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A Permanent Mandibular First Molar with Eleven root canal system diagnosed with Cone Beam Computerized Tomography

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ABSTRACT The aim of this case report is to project the use of advanced imaging techniques in the success of complex root and root canal anatomies which cannot be elicited by two dimensional radiographs. Eleven canals were found in both mesial, distal and with the extra root on the lingual aspect of right mandibular first molar. Additional canals were found in all the roots. The location of the canal orifice was along the mesiopulpal line angle, linguopulpal line angle and distopulpal line angel of the pulp chamber. With this report, it can be concluded that there are occurrences of bizarre entities both in structure and number. These entities if left undiagnosed, may lead to failure of the treatment for sure.

KEYWORDS : CBCT, Radix, Multiple Canals

Introduction:

Hess &Zurcher have demonstrated anatomic complexities of the root canal system. It was established that a root with a tapering canal and a single foramen is the exception rather than the rule.6Hess (1925) announced wide variation and complexity of the root canal system and Weine (1969) 40 years later made the first clinical classification of more than one root canal in a single root teeth.6Weine categorized the root canal systems in any root into four basic types. Vertucci et al. utilized clearing technique which had their pulp cavities stained with haematoxylin dye, found a much more complex canal system and identified 11 types of radicular pulp space configurations.4

Aim:

This case report aims to determine the orifice location and root canal morphology in human permanent mandibular first molar.The primary objective of endodontic therapy is thorough mechanical and chemical debridement of the entire pulp space followed by a three dimensional obturation with an inert obturating material.6 Unusual canal anatomy associated with the mandibular first molar has been reported in several studies. The inability to identify additional root canals is one of the main causes for endodontic treatment failure.2 Therefore the clinician must be on the lookout for extra canals/roots and managing them successful for endodontic treatment. It is important to examine the floor of the pulp chamber as it is like a road map to detect the presence of extra root canal orifice.2 The middle mesial (MM) canal is usually present in the developmental groove between the mesiobuccal (MB) and mesiolingual (ML) canals.9 In vivo methods include clinical treatment of a tooth followed by radiographic evaluation of the root canal anatomy.10In vitro methods include the demineralization and clearing technique and subsequent injection of dyes to study the root canal morphology. Contrasting media (Hypaque) has been used to evaluate the morphology.10 It has been suggested that although various techniques have been used to evaluate root canal morphology, the most detailed information is obtained by demineralization and staining, which is excellent for three dimensional evaluation of root canal morphology.2 Microcomputerized tomography, Cone beam Tomography and Spiral computed tomography have been introduced for endodontic research and have proved to be an invaluable, non-destructive means for examining the shape and morphology of root canal systems.3 With advances in the hardware and imaging software, the resolution of micro-CT has been improved: a 3D model of a root can now be reconstructed allowing qualitative and quantitative examination of the pulpal space.3 This study reports the successful non-surgical endodontic management of Permanent mandibular first molar with eleven root canals, all distributed along the line angles of mesial, distal and buccal aspect.

Case Presentation:

A 37-year-old male patient with a non contributory medical history reported to our department with discomfort and pain in the right mandibular back region. History of present illness showed that there were few episodes of recurrent pain in that region for the past 1 year. There was a large carious lesion in relation to right mandibular first molar with pain on purcussion. Pulp testing with cold and electric pulse tester (EPT) was nonresponsive. Intra oral periapical (IOPA) radiograph revealed radiolucency around the periapex of right mandibular first molar with varied anatomy of the radicular portion suggestive of Radix paraentomolaris that is mandibular molar with four roots as seen in Figure 1.

Figure 1

Diagnosis was made as symptomatic apical periodontitis. Treatment plan was explained to the patient and endodontic treatment was initiated under rubber dam isolation. Seeing the radicular portion presence of extra canals was depicted. Under magnification, it was evident that there are more than three canals. On exploration with DG-16, there was a "catch" or a "stick" feeling all along the mesial, buccal and distal portion of access cavity. As examined clinically it was evident that there are a series of pin point sized orifices spread along the mesial, buccal and lingual line angles. The orifices were enlarged using Vortex Orifice Openers (Densply Tulsa Dental) to enhance access and visualization. To compute the

exact number of canals Cone Beam Tomography was done with the same tooth. Figure 2 shows multiple canals which were numbered from 1-11 seen in Figure 3.

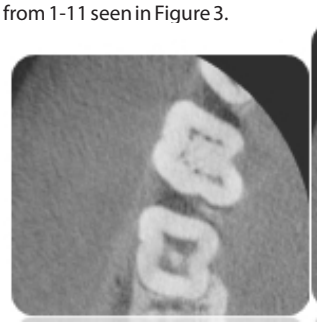

Figure 2

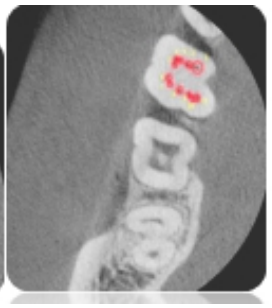

Figure 3

On examining the mesial aspect of the tooth, it could be elicited that there are five orifices starting from mesiopulpolingual point angle, extending along the mesiopulpal line angle towards the mesiopulpobuccal point angle and terminating near the same (Figure 2). To confirm the working length expecting the tortuous anatomy mesial and distal portions were dealt separately. It was observed that there were six canals, the orifices of which started from the distobuccopulpal point angle along the distopulpal line angle and terminating at the distolinguopulpal line angle. These are numbered as 1to 11 in the same sequence combining the mesial and distal aspects. CBCT image confirmed the presence of multiple canal orifices. This was followed by intracanal irrigation with chlorhexidine (Asep-RC, Anabond Stedman). Cleaning and shaping was done upto file size number 25K (Dentsply Maillefer). Obturation was performed at the third appointment using gutta-percha and AH-26 (Dentsply Maillefer) as a root canal sealer.

Discussion:

As reported by Tripathi et.al., four rooted first molar is a rare developmental anomaly. Radixentomolaris means an extra root on the distolingual aspect and radixparamolaris means an extra root on the mesiobuccal aspect; a tooth with a combination of both the two anomalies is termed as radix paraentomolaris.10Such case has extremely high probabilities of having multiple canals and complex anatomies. Krasner and Rankow in a study of 500 pulp chambers determined that the cementoenamel junction was the most important anatomic landmark for determining the location of pulp chambers and root canal orifices.9 The relationships expressed in these rules are particularly helpful in locating calcified canal orifices.

These rules are:

1. 'Rule of symmetry

- Except for maxillary molars, the orifices of the canals are equidistant from a line drawn in a mesiodistal direction through the pulp chamber floor.'

2. 'Rule of symmetry

- Except for maxillary molars, the orifices of the canals lie on a line perpendicular to a line drawn in a mesiodistal direction across the centre of the floor of the pulp chamber.

3. 'Rule of color change:

- The color of the pulp chamber floor is always darker than the walls.'

4. 'Rule of orifices location

- The orifices of the root canals are always located at the junction of the walls and the floor.'

- The orifices of the root canals are located at the angles in the floor–wall junction.'

- The orifices of the root canals are located at the terminus of the root developmental fusion lines.'

Following the same concept and elaborating the CBCT image in figure 2 first the orifices were numbered and then the nomenclature of the canals is termed as:

SUPRATIM'S CANAL NOMENCLATURE and done as follows:
Canal numbered 1- Mesiolingual (ML),
Canal numbered 2- Middlemesial 1 (MM1),
Canal numbered 3- Middlemesial 2 (MM2),
Canal numbered 4- Mesiobuccal 1 (MB1),
Canal numbered 5- Mesiobuccal 2 (MB2),
Canal numbered 6- Distobuccal 1 (DB1),
Canal numbered 7- Distobuccal 2 (DB2),
Canal numbered 8- Middledistal 1 (MD1),
Canal numbered 9- Middledistal 2 (MD2),
Canal numbered 10- Distolingual 1 (DL1),
Canal numbered 11- Distolingual 2 (Dl2)

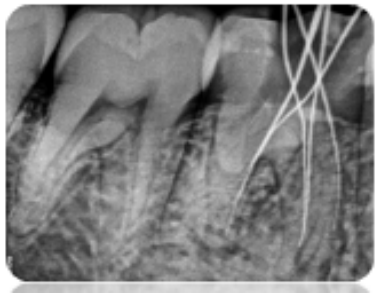

Figure 4

As can be seen in figure 4 Mesiolingual (ML) canal has the type I configuration while Middle Mesial (MM1,MM2) and Mesiobuccal (MB1,MB2) are in type II configuration. Describing the distal aspect in figure 5, the configuration of the canals goes like this, Distobuccal(1,2) and Middledistal(1,2) are in type II configuration.

Figure 5

Canal anatomy with distolingual root is of the variance that has not been reported till date. It has four orifices at the pulpal floor which combines at the junction of middle and cervical third of the root into two and with proceeding apically merges into one, making it 4:2:1. This makes a modification in Gulabiwalala's classification of type 11(figure 6).

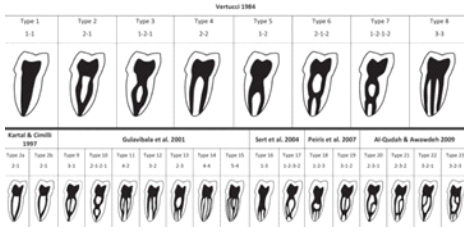

Figure 6

This configuration is of 4-2-1 type rather than just being 4-2.2 Several studies revealed that the majority of these teeth had three roots, but some articles reported four or five roots with a corresponding number of root canals.1Inability to find and properly treat the root canals may cause failures.

Obturation of this tooth requires high precession and in this case the canals were obturated with 2% conventional Gutta Percha (Dentsply Maillefer, India).

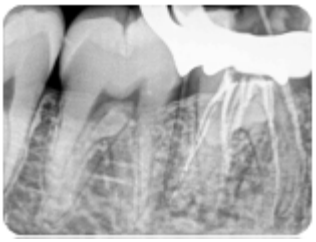

Figure 7

Although the incidence of root and canal variations is rare, dental practitioners must make every effort to find and treat all canals for successful clinical results.

Conclusion:

This case depicts that there is such complex anatomy of the root canal system that if one has this notion of procuring the best treatment outcome one should be looking forward for the variance and should undoubtedly seek the help of advanced imaging techniques. The amount of information gained from conventional radiographs and digitally captured periapical radiographs is limited by the fact that the three-dimensional anatomy of the area being radiographed is compressed into a two-dimensional image.2Newer diagnostic methods such as computerized axialtomography (CT) scanning greatly facilitate access to the internal root canal morphology. Hannsfield devised the computerized axial tomography during the 1970s. CT is an X-ray imaging technique that produces 3D images of an object by using a series of two-dimensional (2D) set of image data to mathematically reconstruct a cross-section of it.7One distinct advantage of CT scanning over the conventional radiograph is that it allows the operator to look at multiple slices of tooth roots and their root canal systems.5

Thus, CBCT scanning was pivotal in the diagnosis of this unusual root canal system and towards its successful endodontic management.8

Consent Disclaimer:

As per international standard or university standard written patient consent has been collected and preserved by the authors.

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