

# Middle Mesial Canal of the Mandibular First Molar: A Case Report & Literature Review

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## Introduction

The main objective of non-surgical root canal treatment is the thorough chemomechanical debridement of the entire pulp space cavity and its complete obturation with an inert filling material<sup>1</sup>. Since the work of Hess and Zurcher<sup>2</sup>, it has become apparent that the pulp cavity comprises a complex network of anatomical structures and knowledge of this complex internal dental morphology is an extremely important step in planning and administering endodontic therapy because nontreatment of even one canal can lead to endodontic treatment failure.<sup>3</sup>

The mandibular first molar which is the earliest permanent posterior tooth to erupt, seems to be the tooth that most often requires root canal treatment. Over the years, there have been numerous studies that describe the morphology of teeth, including mandibular first molars. Skidmore and Bjorndal, Pineda and Kuttler, and Vertucci<sup>4,5</sup> have all reported on the morphology of the mandibular first molar. Anatomical characteristics of permanent mandibular molars are generally described as teeth with two roots. The usual canal distribution is two canals in the mesial root and one or two in the distal root.

In 1974, Vertucci and Williams as well as Barker et al. described the presence of a middle mesial canal.<sup>6-8</sup> Since then, several case reports of multiple canal systems in mandibular first molars have been investigated and described.<sup>8-10</sup>

It has been postulated that secondary dentin apposition during tooth maturation would form dentinal vertical partitions inside the root canal cavity, thus creating root canals. A third root canal may also be created inside the root canal cavity of mandibular molars by this process. Such third canals are situated centrally between the two main root canals, the buccal and lingual root canals. The diameter of those third middle canals is smaller than that of the other two.<sup>11</sup>The

probability of a mandibular first molar having a fifth canal is 1–15%.<sup>10</sup>

Clinically, the middle mesial canal can be described as an intermediate canal between the mesiobuccal and mesiolingual root canals of the mandibular molars; its orifice is disclosed as a depression or a 'bleeding point' within the developmental groove connecting the two canals<sup>12</sup>.

Depending on its clinically recognisable pathway, it has been classified into three categories: [fig 1]

- a 'fin', when at any stage during biomechanical preparation, an instrument could pass freely between the mesiobuccal or mesiolingual canal and the middle mesial canal
- 'confluent', when the prepared canal originated as a separate orifice but apically joined the mesiobuccal or mesiolingual canal
- 'Independent', when the prepared canal originated as a separate orifice and terminated at a separate foramen, or when after preparation of a broad single mesial canal in which three master cones could be inserted occurred<sup>13</sup>.

However, according to Mortman and Ahn<sup>14</sup>, this third canal is not actually an additional mesial canal but rather the sequelae of instrumenting the isthmus between the mesiobuccal and mesiolingual canals.

Either way, it constitutes a distinct anatomical structure needing to be treated, otherwise treatment failure may occur.

Most of the time this intermediate canal will join at the apical or middle third with either the mesiolingual or mesiobuccal canal, ending in one foramen. This intermediate canal joins more frequently with the mesiobuccal canal.

Various authors<sup>11,12,16,17</sup> have suggested that younger patients had intermediate canals which were more easily found.

According to comprehensive in vitro and in vivo studies investigating the occurrence of

three mesial canals, the possibility of a mandibular first or second molar exhibiting this morphological aberration has been reported to be ranging between 0 to 21.7%.

## Case Report

A 25 year-old male patient presented at the Department of Conservative Dentistry and Endodontics, with a complaint of intermittent pain in the posterior right mandibular region for the past two weeks. The pain was spontaneous, diffuse, non-radiating associated with prolonged sensitivity to hot and cold. Clinical examination revealed a carious right mandibular first molar (46). The tooth gave a delayed response to electric pulp tester compared to its contralateral tooth. The tooth was not tender on percussion. The clinical and radiographic findings led to a diagnosis of chronic irreversible pulpitis of the right mandibular first molar (46), necessitating endodontic therapy, and consent was taken from the patient for the same.

Radiographic evaluation of the involved tooth indicated a regular canal configuration of two canals in the mesial root and one canal in the distal root. The right inferior alveolar nerve was anesthetized using 2% Lignocaine with 1:100,000 adrenaline. The tooth was isolated using a rubber dam and an endodontic access cavity was prepared. Clinical examination revealed five distinct orifices: three located mesially (mesio-buccal, middle mesial and mesiolingual) and two distally (distobuccal and distolingual). The canals were explored with #10 K-file (Mani, Inc; Tochigi, Japan). Multiple, working-length radiographs taken at different angulations with one file placed in each of the three mesial and two distal orifices revealed the presence of five distinct canals. Cleaning and shaping was performed using a step back hand instrumentation technique, with K-files (Mani, Inc; Tochigi, Japan), under copious irrigation with 5.25% sodium hypochlorite solution and EDTA (Glyde, Maillefer, Dentsply, Ballaigues,

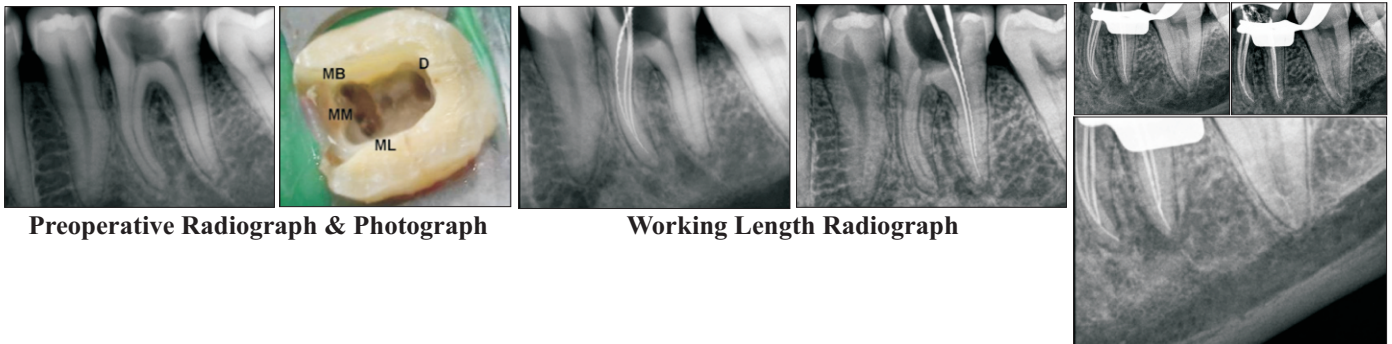


Figure 1

Master Cone & Postobturation Radiograph



Switzerland). The root canals were dried with paper points (Maillefer, Dentsply, Ballaigues, Switzerland) and obturated with cold, laterally condensed gutta-percha (Maillefer, Dentsply, Ballaigues, Switzerland) and zinc oxide eugenol sealer (Dental products of India Ltd). Tooth was temporized and restored with full coverage restoration on subsequent appointments.

**Discussion:**

One of the major challenges clinicians face when performing endodontic treatment in molars is the complexity of the root canal systems and incomplete instrumentation or filling of all root canals accounts for one of the major causes of failure of endodontic treatments<sup>18</sup>. In 2002, Hoen and Pink<sup>19</sup> screened 1100 failing endodontically treated teeth. They found the incidence of missed roots or canals of the retreated teeth to be 42% in their investigation and reported that maxillary first molar was the tooth most often re-treated, followed by the mandibular first molar. Similarly, Vertucci FJ<sup>1</sup> and DeGroot ME and Cunningham CJ<sup>20</sup> reported that a considerable number of failures could be assigned to anatomical variations, such as the presence of canals not usually found.

Careful clinical and radiographic inspection are mandatory to a successful therapy.<sup>21</sup> Diagnostic measures such as multiple preoperative radiographs, examination of the pulp chamber floor with a sharp explorer, troughing of the grooves with ultrasonic tips, staining the chamber floor with 1% methylene blue dye, performing the sodium hypochlorite “champagne bubble test,” and visualizing canal bleeding points are all important aids in locating root canal orifices.<sup>22</sup> ADG 16 endodontic explorer used as a pathfinder can help determine the angle at which the canals depart from the main chamber. The search for an extra orifice is also aided by the use of magnifying loupes and fiber-optic transillumination to locate the developmental line between the mesiobuccal and mesiolingual orifices.<sup>23</sup>

The mandibular molar can also invariably present an aberrant anatomy. However, most clinicians go by norms of 3-4 canals in mandibular molars i.e. 2 mesial and 1 or 2 distal canals. Clinicians must be aware of the fact that the presence of a third canal in the mesial root of the mandibular first molars has been reported to have an incidence rate of 1%~15%.<sup>8</sup> Even though anatomical variations in mandibular first molars are documented in the literature, variations in the anatomy of these teeth are not recognized by a great many dentists. Table 1 presents a list of few studies reporting the prevalence of middle mesial canal, and table 2 lists various case reports reporting the presence of middle mesial or middle distal canals in mandibular molars published in literature till date.

Variations in the mesial root of mandibular first molars can be identified through very careful observation of angled radiographs. Buccolingual views, 20° from mesial and 20° from distal, reveal the basic information on the tooth's anatomy and the root canal system that is required for endodontic treatment.<sup>82</sup> A significant constraint in conventional radiography is that it produces a 2D image of a 3D object, resulting in the superimposition of the overlying structures. Therefore, these

**Table 1: Studies on the prevalence of middle mesial canal in first & second mandibular molars.**

Author (8)	Year	N	%
<b>Ex vivo studies</b>			
Skidmore & Björndal <sup>8</sup>	1971	85	0
Pineda & Kuntler <sup>9</sup>	1972	600	0
Vertucci <sup>1</sup>	1974	200	1
Richard walker <sup>10</sup>	1988	100	1
Caliskan et al <sup>11</sup>	1995	200	55
De Carvalho & Zuolo <sup>12</sup>	2000	204	21.7
Wasti et al <sup>13</sup>	2001	30	33
Gulabivala et al <sup>14</sup>	2001	273	7.1
Gulabivala et al <sup>15</sup>	2002	178	7.6
Sarkar S30	2002	10	70
Sori & Bayirli <sup>16</sup>	2004	400	1.5
Almed et al <sup>17</sup>	2007	200	4
Fomer Navarro et al <sup>18</sup>	2007	52	13.4
Yesiloy et al <sup>19</sup>	2007	80	6.25
Reuban et al <sup>20</sup>	2008	125	-
Petris et al <sup>21</sup>	2008	177	1.1
Shahriar shahi <sup>22</sup>	2008	209	0.95
Chen G <sup>23</sup>	2009	183	6
A.A Al - Qudah and L.A. Awawdeh <sup>24</sup>	2009	330	6
Karapinar -Kazandag et al <sup>25</sup>	2010	96	20
<b>In vivo studies</b>			
van Voerde <sup>26</sup>	1975	136	0.75
Pomeranz et al <sup>27</sup>	1981	100	12
Martinez - Berna & Badanelli <sup>28</sup>	1983	2362	15
Fabra - Campos <sup>29</sup>	1985	145	2.1
Fabra - Campos <sup>30</sup>	1989	760	2.6
Goel et al <sup>31</sup>	1991	60	15

**Table 2: list of case reports reporting the presence of extra mesial or distal canal in mandibular molars**

Author	Year	Tooth reported
Badanelli & Martinez Berna <sup>28</sup>	1979	Mmc 1 case
Weine <sup>32</sup>	1982	46
Martinez Berna & Badanelli <sup>33</sup>	1985	36,46
Lim <sup>34</sup>	1985	1 case
H. Fabra Campos <sup>29</sup>	1985	36,46,46,46
Beatty & Krell <sup>35</sup>	1987	1 case
Bond <sup>36</sup>	1988	36
Jacobsen <sup>37</sup>	1994	36,46,46
De Groot & Cunningham <sup>38</sup>	1997	46
Holtzman <sup>39</sup>	1997	46
Riccucci <sup>40</sup>	1997	4 canals
Reeh <sup>41</sup>	2000	36
Mortman & Ahn <sup>42</sup>	2003	36,36,36,46,46
Baugh & Wallace <sup>43</sup>	2004	46
Min <sup>44</sup>	2004	Mmc 46
Chang <sup>45</sup>	2006	36
Reyhani et al <sup>46</sup>	2007	46
Na varro et al <sup>47</sup>	2007	36
Kontakioti & Tzanetakis <sup>48</sup>	2007	4 canals 36
S Abdeen <sup>49</sup>	2008	Mmc 36
Gianluca Plotino <sup>50</sup>	2008	Mmc 48
Poomi et al <sup>51</sup>	2009	46
Yesiloy et al <sup>19</sup>	2009	46,46
Dr. Abhiney Puri <sup>52</sup>	2009	Mmc 46
Siju Jacob <sup>53</sup>	2009	Mmc 46
Lash et al <sup>54</sup>	2010	46
Sung Ho La <sup>55</sup>	2010	Mmc 46
Mohsen Aminsohbani <sup>56</sup>	2010	46
Surekha Puri et al <sup>57</sup>	2011	Mmc 46,46
Chandra SS. et al <sup>58</sup>	2011	Mmc 36
Shweta Jain <sup>59</sup>	2011	Mdc 46
Vandana Bhardwaj <sup>60</sup>	2011	Mmc 36 Mdc 46 Mmc 46
Patil Jaya Prakash <sup>61</sup>	2011	46
Vijaykumar Shiraguppi <sup>62</sup>	2011	Mmc 46
Moha navela Deepalakshmi <sup>63</sup>	2012	Mmc 46,46,46,36
Xenos M. Petridis <sup>64</sup>	2012	Mmc 37,46,36,37
Dr. Navin Mishra et al <sup>65</sup>	2012	Mmc 37
Dr. Charu Batra <sup>66</sup>	2012	Mmc 47 with radix p
Swati Sharma Kharade <sup>67</sup>	2012	Mdc 37
J.V. Karunakaran <sup>68</sup>	2012	Mmc 37
Sachin Gupta <sup>69</sup>	2012	Mmc 36
Deepak J. Parekh <sup>70</sup>	2012	Mmc 36
Bains R et al <sup>71</sup>	2013	Mdc 46
Lu Q <sup>72</sup>	2013	Mdc 46
Dr. Mukteshree Mahendra <sup>73</sup>	2013	Mdc Mmc 46
Avinash A patil <sup>74</sup>	2013	Mmc 46
Nupur Dhanak <sup>75</sup>	2013	Mmc 36
Manoj Aggarwal <sup>76</sup>	2013	Mdc 36

radiographs are of limited value in cases with complex root canal anatomy.<sup>83</sup> Interpretation and appraisal based on a 2D radiograph may alert the clinician to the presence of aberrant anatomy but would not be able to present the variable morphological structure of root canals and their interrelations.<sup>82</sup> Hence, it is mandatory to use all the available diagnostic aids to locate and treat the entire root canal system.<sup>22</sup>

Nance et al.<sup>84</sup> showed that tuned aperture computerized tomography (TACT) imaging enabled a significant increase in canal detection as compared to conventional radiography. Gopikrishna et al.<sup>82</sup> used spiral computerized tomography for the confirmatory diagnosis of a morphological aberration in the maxillary first molar. The latest technology for most accurate diagnosis is the use of CBCT, but its use is limited due to feasibility and high cost.

In order to easily locate these intermediate canals within the mesial root these four steps have been suggested by Fabra-Campos<sup>16</sup>

Once the access cavity is made, the dentinal protuberance which separates the entrance to the mesiobuccal and mesio-lingual canals are removed with either ultrasonic tips or round bur

An explorer is used to explore through the groove connecting the mesiobuccal and mesiolingual canal to search for any possible intermediate depression. Also in teeth with vital pulp a bleeding spot can be observed which may indicate MMC

Catheterize the third canal by using a thin file (#08 or 10) in an alternating 45° rotating motion

Once the canal is located, enlarge the canal entrance.

In the present case, we were fortunate to locate the third mesial canal with the help of magnification loupes at 2.5x magnification, and successful endodontic treatment could be carried with only multiple angled radiographs.

**Conclusion**

The present case report describes the endodontic management of a mandibular first molar with five canals, three in the mesial and two in the distal. It is mandatory that the clinician should possess a thorough knowledge of not only the normal anatomy of the root canal system, but also aberrations. Thus, multiple angulated radiograph and close clinical inspection of the chamber floor at higher magnification is essential whilst treating teeth that have a high incidence of extra canals.

To summarize, treating additional canals may be challenging, but the inability to find and properly treat the root canals may cause failures. Unforeseen complexities can be managed with the thorough knowledge and armamentarium without the surgical intervention in every other case.

**References**

References are available on request at [editor@healtalkt.com](mailto:editor@healtalkt.com)

