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Incidence of Second Mesiobuccal Canal in Maxillary Second Molar Teeth Using Cone Beam Tomography in Libyan Subpopulation at Zliten City: A Retrospective Study

Ahmed Alteer[1], A Alaali Ehbesh[2*], Mohamed Attir[3]

[1]*Faculty of Dentistry, University International Orthodontic Program, Cairo, Egypt*
[2]*Department of Conservative Dentistry, Endodontics, Dental Anatomy & Oral Histology, Faculty of Dentistry and Oral Surgery, Alasmarya Islamic University, Zliten, Libya.*
[3]*German Board of Oral Implantology (GBOI), Middle East Branch, Jordan*

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A B S T R A C T

This study was carried out to estimate the incidences of second mesiobuccal canals (MB2) in maxillary second molar teeth of a Libyan subpopulation in Zliten city, and to evaluate the frequency of MB2 based on location, gender, and patient age using Cone Beam Computed Tomography. Out of 1180 CBCT images taken from routine Libyan patients at Al-Tasneem private Poly-Clinics in Zliten city since May 2023 until December 2024, only 769 Images met the inclusion criteria. 389 CBCT images of the current study (50.6%) were right teeth. 471 of CBCT images (61.25%) correlated to female patients, while two hundred ninety-eight images (38.75%) related to male patients. The patients' ages ranged between 17 and 83 years. The prevalence of second mesiobuccal canals of maxillary second molar teeth in the Libyan subpopulation was 60.5%. There was no significant statistical variance in the occurrence of MB2 between the right and left occurrence of second mesiobuccal canals in maxillary second molars, the result was found to be approximately equal, with 50.6% and 49.4%, respectively. The incidences of MB2 were slightly higher in males than females (with 61.4% and 60%, respectively), and as such, the total incidence of MB2 canals was found to be 60.5%. The incidence of MB2 in maxillary second molar teeth in the Libyan subpopulation at Zliten city was 60.5%. Total bilateral incidences of MB2 were 74%; the bilateral occurrences of MB2 were higher in females than in males. The three-rooted maxillary second molar teeth were 94.8%.

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INTRODUCTION

Mastering root canal system morphology is essential for improving endodontic treatment outcomes [1]. Fernandes et al reported that the presence of a missed second mesiobuccal canals (MB2) canal is considered a source of continued bacterial infection and contamination that contributes in unsuccessful of root canal treatment [2].

In a CBCT study conducted by Carrion et al to assess the frequency of apical periodontitis in mesiobuccal root of upper maxillary endodontically treated teeth, the authors found that the chance of occurrences of missed canals and apical periodontitis rose either by the presence of two foramina or two canals [3].

In another CBCT study conducted by Alotaibi et al to evaluate the association between untreated canals in mesiobuccal roots in upper molar teeth and apical periodontitis, they found high incidences of apical periodontitis with untreated second mesiobuccal canals in previous endodontic teeth [4].

Fadhil et al found that the critical the probability indicators of apical periodontitis in CBCT include the existence of perforation, presence of voids and underfilling of root filling; they also concluded that the incidences of apical periodontitis was majorly lower in root filled teeth without missed canals than root filled teeth with untreated canals [5].

Ebrahimi et al concluded that the missed canals have to be viewed as a significant reason in the progression and propagation of periapical lesions. The findings of the same study reveal the significant competence of CBCT in identifying and recognizing missed canals [6].

Many previous studies around worldwide to evaluated the incidences of second mesiobuccal canals in maxillary second molar teeth, as illustrated in Table 1, in which the prevalence of MB2 in was ranged between 17.7% to 90.4%. This study was carried out to estimate the incidences of MB2 in maxillary second molar teeth of a Libyan subpopulation in Zliten city, and to evaluate the frequency of MB2 based on location, gender, and patient age using Cone Beam Computed Tomography.

Methods

(X-MIND Prime®3D – Acteon software Version 5.0) obtained from patients who visited Al-Tasneem Private Dental Poly-clinic in Zliten city during the period from May 2023 to December 2024. A total of 769 scans fulfilled the recognized inclusion criteria, while 411 images had been excluded for various reasons. 471 CBCT images (61.25%) were related to female patients, while 298 CBCT images were related to male patients (38.75%). 389 CBCT images were right, while 380 images were left-sided teeth.

*Corresponding E-mail addresses: aalaali.ehbesh@asmarya.edu.ly

Table 1. Prevalence of MB2 canals in maxillary second molar teeth in previous studies

Authors	Year	Population	Sample	Presence MB2
Kim et al.,	2020	American	264	80.64%
Abd Rahman et al.,	2020	Malay ethnic in Malaysian	536	35.2%
Akay et al.,	2021	Turkish, South-eastern Anatolia	528	30.4%
Onn et al.,	2022	Bruneian	181	29.8%
Xu et al.,	2022	Fujian, China	1000	32.9%
Sánchez et al.,	2022	Méxican	129	53.49%
Elatrash & Alawjali	2022	Libyan, Benghazi city	334	90.4%
Alnowailaty & Alghamdi	2022	Jeddah, Saudi Arabia	600	17.7%
Buchanan et al.,	2023	Black South African	386	64.4%
Normando et al.,	2023	Brazilian	405	41.73%
Madfa et al.,	2023	Hail province of Saudi Arabia	499	49.7%
Namdar et al.,	2023	Iranian	375	36.6%
Allawi et al.,	2024	Syrian	500	70.5%
El Taher et al.,	2024	Egyptian	35	48.6%
Sakthivel et al.,	2024	Indian, West Bengal	300	50%
Aqili et al.,	2024	Saudi Arabian, Madinah	204	45.1%

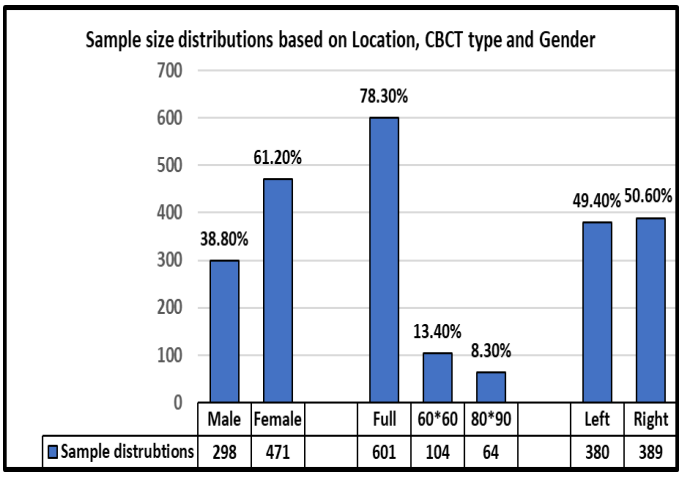

Figure 1. Distributions of sample size based on location, CBCT type, and gender

Sectional CBCT images (60*60 & 80*90) had the following X-ray technique features: Voltage (kV) 85, Current (mA) 8, DAP (mGy*cm2): 846.828; while the full CBCT images had the Voltage (kV) 90, Current (mA) 8, DAP (mGy*cm2): 1339.99. Six hundred and one CBCT images were Full, while 104 images were (60*60) sectional CBCT, whereas 64 images were sectional (80*90) CBCT images.

Images Evaluation

The evaluation of each tooth that met the inclusion criteria had been done by screening the CBCT image in Dark room on 32-inch TV joined to PC; the evaluation of each tooth had done by scrolling the image in axial and sagittal plane to check the presence of second canal in mesiobuccal root of maxillary second molar teeth as shown in Figure 2.

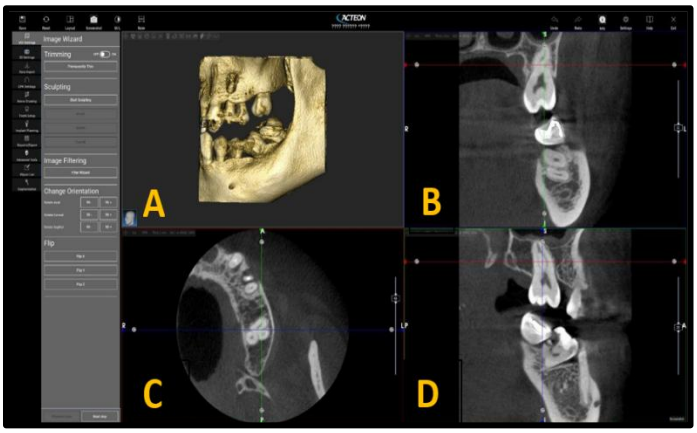

Figure 2. Print screen of (80*90 Sectional CBCT) X-MIND Prime®3D – Acteon software Version 5.0; (A): 3D Skull view ;(B): Sagittal view ;(C): Axial view;(D): Coronal view.

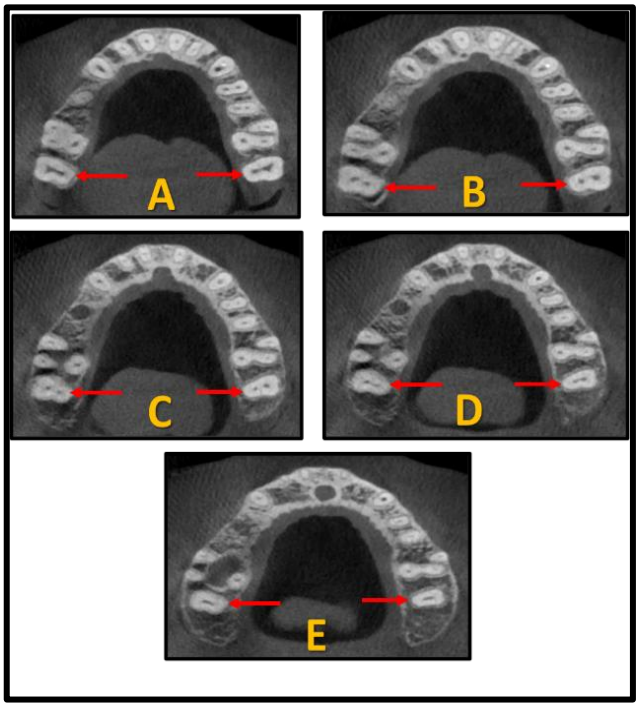

Figure 3. Images from A to E illustrate scrolling of Full CBCT images from Coronal to part portion of bilateral maxillary second molar teeth with two canals.

Based on the age, the patients divided into 4 groups to: Group (1): Patient's age is between 17 to 27 years old, Group (2): Patient's age is between 28 to 40 years old, Group (3): Patient's age is between 41 to 60 years old, Group (4): Patient's age is between is > 60 years old.

Statical analysis

SPSS version 20 for Windows (IBM, Chicago, IL) had been used for descriptive analyses, the presence or absence of MB2 in maxillary second molar teeth was compared in terms of gender, age, location and type of CBCT used in imaging using x^2 test, the relationship between the parameters was tested by Spearman's rank correlation coefficient.

The kappa test was used to check the correlation between the two examiners; the kappa value was 0.718, 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 2.

Table 2. Inter-reliability among the first and second examiners in the present study

Variable		Value	p-value
Measure of Agreement	**Kappa**	0.718	0.000
N of Valid Cases		50	

Table 3. Inclusion and exclusion criteria in the current study

Inclusion Criteria	Exclusion Criteria
▪ Maxillary Second Molar teeth ▪ Libyan nationality ▪ Patient age ≥17 years old ▪ Complete roots formation ▪ CBCT images between May 2023 to December 2024 ▪ Clear CBCT images	▪ Incomplete tooth eruption ▪ Presence of: ○ Any tooth restorations ○ Fixed prosthesis previously ○ endodontically treated teeth ○ Badly decayed teeth ○ Pulp stones ○ Calcification ○ Root resorption

Results

Out of 1180 CBCT images screened, only 769 were included in the present study. 601 images (78.2%) CBCT images were Full type, while 104 images (13.5%) were 60*60 sectional type, whereas 64 images (8.3%) were 80*90 sectional CBCT type.

Analysis based on different tooth locations showed that the mean incidence of MB2 was 50.6% on the right side and 49.4% on the left side. The MB2 canal on the right and left sides was found to be approximately equal. There is no link between the occurrence of the MB2 canal and the tooth location, and there was no statistical difference between the presence of MB2 and the tooth location of patients. The P-value = 0.635>0.05 in the chi-square test, which indicates that there are no statistically significant differences between the MB2 canal and tooth location, as illustrated in Table 4.

Table 4. The incidence of MB2 canal is based on the tooth locations

MB2 Canal	Location				Total		P-value
	Right		Left				
	N	%	N	%	N	%	
Present	232	59.6	233	61.3	465	60.5	0.635
Absent	157	40.4	147	38.7	304	39.5	
Total	389	50.6	380	49.4	769	100	
Spearman correlation	-0.017						

This study included a sample of 769 patients, 298 of whom were males (38.8%) and 471 were females (61.2%). The MB2 canal was found in males was higher than in females (61.4% and 60%, respectively), and as such the total incidence of MB2 canals was found to be 60.5%. There is no link between the occurrence of MB2 canal and the gender of the patient, and there was no Statistical difference between the presence of MB2 and the gender of patients.

The P-value = 0.671> 0.05 in the chi-square test, which indicates that there are no statistically significant differences between the MB2 canal and gender, as illustrated in Table 5.

Table 5. Incidence of MB2 canal in based on patient gender

MB2 Canal	Gender				Total		P-value
	Male		Female				
	N	%	N	%	N	%	
Present	183	61.4	282	60	465	60.5	0.671
Absent	115	38.6	189	40	304	39.5	
Total	298	38.8	471	61.2	769	100	
Spearman correlation	0.015						

Further analysis based on age groups showed that the mean incidence of MB2 was 30.2% in the age group 17-27 years, 37.8% in the age group 21-40 years, 28.9% in the age group 41-60 years, while it was 3.1% in the age group greater than 60. The MB2 canals in the age groups was found to be the highest in the second age group (28-40) years with 62.5%, followed by the third age group (41-60) years with 62.2%, then the first age group (17-28) years with 56.9%, while it was 54.2% in the age group greater than 60.

There was no statistical difference between the occurrence of MB2 canal and the age groups of the patient. The P-value =0.370>0.05 in the chi-square test, which indicates that there are not statistically significant differences between the MB2 canal and age groups, as illustrated in Table 6.

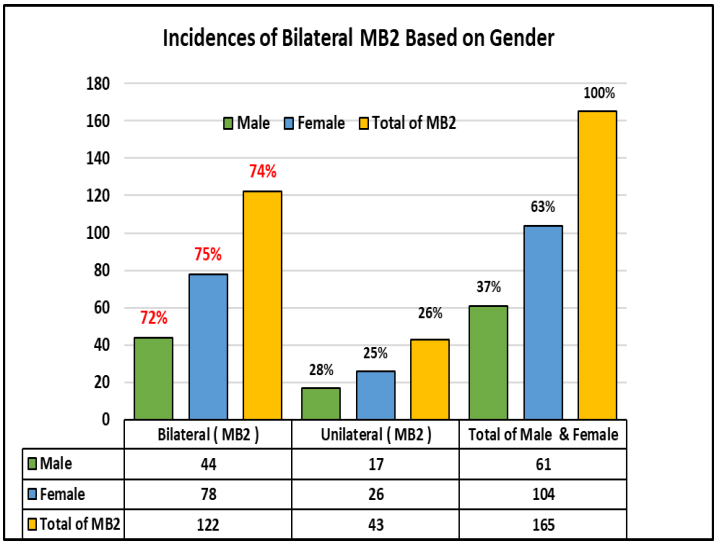

Figure 3. Incidence of MB2 based on gender

In the present study, we found the total bilateral incidence of MB2 was 74%; we also found the bilateral occurrences of MB2 were higher in females than males, with 75% and 72%, respectively, as illustrated in Figure 3.

In the current study, 94.8% of maxillary second molars had three roots, whereas 4% had two roots, and 1.2% had one root. The frequency of three rooted teeth was higher in males than in females, in contrast to that the frequency of three rooted teeth was nearly equivalent based on location, either right or left side.

The incidence of two-rooted teeth was higher in females than males, in contrast to that the incidences of two-rooted teeth were virtually identical in right and left sides. One rooted tooth frequency is almost equal based on location and gender, as illustrated in Figure 4.

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Table 6. Incidence of MB2 canal based on age groups

Frequency of Second Mesio-buccal canals		Age Groups								Total		P-value
		17- 27 years		28-40 years		41-60 years		>60years				
		N	%	N	%	N	%	N	%	N	%	
MB2 Canal	**Present**	132	56.9	182	62.5	138	62.2	13	54.2	465	60	0.370
	Absent	100	43.1	109	37.5	84	37.8	11	45.8	304	40	
Total		232	30.2	291	37.8	222	28.9	24	3.1	769	100	
Spearman correlation		-0.032										

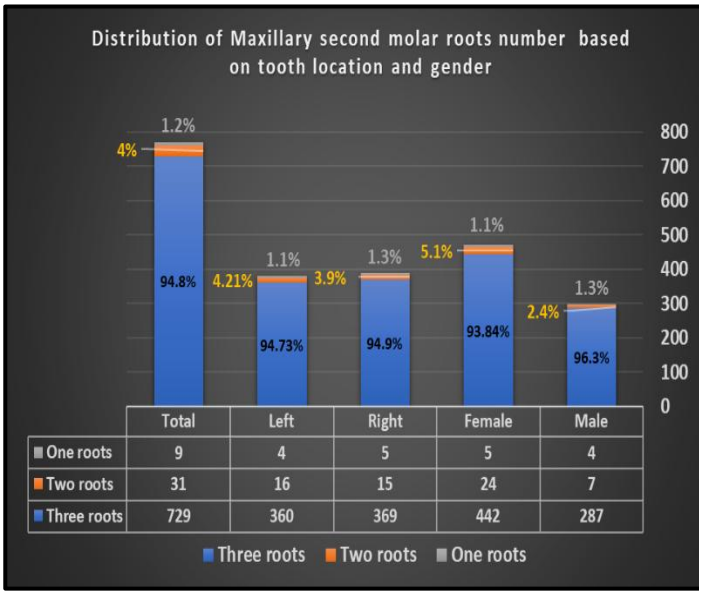

Figure 4. Distribution of Maxillary second molar roots based on tooth location and gender

Discussion

The frequency of second mesiobuccal canals in the current study was 60.5% out of 769 CBCT images that were screened during May 2023 to December 2024 from Al-Tansneem Private Poly-Clinic in Zliten city.

The incidences of MB2 in the present study were lower than previous studies [7,13,19]. In contrast to that, the occurrences of MB2 in the present study were higher than in previous studies [8-12,14,16-22] as mentioned in Table 1.

In the present study, the occurrence of MB2 was almost equal in right and left sides with 50.6% and 49.4%, respectively, which is similar to previous studies [8,13, 22]. dissimilarity to that [14] in which the presence of MB2 was higher on the left side than the right side [9,11]. In the current study, the frequency of MB2 was higher in females than males, with 61.2% and 38.8%, respectively. In contrast to that, the incidences of MB2 in maxillary second molar teeth were higher in males than females in previous studies [8-11,13,16,18,19,22].

In the present study, we found the total bilateral incidences of MB2 were 74%, which is higher than previous studies [8,12,19], while this was lower than the result of previous studies [13,14].

We also found that the bilateral occurrences of MB2 were higher in females than males, as shown in Figure 3. This result was in contrast to the previous studies done by [13,19] in which the bilateral incidences of MB2 were higher in males than females. While in a study by Alnowailaty & Alghamdi, the bilateral incidence of MB2 was almost identical in males and females, with results of 17.3% and 18%, respectively [14].

In the present study, three three-rooted maxillary second molars had the highest incidence among the three types. This result is resembled to many previous studies that showed high incidences of three-rooted maxillary second molars as illustrated in Table 7. We also found the teeth root number with single rooted teeth had lower incidences than teeth with two roots, which is also identical to previous studies.

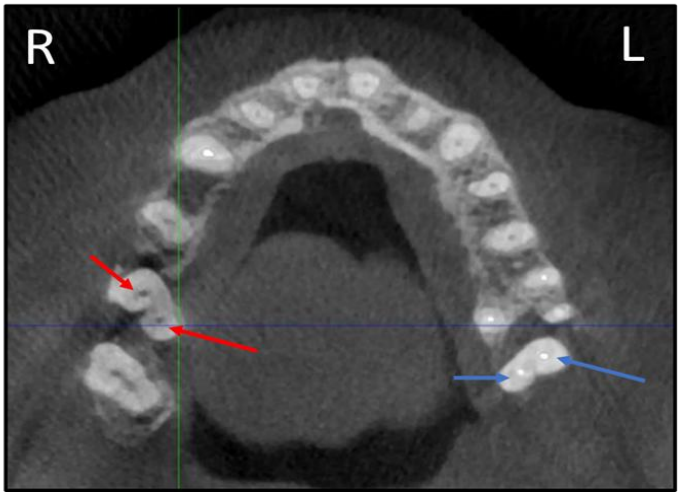

Figure 5. Full Sectional CBCT image show Right Second maxillary molar with two canals; Left one was excluded due presence of root canal filling

Many previous studies have been done to evaluate the presence of MB2 in maxillary first and second molar teeth, as shown in Table 8; they found that the frequency of MB2 was higher in first molar than second molar teeth. We compared the results of this study to our previous study [23]; we found that the incidences of MB2 in maxillary second molar teeth in the Libyan subpopulation in Zliten city had a lower frequency of MB2 than first molar teeth, with results of 60.5% and 70.5%, respectively.

*Corresponding E-mail addresses: aalaali.ehbesh@asmarya.edu.ly

Table 7. Frequencies of MB2 in previous studies of maxillary first and second molars

Author(s)	Year	Country	Incidences of MB2	
			First Molar	Second Molar
Kim et al.,	2020	USA	77%	46.9%
Abd Rahman et al.,	2020	Malaysia	59.9%	35.2%
Onn et al.,	2022	Brunei	51.3%	29.8%
Akay et al.,	2021	Turkey	59.2%	30.4%
Xu et al.,	2022	China	51.1%	32.9%
Alnowailaty & Alghamdi	2022	KSA	46.7%	17.7%
Normando et al.,	2023	Brazil	76.44%	41.73%
Namdar et al.,	2023	Iran	71.3%	36.6%
El Taher et al.,	2024	Egypt	74.3%	48.6%
Aqili et al.,	2024	KSA	46.6%	45.1%

Table 8. Frequencies of root numbers of the maxillary second molar in previous studies

Author(s)	Year	Country	Root number			
			One	Two	Three	Four
Kim et al.,	2020	USA	3.03%	7.20%	89.77%	-
Abd Rahman et al.,	2020	Malaysia	4.9%	14.7%	80%	0.4%
Madfa et al.,	2023	KSA	1.4%	4%	93%	1.6%
Buchanan et al.,	2023	RSA	0.7%	2.8%	96.1%	0.25%
Namdar et al.,	2023	Irian	0.8%	2.7%	95.7%	0.8%
Allawi et al.,	2024	Syria	2.4%	4.8%	90.8%	2%
El Taher et al.,	2024	Egypt	-	11.4%	88.5%	-

According to frequency of presence of second mesiobuccal canal in present study, we found the least frequency was in group of age more than 60 years; while the groups of age (28-40) and (41-60) years old had almost similar frequency of MB2 with 62.5% and 62.2% respectively as shown in Table 6.

In a study had done by Akay et al the least frequency of MB2 were in group of age (20-29) [9]; while the least incidences of MB2 in studies had done by Onn et al and Xu et al were in oldest group of age [10,11] as shown in Table 9.

Table 9. Prevalences of MB2 in maxillary second molar teeth in previous studies based on age groups.

Author (s)	Year	Variable	Results				
Akay et al.,	2021	Age*	20 - 29	30 - 39	40 – 49	≥50	-
		Mb2**	26.1%	32.3%	30.2%	34.1%	-
Elatrash & Alawjali	2022	Age*	15 - 30	31 – 40	> 40	-	-
		Mb2**	89.1%	93.8%	88.9%	-	-
Xu et al.,	2022	Age*	< 20	20 - 29	30 - 39	40 -49	≥ 50
		Mb2**	49.22%	32.05%	46.28%	30.56%	17.57%
Onn et al.,	2022	Age*	15 - 50	> 50	-	-	-
		Mb2**	35.8%	21.3%	-	-	-

Age *: Age group per year; Mb2**: Frequency of Second mesiobuccal canals

Conclusion

The incidence of MB2 canals in maxillary second molar teeth in the Libyan subpopulation in Zliten city was 60.5%. The MB2 canal on the right and left sides was found to be approximately equal, with 50.6% and 49.4%, respectively. Total bilateral incidences of MB2 were 74%; the bilateral occurrences of MB2 were higher in females than in males. The incidences of MB2 canals were slightly higher in males than females with 61.4% and 60%, respectively. The three rooted maxillary second molar teeth were 94.8%.

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