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## Review Article

# Variable morphology of Mandibular First Molar roots and canals:

## A Literature Review

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### ABSTRACT

A precise knowledge of the anatomical characteristics of the various types of human teeth and their possible morphological variations is considered one of the fundamental elements for a successful treatment in various subjects of dentistry especially in endodontic. Studies revealed that improper exploration of all canals of an endodontically treated tooth for subsequent disinfection and obturation may result in failure of the endodontic therapy. Over the years, there have been numerous researches and studies that described the morphology of all teeth including mandibular first molar. The root canals of permanent mandibular first molar in human dentitions exhibit extensive anatomical variations and abnormalities in its number and configuration. Profound understanding and thorough knowledge of both normal and abnormal anatomy considered as a critical factor in determining the success of endodontic therapy. The endodontic treatment of multi-rooted teeth was always a challenging task for dental practitioners. Therefore, a successful endodontic therapy should be always combined by a thorough knowledge as well as the use of specialized and innovated techniques for diagnosis, debridement and obturation. The current review article attempts to list out all the variations of permanent mandibular first molar root canal number in more than thirty studies and case reports published so far.

**Keywords:** Root canal, Root canal morphology, Mandibular first molar

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### Literature Review

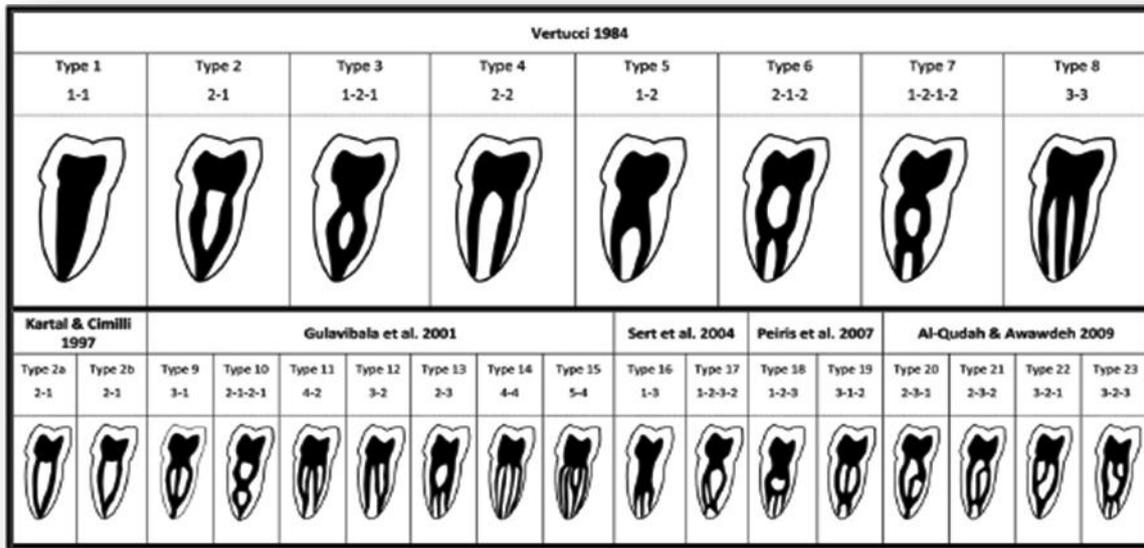
The mandibular first molar is the first permanent tooth to erupt in the oral cavity followed by maxillary first molars, and frequently requires root canal treatment <sup>(1)</sup>. This tooth usually exhibit considerable anatomical variation and abnormalities regarding the number of roots and root canals <sup>(2, 3)</sup>. The mandibular first molar typically presents with two well-defined roots, a mesial root characterized by a flattened mesio-distal surface and widened bucco-lingual surface, and a distal root mostly straight with a wide oval canal or two round canals <sup>(4,5)</sup>.

In 1925, Hess published a study on root canals morphology of all permanent teeth and concluded that

4% of mandibular first and second molars had four canals, 78% had three canals, and 18% had two canals. The most common root canal morphology of this tooth is the presence of two canals in the mesial root and one or two canals in the distal root <sup>(6)</sup>. However, the variations in the number and morphology of the roots and root canals were stated in numerous studies and case reports <sup>(7,8,9)</sup>.

In a review of the literature performed by De Pablo et al in 2010, the vast majority of teeth studies was with two roots and three or four canals. The percentage was as follow, 61.3% for the three canals configuration, 35.7% for the four canals, and 1% for the five canals in the total number of cases. In the previous study it was difficult to detect a single sample with six root canal among 18, 781 teeth from in vivo and in vitro studies <sup>(10)</sup>.

The mid-mesial canal (MMC), which was first described by Vertucci and William in 1974, can be found independent with a separate foramen or it may have a separate canal orifice and then join apically with either the mesio-buccal or mesio-lingual canal. The presence of middle mesial canal accounts for 1-15% of cases <sup>(11)</sup>. Similar findings were reported and the results reached to 14.8% <sup>(12)</sup>. While another study found that only 2.3% of the total cases studied in their review have three canals on the mesial root <sup>(10)</sup> (Figure 1).



**Figure 1:** Mandibular first molar: root canal configuration according to Vertucci classification 1984.

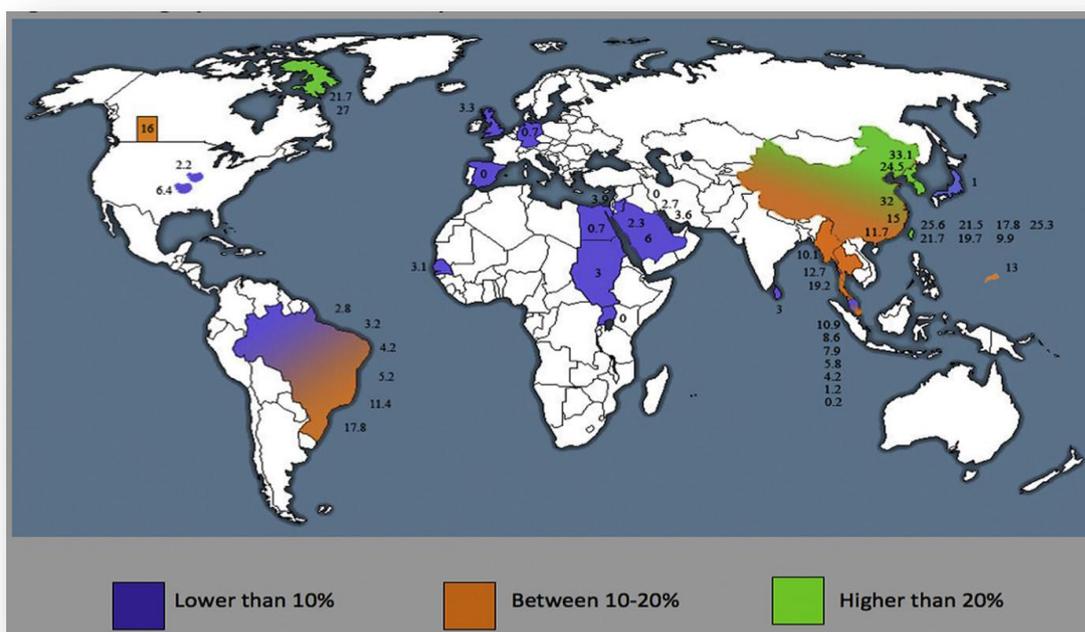
For the first time, the presence of third canal in the distal root of mandibular first molar was announced<sup>(13)</sup>. Since that numerous studies and cases reports have confirmed the presence of three canals in the distal root although the incidence of such cases was uncommon with range of 0.2% to 3%<sup>(14-16)</sup>. A study examined 125 cases of Indian population reported that none of these cases has three distal canals<sup>(17)</sup>. Two cases with five canals, three canals in the distal root and two canals in the mesial root were reported recently<sup>(18)</sup>. Similar pattern was found in another clinical case study<sup>(19)</sup>.

The available knowledge on six root canal configurations of permanent mandibular first molar comes from a very limited number of studies and case reports. Nine case reports of mandibular first molars with two roots and six root canals were presented in different studies. Six cases have three mesial and three distal root canals, while two other cases have four mesial and two distal canals. Furthermore, the last three cases have four distal and two mesial canals<sup>(20)</sup>. Similar configuration of the root canals has been reported using cone beam computed tomography (CBCT) in study of two cases with two roots and six canal with three separate canals in each root<sup>(21,22)</sup>.

It has been observed in a very rare clinical case presented in 1998, for mandibular first molar with seven root canals, four canals in the mesial root and three canals in the distal root<sup>(23)</sup>. A similar case was found recently in 2016, however, in the last case there

were three roots instead of two, with three mesial and three distal and one canal in the disto-lingual root<sup>(24)</sup>. Another rare case of mandibular first molar with eight root canals, four in each root, for a thirty years old female patient. This case was unique, and there were no record of similar cases especially with the presence of eight distinct orifices<sup>(25)</sup>.

In 1844, a mandibular first molar with supernumerary roots was reported for the first time. The extra root was located on the disto-lingual side and was called radix entomolaris (RE)<sup>(26)</sup>. The incidence of supernumerary root in mandibular first molar was strongly correlated with the ethnicity of the studied population, it was higher in specific ethnic group of people (Asians, Mongolians, and Eskimos) when compared with Caucasians and African Americans percentage, and reached to 20% in Taiwan's population<sup>(10)</sup>. The presence of a disto-lingual (DL) root of the mandibular first molar could range from 21.09% to 33.33% in a various group of populations<sup>(14)</sup>. In a recent study, it was found that the prevalence of DL root in mandibular first molar account for 11.3% in Turkish patients. In addition, there was no significant differences in prevalence of disto-lingual root between males and females, but the presence of distolingual root was higher in right side 14% than left side 4%<sup>(27)</sup>. Furthermore, RE can be found in first, second and third molars with the lowest prevalence in the mandibular second molars<sup>(28)</sup> (Figure 2).



**Figure 2:** Geographic incidence of presence of a third root in the mandibular first molar (De Pablo et al, 2010).

The mandibular first molar with single root and single canal is the rarest among the various morphology of this tooth<sup>(5)</sup>. A sample of 125 mandibular first molars from Indian population exhibited only one sample that had a single root and single canal<sup>(17)</sup>. Recent two studies have done on an extremely wide literature on the morphology of the mandibular first molar root canals could not record a single case with this rare anatomy<sup>(10,29)</sup>. This morphology was observed in a case report of a 13 years old Indian girl and up to the date of the last mentioned case report there were only three cases of mandibular first molar with single root and single root canal<sup>(30,31)</sup>.

## CONCLUSIONS

The dental practitioners should have a comprehensive understanding and awareness of internal anatomy as well as variations of root canal morphology and configuration which plays an extremely crucial role in endodontic therapy. Also, the utilization of cone beam computed tomography (CBCT) for the preoperative assessment and diagnosis of extraordinary canal is considered one of the recent valuable approach in endodontic field to reveal the actual number of canals present in the affected tooth for a successful treatment, and to avoid missed canal. Thus, the use of advanced visual and diagnostic aids as well as thorough knowledge of internal tooth anatomy and

morphology enables the clinician to accomplish a long term success of endodontic therapy.

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