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Middle Mesial Canal – A Case Report & Review of Literature

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Abstract: The outcome of endodontic treatment depends on thorough cleaning and shaping of the canal systems. Inability to do so will result in persistence of the infection. Canal systems are not uniform across all the teeth. There are innumerable reports of extra canals and roots being seen in all the teeth. The mandibular first molar is one of the commonly encountered teeth for endodontic treatment. Apart from the commonly seen canals, there is a 1-15% incidence of middle mesial canals. This canal can be identified easily using increased magnification with operating microscope. Inability to identify and treat this canal may lead to endodontic failure. This article reviews the literature about the middle mesial canal in mandibular first molars and gives a report of a case wherein the endodontic treatment was carried out under the surgical operating microscope.
Keywords: endodontic treatment, teeth, mandibular

INTRODUCTION

The main objective of root canal treatment is the thorough mechanical and chemical cleansing of the entire pulp space followed by complete obturation with an inert filling material. Hence, it is imperative that aberrant anatomy is identified prior to and during the treatment of such teeth [1].

The mandibular first molar, as the earliest permanent posterior tooth to erupt, is considered to be frequently involved in endodontic procedures [2] and clinicians may be confronted by aberrant internal anatomy of the mandibular first molars. Studies show that deviations from the normal are more common than previously realized[3-7]

In a Caucasian population, the majority of mandibular first molars are two-rooted, with various canal configurations in both mesial and distal roots. According to Vertucci's classification, the mesial root presents with two separate canals at the apex in 59% of teeth, two canals joining with a single apical foramen in 28% of teeth, a single canal in 12% of teeth, and three canals in 1% of teeth [8,9]. In other studies, the frequency of a middle mesial canal in the mesial root of mandibular molars varies between 1% and 7% of teeth [10-17]. The three mesial canals can be separate [10-13] or can join into two and exit with two apical foramina [14-17]. Furthermore, some authors reported cases of mesial roots with four canals, although this finding should be considered rare [18,19]. When an additional mesial canal is present, it is located between the two main canals and its orifice is often hidden by a dentinal projection of the pulp chamber wall. This layer of dentin can be differentiated from the pulp chamber floor because its color is lighter and similar to the dentin layer that hides the MB2 orifice in maxillary molars. An operating microscope and ultra- sonic tips or long shank round burs should be used to visualize and carefully remove the dentinal strip, respecting the pulp chamber floor, thus finding the extra canal orifices.

A major variant of the two-rooted morphology in the mandibular first molar is the presence of a super-numerary root located disto-lingually [radix entomolaris [RE]] or mesio-buccally [radix paramolaris [RP][20,21]. The rate of occurrence of this root dysmorphia in Caucasians [22] and Africans [23] is less than 5%, whereas in populations with Mongoloid traits [such as the Chinese, Inuit, and Native Americans], RE occurs with a frequency that ranges from 5% to more than 30% [47,48]. A buccally located RP is very rare and occurs with a prevalence of less than 0.5% [20,21]. An unclear view or outline of the distal root contour or the root canal, in the pre- operative radiograph, can indicate the presence of a 'hidden' root [20,24]. A second radiograph, taken from a more mesial or distal angle, generally reveals the profile of the RE [20]. Clinical inspection of the tooth crown and of the cervical morphology of the roots by means of periodontal probing can facilitate identification of an additional root. An extra cusp [tuberculum paramolare] or a more prominent disto-occlusal or disto-lingual lobe, in combination with a cervical prominence or

convexity, can indicate the presence of an additional root [20]. The orifice of the RE is located mesio-lingually from the main distal canal, thus requiring a more rectangular or trapezoidal outline form of the access cavity. A dark developmental line on the pulp chamber floor, carefully explored with an endodontic probe, can indicate the precise location of the RE canal orifice. An operating microscope can be very useful, especially in cases where the orifices are covered by a calcification that can be easily removed with ultrasonic tips or long shank round burs [20]

REVIEW OF LITERATURE

Numerous *in vitro* and *in vivo* studies on the morphology of mandibular first molars have provided new data relating to the presence of extra roots, additional root canals, lateral canals or transverse canal anastomoses between the two or three canals in the mesial root [25-29]. These studies have pointed out the need for careful inspection for the existence of possible additional canals.

Several clinical reports have described more than two canals in the mesial root of mandibular first molars [30-38].

A middle mesial [MM] canal sometimes is present in the developmental groove between the mesiobuccal[MB] and mesiolingual [ML] canals. The incidence of an MM canal ranges from 1% to 15% [39].

Separate apical termination of three mesial root canals is very rare [40]. Very often the middle mesial canal joins with the mesiobuccal canal at the apex. In a series of studies in 100 extracted mandibular molars in 1974, Vertucci [41]observed that 1% of the cases had a middle mesial canal in tooth number 30.

In 1981, Pomeranz et al [42]treated 100 mandibular first and second molars in vivo in which 12 cases of separate middle mesial canals were identified and treated. He classified the middle mesial canals as falling under three types:

1. An independent canal, which originates in a separate orifice and terminates in a separate foramen
2. A confluent canal, that originates as a separate orifice but is apically joined to the mesiobuccal or mesiolingual canal
3. A fin, when the instrument can pass freely between the MB or M L canals and the middle mesial canal during cleaning and shaping.

In a clinical evaluation of 145 mandibular first molars, Fabra Campos found four molars [2.1%] with five canals [6,7]. The occurrence of middle mesial canal has also been reported by Barker et al [3], Beatty & Krell [4], Dean, Baugh & James Wallace [5].

In a radiographic study of extracted teeth in 1991, Goel et al [2] reported that tooth number 30 had three mesial canals in 13.3% of specimens, 4 canals in 3.3% and 3 distal canals in 1.7% of specimens. Their study also showed that one apical foramen was present in 30%, two in 60%, three in 6.7% and four in 3.3% of the cases.

This study again reiterates the importance of the knowledge of the anatomy of each tooth while doing the treatment. The clinician should also keep in mind the chances of any unusual features in that particular tooth.

In a study employing micro-computed tomography [μ-CT]in 2005, Mannocci et al. [43] found isthmuses at all levels with pre- valence figures between 17.25% and 50.25%. In this study, more isthmuses than expected were encountered three millimeter's from the apex. Many calcifications were found in them, as well as some lateral canals that originated from the central part of the isthmuses. The authors conclude that this aspect of root canal anatomy may affect clinical procedures and endodontic surgery in the mesial root of mandibular molars.

Variation in the mesial root of mandibular first molars can be identified through very careful observation of angled radiographs. Buccolingual views, 20^0 from mesial and 20^0 from distal, reveal the basic information on the tooth's anatomy and root canal system required for endodontic treatment [44]

Karunakaran et al. [45]presented a case report describing endodontic treatment of left mandibular second permanent molar. The tooth was found to have three separate canals in the mesial root. The author emphasized the assistance of magnification and illumination in management of such cases.

Sajad Ebdeen et al. [46] reported a case demonstrating the presence of a third canal in the mesial root of the mandibular first molars. To ascertain the complex anatomy of the tooth in a 3-D manner dental imaging was performed with the help of spiral computed tomography. The SCT images confirmed the presence of the middle mesial canal.

The cases presented here are an indication of the importance of knowledge of the variations in root canal anatomy that may be present. The use of the operating microscope has revolutionized the field of endodontics, especially in the location of missed canals. Due to the excellent visibility, finding extra canals has become easier. The success of the endodontic treatment has increased manifold.

Table-1: Mandibular first molar mesial root studies

Authors	Year	No. of teeth	Method	Three canals [%]
Skidmore and Bjorndol[47]	1971	45	Vitro	0
Pineda & Kuttler[48]	1972	300	Vitro	0
Vertucci[41]	1974	100	Vitro	1
Pomeranz[42]	1981	100	Vivo	12
Martinez–Berna & Badanelli[49]	1983	1418	Vivo	1.5
Fabra–Campos[6]	1985	145	Vivo	2.1
Fabra–Campos[7]	1989	760	Vivo	2.6
Goel[2]	1991	60	Vivo	15

CASE REPORT

A 21-year-old female presented with pain in the right lower back tooth region from the past 2 months, She gave a history of throbbing pain along with severe hot and cold sensation.

On clinical examination tooth number 46 was tender on vertical percussion and had a carious lesion on the occlusal surface, which on the radiograph showed extending into the pulp chamber. Consent of the patient was taken for root canal procedure and the treatment was initiated.

Access cavity preparation was prepared using Endo access bur Number 3 [Dentsply Maillefer, USA], chamber was irrigated using 5.25% sodium hypochlorite [Vishal Dental Products, Mumbai] and the floor was examined with a DG-16 explorer. Initially the mesiobuccal, mesiolingual and the distal canal were located with the naked eye, working length was confirmed with an IOPA using a 10 No. K-File [Mani, Japan]and the canals were prepared till a No.20 size along with EDTA [Glyde] and irrigation, the mesial canals were prepared till F_1 and distal till F_3 using protaper hand files [Dentsply Maillefer, USA] following BMP the patient still had pain in the tooth after which the tooth was examined under Dental Operating Microscope which showed a typical “white line” between the mesiobuccal and the mesiolingual canals which was further explored using ultrasonic tips [Carr Killer Tips No.3 And No.3 Diamond] along with ultrasonic unit [Satellec] at a speed of 10 which showed the presence of a middle mesial canal[FIGURE 1], working length was taken using a 8 No. File, and was prepared till a size No. 30 2% k-file [Dentsply Maillefer, USA]. Master cone radiograph was recorded [FIGURE 2].Obturation was carried out using G.P points [Dentsply, USA] using hand spreaders [Dentsply, USA] and zinc oxide eugenol sealer with a lateral condensation technique[FIGURE 3 & 4].
Post endodontic restoration was done using Z350 XT [3M] composite material.

Fig-1: Micro Photograph Showing The Middle Mesial Canal

Fig- 2: Master Cone Radiograph

Fig-3: Obturation Radiograph

Fig- 4 :Obturation Radiograph

DISCUSSION

Many clinicians perform endodontic treatment with the preconceived notion of the number of roots and canals present in that particular tooth. A thorough knowledge of anatomy of the root canal system plays a significant role in endodontic success and failure[51]. A statistically significant percentage of failures are related to missed canals, as these potentially hold tissue, bacteria and related irritants that inevitably contribute to clinical symptoms and lesions of endodontic origin. With the advent of the operating microscope and ultrasonic's, conventional root canal treatment has a better chance of success[52].

Anatomic familiarity is a prerequisite and a good access cavity is essential.

With regards to the middle mesial canal, the mesial extension of the access cavity should extend to almost incorporate the mesiobuccal and mesiolingual cusp tips and run parallel to the mesial marginal ridge[53,54].

Illumination and magnification will play a huge role in the identification of this anatomical feature if present. It can be found anywhere in the pulp chamber wall/floor fold between the mesiobuccal canal and the mesiolingual canal orifices. The use of ultrasonic tips with their abrasive coatings helps remove [sand away] dentine conservatively. The working end of these tips can be introduced into the wall/floor angles of the pulp chamber to look for hidden systems. The use of such tips eliminates the bulky heads of conventional hand pieces, which often obstruct vision, and allows this 'chasing' to be carried out under direct vision. Any instrumentation on the floor of the pulp chamber should only be carried out under direct vision because of the risk of perforation. On careful examination of the pulpal floor if a classical 'white line' between the mesiobuccal and mesiolingual orifices is present the operator should further explore with small hand files for a 'catch'. The preparation of this accessory canal system should be done cautiously and conservatively. The geometry of the mesial root shows it to be hourglass shaped and so a preparation in the mid section of the root is automatically closer to the danger zone [the furcation side of the mesial root] increasing the possibility of a perforation[55].

CONCLUSION

There are numerous cases in the literature concerning the unusual anatomy of the mandibular first molar. The presence of a third canal in the mesial root of mandibular molars has been reported to have an incidence rate of 1 to 15%. This additional canal may be independent with a separate foramen, or the additional canal may have a separate foramen and join apically with either the mesiobuccal or mesiolingual canal.

The use of better diagnostic aids like Cone Beam Computed Tomography and better magnification like the surgical operating microscope have increased the clinician's chances of diagnosing, locating and treating extra canals [50].

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