

Prevalence of Middle Mesial Canals and Isthmi in the Mesial Root of Mandibular Molars: A Retrospective Cone-Beam Computed Tomographic Study

Tushar Luthra¹⁾, Rahul Singh²⁾, Neha Agrawal³⁾, Amit Chhapparwal⁴⁾,
Santosh R Patil⁵⁾, Mohammad Khursheed Alam⁶⁾

ABSTRACT

Objective: To know the prevalence of a true middle mesial canal and isthmus in the mesial root of lower first and second molar teeth using cone beam computed tomography (CBCT) in an Indian population.

Material and Methods: Two hundred fifty-six mandibular first and second molar teeth were evaluated from CBCT scans of 220 patients. Age, gender, presence of isthmuses and middle mesial canals and number of root canals in the mesial root were documented.

Results: Of the 256 teeth studied, 38 (14.8%) of teeth were having true middle mesial canals. The prevalence of the middle mesial canal was 28% in first molar teeth and 7% in second molar teeth and the occurrence among the two teeth was statistically non-significant ($P = 0.83$). No statistical difference was found between the presence of middle mesial canal and age and gender. The frequency of isthmi in the mesial roots was 69.63% and the prevalence of isthmi was significant in patients between 20 to 30 years of age ($P < 0.001$).

Conclusion: This study showed an increased rate of lower molar teeth with middle mesial canals or isthmi.

KEY WORDS

middle mesial canal, isthmus, cone-beam computed tomography

INTRODUCTION

The success of endodontic treatment depends on the ability to explore and debriding all the root canals. It has been confirmed that, any remaining untreated root canal contain necrotic debris and bacterial contents which may lead to apical periodontitis. Hence a detailed knowledge of root canal morphology is necessary to carryout successful endodontic therapy¹⁾.

Isthmi are narrow ribbon like communications between root canals found in the upper and lower molar teeth. The isthmus contain necrotic tissue and organic remnants which promote the growth of bacteria. It is difficult to carry out complete debridement of isthmus by routine techniques²⁾.

Various studies have been carried to assess the morphology of the lower molar teeth, but still the prevalence of the middle mesial canal in the mesial root of the lower molar remains controversial³⁾. The middle mesial canal differs in morphology and site of occurrence and its preva-

lence is known to be different among population of different ethnic groups and age group. Apart from this, the different techniques and methods employed to study the root canal morphology have known to be a reason behind the variation in the prevalence of middle mesial

Table 1: Distribution of the isthmi and middle mesial canals based on location

	Isthmus only <i>n</i> (%)	Middle mesial canal <i>n</i> (%)	Isthmus or middle mesial canal <i>n</i> (%)
Cervical 1/3 rd	84 (32.8)	31 (12.1)	115 (44.9)
Middle 1/3 rd	32 (12.5)	34 (13.28)	66 (25.78)
Apical 1/3 rd	110 (42.9)	30 (11.7)	140 (54.6)

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1) Department of Endodontics, Rama Dental College
Kanpur U.P. India

2) Department of Orthodontics and Dentofacial Orthopaedics, Chandra Dental College and Hospital
Lucknow U.P. India

3) Department of Conservative Dentistry and Endodontics, New Horizon Dental College and Research Institute
Sakri, Bilaspur India

4) Department of Conservative Dentistry and Endodontics, RKDF Dental College
Bhopal, India

5) Department of Oral Medicine and Radiology, New Horizon Dental College and Research Institute
Sakri, Bilaspur India

6) Orthodontics Unit, College of Dentistry, Jouf University
Kingdom of Saudi Arabia

Correspondence to: Santosh R Patil
(e-mail: drpsantosh@gmail.com)

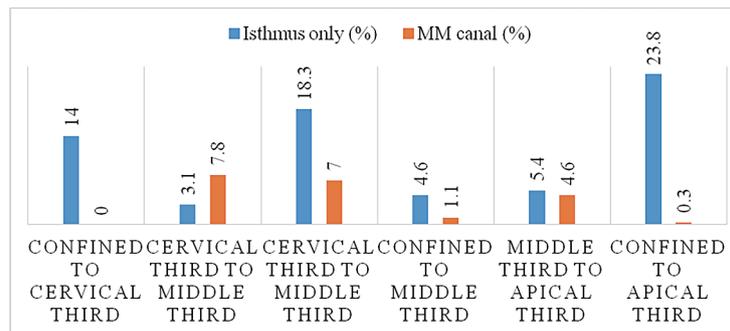


Figure 1: Distribution of isthmi and middle mesial canals based on the location of the medial mesial canal or the isthmus's origin and termination

canal³).

Cone beam computed tomography (CBCT) has been proven to be a useful imaging modality with many advantages over conventional imaging methods and many authors studied root canal morphology using CBCT in both primary and permanent teeth^{1,4,9}.

Various studies have been carried out previously to study the root canal morphology in Indian population but no much information is known about specifically known regarding isthmuses and middle mesial canals among Indian populations¹⁰.

The present study is carried out to know the prevalence of a true middle mesial canal and isthmus in the mesial root of lower first and second molars using CBCT in an Indian population.

MATERIALS AND METHODS

The present study was carried out after obtaining approval by Local Committee of Bioethics of Institute. CBCT scans of 220 patients were evaluated and analysed. Two examiners were calibrated based on the criteria and variants established before interpreting the scans. All the scans were evaluated simultaneously in axial, coronal and sagittal views to reach a consensus for the interpretation and the findings were correlated across these images to arrive at a conclusion.

Age and gender were recorded and the subjects were categorized into 4 age groups: less than 20 years, 21 to 40, 41 to 60 and more than 60 years of age.

The permanent lower first molar and second molar teeth were included in the study. Teeth with root canal therapy and/or having full-coverage prosthesis, teeth with incomplete formation of apices, teeth with resorbed roots, or calcification were not included in this study. While interpreting, the number of roots, the number of existing canals in the mesial root, and the configuration of the root canal system in the mesial root were documented. In the axial view, an isthmus was identified as a narrow ribbon-shaped communication between the mesiobuccal and mesiolingual canals. The middle mesial canal is considered to be present; if a radiolucency with a clear round cross section was observed between the mesiobuccal and mesiolingual canals regardless of the presence or absence of an isthmus. The findings were further divided into six types depending on the location of the middle mesial canal/ isthmus origin and termination¹¹.

The data obtained was analyzed with Statistical Package for Social Sciences version 21.0 (SPSS Inc, Chicago, IL) by applying chi-square test and the level of significance was set at $P < 0.05$.

Results (Tables 1 and Figure 1)

In the present study, two hundred fifty-six lower first and second molar teeth from two hundred twenty patients were evaluated. Among the study subjects, 62 were males and 48 were females with mean age of 42 ± 17.22 years. Out of the 256 teeth studied, 38 (14.8%) had middle mesial canals. The prevalence of the middle mesial canal was 28% in first molars and 7% in second molars and the occurrence among the two teeth was statistically non-significant ($P = 0.83$). Similarly, no significant difference between gender ($P = 0.64$) and age ($P = 0.93$) and the prevalence of the middle mesial canal. Out of the 38 middle mesial canals identified, 7 were identified with separate orifice from the mesio-

buccal and mesiolingual canals, 12 shared the same orifice with either the mesiobuccal or mesiolingual canal, and the rest were branching off from either the middle or the apical third of the mesiobuccal or mesiolingual canal. Only 4 of 20 middle mesial canals had a separate apical foramen.

No significant gender-dependent differences were noted with regards to prevalence of isthmus ($P = 0.592$), but a significant difference was noted when compared among different age group, with an increase in prevalence in patients between 20 to 39 years of age ($P < 0.001$). The frequency of isthmi in the mesial roots was 69.53% and was also higher in second molars when compared to first molar. In 84 (32.8%) of the cases, isthmi were present in the cervical third, 32 (12.5%) in the middle third and 110 (42.9%) in the apical third. Thirty-six (14%) had isthmi beginning from the cervical third and continuing into the apex. Along with these findings it was observed that 10 second molars were having C-shaped canals and 2 were radix entemolaris.

DISCUSSION

Different modalities have been employed to analyse the root canal morphology of lower molar teeth and each technique has some benefits and shortcomings. Various studies using plastic casts, staining and clearing method, assessing with operating microscope, imaging with micro-computed tomographic imaging were carried out previously to study the root canal morphology. There are only limited studies in the literature where CBCT images were used to detect middle mesial canals¹². In the present study, teeth treated with root canal therapy and teeth with restorations covering the entire crown were excluded to avoid the artefacts, there by all the images were precisely interpreted without any bias.

It has been reported that middle mesial canals may be detected using an operating microscope clinically; but it is impractical to distinguish between true middle mesial canal and isthmus¹³. Therefore, a higher prevalence of middle mesial canals may be reported in the previous studies compared with the results of the present study where a true canal was distinguished with isthmus between the mesiolingual and mesiobuccal canals. In this study, true middle mesial canals were detected in 14.8%, and isthmi were detected in 66.53% of cases. In this study, 12.1% and 32.8% of total cases had middle mesial canals and isthmi beginning from the cervical third, respectively. Therefore, in total, 44.9% of cases had spaces between the mesiobuccal and mesiolingual canals (either in the form of a true canal or isthmus), which would be likely negotiable and detectable clinically because of their cervical location in the root. This finding is consistent with a study by Azim *et al.*, in which combined true middle mesial canals and isthmi were detected in 46% of mandibular molars under magnification after troughing in the mesial root within a 2-mm depth¹³. This observation was slightly higher than that of Tahmasbi *et al.*, who noted a lesser incidence (41%) of the similar finding¹⁴.

The apical portion of the root canal is regarded as one of the critical domains in pathological and therapeutic terms and cleaning the isthmuses in this location is considered as a necessary step for successful endodontic treatment results¹⁵. Studies in literature report a clear correlation among canals which were not treated and isthmi and formation of apical periodontitis^{15,16}. A biofilm is seen to be covering the isthmus and canals which were not treated. If not instrumented thoroughly then disinfecting solutions may not reach to these locations during canal irrigation process. It has been also reported that the irrigant may also fail to remove

the biofilm even after reaching to these locations¹⁵). Therefore, irrespective of the presence of an middle mesial canal or isthmus, it is recommended to instrument and thoroughly irrigate these areas. In the present study only 3.1% of the cases revealed middle mesial canals present from a separate apical foramen. Although this finding should not be clinically translated as the biomechanical preparation of these canals being so significant, this may suggest that not identifying a middle mesial canal in a lower molar tooth may not be as dramatic as missing a second mesio-buccal canal in an upper molar tooth, in which 46% of cases reported having a separate apical foramen¹⁶).

In this study, the combined prevalence of the isthmus and the MM canal in the apical third of the mesial roots was 54.6%, this observation was in accordance with the finding of Tahmasbi *et al.*¹⁴). In contrast to this, Von Arx noted a very high value (83%) of isthmi in the mesial root of lower first molars¹⁸). Xu *et al.*, noted a considerably lesser values of true middle mesial canal (3.1%) and 55.5% exhibiting the isthmi using CBCT¹⁹).

In the present study the isthmi and middle mesial canals were defined based on the criteria used in the previous similar studies by Tahmasbi *et al.*¹⁴) and Xu *et al.*¹⁹).

Studies in the literature considered the presence of middle mesial canals if three canals were present in the medial roots²⁰⁻²²). Some studies define isthmuses based on the occurrence of thin ribbon-shaped communications between the mesiobuccal and mesiolingual canals. Isthmi were also defined as type I if having either 2 or 3 canals with no noticeable communication, types II when having 2 canal and type III isthmuses if have 3 canals each with distinct communication between the main canals, type IV isthmuses if the canals were extending into the isthmus region and type V if the isthmi having extensive connections throughout the region¹⁹). These disparities in definitions and different modalities used for assessing the root canal morphology could be the main reasons for the difference of the prevalence of middle mesial canals and isthmi among different studies.

CONCLUSION

CBCT may serve as a promising imaging modality for identifying middle mesial canals and isthmi. The presence of isthmus is regarded one of the main factors which leads to unsuccessful endodontic therapy in lower molar teeth. Middle mesial or Isthmi at the apex of the mesial root may act as portals of exit; therefore, identifying and cleaning these sites while carrying out a surgical root canal therapy is a significant step.

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