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Middle Mesial Canals in Mandibular Permanent Molars – A Case Series And Report

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Abstract: *Eradication of microbes from root canals and impeding of further reinfection is the basic support of endodontic treatment. This is achieved by overall disinfection and shaping of canals which can then be filled using a three-dimensional filling with a fluid-tight seal. To achieve these goals, the clinician must have integral knowledge of regular anatomy and anatomic variants of root canals. One such variant configuration in mandibular molars is the presence of a third canal in the mesial root called middle-mesial canal. This article describes the endodontic therapy of permanent mandibular first molars having this extra mid-mesial canal.*

Keywords: *accessory canal, intermediate mesial canal, mandibular molar, middle mesial, mid-mesial canal*

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I. Introduction

The The primary objective of root canal therapy is the thorough mechanical and chemical cleansing of the entire pulp space from microorganisms, dentin debris and remnant pulp tissue [1]. The presence dentinal tubules, isthmus, accessory canals and apical ramification can aid in harbouring harmful bacteria and may significantly hinder this objective. It was further found that unidentified, and therefore uncleaned canals were also more likely to be associated with apical lesions [2]. Witherspoon DE et al. identified the incidence of additional or missed canal systems in molar retreatment cases and found that in the mandibular first molars, 86% of missed canals were identified in the distal and 14% were identified in the mesial root [3].

As the mandibular first molar is the first posterior tooth that erupts and is the tooth that most often requires root canal treatment. An awareness and understanding of the presence of any unusual root canal morphology along with the ability to correctly identify and treat them can prevent any future complications. The mandibular first permanent molars normally present with two roots, with two canals in the mesial root and with one or two canals in the distal root. One aberrant canal configuration for the mandibular molar is the presence of an additional canal in the mesial root, called "medial mesial canal" as it is present centrally between the main buccal and lingual mesial root canals [4]. It was Vertucci and Williams, who first reported the presence of this Middle mesial or Mid-Mesial canal in 1974 [5]. Pomeranz et al. classified them into three morphologic categories as follows: a) Fin-type, if an instrument could pass freely between the mesiobuccal or mesiolingual canal and the middle mesial canal. b) Confluent-type, when separate orifice is present but the canal joins either the mesiobuccal or mesiolingual canal apically. c) Independent-type where the canal has a separate orifice and terminates at a separate foramen [6]. This case series describes the endodontic therapy of permanent mandibular first molars with 3 canals in the mesial root.

II. Case Presentations

2.1) Case Report -I

A 43-year-old female patient reported with a chief complaint of intermittent pain in the lower right back teeth for the past three months. On clinical examination revealed a large coronal restoration in right mandibular first molar. A diagnostic radiograph was taken [Fig. 1A]. Radiographic evaluation of the involved tooth indicated a large restoration, with secondary caries approximating the pulp. Clinical and radiographic findings led to the diagnosis of chronic irreversible pulpitis, the tooth required endodontic therapy. Local anaesthesis was administered. Isolation of tooth using rubber done was done, and an endodontic access cavity was established. Initially, two canals mesially and two canals distally were located. During refining of the access cavity, a small catch was found on the groove between MB and ML orifices. The catch was explored with a no.

10 K-file (Mani Inc, Tochigi, Japan). Multiple working length radiographs were taken at different angulations with to confirm the presence of 5 distinct canals [Fig. 1B]. The canal orifices were enlarged using GG drills size 1-3 [Fig. 1C].

Instrumentation of the canals was performed using a crown down preparation with Mtwo rotary instruments [20-6%, VDW, Munich, Germany]. Canal irrigation was performed using 2.5% of NaOCl and the lubricant used was 17% EDTA. The canals were then dried and fitted with corresponding gutta-percha and Obturation was completed using AH plus resin sealer (Dentsply, Maillefer, Ballaigues, Switzerland) [Fig. 1D]. The access cavity was then sealed with IRM cement. Postobturation radiograph was taken, which revealed three distinct canals with separate. With regard to Pomeranz's classification this case is classified as independent middle mesial canal.

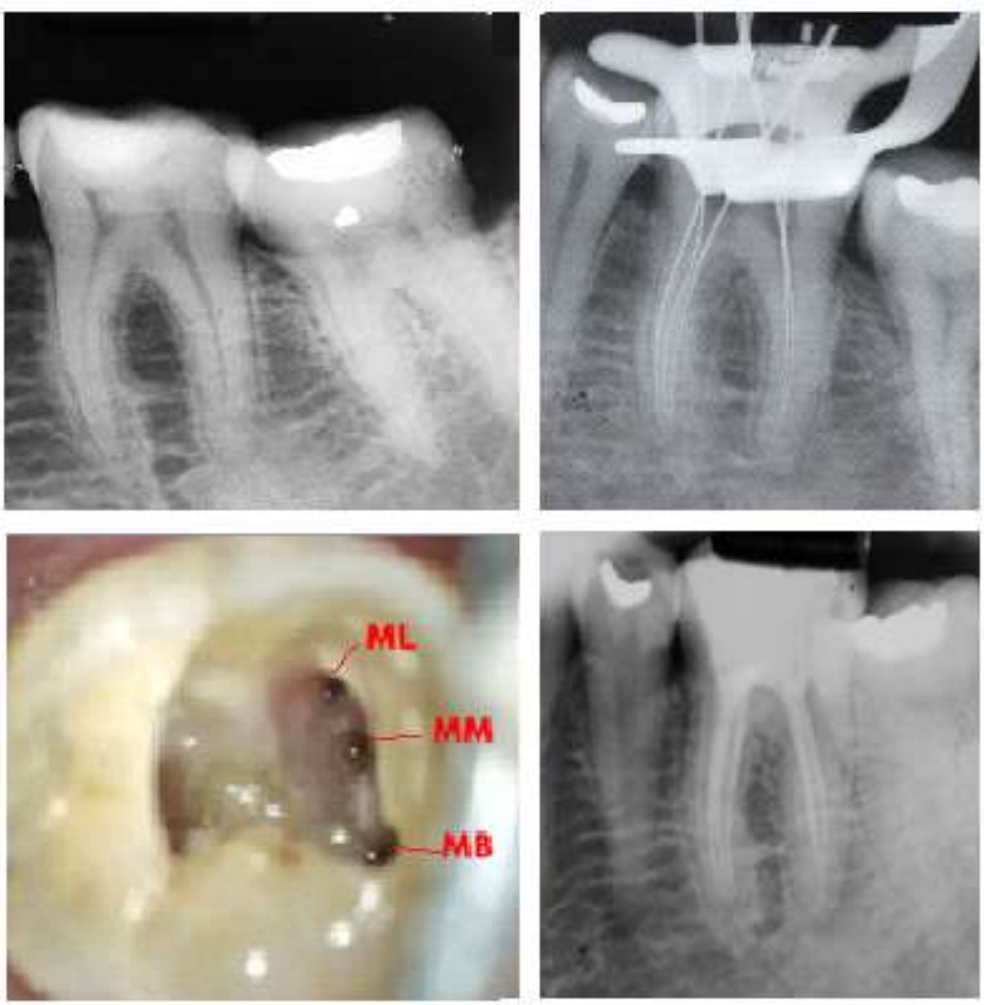

Figure 1: A) Preoperative radiograph, B) Working length determination, C) Access cavity photograph after Orifice enlargement, D) Final obturation radiograph.

2.2) Case Report -Ii

A 35-year-old male patient reported with a chief complaint of pain in the right lower back tooth. The patient reported a history of throbbing pain for the past one month, which increased in intensity on having food and was relieved on taking medication. On examination, the right mandibular first molar displayed deep dental carious which responded negatively on electrical pulp testing.Clinical and radiographic findings led to a diagnosis of symptomatic irreversible chronic pulpitis, endodontic treatment was planned. Local anaesthesis was administered. Isolation of tooth using rubber done was done, and an endodontic access cavity was established. While a clinical examination of the cavity floor was carried out using DG16 endodontic explorer (Hu-Friedy, Chicago, IL, USA), A third mesial canal orifice was found. Coronal enlargements of the canal orifices were performed with ProTaper orifice shaper Sx (Dentsply Maillefer, Ballaigues, Switzerland) [Fig. 2A] . ISO size 10 and 15 files were used to create initial glide path. Working length radiograph to confirm the additional canal as middle-mesial canal was taken [Fig. 2B].

Instrumentation was completed using ProTaper rotary files and 3% sodium hypochlorite irrigation. The canals were dried and obturated with AH plus sealer and post-obturation radiograph was taken [Fig. 2C].

With regard to Pomeranz's classification this case was found initially to be of confluent type, but after instrumentation was carried out the mid-mesial canal was found to join to the mesiolingual canal as in a fin-type configuration.

Figure 2 – A) Access cavity after orifice enlargement, B) Working length determination, C) Obturation.

III. Case Report

A 37-year-old male patient reported with a chief complaint of decayed tooth associated with pain in left lower back tooth region. Intraoral examination revealed class II deep carious lesion in 36. A preoperative diagnostic radiograph of 36 was taken [Fig. 3A] revealed a deep carious lesion involving the pulp with widening of the apical periodontal ligament space. Based on clinical and radiographic findings a provisional diagnosis of necrotic pulp with apical periodontitis was made and endodontic treatment was scheduled. On access cavity preparation, initially 2 mesial canals were located and on further refining of the cavity a small catch was found between the mesial canal which was explored with ISO size 15 file. Working length radiograph was taken which proved the presence of mid-mesial canal [Fig. 3B]. The orifices were enlarged similar to the second case report [Fig. 3C]. Cleaning and shaping was performed similar to previous case reports and canals were obturated with gutta-percha and AH plus sealer [Fig. 3D]. With regard to Pomeranz's classification this case was found to be of confluent-type.

Figure 3 – A) Preoperative radiograph, B) Working length determination, C) Canal Orifices enlarged, D) Obturation radiograph.

IV. Discussion

The Hess in 1925 proposed that the mesial roots of mandibular molars develop as single canal and compressed with age in the middle to form two [7]. It has been hypothesised that secondary dentine deposition in the form of a vertical dentinal partition inside the canal cavity creates the root canals. Hence, Age plays an important role in the presence of MM canals and small accessory canals. It was found that the mesial roots of mandibular first and second molars had mostly one large canal until 11 and 15 years of age; and due to secondary dentine depositions at 30–40 years of age, the canal systems in the apical and middle third of the root was completely established [8]. This relates to our case series that all three patients were in the age group of 30-40years. However, Azim AA et al. reported the incidence of MM in patients aged less than 20 years was 32.1% and in patients aged more than 40 years was 3.8%. With increasing age, calcification occurs and it is very likely for the small Mid-mesial canal to get obliterated decreasing its incidence. Hence, The probability of finding and negotiating an Mid-mesial canal in younger patients is significantly higher than in older individuals [9].

The Middle-mesial canal lies in the isthmus connecting the mesiobuccal and mesiolingual canal orifice. An isthmus or sub-pulpal groove can be defined as a narrow connection between two root canals that contains pulp tissue. Von Arx et al reported the highest ever incidence of isthmuses in mesial roots of mandibular molars [88.5%] [10]. Despite this report of high prevalence of intercanal communications in mandibular molars. The success in locating and accessing a middle mesial canal has been very low, this may be due to the fact : The Mid-mesial orifice lies deep in the isthmus or sub pulpal groove and is smaller than the other mesial orifices due to age-related dentinal deposition. The orifice also tends to lie under a mesial dentinal protuberance, which makes locating and accessing them difficult [11]. Karapinar-Kazandag et al. suggests troughing the isthmus to a mean depth between 0.7 and 1.1 mm [12]. But in a study by Ali Keles et al., 77.41% of the MMC orifices did not require troughing in order to be located [13]. Azim AA et al.[9] in their in vivo study have also shown that 39.6% more MM canals were detected when troughing was done using a 1mm diameter long shank round bur. According to Chavda SM et al., the advantage of using such bur rather than the ultrasonic tip is that it allows the formation of large debris, which can be easily removed by irrigation [14]. But Ultrasonic systems do not have the bulky head of the conventional hand piece that frequently obstructs the vision. Overzealous troughing might jeopardize the dentin thickness around the danger zone and possibly lead to root perforations

The occurrence of mid-mesial canal has been found to be ranging 0-46% in both in vivo and in vitro studies by various authors [8-11, 15].The highest occurrence of Midmesial canals recorded in vivo under high magnification was found to be 46.2% by Azim AA in 2015 [9]. Fabra et al. reported that 2.6% of molars had three canals in the mesial root, 1.7% of third canal joined the mesiobuccal canal in the apical third, and 1.6% converged with the mesiolingual canal and as an independent canal (0.13%) [15]. A separate apical foramen for an MM canal was a rare finding. Highest incidence of a separate apical foramen i.e.; independent configuration was 20% found by Ali Nosrat et al. in 2015 [16]. A study by Mehrnaz Tahmasbi et al. shows that in only 2.4% of 122 total cases did MM canals exit from a separate apical foramen i.e.; a true Mid-Mesial or independent type [17]. Mortman and Ahn [18] suggested that the mesial canal is not an accessory or extra canal, rather sequelae of instrumenting the isthmus between Mesiobuccal and Mesiolingual canals. Although this finding should not translated as the cleaning and shaping of these canals being insignificant, this may imply that missing a MM canal in a mandibular molar may not be as dramatic as missing a second MB canal in a maxillary molar, in which 46% of cases have a separate apical foramen [19]. Despite this, any intercanal communication and isthmi can be covered with biofilm and can be a pathway for reinfection. Therefore, irrespective of whether a Mid-Mesial canal or isthmus, it is recommended to instrument and thoroughly irrigate these areas [20]. In addition Hsu YY and Kim S have shown that the presence of a canal isthmus is one of the main causes of failure of nonsurgical and surgical endodontic treatments in mandibular molars [21]. According to Karapinar-Kazandag et al., the Fin types are likely to be removed during the preparation of the main canals, and may not affect the outcome of the treatment [12]. The confluent types have separate orifices but they merge with the main canal and usually lead to lateral interconnection/transverse anastomosis connecting the Mesiobuccal and Mesiolingual canals, commonly found at the level of 3–6 mm coronal to the apical foramina [22]. Independent types have separate orifice and exit, so undoubtedly needs to be treated.

The incidence of Mid-Mesial canals was found to be more in the first molars than the second molars which is in accordance with our case series [23][24][25]. However, it was not in agreement with findings of Azim AA et al., who found the incidence to be 60% in second molars and 37.5% in the first molars [9]. The association between two distal canals and MM canal was also studied by Nosrat et al.who found no significant association between MM canal and the presence of a separate second distal canal [16].

The importance of diagnostic measures cannot be stressed enough in detection of extra canals. All methods such as multiple preoperative radiographs in different angulations, thorough examination of pulp chamber floor, troughing of the grooves with ultrasonic tips, dye staining , visualization of bleeding points and with use of magnification, should be employed so that the mesial canal can be detected. The use of advanced aids like dental operating microscope or CBCT can also be used.

V. Conclusion

Treating additional aberrant canals can be challenging, but the inability to find root canals may cause failures. Most of the time, the number of canals present in any tooth is predetermined by the data given in books. However, additional canals may be present. The clinician should be aware of the presence of any extra canals and treat it accordingly for long-term success of root canal therapy.

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