspected. Also, an additional root canal can be appreciated when the root outline is unclear or has an unusual contour, or when canal deviates from its normal appearance on radiograph. If two canals are present, direct access to the buccal canal is usually possible, whereas the lingual canal may be very difficult to find. The lingual canal usually tends to diverge from

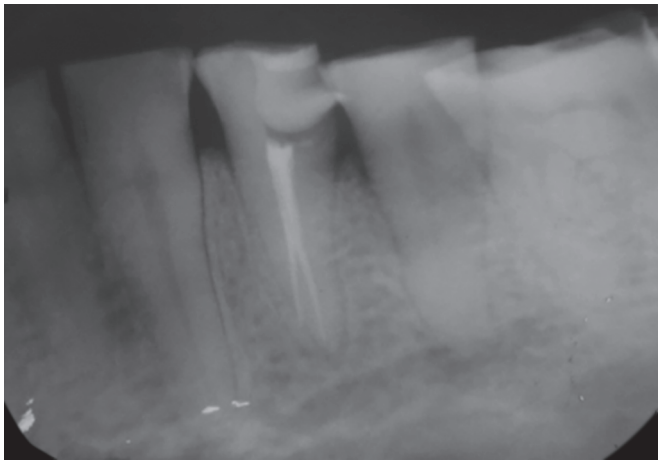


Fig. 6: Obturation (Case1)

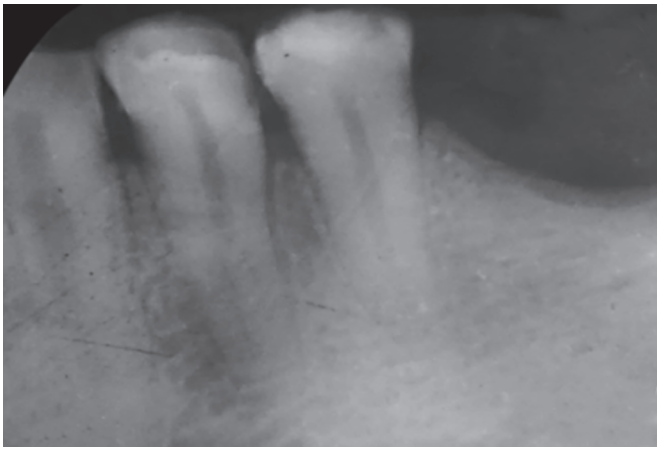
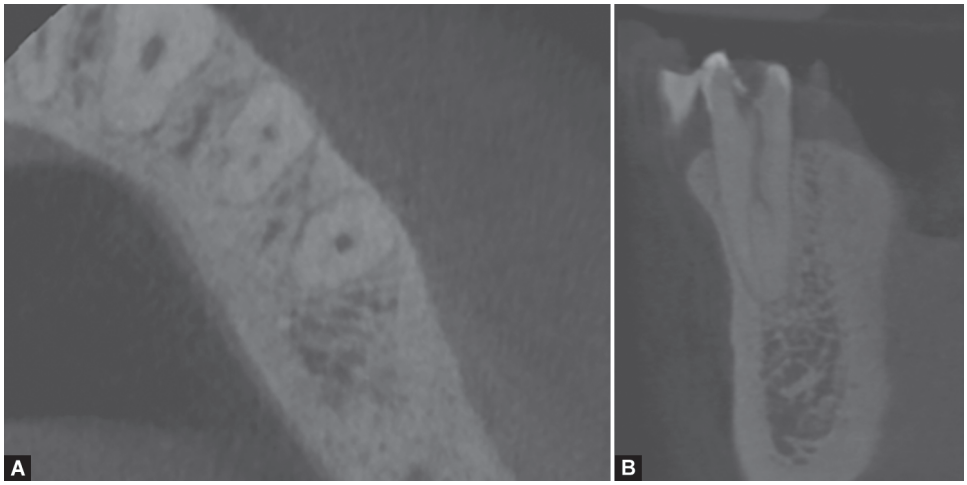


Fig. 7: Intraoral periapical radiograph of irt 34 (Case 2)



Figs 8A and B: Cone-beam computed tomography shows root morphology (Case 2)

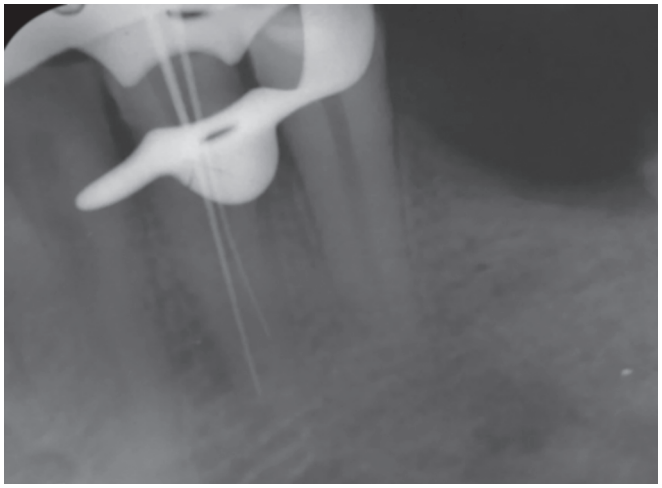


Fig. 9: Working length determination (Case 2)

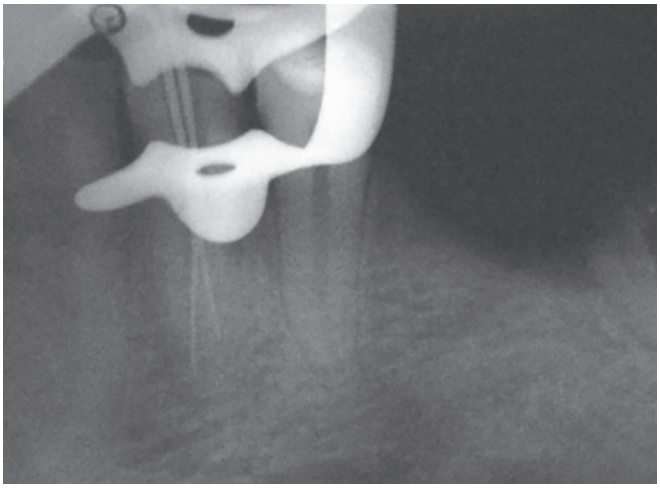


Fig. 10: Master cone radiograph (Case 2)

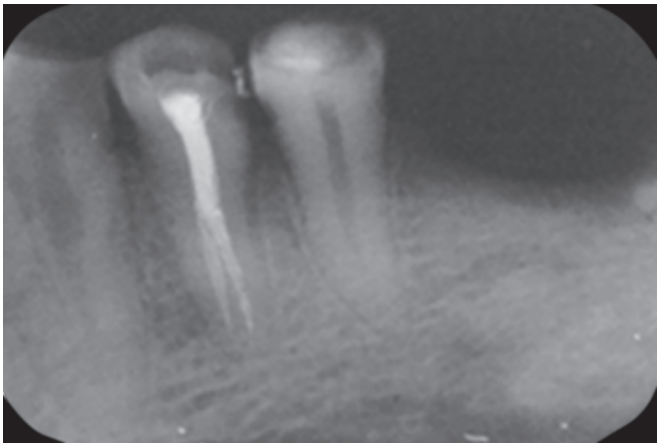


Fig. 11: Obturation (Case 2)

the main canal at a sharp angle more often. Also, the lingually inclined crown tends to direct files more buccally, making location of a lingual canal orifice difficult.[12]

The incidence of one root canal system varied from 69.3 to 86%; two canals, 14–25.5%; and three canals, 0.4–0.9%.[9] The incidence of two root canals varies between 14% and 25% for a Caucasian population.[13] The frequency seems to be somewhat higher for the Chinese at 34%.[14] Three root canals are encountered in less than 1%.[13]

Zillich and Dowson[15] in their study found 72 teeth (5.2%) showing two canals with the same apical foramen, and 243 teeth (17.5%) had two canals with separate foramina when seen radiographically. Thus, 315 of the teeth (22.7%) out of 1,393 would be clinically treated as having two canals. Khedmat et al.[16] investigated the root canal anatomy by both radiography and cross-sectional methods in an Iranian population. They used digital photographs to analyze the cross-sectional root surfaces, with the help of dental microscope (40×). Out of 217 teeth that were examined, single root canal was present in 192 (88.47%). Teeth with two canals in at least one cross-section of their roots with five root canal configurations were seen in remaining 25 teeth (11.53%). In the radiographs with horizontal direction, only 5.99% showed two canals with three root canal configurations. Atul Jain and Bahuguna[17] in 2011 conducted an *in vitro* study on root canal morphology of mandibular first premolar in a Gujarati population. Teeth were observed (after decalcification) under dental microscope at 12× magnification and root canal systems were identified according to Vertucci's Classification—type I canal system was found in 93 teeth (67.39%), type II in 11 teeth (7.97%,), type III in 5 teeth (3.62%), and type IV in 4 teeth (2.89%), type V in 24 teeth (17.39%), and type VI in 1 tooth (0.76%).

Sandhya et al.[18] studied the root canal morphology of mandibular first premolars in the Indian population with the help of spiral computed tomography. The study showed that 80% of the teeth had a single canal, 11% had two canals, and C-shaped canals were found in 2% of the teeth. A microcomputed tomography study of the root canal morphology of the mandibular first premolar in a population from southwestern China by Liu et al.[19] (2012) observed single apical foramen in 50.4 % of the samples and two or three foramina in 28.7 and 14.8%, respectively. Albuquerque[20] et al. in 2014 acknowledged that the mandibular first premolars being comparatively twice more likely to present with two canals (23.55%) than second premolars (12.64%).

Study by Velmurugan et al.[21] to determine the root canal morphology of mandibular first premolar teeth in an Indian population using a decalcification and clearing technique identified to have a round orifice (38%), oval orifice (44%), flattened orifice (17%), and C-shaped orifice (1%). The canal patterns, according to Vertucci's classification, are type I (72%), type II (6%), type III (3%), type IV (10%), and type V (8%).

Various diagnostic tools such as multiple radiographs, careful examination of the pulpal floor with a sharp explorer, and better visualization using an dental operating microscope are all important aids in detecting additional root canals. To obtain the predictable results, good-quality preoperative radiographs should be obtained at different angulations and then carefully evaluated to detect the presence of extra root canal. At the present time, CBCT imaging has gained a lot of attention to the clinician and its use in confirmatory diagnosis of morphologic aberrations in the endodontic field is commonly appreciated.

Therefore, thorough knowledge of root canal anatomy and its variations, careful interpretation of the radiographs, close clinical inspection of the floor of the chamber, and proper modification of access opening along with adequate magnification are essential for successful root canal treatment outcome.

Conclusion

This case report emphasizes on the importance of thorough knowledge of the internal root canal anatomy and execution of the modified techniques by the clinician before and during treatment to prevent their subsequent flare up. Advanced equipment, for example, dental operating microscope, NiTi file systems, ultrasonics, newer obturating system, etc., contribute to successful endodontic treatment. Aberrant anatomical variation if misdiagnosed leads to failure and if diagnosed correctly leads to successful treatment.

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