

Original article

Roots Quantity of Maxillary Wisdom Teeth of Libyan Subpopulation at Zliten City Using CBCT: A Retrospective Study

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Abstract

This study aims to evaluate the number of roots of maxillary wisdom teeth of the Libyan subpopulation at Zliten city, to compare incidences in different side locations, and to compare the prevalence of root number in both genders. This was a retrospective study showing 806 CBCT images met the inclusion criteria out of 2078 CBCT images (X-MIND Prime®3D- Acteon software) that had been collected from Al-Tasneem Private Poly-clinics at Zliten city in Libya over the period from January 2024 to May 2025. 55.7% (425 CBCT images) were right-sided, while 53.6% (432 CBCT images) were female. The highest root numbers of maxillary wisdom teeth in the Libyan subpopulation at Zliten city were three rooted teeth with 80.02%, while the lowest incidences were four rooted teeth with 2.61%. The incidences of three-rooted teeth were slightly higher on the right side than on the left side, with 80.9% and 79% respectively. However, the incidences of three-rooted teeth were higher in females than in males, with 82.4% and 78% respectively. The prevalence of one-rooted teeth was higher in males than in females. The frequencies of two and four-rooted teeth were almost equal in both genders. The number in the current study ranged from 1 to 4 roots. The highest root numbers of incidences of maxillary wisdom teeth in the Libyan subpopulation at Zliten city were three rooted teeth. The most frequent total bilateral root number in the current study was in three rooted teeth, with 25.9%.

Key words: Maxillary Wisdom Teeth, Number of Roots, CBCT, Libyan Subpopulation, Zliten

Introduction

A thorough and insightful understanding of root and root canal morphology is a key determinant in the success of endodontic therapy [1]. Numerous anatomical variations can influence the outcomes of both conventional and unconventional endodontic procedures [1]. Neelakantan et al. (2010) highlighted notable differences in the morphology of upper molars among Mongoloid and Caucasian populations compared to the Indian population, including variations in the number of roots, canal configurations, and root shapes [2]. Todor (2012) emphasized that extraction is often the preferred treatment for maxillary third molars due to several challenges that complicate root canal therapy. These include significant variability in root and canal numbers, limited accessibility, and difficulty in visualizing the canals directly [3]. Ahmed (2012) noted that, beyond their functional role in the dental arch, wisdom teeth can serve as donor teeth for auto-transplantation and as abutments in prosthodontic treatments [4]. He also stressed the importance of addressing structural complexities, conducting precise evaluations, and ensuring comprehensive clinical care to avoid complications during endodontic procedures [4].

Faramarzi et al. found that wisdom teeth often exhibit unpredictable root and canal anatomy [5]. Tomaszewska et al. reported that the anatomy of upper third molars may be less complex than previously assumed and can resemble that of other maxillary molars [6]. Zhang et al. (2018) observed substantial variation in the root and canal morphology of upper and lower wisdom teeth among Chinese individuals [7]. Todor et al. further confirmed the structural diversity of upper wisdom teeth, noting that the most common root counts range from two to four [8]. Awais et al. (2025) attributed the unexpected anatomy of these teeth to the extensive variability in root canal morphology and root number [9]. Neelakantan et al. also advocated for the use of Cone Beam Computed Tomography (CBCT) as a valuable tool in assessing root canal morphology [2]. Similarly, Kim et al. demonstrated that CBCT is an effective method for identifying root and canal structures [10], while Weber et al. affirmed its ability to reveal complex canal systems and high canal incidence [11]. Ahmed (2022) concluded that CBCT is the most suitable diagnostic technique for evaluating root canal morphology and generating population-level data [12]. This study aims to evaluate the number of roots of maxillary wisdom teeth of the Libyan subpopulation at Zliten city, to compare incidences in different side locations, and to compare the prevalence of root number in both genders

Methods

Out of 2078 CBCT images collected from Al-Tasneem Private Dental Poly-Clinics in Zliten city during the period from January 2024 to May 2025, only 806 CBCT images were included. 89.33% of images were full, while (4.34%) were 80*90 images, (6.33%) were 60*60 CBCT images. The evaluation of each image had been done by scrolling the images from the coronal to apical part of each tooth and scrolling the image in

the sagittal and axial planes. The evaluation of CBCT images screened on a 32-inch Television linked to a PC was done independently by two examiners in a dark room, as shown in (Figure 1).

Table 1. Previous Studies illustrated the Number of Roots of Maxillary Third molars teeth

Author(s)	Year	Sample	Method(s)	Country	Number of root(s) of Maxillary Third Molars				
					1	2	3	4	5
Sidow et al.,	2000	150	Vitro	USA	15%	32%	45%	7%	-
Alavi et al.,	2002	151	Vitro	Thailand	1.3%	6.6%	88%*	4%*	-
Faramarzi et al.,	2013	179	Vitro	Iran	15.08%	11.73%	67.6%	5.59%	-
Čosić et al.,	2013	56	Vitro	Croatia	8.9%	5.4%	83.9%	1.8%	-
Singh & Pawar	2015	100	Vitro	India	20%	33%	47%	-	-
Jung and Cho	2015	395	Panorama, CBCT	Korea	46.1%	17.5%	35.7%	0.8%	-
Ahmad et al.,	2016	49	Vitro	Jordan	13.5%	5.6%	74.2%	6.7%	-
Rawtiya et al.,	2016	116	CBCT	India	31%	13.8%	55.2%	-	-
Razumova et al.,	2018	238	CBCT	Russia	47.9%	-	52.1%	-	-
Zhang et al.,	2018	130	Micro-CT & Vitro	China	51.53%	19.23%	25.38%	3.84%	-
Tomaszewska et al.,	2018	78	Micro-CT & Vitro	Poland	38.5%	-	61.5%	-	-
Al-Qudah et al.,	2023	592	Vitro	Jordan	5.91%**	11.48%*	52.36%*	28.2%*	2.03%
Olczyk et al.,	2024	196	CBCT	Poland	24.49%	7.65%	64.29%	3.57%	-
Džanković et al.,	2024	105	Vitro & stethoscope	Bosnia & Herzegovina	8.57%	12.38%	77.13%	1.91%	-
Awais et al.,	2025	39	CBCT	Pakistan	25%	13%	59%	2.5%	-

*= include all types of roots (i.e, Fused and Separated roots)

** = include all types of roots (i.e, Conical & C-shaped)

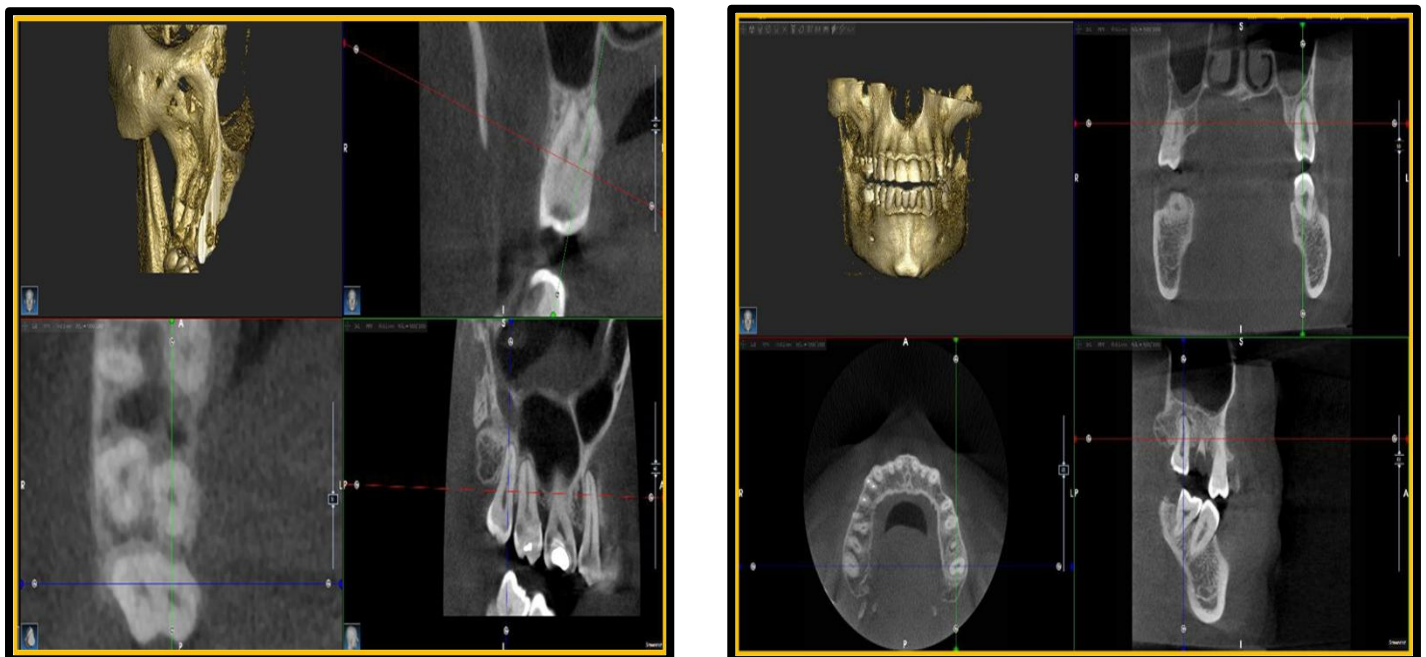


Figure 1. (A) 80*90 CBCT images showing left maxillary wisdom teeth with two roots in different planes. (B) Full CBCT images showing right & left single-rooted maxillary wisdom teeth

Inclusion and exclusion Criteria

The inclusion criteria for this study were carefully defined to ensure the selection of a homogeneous and representative sample. Only Libyan patients were considered eligible, with a specific focus on maxillary third molar teeth that exhibited complete root formation. To maintain diagnostic accuracy, only high-quality Cone Beam Computed Tomography (CBCT) images were included, ensuring clear visualization of root and canal morphology. Furthermore, the study was limited to normally erupted teeth that had not undergone any prior dental procedures, thereby eliminating potential alterations in anatomical structure due to clinical intervention. Conversely, several exclusion criteria were applied to preserve the integrity of the data. Patients of non-Libyan nationality were excluded to maintain population specificity. Teeth with incomplete root development were also omitted, as were those that had been restored or fitted with prosthetic devices, which could obscure or alter the natural anatomy. Additionally, any form of impaction

or pulp canal calcification led to exclusion, given the potential for these conditions to complicate or misrepresent the assessment of root and canal morphology.

Statistical Analysis

Descriptive statistical analysis was performed using SPSS version 20 for Windows (IBM Corp., Chicago, IL, USA) to evaluate the incidences of root numbers of maxillary third molar teeth and to compare the incidences according to tooth location and gender. The Chi-square test indicated no statistically significant differences, suggesting symmetry in root morphology between both sides. Similarly, the Chi-square test did not reveal statistically significant differences between genders. Cohen's Kappa test was used to assess inter-examiner reliability, yielding a coefficient of $\kappa = 0.972$ ($p < 0.001$), indicating an almost perfect level of agreement between the two examiners, as shown (Table 2).

Table 2. The inter-reliability between the two examiners

Inter-reliability	Value	p-value
Measure of Agreement Kappa N of Valid Cases	0.972 60	0.000

Results

The study sample of this study was 53.36% related to females, while 46.4% related to males. 47.3% were left-sided locations, whereas 55.7% were right-sided locations, as shown in (Figure 2). Right-sided teeth in males were 24.8%, while left-sided teeth were 21.6%; whereas right-sided teeth in females were 27.9% as shown in (Figure 2). The right sided teeth in both genders were higher than left-sided teeth as illustrated in (Table 3).

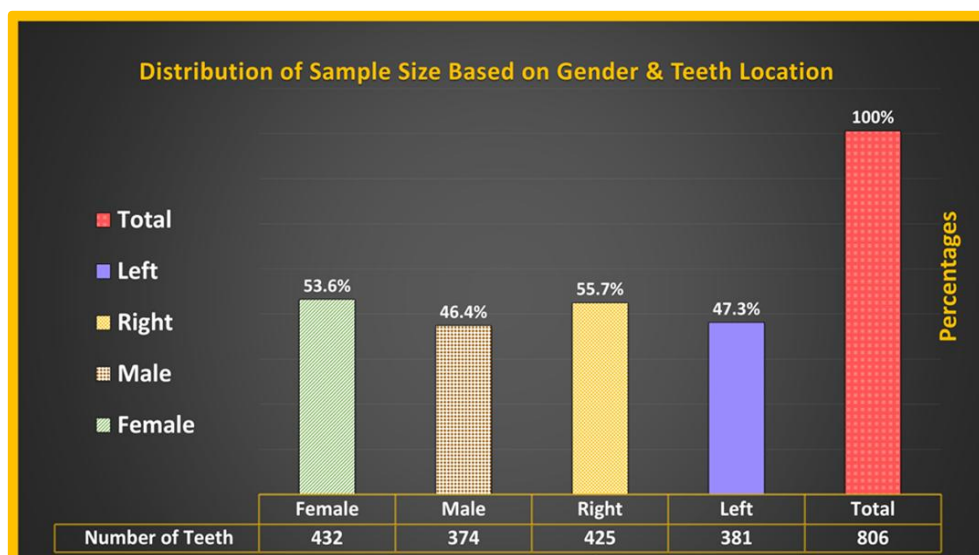


Figure 1. Distribution of sample size of the current study in both genders and tooth locations

Table 3. Distribution of sample size of the current study based on both sides of male & female

Variables		Male		Female	
		Right	Left	Right	Left
Number of Teeth	N	200	174	225	207
Percentages out of Gender	%	53.5	46.5	52.1	47.9
Percentages out of Total	%	24.8	21.6	27.9	25.7

In a total sample of 806 Maxillary wisdom teeth, the majority exhibited three roots, followed by one root and two roots, while four roots were rare. These finding highlights that the three roots were the predominant anatomical pattern in this study, as shown in (Figure 3). The (Figures 4 & 5) show bilateral three-rooted maxillary wisdom teeth. The incidences of three-rooted teeth in the current study were slightly higher on the right side than on the left side. At the same time, the incidences of double-rooted teeth were almost equal in both sides as illustrated in (Table 4). The Chi-Square test indicated no statistically significant difference, suggesting symmetry in root morphology between both sides. In another hand, the incidences of three-rooted teeth were higher in females than in males, while the prevalence of one-rooted tooth was higher in males than in females. We found the frequencies of double- rooted and four-rooted tooth were almost equal in both genders as shown in (Table 5).

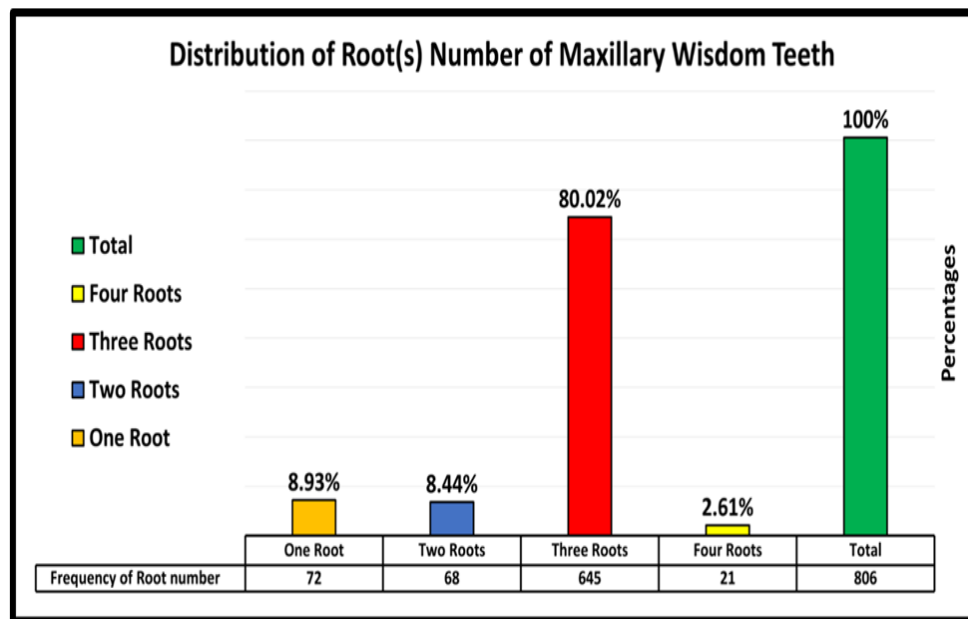


Figure 3. Root Number Distribution of Maxillary Third Molar Teeth

Table 5 shows that the three-root configuration was the most prevalent across both genders. Although minor descriptive variations were noted, the Chi-Square tests did not reveal statistically significant differences. This suggests that root number distribution is independent of both gender and side.

Table 4. Number of Root(s) Based on Tooth Location

Root Number	Right Side		Left Side		Total		Chi-square statistic	P-value
	N	%	N	%	N	%		
One root	36	8.5	36	9.4	72	8.9	2.191	0.534
Two roots	37	8.7	31	8.1	68	8.4		
Three roots	344	80.9	301	79	645	80		
Four roots	8	1.9	13	3.4	21	2.6		
Total	425	52.7	381	47.3	806	100		

Table 5. Distribution of Number of Roots of Maxillary Third Molar Teeth Based on Gender Type

Gender	Single Root		Double Roots		Three Roots		Four Roots		Total of each Gender	
	N	%	N	%	N	%	N	%	N	%
Male	49	8.9	35	8.4	337	78	11	2.6	432	54
Female	23	6.1	33	8.8	308	82.4	10	2.7	374	47
Total	72	11.3	68	8.1	645	80	21	2.5	806	100

Table 6. Comparison between genders and dental aspects

Gender	χ^2 Value	p-value
Males	1.660	0.646
Females	5.502	0.139

In the present study we found the prevalence of three-rooted teeth in females was slightly higher on the right side than on the left side. We also found that the frequencies of four rooted teeth were slightly higher on the left than the right sides, with 3.9% and 1.3% respectively, as shown in (Table 7). In another hand, the incidences the single-rooted teeth in males were slightly higher on the right side than the left side, while the occurrences of three-rooted teeth in males were almost equal on the left and right sides. The rate of occurrences of single-rooted teeth in females in present study was slightly higher on the left side than the right side, while the prevalence of double-rooted teeth was slightly higher on the right side than the left side, as illustrated in (Table 7). The incidences of three-rooted teeth on the right side of females were slightly higher than on the left side, with 80% & 75.8% respectively.

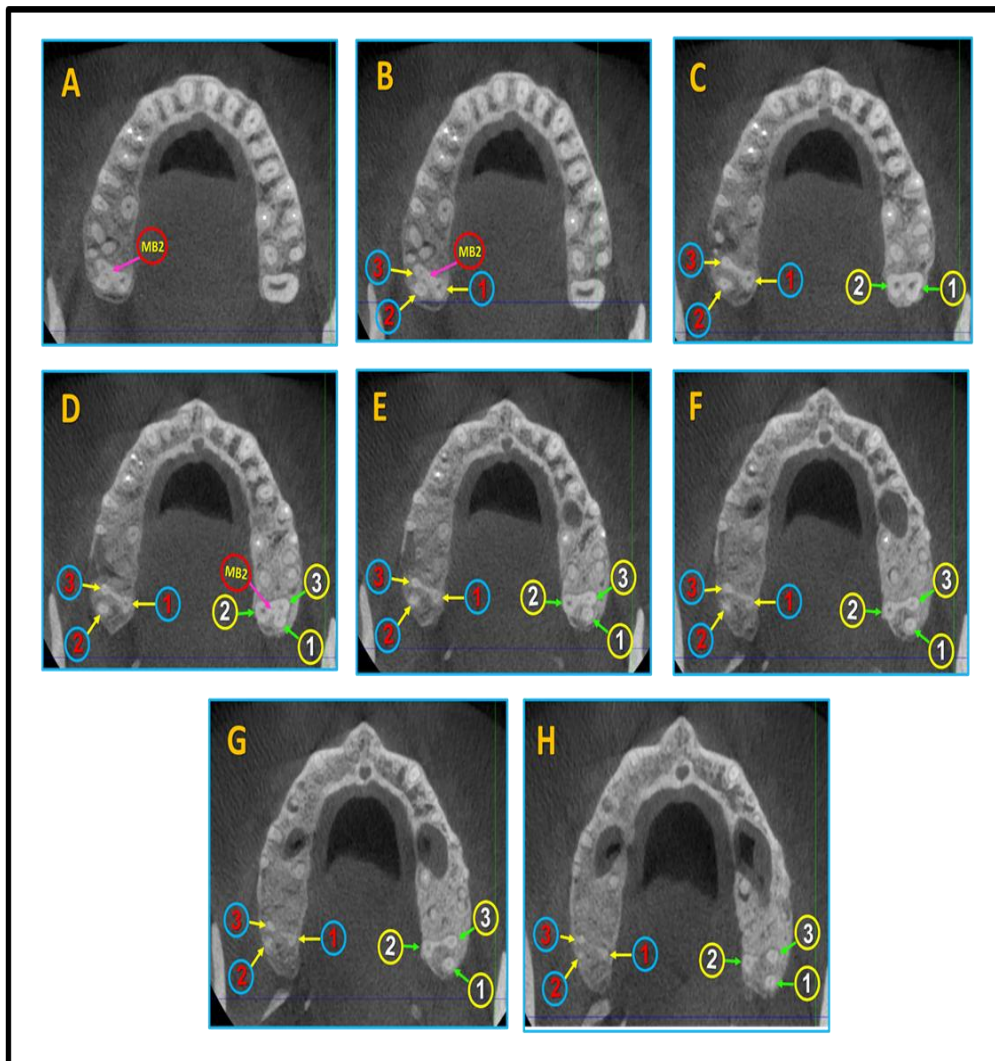


Figure 4. (A to H) illustrate the evaluation procedure of a Full CBCT image of bilateral maxillary three-rooted wisdom teeth. D image illustrates the MB2 canal in the right wisdom teeth

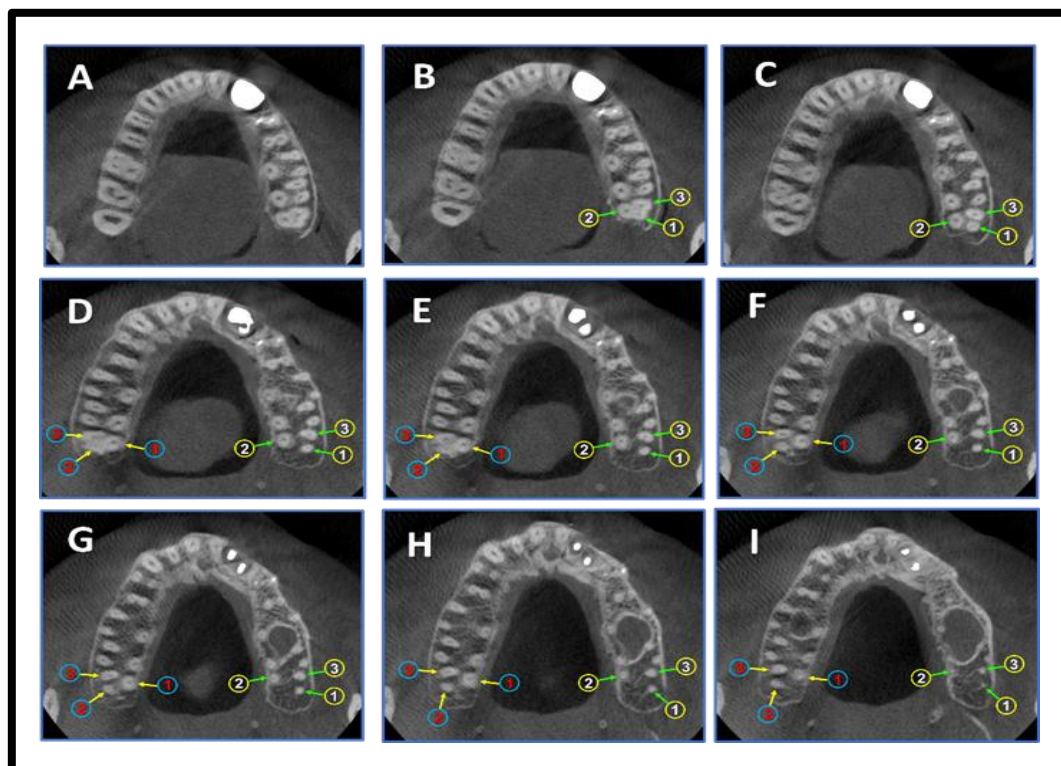


Figure 5. (A to I) illustrate the evaluation procedure of a Full CBCT image of bilateral maxillary three-rooted wisdom teeth.

The frequencies of single-rooted teeth in the right side of females in the current study were slightly higher than the right side of males, whereas the frequencies of single-rooted teeth in the left side of females was higher than the left side of males, as shown in (Table 7). The prevalence of double-rooted teeth on the left side of males was slightly higher than on the left side of females. However, the incidences of three-rooted teeth in the right side of males were slightly higher on the right side of females, with 82% and 80% respectively, while the incidences of three-rooted teeth on the left side of males were higher than on the left side of females.

Table 7. Distribution of Root Number of Maxillary Third Molar Teeth Based on Gender & Location

Gender		Single Root		Double Roots		Three Roots		Four Roots		Total	
		N	%	N	%	N	%	N	%	N	%
Male	Right	15	7.5	16	8	164	82	5	2.5	200	24.8
	Left	8	4.6	17	9.8	144	82.8	5	2.9	174	21.6
Female	Right	21	9.3	21	9.3	180	80	3	1.3	225	27.9
	Left	28	13.5	14	6.8	157	75.8	8	3.9	207	25.7
Total		72	8.9	68	8.4	645	80	21	2.6	806	100

The most prevalent total bilateral root number in the current study was in three-rooted teeth with 25.9%, followed by double-rooted teeth, then single-rooted teeth, whereas four-rooted teeth had the lowest incidences, as demonstrated in (Table 8). Out of total bilateral incidences, the single-rooted and four-rooted teeth in females had higher bilateral incidences than single and four-rooted teeth in males. In contrast to that, the bilateral incidences of double-rooted teeth were higher in males than in females. (Figures 6 & 7) showed bilateral maxillary double-rooted and bilateral single-rooted wisdom teeth respectively.

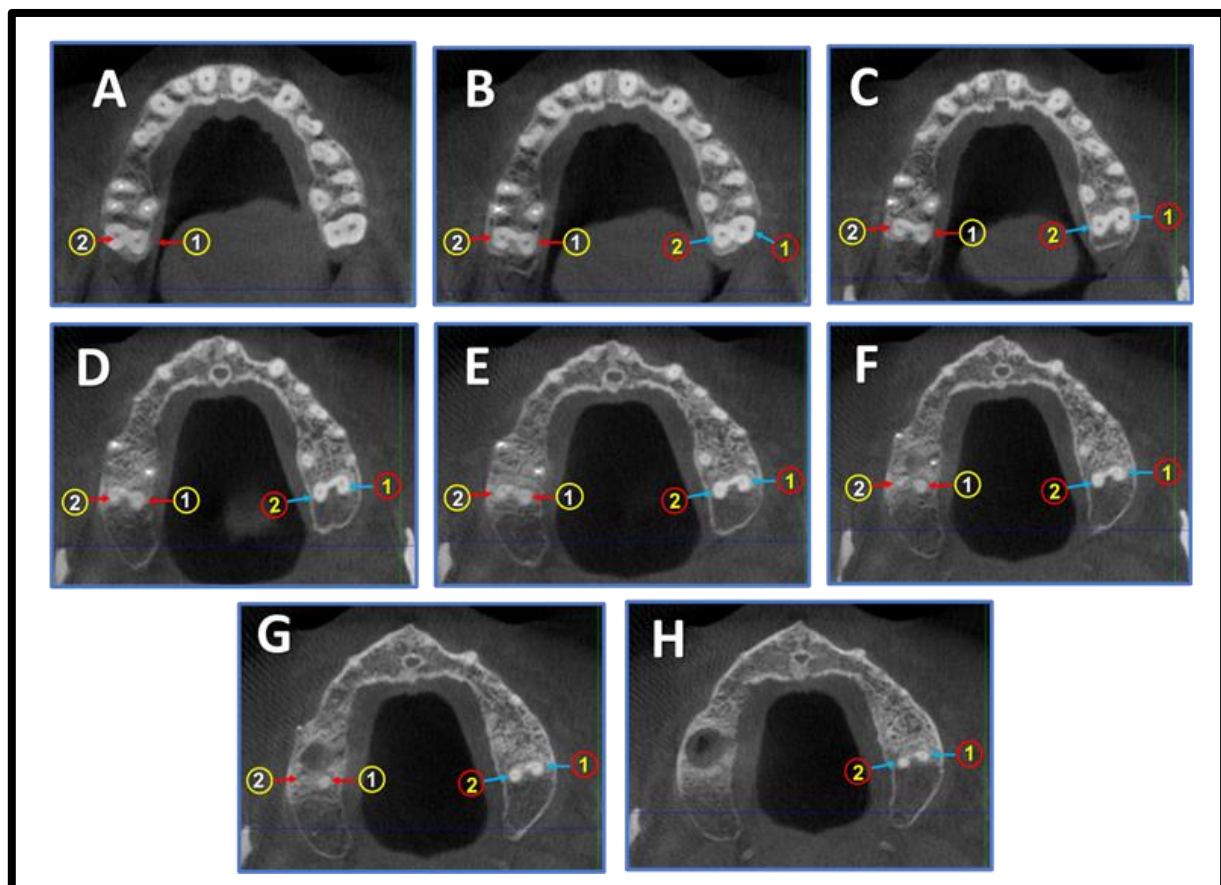


Figure 6. (A to H) Demonstrate the evaluation procedure of a Full CBCT image of bilateral maxillary double rooted wisdom teeth.

Table 8. Total Bilateral Prevalences of Roots Number of Maxillary Third Molar

Variables	Single Root		Two Roots		Three Roots		Four Roots	
	N	%	N	%	N	%	N	%
Bilateral Incidences in Male	4	36.4	9	64.3	82	49.1	1	33.3
Bilateral Incidences in Females	7	63.6	5	37.7	85	50.9	2	66.7
Total Bilateral Incidences	11	15.3	14	20.6	167	25.9	3	14.3
Total Incidences of Root(s)	72	8.9	68	8.4	645	80	21	2.6

The bilateral incidences of single and four-rooted teeth in females out of the total bilateral incidences were higher than in males. In contrast to that, the bilateral incidences of double-rooted teeth in males were higher than in females. On another hand, the bilateral incidences of three-rooted teeth in females were slightly higher than in males, as illustrated in (Table 8).

In the hand, the highest bilateral incidences of root number in females out of female incidence were single-rooted teeth, followed by three-rooted teeth, then four-rooted teeth, while the two-rooted teeth had the lowest bilateral incidences, as shown in (Table 9). The lowest bilateral incidences of root number in males out of male incidence were single-rooted teeth, while the highest bilateral incidences were in double-rooted teeth two-rooted teeth, followed by three-rooted teeth.

Table 9. Bilateral Prevalences of Root Numbers out of Gender Incidences

Variables	Single Root		Two Roots		Three Roots		Four Roots	
	N	%	N	%	N	%	N	%
Bilateral Incidences in Male	4	8.2	9	25.7	82	24.3	1	9.1
Bilateral Incidences in Females	7	30.4	5	15.2	85	27.6	2	20
Total Incidences in Male	49	68.1	35	51.5	337	52.2	9	52.4
Total Incidences in Females	23	31.9	33	48.5	308	47.8	10	47.6
Total Incidences of Root(s)	72	8.9	68	8.4	645	80	21	2.6

Discussion

In the current study, the number of maxillary wisdom teeth ranged between 1 and 4 roots, which results in a similar range to many previous studies [5,7,9,13,14,5,15,17,18,22,24]. In some previous studies, the root number ranged between 1 and 3 roots [16,19], whereas in studies done by Razumova et al and Tomaszewska et al, only single and three teeth existed, in which the three-rooted teeth were the highest incidences [6,20]. However, in some studies, the number of maxillary wisdom teeth ranged between 1 and 5 roots [21,23]. In addition to that, in a case reported by Andrei et al, they reported a maxillary wisdom tooth had 5 separated roots [25].

The highest root number of the current study was three roots with 80.02% which is similar to many previous studies [5,6,9,13,14,15,16,18,19,20,21,22]. In contrast to that, there were some previous studies that had the highest root number of the Maxillary third molar were single root [7,17]. The incidence of a single root with 9.8% was the second-highest root number in the current study, which resembled many previous studies [5,9,15,18,19,22,23]. In contrast to that, the second highest root number was double roots in some previous [13,14,16,24]. While the second-highest root number in a study done by Al-Qudah et al was 4 roots [21]. However, in a study done by Zhang et al, the second highest incidence root number was three rooted teeth with 25.38% [7].

The lowest frequency root number in this study was in four root teeth, which resembles many previous studies [5,9,7,13,15,17,22,24]. Other studies showed that the double root had the lowest incidences [18,19]. However, the single root had the lowest incidence in some previous studies [14,16] the single root had the lowest incidence. In studies done by Al-Qudah et al and Olczyk et al, the lowest root number was five roots [21,23]. respectively [22]. In addition to that, in a study done by Ahmad et al, the prevalence of three-rooted teeth was slightly higher in females than males, with 75% & 73% respectively [18].

In current study the incidences of four rooted teeth were almost equal in female and male with 2.7% & 2.5% respectively, and double rooted teeth with 8.8% in female and male with 8.1% that similar to study had done Olczyk et al in which the incidences of four roots were 3.84% & 3.39%, while the male incidence of double roots in same study with 8.48% were slightly higher than female incidences with 6.41% [22]. In the study done by Ahmad et al, the incidences of two and four-rooted teeth were slightly higher in males than in females [18].

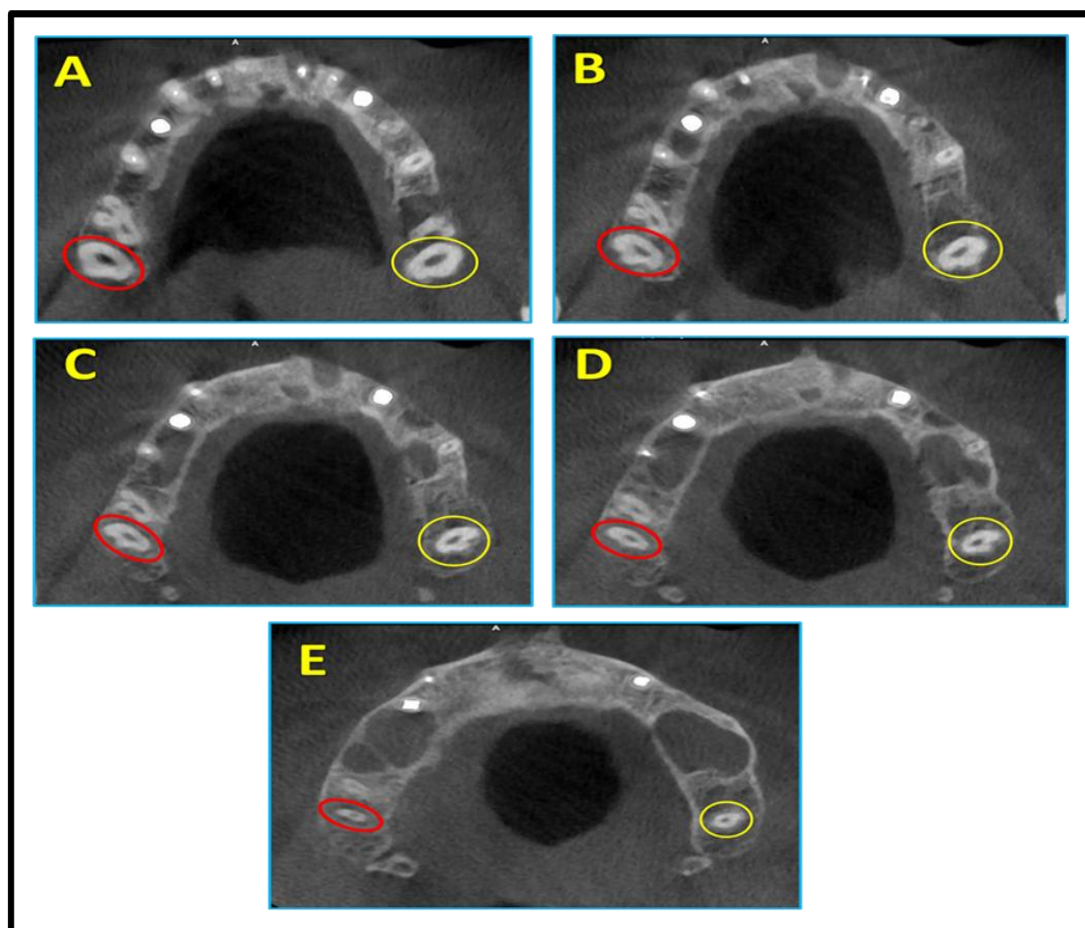


Figure 7. Full CBCT Images from the coronal to apical part of the maxillary third molar showing bilateral single-rooted teeth

The prevalence of three-rooted teeth in the current study was higher in females than in males, with 82.4% & 78% respectively, like that in a study done by Olczyk et al, with females than males, with 79.49% & 54.24%. In the present study, the prevalence of single-rooted teeth was higher in males than in females, with 11.3% & 6.1% respectively, which resembles studies done by Ahmad et al and Olczyk et al [18,22]. We found in the current study the incidences of three rooted teeth were 80.02%, which lower than the incidences of three rooted teeth in first and second maxillary molar in previous studies in same Libyan subpopulation that had done by Ehbesh et al and Alteer et al [26,27] with 100% and 94.8% respectively, which resemble to some previous studies [9,14,16].

In contrast to that, the prevalences of single and double roots of maxillary third molar teeth in this study were higher than the single and double roots of maxillary second molar teeth in same Libyan subpopulation that had done by Alteer et al [27] that resemble to some previous studies [9,16], while the maxillary first molar teeth in same Libyan subpopulation there were not in frequencies of single or double roots that had done by Ehbesh et al [26] that also resemble to previous studies [9,16]. In addition to that, with 2.6% the four-rooted teeth in the Libyan subpopulation at Zliten city only existed in maxillary third molar teeth [26,27], which resembles the study done by Awais et al [9]. The only maxillary wisdom teeth among maxillary molar teeth had single, double, and four roots in some previous studies [14,20]. [26,27] that resemble to study had done by Awais et al [9]. The only maxillary wisdom teeth among maxillary molar teeth had single, double and four rooted in some previous studies [14,20]

In the present study, the frequencies of three and four-rooted teeth in males were almost equal on the right and left sides. The most prevalent total bilateral root number in the current study was in three-rooted teeth, while the four-rooted teeth had the lowest total bilateral incidences.

Conclusion

The number of maxillary wisdom teeth in the Libyan subpopulation at Zliten city ranged between 1 and 4 roots. The most common prevalences of the root number of maxillary wisdom teeth were three roots with 80.02% whereas four roots were the lowest incidence with 2.6%. The incidences of all root numbers of the maxillary third molar were slightly different on the right or left side. The incidences of all root numbers in right-sided and the incidences of double and four-rooted teeth of the left side in both genders had slight differences, whereas the incidences of single-rooted teeth in left-sided teeth of females (with 13.5%) were

higher than those of males (with 4.6%). The most frequent total bilateral root number in the current study was in three rooted teeth with 25.9%.

Conflict of interest. Nil

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