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Research Article

EVALUATION OF THE PREVALENCE AND LOCATION OF SECOND MESIOBUCCAL CANALS IN 2100 UPPER FIRST AND SECOND MOLAR TEETH: A CONE BEAM COMPUTED TOMOGRAPHY STUDY

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ABSTRACT

It is essential to undertake thorough preparation, debridement and filling of all root canals in order to achieve a clinically successful treatment outcome. A total of 525 CBCT images of both maxillary first and second molars were analyzed. The observations and measurements were positioned 1 millimeter (mm) apically from the pulp base to standardize the methodology for the detection of the second mesiobuccal canal (MB2). To assess the distances between the canals and the relationship between the presence of MB2 and mesiobuccal (MB) root length, MB root length was quantified in millimeters. IBM SPSS Version 21.0 was employed for statistical analyses, with a type I error level of 5% accepted. MB2 was identified in 36.5% of the first maxillary molar (1MM) and second maxillary molar (2MM) teeth of the patients included in the study. When the frequency of MB2 was evaluated according to gender and right-left side, no statistically significant difference was found ($p>0.05$). When examining the relationship between the presence of MB2 and the length of the MB root, it was observed that only in the left second molars with MB2 present, the root length was slightly shorter. It is our contention that this study will furnish dentists with crucial data that will enhance the efficacy of root canal therapy for these teeth.

INTRODUCTION

The most common form of endodontic treatment in the oral cavity is a root canal procedure on maxillary molars (Çetin & Akgünlü, 2023). The successful completion of a root canal treatment necessitates the implementation of a multifaceted approach, encompassing rigorous isolation techniques, meticulous chemo-mechanical preparation, and precise three-dimensional filling (Asiri, 2023). The anatomy of maxillary molars exhibits considerable variability. The morphology of the root canal plays a pivotal role in the efficacy of endodontic treatment. The complexity of root canal anatomy, the presence of the MB2 and the inability to identify these canals are critical factors contributing to treatment failure in maxillary molars.

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(Çetin & Akgünlü, 2023; Faraj, 2021; Martins et al., 2020; Önem, Şen Baksı, Turhal, & Şen, 2020).

A recent systematic review revealed that the mean prevalence of MB2 is higher in upper first molars (69.6%) than in second molars (39.0%) (Martins et al., 2020). Furthermore, factors such as race, age, and gender also influence the anatomical variability and frequency of the MB2 (P Betancourt, Cantín, & Fuentes, 2014; Cleghorn, Christie, & Dong, 2006). The most prevalent methodology for delineating the anatomy of root canals is periapical radiography, which offers only limited insights into root canal anatomy (Al-Habib & Howait, 2021). Nevertheless, other methods employed in the field include dye injection, histological sections, scanning electron microscopy, endodontic surgical microscopy, micro-CT, and CBCT (Alnowailaty & Alghamdi, 2022; Pablo Betancourt, Navarro, Muñoz, & Fuentes, 2016). CBCT is an imaging method that provides accurate information through the use of high-quality images, which enable three-dimensional determination and analysis of dental morphologies in greater detail (Coelho, Lacerda, Silva, & Rios, 2018; Çetin & Akgünlü, 2023; Önem et al., 2020; Patel, Dawood, Whaites, & Pitt Ford, 2009; Zhuk, Taylor, Johnson, & Paranjpe, 2020). CBCT with images acquired with a small field of view (FOV) is the gold standard imaging tool for the visualization of complex anatomy in three dimensions (Alnowailaty & Alghamdi, 2022).

The aim of this retrospective study was to ascertain the prevalence of the second mesiobuccal canal in the mesiobuccal root of maxillary first and second molars, to examine the relationship between prevalence and demographic data and mesiobuccal root length, and to identify the localization of the mesiobuccal canal orifice and its distance to other canal orifices using CBCT imaging in three different centers.

MATERIAL AND METHOD

This study was submitted to the Dicle University Faculty of Dentistry Local Ethics Committee for review and approval. The committee approved the study with protocol number 2023-38. This is a retrospective study. The study group consists of 525 patients who applied to the Departments of Oral, Dental, and Maxillofacial Radiology at Dicle University Faculty of Dentistry, Van Yüzüncü Yıl University Faculty of Dentistry, and Lokman Hekim University Faculty of Dentistry for different reasons between 2021 and 2023. Images were obtained with CBCT devices (i-CAT®, Model 17-19 Imaging Sciences International, Hatfield, USA; Newtom VGI Evo, Verona, Italy; Kavo 3D Exam) using voxels with a diameter of 0.2-0.4 mm, a voltage of 110-120 kV, and a current of 5-7.65 mA.

In order to standardize the methodology employed for the detection of MB2, observations and measurements were positioned at a distance of 1 mm from the pulp base. The measurements were retrospectively conducted by three oral and maxillofacial radiologists with 9 years (A.G.Ö.T), 7 years (M.A), and 6 years (B.K) of experience, respectively. The measurements were repeated at different times by the same researcher. The intra-observer agreement was calculated as 0.95. The images were observed by continuously moving them in the sagittal, coronal and axial planes (Figure 1). The distances between the canals were measured in millimeters from the center point of MB2 to the center of mesiobuccal 1 (PMB2-PMB1), distal (PMB2-PD), palatal (PMB2-PP) canal mouths, and the perpendicular distance of MB2 to the PMB1-PP line (PT point) passing through the palatal and MB1, PMB2-PT line (Figure 2). In order to assess the association of MB2 presence with mesiobuccal (MB) root length, MB root length was also measured in millimeters. The MB root length was determined as the distance from the cementoenamel junction to the apical foramen in the sagittal plane (Figure 3) (Xu & Guan, 2022). Two measurements were taken for each tooth, and a single value was obtained by averaging the data. This value was then subjected to statistical analysis. Demographic data, including age and gender, was also recorded. Age groups were determined as follows: 16-20, 21-30, 31-40, 41-50, 51-60, and 61 years and older.

The study included CBCT images of individuals aged 16 and above with root apex closure. A total of 1,050 right and left first maxillary molar (1MM) and 1,050 right and left second maxillary molar (2MM) CBCT images were included, in which the presence of all maxillary molar (MM) teeth could be observed. The study excluded subjects who lacked at least one maxillary first or second molar, or maxillary molars exhibiting developmental anomalies, root restoration, intra-canal posts, coronal restoration, or teeth with prostheses. Additionally, subjects with molars that could not be evaluated due to artifacts were excluded.

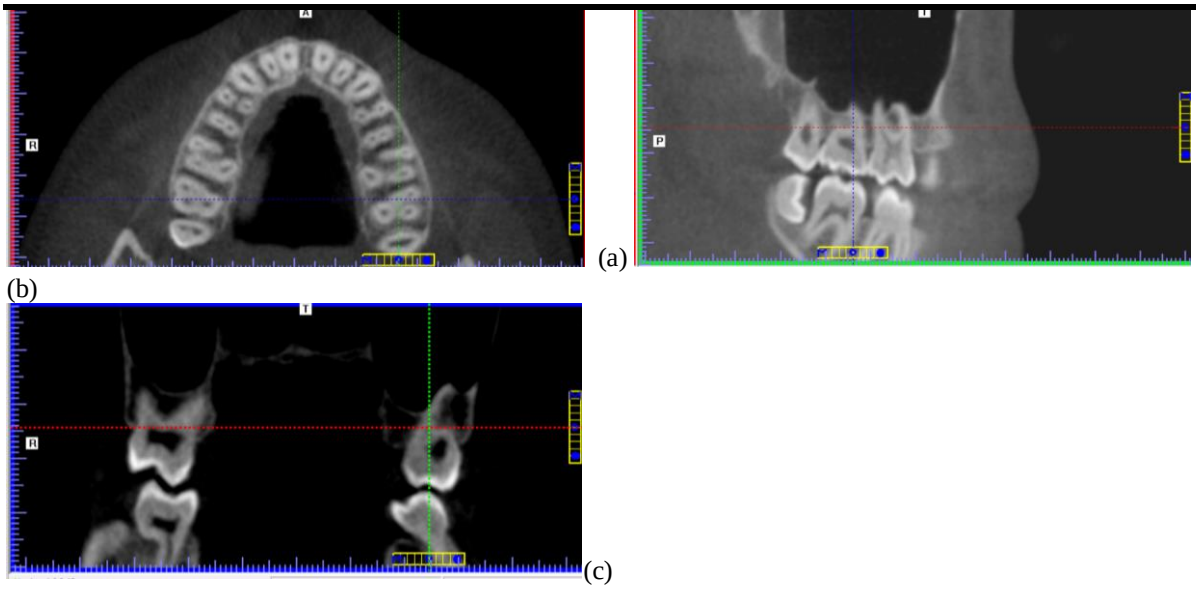

Figure 1. Axial (a), Saggital (b) and Coronal Se<ctions (c) Used to Determine the Presence of the MB2 in Root 27

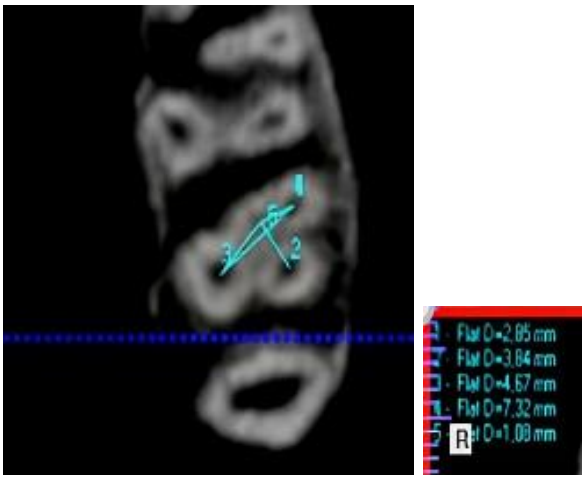

Figure 2. CBCT Images of a Left Maxillary Second Molar; Measurements After Determination of the Presence of the MB2
1: Distance from the center of the second mesiobuccal canal to the center of the first mesiobuccal canal =PMB2-PMB1
2: Distance of the center of the 2nd mesiobuccal canal from the center of the distal canal =PMB2-PD
3: Distance from the center of the 2nd mesiobuccal canal to the center of the palatal canal)=PMB2-PP
4: Distance from the center of the 2nd mesiobuccal canal to the center of the palatal canal)=PMB1-PP
5: Perpendicular distance of the mesiobuccal 2nd canal to the line drawn through the center of the mesiobuccal 1st canal and palatal canal (PP) distance =PMB2-PT

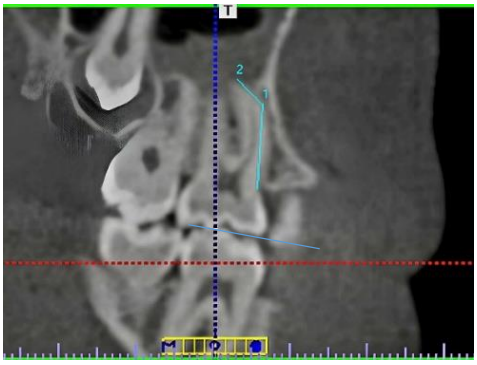

Figure 3. Length Measurement of the MB Root in the Right Upper First Molar

Statistical Analysis

The conformity of continuous variables to a normal distribution was examined using the Shapiro-Wilk test. Continuous variables were expressed as the mean ± standard deviation and median (minimum: maximum) values, while categorical variables were expressed as the number of cases (and percentage). According to the results of the normality test, the Mann Whitney U test and independent paired sample t tests were used for intergroup comparisons. Categorical variables were analyzed using the Chi-square test. SPSS Statistics for Windows (Released 2012 Version 21.0 Armonk, NY: IBM Corp) was used for all statistical analyses and the type I error level accepted as 5% in statistical analyses.

RESULTS

The study included CBCT images of 525 patients, 209 (39.8%) males and 316 (60.2%) females, with a mean age of 29.4 ± 11.2 years. The total number of teeth scanned in 525 CBCT images was 2100. The analysis revealed no significant differences between the age groups with and without MB2 in the first and second maxillary molars (p=0.138, see Table 1).

Table 1: General Distribution of the Number of Second Mesiobuccal Canals in all Maxillary First and Second Molars According to Age

Number of MB2 in all maxillary 1st and 2nd molars	MB2 in all maxillary 1st and 2nd molars			
	Present	Absent	Total	p-value[c]
Age				
16-20 y	179(36.7%)	309(63.3%)	488	
21-30 y	301(35.7%)	543(64.3%)	844	
31-40 y	182(40.3%)	270(59.7%)	452	
41-50 y	59(29.5%)	141(70.5%)	200	0.138
51-60 y	25(36.8%)	43(63.2%)	68	
61+ y	21(43.8%)	27(56.3%)	48	
Total	767(36.5%)	1333(63.5%)	2100	

The data are expressed as n%.
c: Chi-Square test
MB2: second mesiobuccal canal

The presence of MB2 was identified in 36.5% of the first and second molars of the patients included in the study (767/2100; see Table 2). A gender-specific analysis of the prevalence of MB2 revealed a 36.2% prevalence in females and a 37% prevalence in males. No statistically significant difference was observed (p=0.735; see Table 2). Upon examination of the percentage distribution of the MB2 according to the side, it was determined that 37.2% was located on the right side and 35.9% was located on the left side. No statistically significant difference was found (p=0.556; see Table 2).

Table 2: The General Distribution of the Number of Second Mesiobuccal Canals in all the Maxillary First and Second Molars by Gender and Side

Number of MB2 in all maxillary 1st and 2nd molars		MB2 in all maxillary 1st and 2nd molars			
		Present	Absent	Total	p-value[c]
Gender	Male	309(37%)	527(63%)	836	0.735
	Female	458(36.2%)	806(63.8%)	1264	
	Total	767(36.5%)	1333(63.5)	2100	
Side	Right side	390(37.2%)	660(62.9%)	1050	0.556
	Left side	377(35.9%)	673(64.1%)	1050	
	Total	767(36.5%)	1333(63.5%)	2100	

The data are expressed as n%.
c: Chi-Square test
MB2: second mesiobuccal canal

The MB2 were identified in 46.3% of the 1MM teeth of the patients included in the study (486/1050; see Table 3). A statistical analysis of the prevalence of MB2 according to gender reveals no significant difference between the genders, with 47.9% of females and 43.8% of males exhibiting the condition (p=0.185; see Table 3). Upon analysis of the percentage distribution of the MB2 according to the side, it was determined that 47.8% was located on the right side and 44.8% was located on the left side. No statistically significant difference was observed (p=0.322; see Table 3). The MB2 was identified in 26.8% of the 2MM teeth of the patients included in the study (281/1050; see Table 3). A comparison of the frequency of the MB2 according to gender revealed that it occurred in 24.5% of females and 30.1% of males. This analysis demonstrated that the MB2 was more prevalent in males (p=0.044; see Table 3). Upon examination of the percentage distribution of the MB2 according to the side, it was determined that 25.5% of the canal was located on the right side and 27% was located on the left side. Additionally, it was determined that there was no statistically significant difference between the two sides (p=0.884; see Table 3).

Table 3: The Distribution of the Number Of MB2 in Maxillary First Molars and Second Molars by Gender and Side

Number of MB2 in maxillary 1st molars		MB2 in 1st molars			
		Present	Absent	Total	p-value[c]
Gender	Male	183(43.8%)	235(56.2%)	418	0.185
	Female	303(47.9%)	329(52.1%)	632	
	Total	486(46.3%)	564(53.7%)	1050	
Side	Right side	251(47.8%)	274(52.2%)	525	0.322
	Left side	235(44.8%)	290(55.2%)	525	
	Total	486(46.3%)	564(53.7%)	1050	
Number of MB2 in maxillary 2nd molars		**MB2 in 2nd molars**			
		Present	**Absent**	**Total**	**p-value[c]**
Gender	Male	126(30.1%)	292(69.9%)	418	**0.044**
	Female	155(24.5%)	477(75.5%)	632	
	Total	281(26.8%)	769(73.2%)	1050	
Side	Right side	139(25.5%)	386(73.5%)	525	0.884
	Left side	142(27%)	383(73%)	525	

Total	281(26.8%)	769(73.2%)	1050

The data are expressed as n%.
c: Chi-Square test
MB2: second mesiobuccal canal

In the appropriate right 1MM teeth, the MB root length was found to be 12.3 mm in both the MB2 and non-MB2 groups, with no significant difference between the groups (p=0.879). The root length of the left 1MM teeth was 12.2 mm in the group with MB2 and 12.5 mm in the group without MB2. There was no statistically significant difference between the two groups (p=0.435). In the appropriate right 2MM tooth, the MB root length was determined to be 12.4 mm and 12.8 mm in the groups with and without MB2, respectively, with no significant difference between the groups (p=0.329). The root length of the left 2MM was determined to be 12.2 mm and 12.8 mm in the groups with and without MB2, respectively. The root length of the MB was found to be lower in the group with MB2 (p=0.013, see Table 4**)**.

Table 4: Comparison of the Distance of MB Root Canal Between Groups with and without MB2.

	Root 16	**Root 17**	**Root 26**	**Root 27**
With MB2	12.3(8.5:18.5) 12.4±1.9	12.6±1.7 12.4(7.5:19.1)	12.2(7.3:19.2) 12.6±5.8	12.2(7.9:19.6) 12.4±1.9
Without MB2	12.3(8.1:18.3) 12.4±1.8	12.8±1.9 12.8(8.6:17.4)	12.5(8.3:17.7) 12.5±1.8	12.8(8.3:17.9) 12.8±1.9
p-value	0.879[a]	0.329[b]	0.435[a]	**0.013[a]**

The data are mean ± st.the deviation and median are expressed as (minimum: maximum).
a: Mann Whitney U test. b: Independent samples t-test
MB2: second mesiobuccal canal

In the first maxillary molars (1MM), the mean distance between the MB2 and MB1 was 2.6 ± 0.6 mm, while in the second maxillary molars (2MM), it was 2.5 ± 0.6 mm. The mean distance from MB2 to the distal canal was 4.2 ± 1.0 mm in 1MM and 3.6 ± 0.9 mm in 2MM. The distance from MB2 to the palatal canal averaged 5.4 ± 1.2 mm in 1MM and 5.1 ± 1.2 mm in 2MM. Additionally, the mean perpendicular distance from MB2 to the line drawn between MB1 and the palatal canal (PT point) was 1.3 ± 0.5 mm in 1MM and 1.1 ± 0.6 mm in 2MM. All measurements (PMB2–PMB1, PMB2–PD, PMB2–PP, and PMB2–PT) were analyzed separately based on gender and right/left (see Table 5).

Table 5: Distances Between PMB2-PMB1 in 1st and 2st molars, PMB2-PD in 1st and 2st molars, PMB2-PP in 1st and 2st Molars and PMB2-PT in 1st and 2st molars

PMB2-PMB1		**PMB2-PMB1 in 1st molars**	**PMB2-PMB1 in 2st molars**
Gender	**Male**	2.7±0.6 2.6(1.3:4.2)	2.6±0.6 2.5(1.2:4.9)
	Female	2.5±0.6 2.5(1.2:4.9)	2.5±0.5 2.4(1.2:3.9)
	p-value[a]	**0.018**	0.241
Side	**Right side**	2.6±0.6	2.6±0.6

		2.6(1.2:4.9)	2.5(1.2:4.9)
	Left side	2.6±0.6	2.5±0.6
		2.5(1.2:4.5)	2.4(1.2:3.9)
	p-value[a]	0.671	0.296
PMB2-PD		**PMB2-PD in 1st molars**	**PMB2-PD in 2st molars**
Gender	**Male**	4.2±0.9	3.7±0.9
		4.2(1.8:6.8)	3.6(1.8:6.1)
	Female	4.1±1	3.6±0.9
		4.1(1.8:7.7)	3.5(1.8:6.3)
	p-value	0.875[b]	0.513[a]
Side	**Right side**	4±1.1	3.5±0.9
		3.9(2:7.7)	3.4(1.8:6.3)
	Left side	4.3±0.9	3.7±0.9
		4.3(1.8:6.8)	3.7(1.8:6.1)
	p-value	**<0.001[a]**	**0.033[a]**
PMB2-PP		**PMB2-PP in 1st molars**	**PMB2-PP in 2st molars**
Gender	**Male**	5.4±1.1	5.1±1.2
		5.5(2.8:8.5)	5.2(2:7.7)
	Female	5.5±1.3	4.9±1.3
		5.4(2.7:9.4)	5.1(2.3:8.3)
	p-value	0.678[b]	0.388[b]
Side	**Right side**	5.4±1.2	5±1.3
		5.5(2.7:9.4)	5.1(2:8.3)
	Left side	5.5±1.2	5.1±1.2
		5.5(2.8:8.3)	5.1(2.3:7.4)
	p-value	0.499[a]	0.888[b]
PMB2-PT		**PMB2-PT in 1st molars**	**PMB2-PT in 2st molars**
Gender	**Male**	1.3±0.6	1.2±0.7
		1.3(0.4:5.1)	1.1(0.3:8.1)
	Female	1.2±0.4	1±0.4
		1.3(0.2:3.8)	1.1(0.3:1.8)
	p-value[a]	0.169	0.797
Side	**Right side**	1.2±0.5	1.1±0.4
		1.1(0.4:5.1)	1.1(0.3:2.1)
	Left side	1.3±0.5	1.1±0.7
		1.3(0.2:4.7)	1.1(0.4:8.1)
	p-value[a]	**0.001**	0.692

The data are mean ± st.the deviation and median are expressed as (minimum: maximum).
a: Mann Whitney U test, b: Independent samples t test
Distance from the center of the second mesiobuccal canal to the center of the first mesiobuccal canal =PMB2-PMB1
Distance of the center of the 2nd mesiobuccal canal from the center of the distal canal =PMB2-PD
Distance from the center of the 2nd mesiobuccal canal to the center of the palatal canal)=PMB2-PP
Perpendicular distance of the mesiobuccal 2nd canal to the line drawn through the center of the mesiobuccal 1st canal and palatal canal (PP) distance =PMB2-PT

DISCUSSION

Inappropriate chemo-mechanical preparation and root canal filling during root canal treatment due to the anatomical complexity of the canals may result in the persistence of infection in the root canal (Mordanov et al., 2019; Parker, Mol, Rivera, & Tawil, 2017; Von Arx, 2005). While magnification systems are useful for locating the MB2, they only provide a superficial view of the MB2 orifice and do not allow for the visualization of the entire root canal system. Furthermore, imaging becomes even more challenging in inclined and rotational

teeth due to limited access (Pablo Betancourt et al., 2016). Periapical radiographs are an essential diagnostic tool in endodontics, with a high prevalence in daily practice. However, the two-dimensional nature of periapical radiographs limits their diagnostic efficacy. Factors such as superposition of anatomical structures, excessive bone density of the zygomatic arch, and impacted teeth can also impede interpretation (Lofthag-Hansen, Huumonen, Gröndahl, & Gröndahl, 2007; Patel et al., 2009). In comparison to conventional radiographic techniques, CBCT exhibits a multitude of advantages. CBCT enables a comprehensive three-dimensional analysis of the actual size, extent, type, and location of periapical pathologies and lesions (S.-J. Lee, Lee, Park, Cho, & Kim, 2020; Olczak & Pawlicka, 2017; Sert & Bayirli, 2004; Zeng et al., 2016).

This study was particularly useful in detecting the presence of MB2 in maxillary molars using existing images and making more accurate measurements based on various points and lines.

A significant body of research has been conducted to elucidate the root canal morphology of maxillary molars, with a particular focus on the MB2 morphology in mesiobuccal roots (Alnowailaty & Alghamdi, 2022; Pablo Betancourt, Navarro, Cantín, & Fuentes, 2015; Pablo Betancourt et al., 2016; Çetin & Akgünlü, 2023; S.-J. Lee et al., 2020; Xu & Guan, 2022; Zhuk et al., 2020). In a recent systematic review by Martins et al., the prevalence of MB2 in 1MM teeth was found to be between 64.5% and 74.8%, while in 2MM teeth, the prevalence was between 31.1% and 46.9%. The prevalence of MB2 in 1MM teeth was found to be significantly higher than in 2MM teeth (Martins et al., 2020). In our study, the prevalence of MB2 was 486 cases (46.3%) in 1050 1MM teeth and 281 cases (26.8%) in 1050 2MM teeth. In their study, Faraj et al. determined the frequency of MB2 to be 53.78% (341 teeth) in 634 maxillary first molars. Çetin et al. subsequently determined a frequency of 43.2% in 190 1MM teeth (Çetin & Akgünlü, 2023; Faraj, 2021). A further study by Lee et al. revealed an incidence of 42.2% in maxillary second molars (J.-H. Lee et al., 2011). In a study evaluating 1200 teeth, Alnowailaty et al. reported the prevalence of MB2 in upper first molars at 1mm and 2mm to be 46.7% and 17.7%, respectively. In contrast, Lee et al. reported rates of 86.8% and 28.9% (Alnowailaty & Alghamdi, 2022; S.-J. Lee et al., 2020). The observed differences in incidence may be attributed to a number of factors, including differences in race, sample size, voxel size, MB2 definition, and reference plane settings (Bauman et al., 2011).

A comparison of the relationship between the age of the patients and the presence of MB2 revealed no statistically significant difference in the six-year age group. Martins et al. reached

the conclusion in their systematic meta-analysis that age does not affect the prevalence of MB2 (Martins et al., 2020). In their respective studies, Faraj et al. (Faraj, 2021) and Naseri et al. (Naseri, 2016) did not identify any significant differences in the prevalence of MB2 between younger and older groups. The results of our study indicate that there is no significant difference in age between the two groups, namely those with and without MB2 in maxillary molar teeth. The mean age of the individuals with MB2 was found to be 29.3±11.1 years, which is comparable to the findings of Betancourt et al., who reported a mean age of 26.36±10.85 years (Pablo Betancourt et al., 2015).

The results of our study indicated that the presence of the MB2 was slightly higher in males, with a frequency of 36.2% in females and 37% in males. However, there was no statistically significant difference between the two groups. Previous studies have also demonstrated that there is no significant relationship between gender and MB2 prevalence (Fernandes, Herbst, Postma, & Bunn, 2019; J.-H. Lee et al., 2011; Su et al., 2019). The reason for the lower detection rate of the MB2 in females compared to males remains uncertain. However, it has been postulated that factors such as a higher demineralization rate and a greater loss of bone mass in females compared to males may be the cause (Benson, Prihoda, & Glass, 1991). This condition may reduce the visibility of the boundary of an additional canal in the mesiobuccal root during image analysis in female cases, potentially resulting in a lower detection rate of the MB2 canal compared to male cases (Faraj, 2021). Faraj et al. (Faraj, 2021) and Magat et al. (Magat & Hakbilen, 2019) found a significant difference between gender and the presence of MB2. In their study, Çetin et al. observed that out of a total of 82 first molars, 34 teeth (41%) belonged to female patients and 48 (59%) to male patients (Çetin & Akgünlü, 2023). In contrast to the aforementioned studies, a study by Alnowailaty et al. evaluated 1,200 teeth and found a significant correlation between gender and the presence of MB2 in upper first and second molars (p=0.048). However, the frequency of MB2 was higher in females (34.5%) than in males (29.8%) (Alnowailaty & Alghamdi, 2022). The results of our study align with those of previous studies that have evaluated the presence of MB2 on different sides (Alnowailaty & Alghamdi, 2022; Pablo Betancourt et al., 2015; Pablo Betancourt et al., 2016). In this study, the percentage distribution of the MB2 according to the side was 37.2% on the right side and 35.9% on the left side. There was no statistically significant difference between the two sides.

In our study, in addition to the frequency of MB2 openings in maxillary molars, CBCT images were analyzed to estimate MB2 positions according to various measurements. Zhuk et

al. measured the distance of the MB2 to the MB1 in maxillary first molar teeth with reference to the pulp base as 2.03 mm ± 0.55 mm on average. These distances were reported to be higher in males (Zhuk et al., 2020). In a study conducted by Çetin et al., the same method was employed to measure the average distance between the MB2 and the MB1, which was found to be 2.56 ± 0.33. It was also observed that the PMB1-PMB2 distance in maxillary first molar teeth was longer in males. However, no significant difference was found between the right and left teeth (Çetin & Akgünlü, 2023). Our study corroborates these findings and yielded comparable results. In their study on the distances between the MB1 and MB2 in maxillary molars, Kulild et al. (JC, 1990) measured a distance of 1.82 mm, while Lee et al. (S.-J. Lee et al., 2020) measured the distance between the MB1 and MB2 as 2.1 ± 0.44 mm in the first molar and 1.98 ± 0.42 mm in the second molar. In a separate study, the mean distance between PMB1 and PMB2 for 1MM and 2MM was found to be 1.87 ± 0.42 mm and 1.24 ± 0.76 mm, respectively. The mean distances of PMB2-PT were 0.74 ± 0.21 mm and 0.43 ± 0.18 mm for 1MM and 2MM, respectively (Alnowailaty & Alghamdi, 2022). Betancort et al. reported that, for maxillary first molars, the mean PMB1–PMB2 distance was 2.68 ± 0.49 mm and the PMB2–PT distance was 1.25 ± 0.34 mm; for second molars, the PMB1–PMB2 distance was 2.41 ± 0.64 mm and the PMB2–PT distance was 0.98 ± 0.33 mm. (Pablo Betancourt et al., 2016). The mean distance of the MB2 to the MB1 was 2.5 mm ± 0.6 mm for the second molar in the present study. The mean distance of the MB2 to the line drawn perpendicular to the PT point was 1.3 mm ± 0.5 mm for the first molar and 1.1 mm ± 0.6 mm for the second molar. Magat et al. reported the distances between PMB1-PMB2 as 2.95 ± 0.58 mm and 3.08 ± 0.67 mm for maxillary first and second molars, respectively, and the mean PMB2-PP distances as 5.81 ± 1.09 mm and 5.55 ± 1.09 mm, respectively *(Magat & Hakbilen, 2019). Zhuk et al. reported a mean PMB2-PP distance of 5.20 ± 0.96 in maxillary first molars* (Zhuk et al., 2020). The mean distance of the MB2 to the palatal canal was 5.4 mm ± 1.2 for the first molar and 5.1 mm ± 1.2 for the second molar in the present study.

The mean distance of the MB2 to the distal canal is 4.2 mm ± 1 for the first molar and 3.6 mm ± 0.9 for the second molar. In both tooth groups, the distance from the MB2 to the distal canal was not significantly different between genders, but was slightly higher in males. Upon examination, the measurement was found to be slightly higher on the left side. A search of the relevant literature revealed no studies in which the distance of the mesiobuccal second canal to the distal canal was measured in millimeters.

When the relationship between the length of the MB root and the presence of MB2 was evaluated in the MB2 and non-MB2 groups, a significant difference was found only in the left second molar. However, this relationship was not statistically significant for the right and left 1MM and the right 2MM. A comparison of the maxillary second molars on the left side revealed that the MB root length was significantly shorter in the MB2 group. This study presents a contradictory finding to that of Xu et al., who initially evaluated the relationship between MB root length and MB2 incidence in upper molars (Xu & Guan, 2022). Further research is required at the clinical and radiological levels.

CONCLUSION

This study demonstrates the utility of CBCT images in the detection of the presence of MB2 in maxillary molars and the determination of root canal morphology based on various points and lines.

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