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Cover Page Footnote

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CASE REPORT

Endodontic Management of Mandibular First Molar with Four Roots - A Rare Case Report with Clinical Management Guidelines

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ABSTRACT

Mandibular molar is usually two rooted with one mesial and one distal root. Additional roots are rare which requires accurate diagnosis and a methodical and scrupulous endodontic treatment. **Objective:** This paper aims to report the endodontic management of an unusual case of a mandibular permanent first molar with four roots (two mesial & two distal) and provide a clinical guideline to detect and manage these variant cases. **Case report:** A 15-year-old boy reported with a deep carious lesion in the lower left first molar (#36). The apical root contour of #36 on an intraoral periapical radiograph taken in different angulations suggested the presence of extra roots. A Spiral Computed Tomographic scan with multiplanar three-dimensional reconstructed images confirmed a four-rooted mandibular molar. Endodontic treatment of #36 was planned based on a diagnosis of pulpal necrosis with symptomatic apical periodontitis. The pulp chamber floor was assiduously explored along the developmental root fusion line (DRFL) to guide a trapezoidal access cavity and expose two mesial and two distal orifices. **Conclusion:** The present case report highlights the successful endodontic treatment of an atypical four rooted mandibular first molar by following a systematic approach from diagnosis to its clinical management.

Key words: computed tomography, mandibular first molar, root canal anatomy, root canal treatment

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INTRODUCTION

Teeth with untreated canals harbours the bacterial aetiology and are often the cause of failure of root canal treatment. An understanding and anticipation of the uncommon morphology allows clinicians to negotiate and chemo-mechanically debride the entire root canal complex and significantly influence the success of the endodontic treatment. Mandibular molars are usually two rooted with one mesial and one distal root.[1] An anatomic variation, first mentioned in the literature by Carabelli (1844), is an additional third root. The nomenclature of radix entomolaris and radix paramolaris refers to supplemental roots located distolingually and mesiobuccally, respectively.[2] This variation is well accounted for in the literature, and the majority of publications report anomalous three rooted first molars.[3,4]

The presence of four roots in a mandibular first molar is a rare variation, and very few cases have been reported in the literature.[5,16] In an in vitro study, Morita et al.[6] examined 2,164 extracted mandibular first molars of the Japanese population. They only found a single four-rooted first molar representing a prevalence of 0.04%. Ahmed et al.[7] studied the variations in root canal systems of first and second molar in the Sudanese population and did not detect a single case of a mandibular first molar with four roots. Hemant Ramesh Chourasia et al.[8] examined the root canal morphology of permanent mandibular first molars in an Indian population and reported the prevalence of three rooted mandibular first molars to be 5.3%. However, no four rooted first molar was reported in the study. A significant number of population-based studies on different races and ethnicity of roots and pulpal anatomy did not report a single case of four rooted first molars in their sample population.[9-11]

The first step in predictable endodontic treatment warrants an accurate diagnosis of the rare morphology of four rooted mandibular first molar. The conventional

radiography images produce anatomical noise due to the superimposition of three-dimensional structure in a two-dimensional image. Additional roots and canals superimposed in a buccolingual plane may not be identified on a conventional dental radiograph. The Dental CT or Dentascan, developed by Schwartz et al., is a significant advancement in dental radiography. The Dentascan software programme can be incorporated with Spiral CT and allows visualisation of dental anatomy in a multiplanar or three-dimensional reconstruction. The integration of Computed tomography in endodontics allows an accurate discernment and diagnosis of even complex anatomic morphology.[12]

The presence of supplemental roots and pulp canal has implications in the endodontic treatment of the tooth. An informed approach towards the access cavity design, locating the root canal orifices, and biomechanically cleaning the root canal system can prevent procedural mishaps and complications. This paper highlights the endodontic management of an atypical case of four rooted permanent mandibular first molar (two mesial and two distal roots) diagnosed with the aid of spiral computed tomography integrated with Dentascan software.

CASE REPORT

A 15-year-old boy reported to the Department of Conservative Dentistry & Endodontics with the chief complaint of pain in the lower left back region of mouth since two weeks. Clinical examination revealed the presence of decayed left mandibular first molar (#36). Tooth #36 was tender on vertical percussion. The mobility of #36 was within the physiologic limit, and cold and electric pulp testing elicited a negative response. Evaluation of intraoral periapical radiographs showed double lining of the periodontal ligament, suggesting accessory root. A 30° mesial angulation intra-oral periapical radiograph (IOPA) reinforced the possibility of two extra roots as the apical contour of the mesial and distal root diverged into two separate termini (Figure 1). Three-dimensional imaging by Spiral Computed Tomographic scan (CT Face 3-D; Siemens Germany 16 slices multidetector; Somatom Scope) was decided upon to ascertain the accessory roots and determine the root canal configuration. Scan images of the patient confirmed the Type 1 root canal configuration present in each of the four roots (Figure 2). Based on the clinical and radiographic assessment, a diagnosis of pulpal necrosis with symptomatic apical periodontitis was made, and endodontic treatment was planned.

Following administration of local anaesthesia, the access cavity was prepared as a conventional triangular outline form. Three orifices corresponding to Mesiobuccal Root (MBR), Mesiolingual Root (MLR),

Figure 1. A 30° mesial angulation intra-oral periapical radiograph (IOPA) revealed the apical contour of mesial and distal roots diverging into two separate termini suggesting the presence of two supplemental roots. (Indicated by the blue arrows)

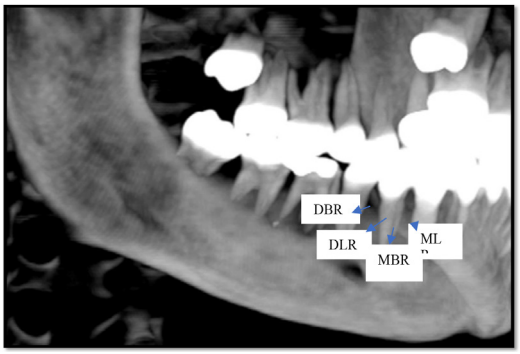

Figure 2. Spiral Computed Tomography image reconstructed by Dentascan software confirmed the presence of four rooted mandibular first molar

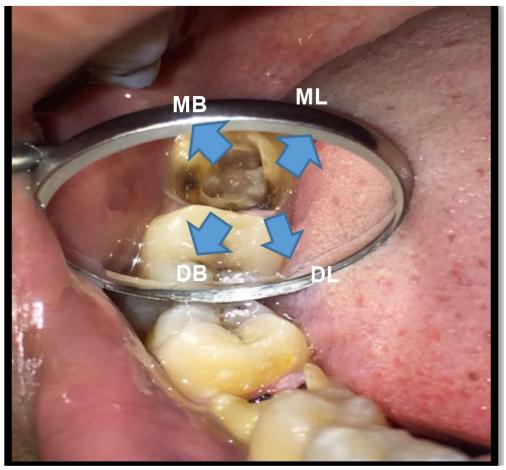

Figure 3. Pulp chamber floor showing four orifices corresponding to four roots

and Distobuccal root (DBR) roots were detected. Visual examination of the pulp chamber floor indicated unique pattern of developmental root fusion lines forming X configuration. Start x ultrasonic tips (Dentsply Maillefer, Ballaigues Switzerland) was utilised for

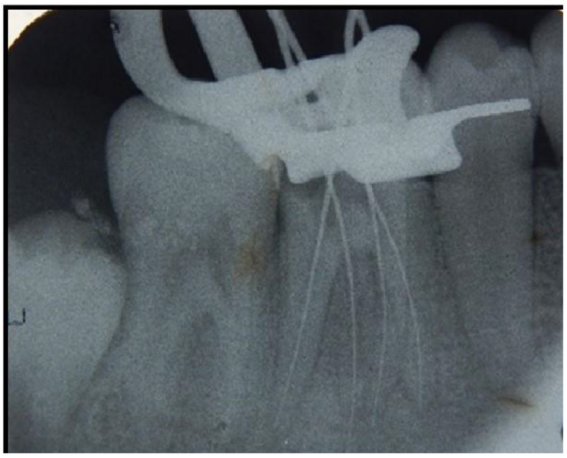

Figure 4. Working length radiograph illustrating the files placed in four distinct roots

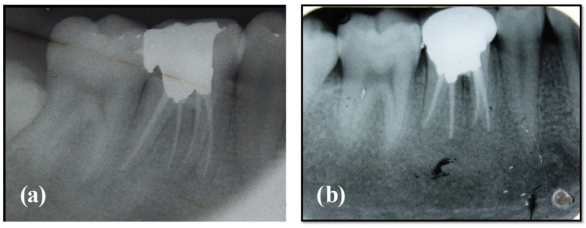

Figure 5. (a) Immediate post obturation radiograph **(b)** A two year follow up radiograph

controlled extension of the access cavity to expose the distolingually located Distolingual (DLR) root canal orifice (Figure 3). All the orifices were found to be at the terminus of developmental root fusion line.

The entrance to the root canal orifice of the supplementary (DLR) was blocked by calcification. Troughing the entrance of the root canal orifice was done with ultrasonic tips, which helped to negotiate the calcific blockage and gain access to the DL root canal.All the root canals were then negotiated with a 10 Kfile (Mani Inc, Tokyo, Japan) and working length was determined by an electronic apex locator (Root ZX, Morita, Tokyo, Japan) and confirmed radiographically (Figure 4). The manual glide path preparation with 10 K-file was followed by biomechanical preparation of the root canals by a crown down technique using Pro-Taper gold rotary files (Dentsply Maillefer, Switzerland). The canals were sequentially irrigated using 2.5% Sodium hypochlorite and 17% EDTA during the cleaning and shaping procedure. A calcium hydroxide intracanal medicament was placed, the access cavity was sealed with a temporary restoration (Cavit G, 3M ESPE, Germany) and the patient was recalled after one week. In the subsequent appointment, the patient was asymptomatic. The canals were dried with paper points (Protaper Universal Paper points, Dentsply, Maillefer, Switzerland) and obturated with F2 Pro Taper Guttapercha and AH Plus sealer (Dentsply, Maillefer, Switzerland) (Figure 5a). The postendodontic permanent restoration was completed, and a full coverage porcelain jacket crown was subsequently placed. The patient was found to be asymptomatic on follow-up visits (Figure 5b).

DISCUSSION

Four rooted mandibular first molar is a rare occurrence with a reported incidence of 0.04%.[6] The variable anatomical configurations of the two supplemental roots further complicates its identification and diagnosis.

Friedman et al.[13] and Lee et al.[14] reported four rooted mandibular first molar with three distal and one mesial root, while Purra et al.[15] described a mandibular second molar with three mesial and one distal root. Kottoor et al.[16] diagnosed a mandibular first molar with two mesial and two distal roots using multiple angulated intraoral periapical radiographs. They also proposed a visual guide of the Developmental Root Fusion Line in the pulp chamber as a cue to suspect a four-rooted mandibular first molar. While conventional radiography in multiple angulations and Developmental Root Fusion Line offer important diagnostic information, the introduction of computed tomography enables visualisation of the anatomy in three dimensional planes and confirms the diagnosis.

In the present case, an intraoral periapical radiograph taken in multiple angulated views revealed a double periodontal ligament and an apical root contour suggestive of extra roots. The roots and the pulp canal anatomy overlying in a buccolingual plane can be obfuscated in two-dimensional radiography, and the three-dimensional computed tomography images can overcome this limitation. A decision to clarify the anatomy by computed tomography was taken considering the unusual radiographic presentation.

However availability of dedicated dental Cone Beam Computed Tomography can be limited in semi-urban locations like in our case, Spiral CT available in hospital setup integrated with Dentascan software can help us obtain three-dimensional scan images to diagnose complex root configuration and its internal canal anatomy. The Computed tomography images disclosed a four-rooted mandibular first molar, with two mesial and two distal roots and Type 1 root canal configuration.

Mesiobuccal and mesiolingual roots were fused in the coronal two-thirds and bifurcated into separate MB and ML roots in the apical third. In contrast, the DB and DL root originated as separate roots and flared out from each other further apically. The DL root had a

Figure 6. A diagrammatic representation of first molar showing morphology of four roots

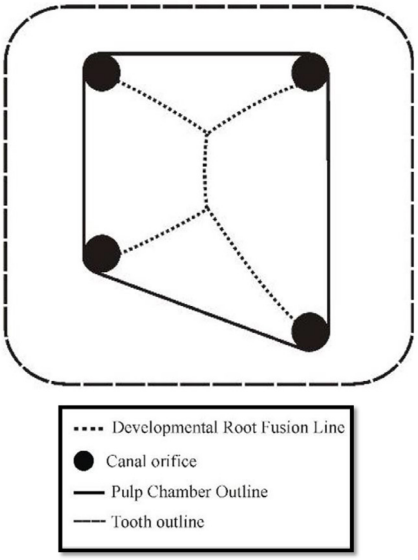

Figure 7. Diagrammatic representation of the pulp chamber floor depicting unique pattern of developmental root fusion lines and the location of all root canal orifices

buccolingual curvature in the apical third, which could be appreciated in the spiral CT images. A diagrammatic representation of first molar was done to better explain the morphology of four roots (Figure 6).

A limitation of spiral CT can be its increased radiation exposure compared to the Cone Beam Computed Tomography scan images. However, the availability of dedicated dental Cone Beam Computed Tomography can be limited in semi-urban locations. Spiral CT available in hospital setup can be integrated with Dentascan software to obtain three dimensional images for clarifying complex root and pulp canal configuration.

Visual inspection of the Developmental Root Fusion Line (DRFL) in the floor of the pulp chamber guides the extension of pulp chamber and also provides diagnostic clues of the root anatomy. Kottoor et al.[15] described the DRFL in the pulp chamber of a four rooted mandibular molar with four roots (two mesial and two distal) as an X configuration and suggested it as a diagnostic predictor of four rooted mandibular molar. This case report found a similar configuration and confirms the findings of Kottoor et al. A diagrammatic representation of the pulp chamber floor shows the location of canal orifices in the present case (Figure 7). All the orifices were at the terminus of developmental root fusion line (DRFL) and formed a trapezoidal configuration. The mesial orifices formed the shorter side while the distal orifice formed the longer side of the trapezoid due to the distolingual root orifice's asymmetrical displacement towards the distolingual corner.

The utilisation of magnification and straight and angled endodontic explorers are useful tools to locate the canal orifices. Start X ultrasonic tips were utilised for a controlled extension of the access cavity and to trough the calcification overlying the root canal orifices. Supplemental roots often have curvatures, especially in the apical third, and can cause procedural aberrations during biomechanical instrumentation. The creation of a manual glide path was followed by biomechanical instrumentation with flexible heat-treated rotary files in the present case for a centered root canal preparation and to avoid procedural errors.

Clinical approach while dealing with extra roots and canals

Awareness and diagnosis of unusual morphology like extra roots helps avoid complications like missed canal and is critical for a successful treatment outcome. Intra oral periapical radiographs are two dimensional images and additional roots superimposed in the buccolingual plane may not be identified. Radiographs exposed at more mesial or distal angle ($20\text{-}30^0$) may be utilised to expose the contour of the extra roots but a three-dimensional Computed Tomography is the gold standard examination to unequivocally diagnose a complex anatomy. Clinical inspection of tooth crown and analysis of cervical morphology by means of periodontal probing can facilitate detection of additional roots. Sometimes presence of extra cusp or cervical prominence or convexity can reveal the possibility of extra roots.

An X shaped Developmental Root Fusion Line as described by Kottoor et al. can be a diagnostic marker

to suscept a four rooted mandibular molar.The map of the developmental fusion line on the pulp chamber floor guides the access cavity design from a triangular to a rectangular or trapezoidal form and helps locate the supplemental roots and canals.The entrance to the root canal orifice of the supplementary roots may be constricted or blocked by calcification. Troughing the entrance of the root canal orifice with ultrasonic tips under magnification will help negotiate the calcific blockage and gain access to the root canal system. After location of all the canal orifices, the initial root canal scouting and negotiation should be done with small sized K files (size 10 or less) with gentle tactile advancement to its apical end. The initial file should be visually inspected as it may provide an insight of the canal curvature. The supplementary roots may have severe root curvatures especially in its apical third. A reproducible glide path should be established and files progressed sequentially to avoid any procedural errors.

The preparation of a glide path followed by biomechanical preparation with a heat treated rotary Ni-Ti files will lead to a centred root canal preparation and decrease the possibility of ledge formation, zipping and transportation of canals in supplemental roots with sharp curvatures.

CONCLUSION

Clinicians can encounter variations in the endodontic anatomy and must familiarise and anticipate its occurrence. The present case report highlights the successful endodontic treatment of an atypical four rooted mandibular first molar by following a systematic approach from diagnosis to its clinical management. Careful analysis of preoperative radiographs in different angulations supplemented with three-dimensional scan images, modification of access cavity outline dictated by the dentinal map guide of the pulp chamber floor and an informed clinical approach to negotiate the root canal curvatures can be attributed for the successful endodontic treatment outcome.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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