Original article

Frequency of Second Mesiobuccal Canals in Maxillary First Molar using Cone Beam Computed Tomography in Libyan Subpopulation in Zliten city

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ABSTRACT

This study was conducted to evaluate the frequency of Second Mesiobuccal Canals (MB2) in maxillary first molar teeth of a Libyan subpopulation in Zliten city, and to assess the presence of MB2 based on gender and location using Cone Beam Computed Tomography. The study was a retrospective study done by screening 764 CBCT (X-MIND Prime®3D – Acteon software), with patients being came routinely to Al-Tasneem Private Dental Ploy-clinic in Zliten city during the period from July 2023 until June 2024. Two hundred seventy-three teeth of this study (62.6%) were female; whereas 163 (37.4%) were male. About 48% of these maxillaries first molar teeth were right, while 52% were left teeth. The age of patients in present study were between 13 and 84 years old. The frequency of MB2 of maxillary first molar in Libyan subpopulation in Zliten city were 77.5%. Although there was no significant statical differences in frequency of MB2 between the male and female; the occurrence of MB2 in maxillary first molar teeth were higher in male with (80.4%) than in female with (75.8%). In the current study although there was no significant statical differences in frequency of MB2 between the left and right occurrence of MB2 of maxillary first molar, which was slightly higher in the left side with (51.77%) than the right side with (48.22%). The incidences of MB2 in maxillary first molar teeth of a Libyan subpopulation in Zliten city were 77.5%. The three separated roots were in 100% of teeth. The frequency of MB2 in male was greater on the right side compared with the left, whereas incidences of MB2 in female were higher in the left side than the right side. The age group of 21-40 years old had the greatest rates of MB2

INTRODUCTION

Root canal therapy involves cleaning and shaping the root canals to eliminate necrotic tissue, prevent bacteria from entering the root canal system, and obturate the root canal system [1]. As a result, the pulp complex determines the appropriate therapy for dental pulpal illness; therefore, any dentist who performs such a treatment should be efficient in

this outstanding effort. The structure of dental pulp is an extremely important factor in the problem of the pulpless tooth and its relationship to systemic illness [2]. In 2014, the European Society of Endodontology issued a statement regarding the application of Cone Beam Computed Tomography (CBCT) in the field of endodontics. This statement outlined several specific arising from endodontic therapy, the evaluation and management of root resorption, and the identification of the causes of non-odontogenic pathosis [3]. In 1984, Vertucci proposed a classification system for root canal configurations, categorizing them into eight distinct types. This classification has since gained significant recognition in the field of endodontics. Within this framework, Vertucci described Type II as a configuration where two separate canals emerge from the orifice but converge into a single canal at the apex. Conversely, Type IV is characterized by two distinct canals that extend from the orifice all the way to the apex without merging [4].

Numerous studies conducted globally have sought to assess the existence of second mesiobuccal canals in maxillary first molars, with several of these investigations employing Vertucci's classification to present their findings, as illustrated in table 1.

Table 1. Previous studies used Vertucci classification to demonstrate frequency of MB2 in maxillary first molar

Investigators	Year	Sample Size	Vertucci classification								Others
			Type I 1-1	Type II 2-1	Type III 1-2-1	Type IV 2-2	Type V 1-2	Type VI 2-1-2	Type VII 1-2-1-2	Type VIII 3-3	
Al-Saedi et al.,	2020	655	18.32%	44.58%	2.29%	31.30%	2.29%	0.61%	0.61%	-	-
Al Mheiri et al.,	2020	522	19.9%	59%	6%	15.3%	-	-	-	-	-
Abd Rahman et al.,	2020	469	40.1%	17.9%	6.8%	22%	10.4%	1.7%	0.6%	0.5%	-
Kim et al.,	2020	212	22.73%	37.63%	1.77%	33.84%	2.27%	1.76%			-
Uysal & Koç	2021	654	16.5%	54.6%	0.1%	27%	-	-	-	-	-
Diaconu et al.,	2023	271	-	69%	-	31%	-	-	-	-	-
Mufadhal et al.,	2023	373	17.7%	25%	23.1%	11.3%	5.6%	6.7%	2.2%	4.3%	4.2%
Xiang et al.,	2024	486	-	30.9%	0.6%	65%	1.2%	1.2%	0.4%	-	0.6%
Al-Assadi	2024	399	38.7%	34.3%	4.6%	19.5%	0.8%	0.6%	0.9%	0.3%	-
El Taher et al.,	2024	35	25.9%	40%	-	28.6%	5.7%	-	-	-	-

In a systemic review study conducted by Barbhai et al; they stated that cone-beam computed tomography were secondary tool that can help the endodontists to get improved visualization anatomy of root canal and act as beneficial to detect extra canals [15] as shown in table 2.

Table 2. Incidences of MB2 canal in maxillary first molar in previous studies

Investigator	Year	Country	Sample	Presence MB2
Faraj	2021	Kurdistan Region-Iraq	634	53.78%
Uysal & Koç	2021	Turkey	654	81%
Mirza et al.,	2022	Saudia Arabia	323	85.6%
Xu et al.,	2022	Fujian- China	1000	51.1%
Barbhai et al	2022	Systemic review study	12056	68.2%
Normando et al.,	2023	Brazil	250	76.44%
Diaconu et al.,	2023	Romania	271	75%
Mufadhal et al.,	2023	Yemen	373	82.3%
Al-Assadi	2024	Iraq	399	61.1%
El Taher et al.,	2024	Egypt	35	74.3%

After many developments nowadays, CBCT had been used in different dentistry fields as endodontics, implantology, orthodontics, pedodontics, oral surgery [20], evaluation of dental trauma, evaluation of root canal, detection of apical periodontitis, evaluation of dental anatomy, endodontic treatment plan and surgical endodontic treatment [20-24].

METHODS

A retrospective study involved the examination of 764 CBCT (X-MIND Prime®3D – Acteon software Version 5.0) obtained from patients whom visited Al-Tasneem Private Dental Ploy-clinic in Zliten city during the period from July 2023 to June 2024. A total of 436 scans fulfilled the established inclusion criteria, while 328 images had been excluded. The full CBCT images had the following X-ray technique factors: Voltage (kV) 90, Current (mA) 8, DAP (mGy*cm$^{2)}$: 1339.99. In other hand, Sectional CBCT images (60*60 & 80*90) had following X-ray technique factors: Voltage (kV) 85, Current (mA) 8, DAP (mGy*cm$^{2)}$: 846.828. Out of 238 full CBCT images, only 348 images were included in this study; while other were sectional CBCT as shown in table 3.

Table 3. Distribution of the sample size

Variables	CBCT Type			Gender		Location		Total
	Full	60*60	90*80	Female	Male	Right	Left	
Number	348	71	17	273	163	211	225	**436**
Percentage	79.8%	16.3%	3.9%	62.6%	37.4%	48.4%	51.6%	**100%**

Screening of CBCT images

A 32-inch TV screen connected to PC had been used to screening the CBCT images had been in dark room by (X-MIND Prime®3D – Acteon software Version 5.0). By image, scrolling in coronal plane the root canal had been evaluated in axial plane; in addition, the examiner could scroll the CBCT images in sagittal and axial plane. The evaluation of tooth had done independently by two examiners, with forty CBCT images out of the sample of this study to check the presence or the absences of MB2 in maxillary first molar. The kappa test was used to check the correlation between the two examiners; the kappa value was 0.754, indicating a strong correlation between the first and second examiners and the p-value =0.00 which is less than 5% confirming this correlation, as illustrated in Table 5.

Table 5. Inter-reliability of the examiners between the first and second examiners

Inter-reliability of the examiners		Value	P-value
Measure of Agreement	Kappa	0.754	0.000
N of Valid Cases		40	

The patients divided based on age to four groups as following: Group A: age of patients between 13 – 20 years. Group B: age of patients between 21- 40 years. Group C: age of patients between 41-60 years. Group D: age of patients between more than 60 years.

Inclusion Criteria

The inclusion criteria encompass fully erupted maxillary first molars in individuals over the age of 13 years. Additionally, participants must be of Libyan nationality and have clear cone-beam computed tomography (CBCT) images available during the study period, which spans from July 2023 to June 2024.

Exclusion Criteria

The study excluded any maxillary first molars exhibiting an open apex, those with existing restorations, prior endodontic treatments, crowns or bridges, instances of root resorption, calcification, or unclear CBCT imaging results.

Statical Analysis

Descriptive analyses were conducted using SPSS version 20 for Windows (IBM, Chicago, IL). The presence or absence of the MB2 canal was analyzed in relation to gender, age, location, and the type of CBCT imaging employed, utilizing the $\chi 2$ test. Additionally, the interrelationships among these parameters were assessed through Spearman's rank correlation coefficient.

RESULTS

This study included a sample of 436 patients, comparing 163 males (37.4%) and 207 females (62.6%). The MB2 canal was observed to be grater in males than in females, with rates of (80.4% and 75.8%, respectively) leading to an overall incidence of MB2 canals at 77.5%.

The analysis revealed no correlation between the occurrence of MB2 canal and the gender of the patients, as evidenced by a P-value of 0.288, which exceeds the threshold of 0.05 in the chi-square test. This finding suggests a lack of statistically significant differences regarding the MB2 canal in relation to gender, as illustrated in table 6.

Table 6. Incidence of MB2 canal in different genders

Incidence of MB2 canal	Gender				Total		P-value
	Male		Female				
	N	%	N	%	N	%	
Present	131	80.4	207	75.8	338	77.5	
Absent	32	19.6	66	24.2	98	22.5	0.288
Total	163	37.4	273	62.6	436	100	
Spearman correlation	0.058						

The mean incidence of the MB2 canal by tooth location was found to be 48.4% on the right side and 51.6% on the left side, indicating a nearly equal distribution between the two sides. Furthermore, no significant relationship was established between the occurrence of the MB2 canal and tooth location, with a P-value of 0.909, again surpassing 0.05 in the chi-square test, confirming the absence of statistically significant differences, as shown in table 7.

Table 7. Incidence of MB2 canal in different locations

Incidence of MB2 Canal	Location				Total		P-value
	Right		Left				
	N	%	N	%	N	%	
Present	163	77.3	175	77.8	338	77.5	
Absent	48	48.1	50	22.2	98	22.5	0.909
Total	211	48.4	225	51.6	436	100	
Spearman correlation	-0.006						

Additionally, an age group analysis indicated that the mean incidence of the MB2 canal was 14.2% for individuals aged 13-20 years, 56.7% for those aged 21-40 years, 24.5% for the 41-60 age group, and 4.6% for those over 60 years. The highest prevalence of the MB2 canal was recorded in the 21-40 age group at 81.4%, and mere 0.5% in individuals older than 60 years.

There was no link between the occurrence of MB2 canal and the age groups of the patients. The P-value =0.002 < 0.05 in the chi-square test indicated that there were statistically significant differences between MB2 canal and age groups, as illustrated in table 8.

Table 8. Incidence of MB2 canal in different age groups

| Incidence of MB2	Age Groups								Total		P-value
	13-20years		21-40years		41-60years		>60years				
	N	%	N	%	N	%	N	%	N	%	
Present	42	67.7	201	81.4	85	79.4	10	0.5	338	77.5	
Absent	20	32.2	46	18.6	22	20.6	10	0.5	98	22.5	0.002
Total	62	14.2	247	56.7	107	24.5	20	4.6	436	100	
Spearman correlation	0.001										

In the current study, the total frequency of bilateral presence of MB2 was 82.3%. In addition, the occurrence of bilateral presence of MB2 was higher in male than female as illustrated in table 9.

Table 9. Frequency of bilateral and unilateral presence of MB2 in maxillary first molar teeth

Variables	Male		Female		Total	
	N	%	N	%	N	%
Unilateral	9	15.3	8	21.6	17	17.7
Bilateral	50	84.7	29	78.4	79	82.3
Total	59	100	37	100	96	100

DISCUSSION

Established in 1992, Al-Tasneem Private Dental Poly-clinic became the first dental facility in Zliten city to incorporate a Cone Beam Computed Tomography (CBCT) device in 2019. The clinic's long-standing presence in the community has contributed to a consistently high patient volume, making it an ideal choice for conducting this research. The following Figure showed examples of different types of CBCT image which include: Full, Sectional (60*60) & Sectional (80*90) images.

| (a) | (b) | (C) |
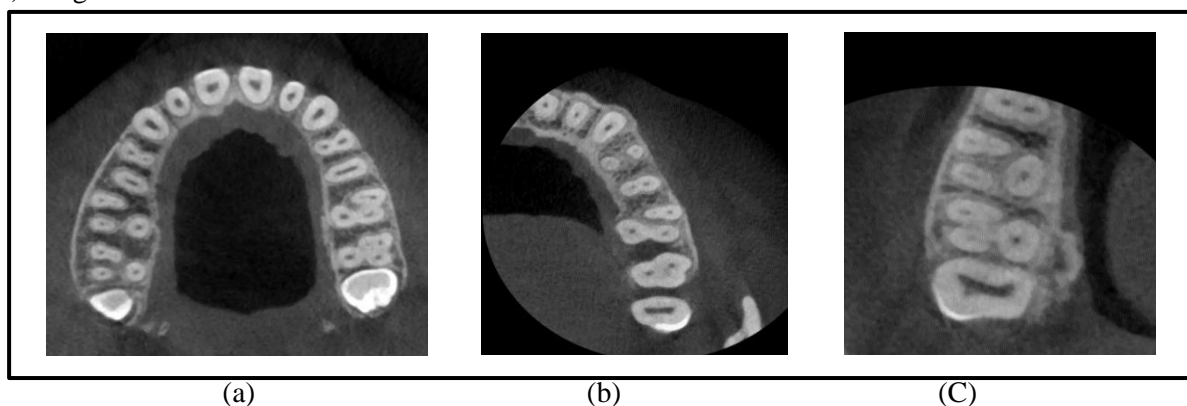
*Figure 1. (a): Full CBCT image, (b): Sectional CBCT (80*90) image & (c): Sectional CBCT (80*90) image*

In current study, the incidence of MB2 was 77.5%; which is higher than the previous studies [10,13,14,16,18,19,28]. In addition, the frequency of MB2 in present study was higher than worldwide studies [15,29,30]. However, the result of occurrence of MB2 in this study was less than many previous studies [5,9,11,17,31,32].

The analysis revealed no statistically significant differences in the frequency of MB2 canals between males and females; however, the prevalence of MB2 in maxillary first molars was greater in males, recorded at 80.4%, compared to 75.8% in females [7,18,19,25,30,31]. In contrast, a study conducted by Al-Assadi indicated a slightly higher frequency of MB2 canals in females, with a rate of 39.3%, as opposed to 38.4% in males [13]. In the present study, while no statistically significant differences were observed in the frequency of MB2 between the left and right sides, the occurrence of MB2 in the maxillary first molar was slightly greater on the left side, recorded at 51.6%, compared to 48.4% on the right side. This finding aligns with the results of a global study conducted by Martins et al., which reported frequencies of 74.1% and 73.4% for the left and right sides, respectively [29].

Earlier studies found that the presence of MB2 was identical bilaterally with 76.2%, 80% and 73.6% respectively [6,7,13]. The incidences of bilateral presence of MB2 in present study (with 82.3%) were higher than unilateral as shown in table 9. In present study the occurrences of MB2 in male were higher in right side than left side with (41.1.%) and (37.14%) respectively; In contrast to that the incidences of MB2 in female were higher in left side than right side with (62.86%) and (48.9%) respectively.

In current study the highest incidences of MB2 depend on age group was in group B (21-40 years), with 56.7%, while the group D (> 60 years) had the lowest incidence of MB2 as shown in Table 6. We found 95.4% of MB2 presence in age group D (>60) had only 4.6%. In a study had done by Martins et al they reported that the highest frequency of MB2 in a worldwide study was in younger patients [28]. In a study had done by Magat & Hakbilen; found that the highest frequency of MB2 in maxillary molar teeth was in group of age 13-25 years, while the lowest incidence was in group of age >40 [31]. In present study the incidences of three separated root of maxillary first molar were 100% of teeth which similar to some previous studies [14,17,25].

CONCLUSION

The occurrence of MB2 in maxillary first molars within the Libyan subpopulation of Zliten city was 77.5%. All maxillary first molars exhibited three distinct roots. Furthermore, the prevalence of the MB2 canal was greater in males, recorded at 80.4%, compared to 75.8% in females. Analysis across various age categories revealed that the highest frequency of MB2 canals were observed in the 21–40-year age group.

Conflict of interest. Nil

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معدل تكرار القنوات الدهليزية المتوسطة الثانية في الضرس العلوي الأول باستخدام التصوير المقطعي المخروطي الشعاعي في السكان الليبيين في مدينة زليتن

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المستخلص

أجريت هذه الدراسة لتقييم نسبة تكرار القنوات الدهليزية المتوسطة الثانية في الضرس الأول في الفك العلوي لفئة فرعية من السكان الليبيين في مدينة زليتن، وتقييم وجود القنوات الدهليزية المتوسطة الثانية بناءً على الجنس وموقع السن باستخدام التصوير المقطعي المخروطي الشعاعي. كانت الدراسة دراسة استرجاعية أجريت من خلال فحص 764 - CBCT (X-MIND Prime®3D ، برنامج(Acteon ، مع المرضى الذين يأتون بشكل روتيني إلى عيادة التسنيم الخاصة لطب الأسنان في مدينة زليتن خلال الفترة من يوليو 2023 حتى يونيو 2024. كانت مائتان وثلاثة وسبعون سنًا في هذه الدراسة (62.6٪) من الإناث؛ بينما كان 163 (37.4٪) من الذكور. حوالي 48٪ من هذه الضروس الأولى العلوية كانت يمنى، بينما كانت 52٪ من الأسنان اليسرى. تراوحت أعمار المرضى في الدراسة الحالية بين 13 و 84 عامًا. كان معدل حدوث القنوات الدهليزية المتوسطة الثانية في الضروس الأولى العلوية في السكان الليبيين في مدينة زليتن 77.5٪. وعلى الرغم من عدم وجود فروق إحصائية كبيرة في معدل حدوث القنوات الدهليزية المتوسطة الثانية بين الذكور والإناث؛ إلا أن حدوث القنوات الدهليزية المتوسطة الثانية في الضروس الأولى العلوية كان أعلى عند الذكور بنسبة (80.4٪) منه عند الإناث بنسبة (75.8٪). في الدراسة الحالية، على الرغم من عدم وجود فروق إحصائية كبيرة في تكرار القنوات الدهليزية المتوسطة الثانية بين حدوث القنوات الدهليزية المتوسطة الثانية في الضرس الأول العلوي الأيسر والأيمن، والذي كان أعلى قليلاً في الجانب الأيسر بنسبة (51.77٪) من الجانب الأيمن بنسبة (48.22٪). بلغت حالات القنوات الدهليزية المتوسطة الثانية في الضرس الأول العلوي لدى مجموعة فرعية ليبية في مدينة زليتن 77.5٪. كانت الجذور الثلاثة المنفصلة في 100٪ من الأسنان. كان تكرار القنوات الدهليزية المتوسطة الثانية لدى الذكور أعلى في الجانب الأيمن مقارنة باليسار، في حين كانت حالات القنوات الدهليزية المتوسطة الثانية لدى الإناث أعلى في الجانب الأيسر من الجانب الأيمن. كانت الفئة العمرية 21-40 عامًا لديها أعلى معدلات القنوات الدهليزية المتوسطة الثانية.

الكلمات المفتاحية. الضرس الأول الفكي العلوي، القناة الدهليزية المتوسطة الثانية، زليتن، ليبيا.