ASSESSMENT OF PREVALENCE OF MIDDLE MESIAL CANAL IN MANDIBULAR FIRST MOLARS USING 3-D IMAGING

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Abstract

Introduction- The endodontic therapy is mainly done to prevent or heal apical periodontitis. Due to highly variable root canal anatomy, cleaning and shaping procedures are highly affected. **Methodology-** The main purpose of this study was to assess the prevalence of middle mesial canal in mandibular first molars using three -dimensional imaging in the population of North India using spiral CT. **Results-** Three hundred mandibular first molars were examined for the present research. 36 (16.4%) of the 300 teeth have MM canals. The remaining 15 (41.6%) MM canals have been branching off from either the middle or apical third of the MB or ML canals. Of the 36 MM canals identified, 5 (13.88%) had a completely saperate orifice from the MB and ML canals, 18 (50%) shared the same orifice with either the MB or ML canal, and the remaining MM canals were 15 (41.6%). Of the 36 MM canals, only 4 (11.11%) possessed a distinct apical foramen. **Conclusion-** The MM canal originates as a separate orifice but apically joins the MB or ML canal, and independent: The MM canal originates as a separate orifice and terminates as a separate apical foramen.

Keywords- MM Canals, Orifice, Apical Foramen, Mandibular Molars

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1. Introduction

The endodontic therapy is mainly done to prevent or heal apical periodontitis. Due to highly variable root canal anatomy, cleaning and shaping procedures are highly affected. In order to avoid incomplete instrumentation and the preservation of bacteria, the presence of the extra canal needs to be recognized, which can compromise the end result of root canal treatment. Therefore, the understanding of the internal anatomy of a tooth is crucial for successful endodontic therapy.[1]

The most frequent type of tooth to be treated endodontically are mandibular molars.[2] It possesses a series of anatomic challenges which includes multiple canals, lateral canals, isthmus, and apical ramifications.[3]

Traditionally, mandibular molars are two rooted teeth, one mesial root with two canals- mesiobuccal (MB) and mesiolingual (ML) and one distal root with one canal. Sometimes two canals are present.[2] Additionally, the distal surface of the mesial root of the mandibular molars presents with the thin area of dentin known as "danger zone" as there is increased risk of perforation of furcal dentin in this area during mechanical instrumentation.[3]

Studies have shown different variability in the first and second permanent mandibular molars, which includes isthmus between the mesiobuccal and mesiolingual root, a separate distolingual duct or canal, c-shaped anatomy of root canal and third canal in mesial root apart from mesiobuccal and mesiolingual canal known as Middle mesial canal(MMC).[2] The presence of the MM canal was first established in mandibular molars by clearing technique by Barker et al. and Vertucci and William.[4]

Pomeranz et al described the anatomy of MM canals as follows: (1) fin: The file passes freely between the main mesial canal (ML or MB) and the MM canal (transverse anatomies), (2) confluent: The MM canal originates as a separate orifice but apically joins the MB or ML canal, and (3) independent: The MM canal originates as a separate orifice and terminates as a separate apical foramen.[2]

The presence/absence of MM canal is influenced by MB-ML intracanal orifice distance and the age of the patient.[5]The third canal in the mandibular molars are also termed as intermediate canal, mesiocentral canal, third mesial canal, accessory mesial canal, middle mesial canal. Middle mesial canal have a small orifice deep within the isthmus or a developmental groove between orifices of MB and ML root canal.[1]

There are various studies which have investigated the anatomy of mandibular molars, but the incidence of middle mesial canal in the mesial root of mandibular molar is still the subject of disagreement. Various methods such as clearing, troughing and magnification under Dental operating microscope have been used for detection of middle mesial canal and the frequency with the canal is seen which ranges from 0% to 46%.[6 7]

Will Kalender invented the spiral Computed tomography (CT) technique, also known as helical CT. CT scan utilises x-rays and computers to produce cross-sectional slices of the body part. Each picture appears like a slice from a loaf of bread showing both internal and outline structures. It is also used to determine the unusual root canal anatomy compared to routine intracanal periapical radiograph as it gives 2D image of 3D object.[8] Spiral computed tomography has contributed in making confirmatory diagnosis and successful nonsurgical endodontic management.[1]

As CT allows a thorough analysis of fine details of the root canal anatomy and literature review does not suggest any study conducted in south Indian population on prevalence and morphology of middle mesial canal using this technique, so this

study is undertaken to evaluate the prevalence and configuration of middle mesial canal in mandibular first molar using Spiral CT. This research was carried out to assess the prevalence of middle mesial canal in mandibular first molars using three -dimensional imaging.

2. Methodology

The study was conducted in postgraduate Department of Conservative Dentistry and Endodontics, Sri Siddhartha Dental College and Hospital, Agalakote, Tumkur. The main purpose of this study was to assess the prevalence of middle mesial canal in mandibular first molars using three -dimensional imaging in the population of North India using spiral CT.

Armamentarium:

The following materials were used during this study (Figure 1):

1. One hundred thirty freshly extracted maxillary first molars
2. Modelling wax sheet (Pyrax Polymars, Roorkee)
3. 0.9 % Normal saline (kunal Remedies Pvt. Ltd., Lucknow)
4. Ultrasonic Scaler (Suprasson P5, France)
5. Spiral CT scanner (G.E. Brightspeed,Germany)
6. RadiAnt Dicom viewer

MATERIALS	COMPANY	PURPOSE
1. Modelling wax sheet	Pyrax Polymars, Roorkee	To mount the sample teeth
2. 0.9 % Normal saline	saline kunal Remedies Pvt. Ltd., Lucknow	To store the teeth in it so as to prevent dehydration
3. Ultrasonic Scaler	Suprasson P5, SATELEC a company of ACTEON, France	To clean the teeth of any calculus and debris
4. Spiral CT scanner	G.E. Brightspeed, Germany	To scan the teeth

Table 1- Purpose of materials used

Inclusion Criteria

- Sound tooth
- Teeth with complete root development

Exclusion Criteria

- Endodontically treated teeth
- Crowned teeth
- Fractured teeth
- Teeth with severe calcification
- Teeth with C-shaped canal

Intervention/Procedure:

Sample selection and storage:

Human mandibular molars were randomly chosen from Department of Oral and Maxillofacial Surgery, Institute of Dental Sciences, Bareilly.

Teeth were disinfected by immersion in 5.25% NaOCl solution for 15 mins and any attached soft tissue and calculus was removed with an ultrasonic scaler and then these were stored in normal saline solution.

The storage and handling of teeth was performed as per Occupational safety and Health administration guidelines and regulation.

Scanning Procedure:

The teeth was mounted horizontally on a modelling wax sheet and scanned using a Spiral Computed Tomography. They were viewed both cross-sectionally with a constant thickness of 0.625mm/slice and a constant spiral or table speed of 5.62, pitch 0.56 and 120KVP. Subsequently, volume rendering and multiplanar volume reconstruction was performed to evaluate the criteria.[5] The scanned data was then transferred to the RadiAnt DICOM viewer and evaluated

for the following –

- Prevalence of middle mesial canal
- Configuration of middle mesial canal

3. Results

Three hundred mandibular first molars were examined for the present research. 36 (16.4%) of the 300 teeth have MM canals. The remaining 15 (41.6%) MM canals have been branching off from either the middle or apical third of the MB or ML canals. Of the 36 MM canals identified, 5 (13.88%) had a completely seperate orifice from the MB and ML canals, 18 (50%) shared the same orifice with either the MB or ML canal, and the remaining MM canals were 15 (41.6%). Of the 36 MM canals, only 4 (11.11%) possessed a distinct apical foramen.

TABLE 1. Distribution of the configuration of Middle Mesial (MM) Canals

Configuration	**MM canal, n (%)**
Separate orifice from the MB and ML canals	5 (13.8%)
Shared the same orifice with either the MB or ML canal,	18 (50%)
Branching off from either the middle or the apical third of the MB or ML canal.	15 (41.6%)
Separate apical foramen.	4 (11.11%)

TABLE 2. Distribution of the Isthmi and Middle Mesial (MM) Canals Based on Their Presence in Different Axial Slices

	Isthmus only, n (%)	**MM canal, n (%)**	**Isthmus or MM canal, n (%)**
Cervical third	57 (19)	17(5.6)	45 (15)
Middle third	38 (12.6)	13 (4.3)	31 (10.3)
Apical third	74 (24.6)	6 (2)	72 (24)

The occurrence of a single isthmus or MM canal at more than one axial location was considered, which explains the cumulative frequency of more than 100%.

Compared using the chi-square test. The level of significance was set at $P < .05$.

TABLE 3. Distribution of Isthmi and Middle Mesial (MM) Canals in Mandibular Molars Based on the Location of the MM Canal or the Isthmus's Beginning and End

	Isthmus only, n (%)	**MM canal, n (%)**	**Total, n (%)**
Confined to cervical	48 (18.8)	13 (36.1)	61(20.33)

third			
Cervical third to middle third	37 (14.01)	5(13.8)	42 (14)
Cervical third to apical third	29 (10.98)	7 (19.44)	36 (12)
Confined to middle third	28 (10.6)	4(11.1)	32 (10.66)
Middle third to apical third	38 (14.39)	5 (13.88)	43 (14.33)
Confined to apical third	84 (31.81)	2 (5.55)	86 (28.66)
Total	**264 (88)**	**36 (12)**	**300 (100)**

4. Discussion

Mandibular molar root canal morphology has been studied using a variety of approaches, each of which has pros and cons. Plastic moulds, staining and cleaning, an operational microscope, and micro-computed tomographic imaging were some of the techniques used in in vitro investigations. [9,10,11,12] While some of those methods enable a thorough examination of the intricate intricacies of the root canal system, it can be claimed that extracted teeth are not a fair representation of sound human teeth due to the likelihood of prior endodontic or periodontal disease and root canal calcifications. This may aid in understanding why the prevalence of the MM canal was generally lower in earlier investigations on removed teeth than it was in this analysis.

We are aware of no research examining the efficacy of CBCT imaging for MM canal detection. The accuracy of CBCT imaging with a 6 FOV and a voxel size of 0.125, however, has been proven to be 96% for recognising the second MB canal.[13] In contrast to their study, the CBCT imaging employed in this one had a narrower FOV and voxel size, and the image artefacts were decreased by eliminating teeth that had full-coverage restorations and teeth that had received root canal therapy. We may therefore conclude with confidence that the technique employed in this investigation was successful in locating MM canals.

Evaluating negotiable MM canals in nonextracted teeth can be done in clinical in vivo research using an operating microscope; however, it may not always be possible to tell a true MM canal from an isthmus. [14] In contrast to our study, where a real canal was distinguished from an isthmus between the ML and MB canals, those studies (46% and 20%, respectively) may have had a higher incidence of MM canals due to this reason. In this investigation, isthmi were found in 19% of cases while real MM canals were found in 5.6% of cases. We discovered that MM canals and isthmi, which start at the cervical third, were present in 10.7% and 30.3% of all instances, respectively. Due to their cervical placement in the root, gaps between the MB and ML canals in 13.8% of cases (either in the form of a genuine canal or an isthmus) would likely be negotiable and observable clinically. That result is in line with a research by Azim et al.[18] , which found combined true MM canals and isthmi in 46% of mandibular molars beneath magnification following troughing in the mesial root within a 2-mm depth.

For therapeutic and pathogenetic purposes, the apical portion of the canal is the most important domain.[8] According to study results, MM canals

only left through a distinct apical foramen in 11.11% of all cases. This finding may suggest that missing an MM canal in a mandibular molar may not be as significant as missing a second MB canal in a maxillary molar, in which 46% of cases have a separate apical foramen, even though the cleaning and shaping of these canals shouldn't be clinically interpreted as insignificant. 48 Despite this, the response to the preceding query is obvious. It has been demonstrated that infected canals, isthmi, and apical periodontitis are related.[15] The untreated canals and isthmus can become biofilm-covered or, in treated situations, even more clogged with microorganisms. Additionally, if not instrumented, disinfecting irrigants would not be capable of reaching these locations.[18] Even if the irrigant only reaches certain areas, it might not be sufficient to completely remove the biofilm.[17] Therefore, it is advised to measure and completely irrigate these sites regardless of the presence of an MM canal or isthmus.

The canal configuration of mandibular first molars' mesial roots varies greatly. Vertucci, Williams, Barker, and others first mentioned the existence of an independent MM canal in 1974.[19,20] A fin, confluent, and independent morphologic classification of MM canals was made by Pomeranz et al.[21] The MM canal, according to Mortman, is not an additional canal but instead the result of instrumenting the isthmus between the MB and ML canals. [22]Nevertheless, in these categories, an isthmus and a real MM canal were not distinguished.

5. Conclusion

The occurrence of a single isthmus or MM canal at more than one axial location was considered, which explains the cumulative frequency of more than 100%. The MM canal originates as a separate orifice but apically joins the MB or ML canal, and (3) independent: The MM canal originates as a separate orifice and terminates as a separate apical foramen

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