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Radiographic analysis of interorifice distance and canal configuration in mesial roots of mandibular first molars

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Abstract---Introduction: The Middle Mesial Canal (MMC) is an additional root canal that can be present in the mandibular molars of some patients with high chances of being missed. The aim of this study is to determine the inter orifice distance between Mesio Buccal (MB) and Mesio lingual (ML) canal orifice and its association with the presence or absence of MMC using CBCT to help the operator clinically in identifying the presence of MMC. Methods: 50 CBCT samples consisting of 100 permanent mandibular first molar teeth were analysed. The distance between the mesiobuccal and mesiolingual orifice was recorded. Statistical Analysis such Independent T test and Pearson correlation were used to determine the association between MB and ML interorifice distance and presence of MMC and variation in the prevalence of MMC among male and female and different age groups. Results: The mean distance between MB and ML canal orifice was 3.19 ± 0.42 mm, in the presence and absence of MMC the mean distance was 3.66 ± 0.24 mm and 3.07 ± 0.38 mm respectively. The mean inter orifice distance in males was 3.29 ± 0.38 mm and in females was 3.08 ± 0.45 mm. There was no significant correlation between the MB and ML inter orifice distance and the presence of MMC ($P=0.553$). However the distance was longer in the presence of MMC. No significant difference in the prevalence of MMC among different age groups and gender. Conclusion: Although there was no significant correlation between MB and ML inter orifice distance and presence of MMC, the distance was longer in the presence of MMC. Further clinical studies under magnification are

required to assess the inter orifice distance clinically and establish its association with the presence of MMC.

Keywords---canal configuration, inter orifice distance, mandibular first molar, middle mesial canal.

Introduction

The purpose of root canal treatment is complete debridement and disinfection of root canal space and filling it with inert material to prevent leakage.¹ Hess stated that before completion of root growth, the mesial canal is a single wide canal, with age there is deposition of dentin in the middle dividing it into two different canals. He also found that the sections of teeth from older individuals revealed two distinct mesial canals with microscopic fissures connecting them.² Vertucci and Williams and Barker et al, first noticed the presence of the Middle Mesial Canal (MMC) in the mandibular molars in 1974.^{2,3}

The prevalence of MMC varied widely from 1% to 36% in various ex vivo and clinical studies.⁴⁻¹⁰ Pomeranz et al reported three different anatomical variations of MMC (i) Fin: when a file can pass without any hindrance between the Mesio Buccal canal (MB), Mesio lingual canal (ML) and MMC, (ii) Confluent when MMC begins as a separate canal but joins the MB or ML canal at the apex, (iii) Independent when the MMC begins and ends as a separate canal.¹⁰ These complicated root canal morphologies are a challenge to the endodontic procedures.

Although conventional intraoral periapical radiographs are essential for endodontic procedure they possess certain limitations in diagnosing the canal morphology completely due its two dimensional nature. In 1990 computed Tomography was introduced to endodontics.^{10,11} Cone Beam Computed Tomography (CBCT) with lesser radiation exposure and cost has been reported to be very useful in endodontics especially in the examination of root canal morphology.¹²⁻¹⁴ The aim of the present study is to determine the inter orifice distance between Mesio Buccal and Mesio lingual canal orifice and its association with the presence or absence of MMC using CBCT in the South Indian population.

Materials and method

Sample Collection and Analysis

This cross sectional study was conducted in Saveetha Institute of Medical and Technical Sciences from September, 2020 to February, 2021. Ethical permission and approval for the project was obtained from the institutional review board of Saveetha Institute Of Medical And Technical Sciences, Chennai, India.

Mandibular or Full mouth CBCT was Collected from the Saveetha Dental College DataBase. The Sample size was 50 at the power of 95%. The Samples were randomly selected using odd and even number methods. The CBCT samples were validated. The CBCT which belonged to patients in the age group of 18-60 years

and only the CBCT with the presence of bilateral mandibular first molars were included in the study.

The demographic data such as name, age and gender of the patient along with the dependent variable such as Distance between mesiobuccal and mesiolingual canal orifice in millimeters (mm), presence of middle mesial canal and the mesial canal configuration were recorded.

Statistical Analysis

The data was entered in an excel sheet and coded. The Data was imported to IBM SPSS V.20 software. Shapiro - Wilks analysis was done to determine the normality in data distribution. Descriptive analysis such as Mean and standard deviation was done for the distance between mesiobuccal and mesiolingual canals. Pearson correlation test was performed to establish association between presence of middle mesial canal. There was a significant correlation if $P < 0.01$. Independent T test was performed to determine the variation in mean MB and ML inter orifice distance between different age groups and gender. Chi square test was done to determine the variation in the prevalence of MMC among the 2 age groups and genders. $P < 0.05$ was considered significant.

Results

50 CBCTs with a total of 100 mandibular first molars belonging to 25 males and 25 females in the age group of 18-60 years were analysed in the study. The mean distance between the Mesiobuccal (MB) and Mesiolingual (ML) canal orifice was 3.19 ± 0.42 mm, in the right mandibular first molar (46) it was 3.23 ± 0.44 mm and 3.14 ± 0.41 mm in the left mandibular first molar [Table 1]. The mean distance between MB and ML canal orifice for male and females was 3.29 ± 0.38 mm and 3.08 ± 0.45 mm respectively. There is no significant difference among males and females ($P = 0.591$) (Table 2). Out of 100 examined mandibular first molars 20% ($N=20$) showed the presence of the Middle Mesial Canal (MMC) with a mean distance of 3.66 ± 0.24 mm. The mean distance between MB and ML orifice was 3.07 ± 0.38 mm in the absence of MMC. Pearson correlation showed no significant association between the distance between MB and ML and the presence of MMC ($P = 0.553$) [Table 3]. Out of 80 teeth without MMC, 39 teeth showed 2-1 configuration with mean inter orifice distance of 3.04 ± 0.40 mm and 41 had 2-2 configuration with a mean inter orifice distance of 3.09 ± 0.36 mm. All the teeth with MMC had confluent 3-1 or 3-2 configuration with a mean inter orifice distance of 3.67 ± 0.26 mm and 3.65 ± 0.23 mm respectively [Figure 3]. The presence of MMC in the 18-34 years age group was 21.67% and in the 35-60 years age group was 17.5%. No significant difference between the age and the presence of MMC ($P = 0.799$) [Table 2] [(Figure 2)].

Discussion

Variations in root canal morphology is a commonly reported phenomenon and mandibular molars are no exception. Early Studies by Hess and Skidmore et al showed the presence of anastomoses of canals in the mesial root of the mandibular molars at all levels. The prevalence of MMC ranged from 0- 15% in

studies that were published from 1970s to 1990s. However Azim et al in 2015 detected the presence of MMC in 37.5% of mandibular first molars among the 56 teeth under magnification.¹⁵ Weinberg in 2020 reported the presence of true MMC or broad isthmus in 66.6% of teeth using CBCT.^{15,16} With magnification and latest imaging techniques the detection of MMC has increased greatly over the past few years.¹⁷

In the present study the prevalence of MMC in the mandibular first molar was found to be 20%, this was similar to a study by Nosrat et al, where he found 20% of the endodontically treated mandibular first and second molars had a negotiable MMC.¹⁷ There was an increased prevalence of MMC in the younger age group (18-34 years) than in the older population (35-60years) though not significant. This result was in agreement with two other previous studies where 32.1 % MMC were negotiable in mandibular molars in patients of 20 years or below and Gu et al reported the patients aged 20-39 years had significantly higher prevalence of isthmuses than in individuals older than 60 years using in vitro micro Computed Tomography reconstructions.^{17,18} It was also reported that with age the average ratio of a partial isthmus to a complete.^{17,18} In our study we found no significant difference in incidence of MMC between male and female which is similar to the study by Nosrat et al where there is no significant difference in the prevalence of mmc based on gender or ethnicity.^{17,18}

In this study there was an increase in mean distance between mesiobuccal and mesiolingual canal orifice in the presence of MMC but the difference in distance between the MB and ML in absence and presence of MMC was not significant. This is in contrast to that of Weinberg et al study where the mean distance between MB and ML orifice in presence of MMC was lower than in absence of MMC but the difference was insignificant, similar to that of our present study.¹⁶

The mean distance between the canals was lowest in 2-1 configuration and highest in 3-2 configuration. The mean distance was lower in 2-1 configuration than in 2-2 configuration, this result was similar to that of study by Cimilli et al.2006. In addition, it was reported that an increase in the distance between MB and ML canal orifice is a predictive factor for the presence of 2-2 (Vertucci Type IV) configuration.¹⁹

The distance between the MB and ML canal orifice could be a predictive factor for the presence of MMC and can be helpful in endodontic treatment planning. The detection of aberrant root canal anatomy is a huge challenge in endodontics. Use of radiographs and clinical examination of the pulpal floor under magnification can aid in detection of extra root canals.²⁰ It is well documented that there is a better visibility of the pulp chamber with the use of magnification such as a dental operating microscope.^{5,21} The introduction of CBCT has revolutionized the diagnosis and treatment planning especially in complicated endodontic cases to assess the root canal morphology.^{22-24,25} The advantage of CBCT is that it allows the clinician to view the root canal in various slices, at various levels and different axes.^{26,27}

The limitations of the present study include the inability to assess the variation in prevalence of MMC based on inter orifice distance between MB and ML canals

among the various ethnicities since the study was confined to the south Indian population. This study used only CBCT analysis, for accurate correlation between inter orifice distance between MB and ML canals it is important to determine the inter orifice distance clinically and correlate it with the presence of MMC and also with the morphological differences.

Conclusion

The prevalence of MMC was found to be 20% in the South Indian Population. There was an increase in inter orifice distance between MB and ML canals in the presence of MMC but it was not significant. Hence, the distance between the MB and ML can be a predictive factor for determining the root canal configuration.

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Table 1 : Mean distance between MB and ML canal orifice

Teeth	No. of teeth	Mean distance between MB and ML orifice in mm
Left mandibular first molar(36)	50	3.14±0.41
Right mandibular first molar (46)	50	3.23±0.44
Total	100	3.19±0.42

Table 1: The mean±SD inter orifice distance between Mesiobuccal (MB) and Mesiolingual (ML) in millimeters (mm) for left and right mandibular first molars.

Table 2: Mean inter orifice distance between MB and ML canals based on Gender and Age

Category	Sub group	No. of teeth analysed	Presence of MMC	P value	Mean distance between MB and ML canal orifice in mm	P value
GENDER	Male (n=25)	50	12	0.598	3.29±0.38	0.591
	Female (n=25)	50	8		3.08±0.45	
AGE GROUP	18-34 years (n=30)	60	13	0.799	3.23±0.41	0.455
	35-60 years(n=20)	40	7		3.13±0.44	

Table 2: The variation in the mean±SD inter orifice distance between MB and ML and prevalence of MMC in different age groups and gender. $p < 0.05$ is significant.

Table 3: Presence of MMC and mean inter orifice distance

Presence of Middle Mesial Canal (MMC)	No. of Teeth	Mean distance between MB and ML orifice	P value
MMC Absent	80	3.07±0.38	0.553

MMC Present	20	3.66±0.24	
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Table 3: The association between the mean±SD MB and ML inter-orifice distance and the presence or absence of MMC. $P < 0.01$ is significant.

Figure 1

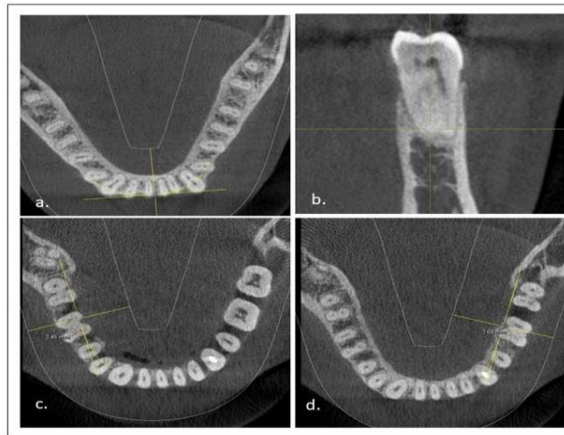


Figure 1: CBCT of mandibular arch, a- Axial section of the mandibular arch, b- Sagittal section of the mandibular first molar with Middle Mesial Canal, c and d - Axial section of right and left mandibular first molar with MB and ML inter orifice measurement in millimeters.

Figure 2

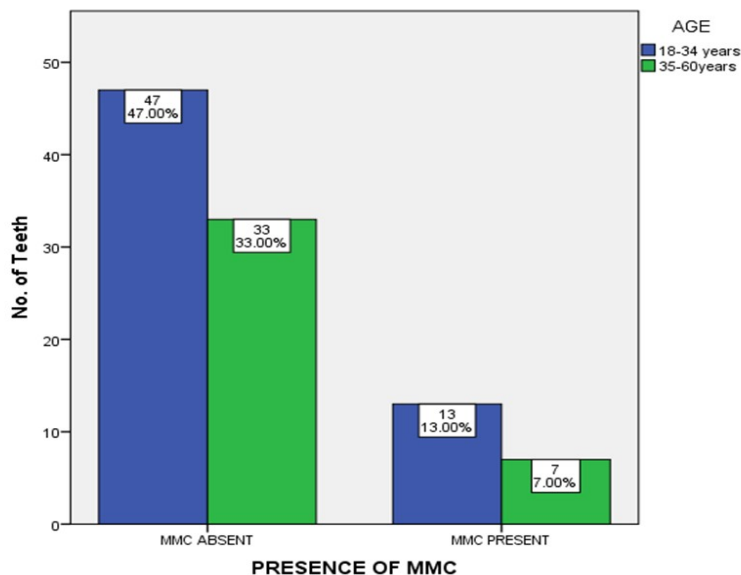


Figure 2: Clustered Bar chart representing the presence of MMC in 2 different age groups

Figure 3

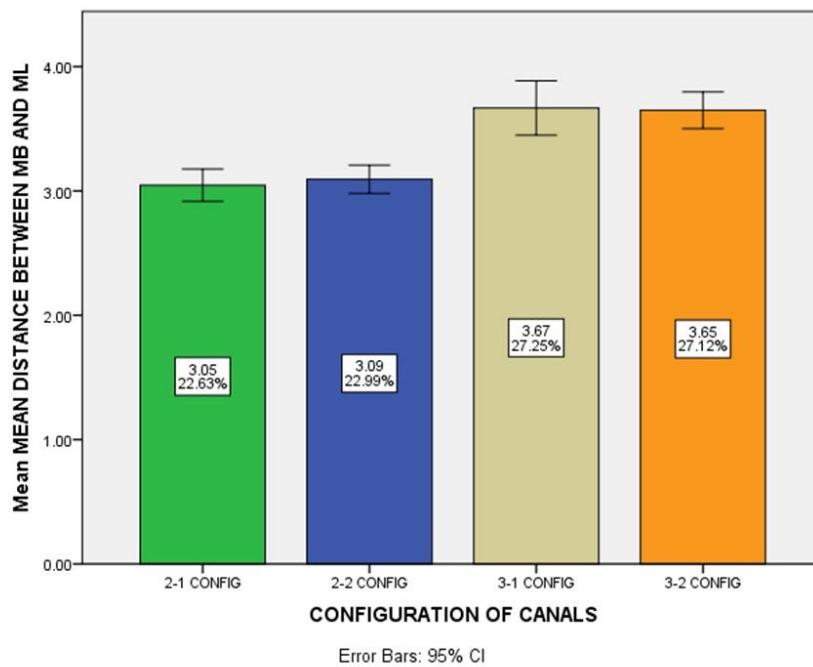


Figure 3: Clustered Bar chart representing the mean inter orifice distance between MB and ML and the canal configuration clustered based on gender.