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Prevalence of The Second Mesio-buccal Canal and Second Distobuccal Canal in The Maxillary First Molars Among A Sample of Erbil –Kurdistan Region Population Using CBCT

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ABSTRACT

Background and Objectives: Adequate knowledge of anatomic variations in root canal morphology is essential for improving the outcome of root canal treatment. The maxillary first molars commonly require endodontic treatment; however, they are known to have the most complex root canal systems.

Aim: To evaluate the frequency of the second mesiobuccal (MB2) canal and the second distobuccal (DB2) canal in maxillary first molars, as well as the bilateral symmetry of the maxillary first molars (MFM) with the second mesiobuccal canal, and the association of gender and age to their occurrence using cone beam computed tomography (CBCT).

Methods: This retrospective study investigated 140 maxillary first molars from 80 CBCT scans collected from a private dental imaging centre in Hawler over 4 months from May to August 2024. The patients were aged 13 to 57 years (mean age: 29.1 years). Data were analysed using SPSS (version 25) with descriptive statistics and the Chi -Square test.

Results: The prevalence of the MB2 canal in MFM was 53.6%. Both males and females have a similar prevalence of MB2 canals in their MFM. In 75 MFM with MB2 canals, a single apical exit was found in 51.9% of the cases. No significant correlation was found between the prevalence of the MB2 canal and gender or age. In the 41 patients with MB2 canals in their MFM, the likelihood of bilateral MB2 canals was high (82.9%). The frequency distribution of the second distobuccal canal was low (7.9%); however, the age group 21-30 showed the highest occurrence of second distobuccal canals in MFM.

Conclusion: The use of CBCT is a valuable tool in detecting MB2 canals, therefore improving the outcomes of root canal treatment. A high prevalence of MB2 canals was found in the study. The prevalence of bilateral MB2 was high.

Keywords: Cone beam computed tomography (CBCT), Maxillary first molar, MB2, Root canal system, Distobuccal canal.

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INTRODUCTION

Despite overall improvements in oral health, Root Canal Treatment remains a standard procedure in dental practice. The goal of Root Canal Treatment (RCT) is the thorough debridement, disinfection, and three dimensional obturation of the all root canal system.[1] To obtain a successful Root Canal Treatment a detailed knowledge of root canal system, particularly in teeth that show complex and variable internal configurations is required.[2] Inability to locate these variations in root canal morphology can result in harboring of bacteria and resultant failure of the treatment.[3]

The first maxillary molars present the most significant variations in their root canals with respect to their mesiobuccal root canal configurations. In contrast to mesiobuccal canals, the distobuccal and palatal root canals of MFM show slight variation.[4] However, some studies have reported the presence of additional canals for the distobuccal and palatal roots of maxillary first molars.[5, 6]

At present, numerous methods have been used to evaluate the root canal system, including micro-CT, radiographic examination, spiral computed tomography (CT), thin-layer scanning, cone beam computed tomography (CBCT), and dental operating microscope. However, CBCT has been used to assess the root canal system due to its short exposure time, noninvasiveness, minimal distortion, accuracy, and three-dimensional visualisation.[7, 8]

It has also been suggested that several factors may contribute to root canal morphology, including hereditary, racial, demographic, and environmental factors.[9, 10]

The study aimed to assess the root canal configuration in MFM, evaluate the prevalence of MB2 and DB2 canals, the portal of exit of MB2 canals, and the concurrence of MB2 canals in bilateral MFMs in the same person using CBCT. Also, it was evaluated to determine whether there is an association between the MB2 canal and gender and age.

MATERIALS AND METHODS

This retrospective cross-sectional study has received approval from the institutional ethics committee of college of dentistry, Hawler Medical University (DEP_Cons10224_REF_HMUD2425 120). CBCT images of maxillary first molars were collected from 80 patients, including both genders. MFM on the right and left sides of the patients were assessed. One hundred forty maxillary first molars met the inclusion criteria; patients were aged 13-57 years (mean age: 29.1). CBCT scans were taken for diagnostic purposes or other dental procedures at Alpha Oral radiology and imaging centre located in Hawler from May to August 2024.

Inclusion and Exclusion Criteria

Teeth with complete root development and pulp cavity, without coronal restorations or any root canal filling materials, were included in the study. At the same time, exclusion criteria were teeth with open apices, artefacts caused by root canal operation, and calcification of the pulp cavity, or the canal that could affect the integrity of root canal morphology.

CBCT Source

A single CBCT device took existing scans with the scanning parameters set as the Following: 94 kVp, 8.4 ma, 20 – 40 s exposure time, 0.25 mm voxel size, with the image resolution of 0.08 mm. After adjusting the contrast and brightness of each CBCT image, a radiologist observed the axial, sagittal and coronal images of the maxillary first molars by moving the roller downward and upward from the pulp chamber to the radiographic apex in the image to evaluate the presence of the MB2 canal, as well as other remaining canals (DB2) in the coronal third of the teeth and the apical portal of the exit of the mesiobuccal canals. (figure 1 and figure 2)

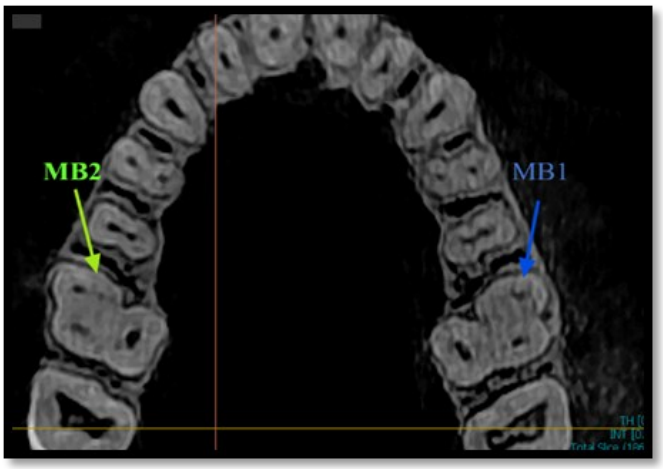

Figure 1. Indicates MB2 canal (green arrow) on an axial cross-section of right MFM, MB1 canal on the left MFM (blue arrow)

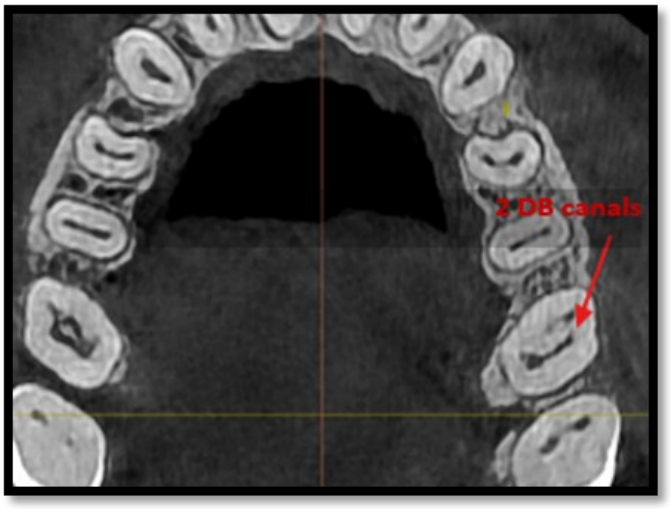

Figure 2. Indicates second distobuccal canal (red arrow) on an axial cross-section of right MFM

Statistical method

The data in this study were analysed using SPSS version 25 (IBM SPSS Statistics) with descriptive analysis and the Chi-Square test. In all statistical tests, $P < 0.05$ was considered statistically significant.

RESULTS

Of the 80 CBCT scans examined, 70 met the inclusion criteria and were analysed in the study. A total of 140 maxillary first molars (66 males, 74 females) were observed. The patients' ages ranged from 13 to 57 years (mean age, 29.1 years). Table 1shows the descriptive analysis of the study.

The overall prevalence of MB2 in the maxillary first molars was 53.6% (75 teeth). Among all age groups, those aged 21–30 years had the highest prevalence of MB2 canal (42.7%), whereas those aged 50+ had the lowest (8%). However, when the data were analyzed using the Chi-Square test, there was no significant difference among the five age groups ($P = 0.632 > 0.05$). (Table 2)

Table 1. Summary of the descriptive analysis of the study data.

Mean	29.21
Median	26.00
Std-deviation	10.401
Minimum	13
maximum	57

Table 2. The prevalence of MB2 canals in MFM in relation to age

	MB2 canal present n	Percentage	MB2 canal absent n	Percentage	Total	Chi-Square (df)	P value
Age groups							
13-20 yrs	13	17.3%	12	18.5%	25 (17.9%)	1	0.632
21-30 yrs	32	42.7%	29	38.7%	61 (43.6%)	1	
31-40 yrs	17	22.7%	11	14.7%	28 (20%)	1	
41-50 yrs	7	9.3%	8	10.7%	14 (10%)	1	
>50 yrs	6	8%	5	6.7%	12 (8.6%)	1	
Total	75	53.57%	65	46.43%	140(100%)		

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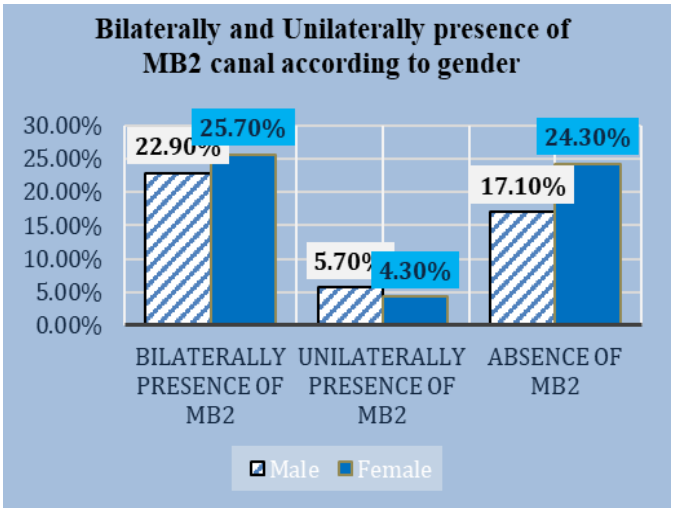
The frequency of MB2 canal occurrence in both genders was illustrated in Table 3. Females (50.7%) had a slightly higher percentage of MB2 canal in MFM than males (49.3%); however, this difference was not significant ($p = 0.316 > 0.05$).

Among the 75 maxillary first molar teeth with MB2 canal, the frequency distribution of MB2 The canal conjoins with the MB1 Canal at apical exit (51.9%), which was greater than the MB2 canal (48.1%) exit through a separate apical foramen. When the data were analysed using the Chi-Square test, the difference was not statistically significant ($P > 0.05$).

Out of 41 patients with MB2 canals, 34 (82.9%) had bilateral maxillary first molars with MB2 canals, whereas 7 (17.1%) had unilateral maxillary first molars with MB2 canals. The data shown in graph 1

It was based on all patients having MFM with MB2 canals bilaterally, unilateral MB2 canals, or only maxillary first molars. Overall, the prevalence of the second distobuccal canal in MFM was 7.9%. Table 4 illustrates the prevalence.

However, the frequency distribution was similar for females and males, and no significant correlation was found between gender and the prevalence of a second distobuccal canal ($P > 0.05$).



Graph 1. The distribution of bilaterally and unilaterally presence of MB2 canals by gender

Table 3. The prevalence of MB2 canals in MFM in relation to gender

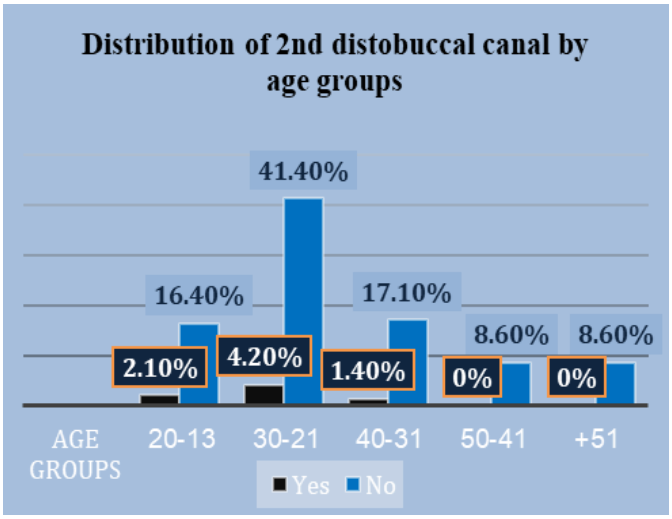
	MB2 canal present n	Percentage	MB2 canal absent n	Percentage	Total	Chi-Square (df)	P value
Gender							
Male	38	50.7%	28	43.1%	66(47.1%)	1	0.316
Female	37	49.3%	37	49.3%	74(52.9%)	1	
Total	75	100%	65	100%	140(100%)		

Table 4. The frequency distribution of MB2 canal conjoins with MB1canal in relation to gender

	Single exit n (%)	Two exit n (%)	Total	Chi-square (df)	P value
Gender					
Males	28 (51.9%)	12 (57.1%)	40 (57.1%)	1	0.131
Females	26 (48.1%)	9 (42.9%)	35 (42.9%)	1	
Total	54 (100%)	21 (100%)	75 (100%)		

Table 5. The prevalence of MB2 canals in MFM in relation to gender

	2nd distobuccal canal presence	Percentage	2nd distobuccal canal absence	Percentage	Total	Chi-Square (df)	P value
Gender							
Male	5	7.6%	61	92.4%	66(47.1%)	1	0.231
Female	6	8.1%	68	91.9%	74(52.9%)	1	
Total	11	7.9%	129	92.1%	140(100%)	1	



Graph 2. The distribution of 2nd distobuccal canals by age groups

DISCUSSION

Considering the frequency distribution of the second distal canal, no statistically significant difference was found among the five age groups ($P > 0.05$). The age group 21–30 years old showed the highest occurrence (4.2%) of the second distobuccal canal. (graph 2)

In this study, the prevalence of the MB2 canal and the second distobuccal canal in MFM, and their association with several demographic factors, were assessed.

CBCT may be an efficient tool for the detection of MB2 canals in MFM before endodontic treatments, owing to high accuracy, noninvasiveness, and precise visualization of complex root canal morphology in a three-dimensional manner. 11 However, its use as a routine preoperative diagnostic tool is not currently advocated.

In the present study, CBCT was used to evaluate the canal system of MFM through a three-dimensional scan to understand its complex morphology and to ensure successful root canal treatment. The prevalence of MB2 canals in MFM (54.6%) was lower than that reported in several countries.[12,13,14] This may be due to differences in sample size, the way samples were collected, or the methods used to evaluate the presence of MB2 canals in MFM. However, a study conducted in Malaysia by Rahman et al. showed that 59.9% of MB2 canals in Maxillary first molars, a finding similar to that of the present study.[15]

There were no significant differences in the frequency of the distribution of MB2 canals in Maxillary First Molars within different age groups. The current findings were consistent with a study done by Martins et al. (2020).[16]

They claimed that age could not significantly affect the prevalence of MB2 canals in MFM; therefore, dentists should be aware of the presence of canals at any age. The study found no significant differences in the prevalence of MB2 canals in MFM across genders. The study's findings were similar to those of Reis et al. and Al-Habib et al., who reported no correlation between the Prevalence of MB2 canals and gender. [17, 18]

In contrast, a study conducted by Betan et al. concluded that females have a lower prevalence of MB2 canals than males, explaining that females have a higher incidence of bone loss and demineralization, which decreases contrast and boundaries on radiographs, leading to difficulty in detecting second mesiobuccal canals in females.[19]

Regarding the presence of MB2 canals, MFM females showed a higher tendency than males;

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moreover, in our study, the Bilateral occurrence of MB2 canals was 82.9%, which is consistent with previous studies. [20, 21]

These studies concluded that if clinicians find MB2 canals in MFM; they should consider the possibility of finding MB2 canals in the contralateral maxillary first molars. Anatomic variations in the number of root canals with respect to the distobuccal root are rare; nevertheless, their presence cannot be ignored. The prevalence of the second distobuccal canal in MFM in this retrospective study was low, 7.9%. The study reported no significant correlation between gender or age and the distribution of the second distobuccal canal in MFM. A study conducted by Howard et al reported a prevalence of 1.25% of additional distobuccal canal in MFM. Similar to our study, the prevalence is low; however, differences in the percentages may be due to differences in study sample sizes.[20]

In the Kurdistan region, several studies used CBCT to report the prevalence of MB2 canals and anatomical variations among teeth, conclusively demonstrating that CBCT is the most reliable tool for analyzing specific canal characteristics. A higher percentage of MB2 canal was reported in previous studies than in the present study; however, these differences are likely due to variable sample sizes and differences in CBCT interpretation among observers.[22, 23, 24]

CONCLUSION

Our study concluded that the frequent occurrence of MB2 and possible additional canals, such as a second distobuccal DB2 canal in maxillary first molars, underscores the importance of careful CBCT image evaluation for successful root canal treatment. The study also concluded that when the MB2 canal is found in an MFM, the possibility of the MB2 canal in a contralateral MFM is high. Gender and age were not correlated with the prevalence of MB2 canals in MFM.

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CONFLICT OF INTEREST

The authors confirm that there are no conflict of interests.

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