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Number and Roots Type Differences Between Genders: A Comprehensive in-vivo CBCT Study in a Yemeni Population

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1. Abstract

1.1. Objective: This study used cone-beam computed tomography (CBCT) analysis to examine the root number and types of maxillary third molars in Yemen.

1.2. Material and Methods: Three hundred and twenty CBCT images of permanent maxillary third molars of Yemeni patients were included in this study. Each root's number and types of Roots (R) (separated or fused) were evaluated.

1.3. Results: Of the 320 investigated maxillary third molars, 50 had several Rs. Among the cases, 15.6% featured a single R, and 29 cases (9.1%) exhibited two Rs. 220 cases, accounting for 68.8%, had three Rs; a smaller proportion, 21 of cases, constituting 6.6%, displayed four Rs.

1.4. Conclusion: Gender differences in R distribution are evident in the Yemenis' maxillary third molars. Significantly, more males displayed two Rs, and more females than expected displayed three Rs. On the other hand, fewer females than expected had one and four Rs. In comparison, fewer males than expected had one R.

2. Introduction

Maxillary third molars display notable variations in size, shape, and positioning relative to neighboring teeth. According to Vertucci, The number of roots in maxillary third molars can range from one to five, and the reported number of root canals ranges from one to six. (Vertucci, 2005) However, the standard root canal configurations involve single, double, or three-root Canal variants, separate or fused Roots, with between one and four Roots.

Dentists often encounter these morphological variations, and failure to detect them can lead to treatment failures. Additional radiographic exams should be considered to find any unexpected anatomical anomalies when a preoperative radiograph indicates an irregular tooth shape. The maxillary third molars typically emerge as the last tooth in the human dental arch, usually between the ages of 17 and 25. They exhibit significant variability in size, shape, position, and timing of development and eruption. (Zhang et al., 2018a). Known as a "troublemaker," the third molar can cause various issues such as impaction, unusual face pain, dental cavities, or pockets of gingiva. (Schlüter et al., 2013). Extraction is often the preferred treatment option for third molars. (Hasegawa et al., 2013).

However, with advancements in dental materials and technology, even with intricate Root Canals (RCs), the Root Canal system's (RCS) success rate has significantly increased. Third molars are frequently retained today and undergo Root Canal treatment (RCT). They may be used as bridge abutments or donor teeth to replace lost or non-restorable first or second molars. (Fatemi et al., 2013). Thorough RCT within 3–4 weeks is crucial to prevent pulp and periapical inflammation in autotransplantation of mature third molars. Successful RCT hinges on comprehensive familiarity with the anatomy of Root Canals. Accurate identification of internal and external morphological features of third molars planned for RCT is crucial for a thorough cleaning, shaping, and threedimension-

al obturation of the complete RCS. (Zhang et al., 2018b). Ignorance of this raises the possibility of mishandled procedures and neglected RCs, which could lead to treatment failure. (Weine et al., 1969a). The maxillary third molars play vital roles in restorative, prosthodontic, and orthodontic contexts. (Scott & Turner, 1997). These teeth are frequently used as abutment teeth for fixed partial dentures and are also employed in autotransplantation procedures to replace non-restorable teeth. (Fatemi et al., 2013). Various methods, including replication or modeling, have been employed to evaluate the human tooth Root, shape, and Canal morphology. (Weine et al., 1969b). Grinding or sectioning techniques (Pineda & Kuttler, 1972). Decalcification and clearing techniques (F. J. Vertucci, 1984). Radiography (Pineda & Kuttler, 1972) Sometimes supplemented with contrast media. Advanced computer-aided methods like micro-computed tomography (Micro-CT) (Ratanajirasut et al., 2018). Cone beam computed tomography (CBCT) ((Neelakantan et al., 2010); (Ratanajirasut et al., 2018). Until 2023, there has been a notable absence of studies focusing on the M3M in Yemen. No research has been carried out to ascertain the variance and frequency of the M3Ms' Rs and RCs structure in the Yemeni population. Consequently, this knowledge gap prompted the selection of this theme for study. In this study cone-beam computed tomography (CBCTwas used.

3. Materials and Methods

3.1. Study Design

The study aimed to evaluate M3M in root shape and RCM. Yemeni individuals. It employed a retrospective cross-sectional observational design, utilizing cone-beam computed tomography (CBCT). The sample comprised individuals from the people of Yemen who visited various dental radiograph centers, including a center for a 3D green scan on Hada Street, azal center for a 3D green scan on Taiz Street, and Almamon Center for a 3d green scan on Taiz Street in Sana'a city.

3.2. Sample Size Calculation

(n = z2. p (1-p) / e2) Where n = desired sample size. p = The estimation of the percentage of this outcome, e = maximum size of standard error. It is fixed at 5%. z = N of SDs = 1.96 for a 95% confidence level. n = (1.96)2 x (0.706) x (1- 0.706) / (0.05)2 = 320 individuals.

3.3. Study Population

2,684 CBCT scans were randomly selected using the fish-bowl sampling method. These scans were then filtered to include only CBCT scans of M3Ms, resulting in 549 scans. From this pool, exclusion criteria were applied, including 320 individuals, encompassing both males and females, with both left and right M3M. These individuals are between 20 and 60 years old, ensuring that the third molars have completed R formation, are fully erupted, and are free from decay or periodontal disease. The CBCT scans will be sourced from Sana'a patients attending various Dental Radiograph City centers between March and May 2023. The reconstructed CBCT images serve the intention of this study and will also be utilized among the components of routine examination, diagnosis, and therapy strategy. The inclusion criteria for the study sample were as follows:

1. Aged between 20 and 65, with mature Rs.

2. Have high-quality CBCT images

3. and completely erupted teeth.

4. There are no periapical lesions in the third molars.

5. Sound teeth

6. No developmental anomalies or other pathologies

7. No extensive metallic restoration or post or root canal treatment was performed.

8. Teeth with no fracture or calcification

3.4. Radiographic Technique

The CBCT images were obtained using the Green CBCT scanner, model PHT60CFO, manufactured by VATECH in Gyeonggi-do, Korea. This scanner has a 5 cm diameter–5 cm height scan volume and operates within a range of 2-10 mA and 50-90 kV. The field of view (FOV) for the scans will be 50x50 mm, with an exposure time of

15 seconds and a voxel dimension of 120 μm^3. Ez3D-I software (version Ewoo soft, Gyeonggi- do, Korea) was used to analyze and process the CBCT pictures on a 32-bit Windows 10 system. A Dell LCD screen in a dark room with a resolution of 1280 x 1024 pixels will evaluate every image. It is used to deliver optimal visual representation, and the software's image processing function will be utilized to adjust the brightness and contrast of photographs.

3.5. Recorded Features

Analyzing CBCT images involves rolling the software toolbar downwards through the coronal, sagittal, and axial planes. During this process, the M3Ms were inspected for the following observations estimated:

1. Number of roots (one, two, three, four, or more).

2. Shape (type) of the roots to assess whether they are separate or fused and evaluate their continuity along their lengths. This navigation occurs in two directions: M-D, buccal-lingual, and coronal-apical (Figures 1-8).

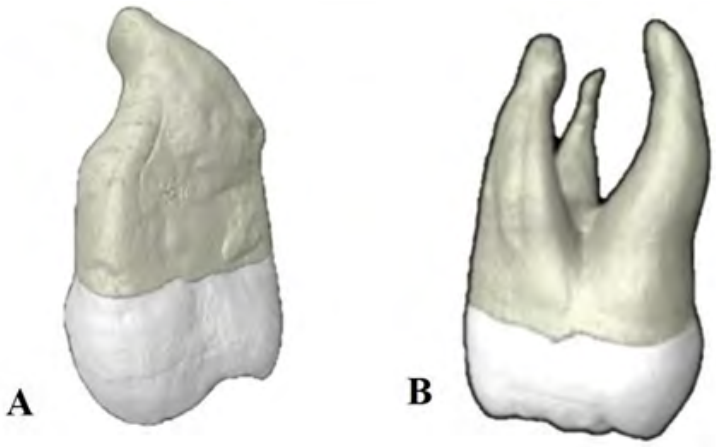

Figure 1: Types of Roots
(A) fused roots, (B) separated roots.

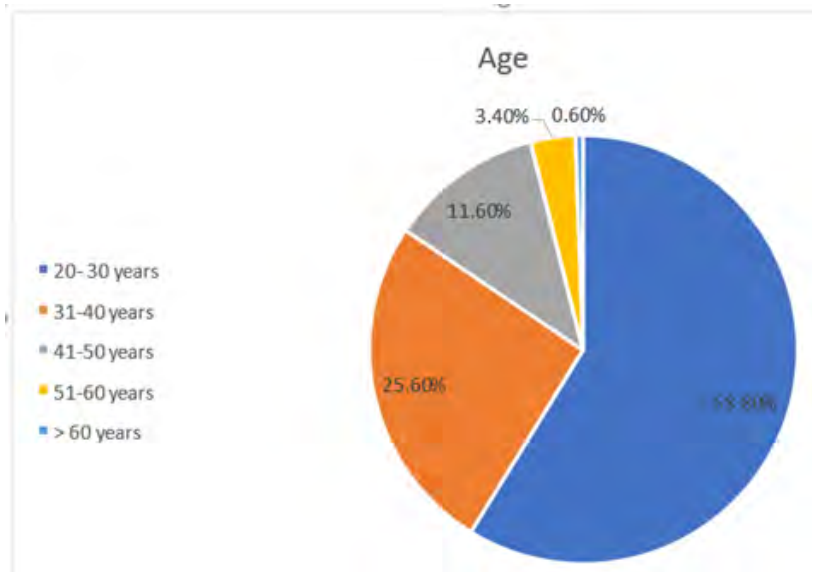

Figure 2: Pie chart Demographic data

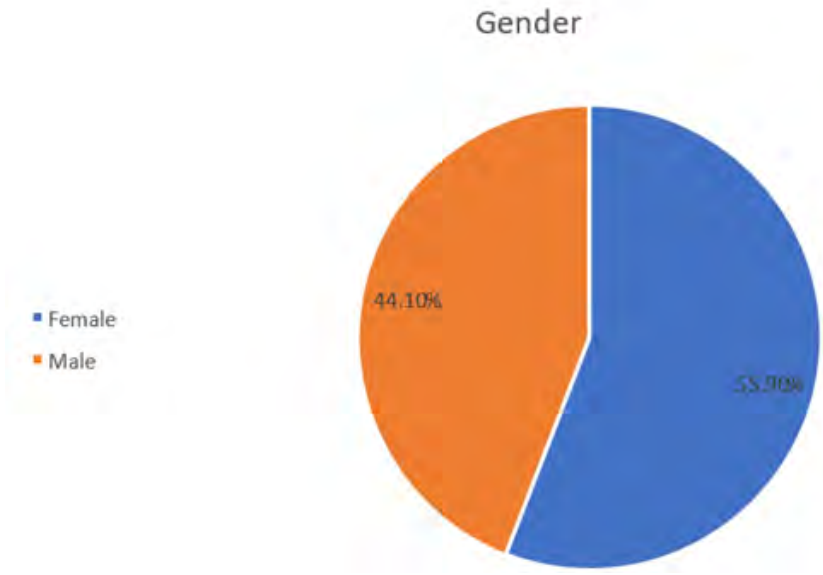

Figure 3: Pie chart In terms of gender distribution

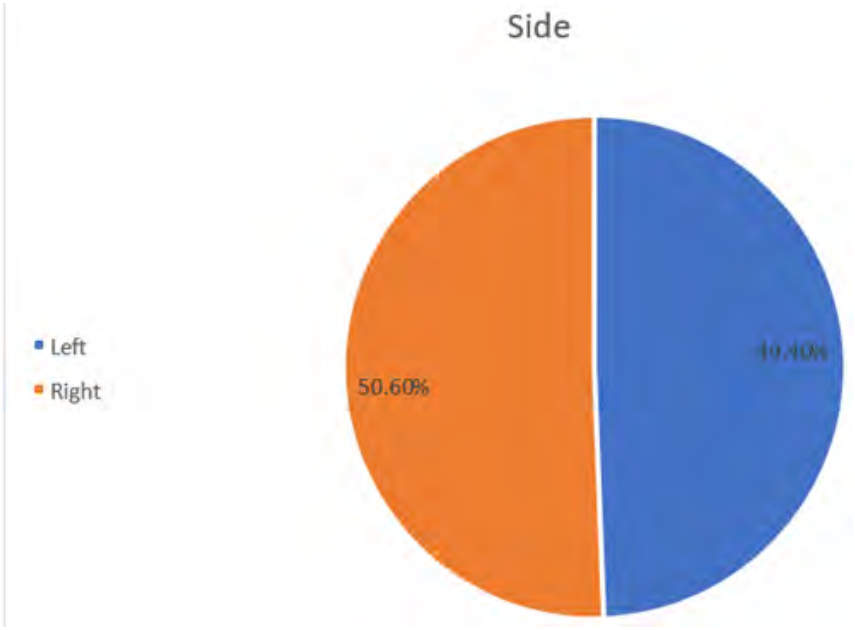

Figure 4: Pie chart Regarding the distribution by side, right and left

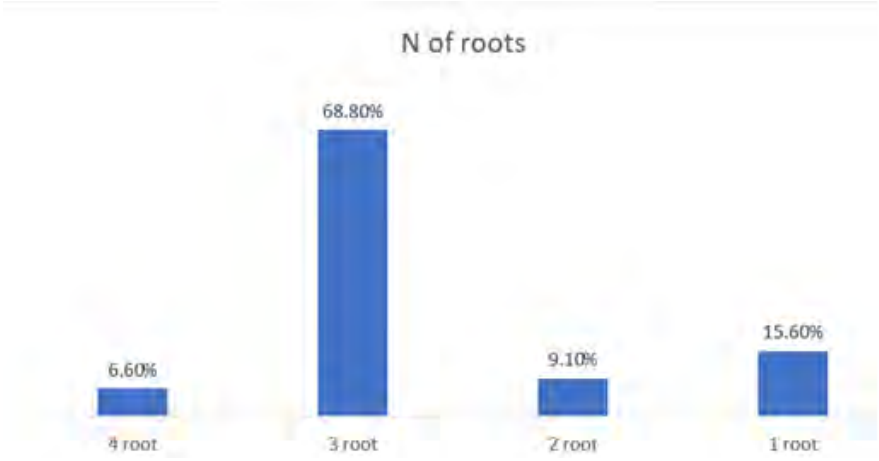

Figure 5: Bar chart Number of Roots

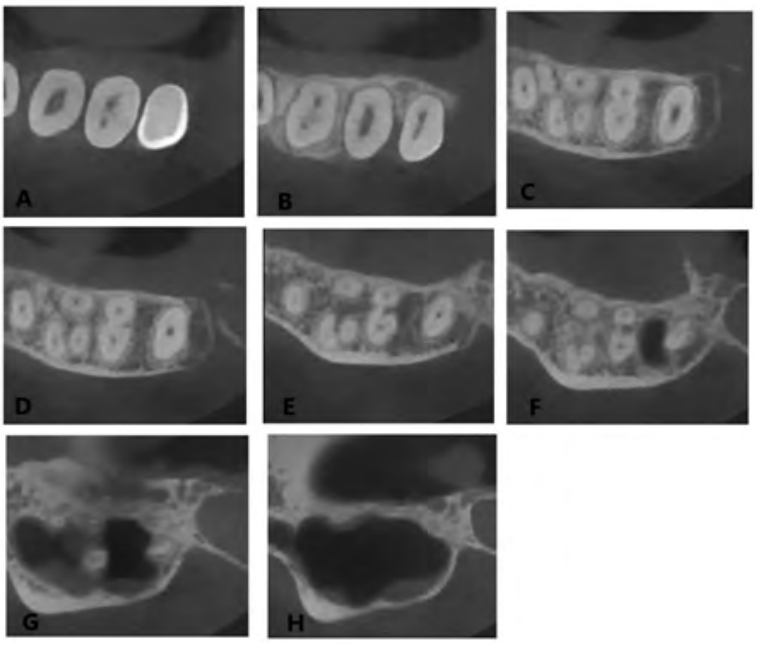

Figure 6: Root's Number will be noted by analyzing the CBCT images in the axial plane. In this plane, the N of R was one R.

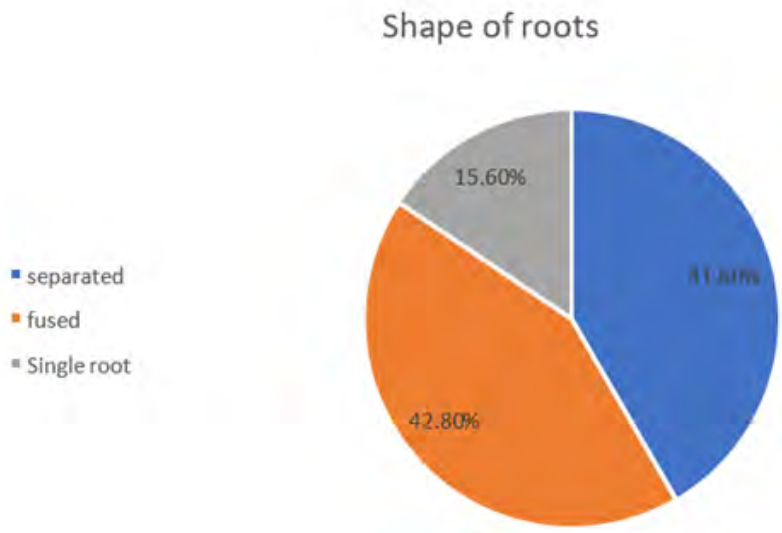

Figure 7: Pie chart Shape(type) of the Rs

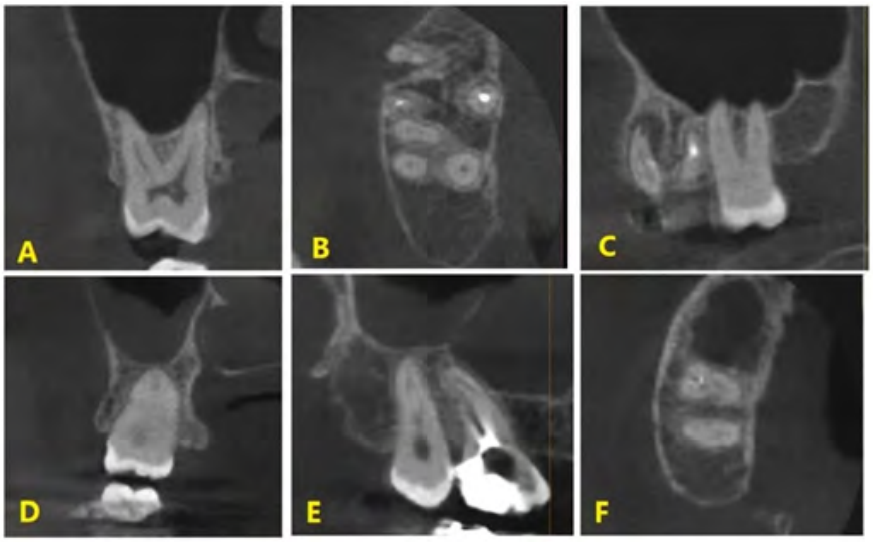

Figure 8: Types of Roots, separated or fused separated in the (A) coronal, (B) axial, and (C) sagittal planes. Fused in the (D) coronal, (E) sagittal and (F) axial planes.

3.6. Data Management and Analysis

The SPSS® statistical package version 28 was hired to manage the data. Descriptive statistics, including means, frequencies, and percentages, were calculated. Inferential statistics, like the Chi-square test and independent t-test, were utilized. A significance level of $P < 0.05$ was applied to all tests, and an interval with a 95% confidence level was used.

4. Results

4.1. Demographic Data

As shown in (Table 1), a total of 320 cases, the data reveals that the respondents have a mean age of 30.62 years, with a standard deviation of 9.26. The age distribution of the participants in the study is diverse. The majority, comprising 58.8% of the total, falls within the 20-30 years age bracket, with 188 individuals. Following closely, the 31-40 years age group constitutes 25.6% of the participants, with 82 individuals. A smaller but notable portion comprises individuals aged 41-50, accounting for 11.6% of the total, with 37 participants. Participants aged 51-60 constitute 3.4% of the total, with 11 individuals. Finally, the 60 years and above category includes 2 participants, making up 0.6% of the total sample Regarding gender distribution, there were 179 female respondents, constituting 55.9% of the total, and 141 male respondents, making up 44.1%. Regarding the distribution by side, 158 respondents reported being on the left side, representing 49.4%, while 162 respondents were on the right side, comprising 50.6%.

Table 1: Demographic data

		Mean (SD)	N	%
Age	20- 30 years	30.62(±9.26)	188	58.80%
	31-40 years		82	25.60%
	41-50 years		37	11.60%
	51-60 years		11	3.40%
	> 60 years		2	0.60%
Gender	Female		179	55.9% 44.1%
	Male		141	
Side	Left		158	49.40%
	Right		162	50.60%

4.2. Number of Roots

The provided data in (Table 2) outlines the distribution of Rs in the examined cases. Among the cases, 15.6% featured a single R, while 9.1% exhibited two Rs. The majority, accounting for 68.8% of the cases, had three Rs; a smaller proportion, 6.6%, displayed four Rs.

Table 2: Number of Roots

N of Rs	N of cases	%
1 R	50	15.60%
2 Rs	29	9.10%
3 Rs	220	68.80%
4 Rs	21	6.60%
Total	320	100.00%

4.3. Shape (type) of the Roots

The (Table 3) illustrates the distribution of R shapes in a sample of 320 cases. Within this sample, 41.6% (133 out of 320) of cases exhibit separated Rs, while 42.8% (137 out of 187) display fused Rs, and in 50 cases, 15.6% showed a single R.

Table 3: Shape (type) of the Roots

			N	Percent
Shape of Rs		separated fused	133	41.60%
			137	42.80%
		Single R	50	15.60%
	Total		320	100.00%

4.4. Association Between Gender and Number of Roots

(Table 4) investigates the relationship between gender and the number of Rs in tooth cases, offering a comprehensive overview through counts, percentages, and statistical measures. Examining the distribution of Rs among males, it is observed that 38.0% have one R (N = 19), 69.0% have two Rs (N = 20), 40.0% have three Rs (N = 88), and 66.7% have four Rs (N = 14). On the other hand, females exhibit a distribution where 62.0% have one R (N = 31), 31.0% have two Rs (N = 9), 60.0% have three Rs (N = 132), and 33.3% have four Rs (N = 7). The Chi-Square Test ($\chi 2$) results in a value of 13.869 with 3 degrees of freedom, indicating a statistically significant association between gender and the number of Rs (p = .003). This suggests that the distribution of Rs is not random regarding gender. Furthermore, the table provides percentages within each gender category, illustrating the proportion of each R number. Additionally, Z-scores are included to depict how observed counts deviate from expected values. Negative Z-scores signify fewer cases than expected, while positive values indicate more cases than expected. Upon closer inspection, it becomes evident that the distribution of Rs varies significantly between genders. More males exhibit two Rs, and more females than expected showcase two and three Rs. Conversely, fewer males than expected have one R and fewer females possess one and four Rs. The statistical analysis underscores a meaningful association between gender and the number of Rs in tooth cases. The detailed breakdown provides valuable insights into specific deviations in R distribution, prompting further exploration into potential factors influencing these observed patterns.

Table 4: Association between Gender and Number of Roots

			1	2	3	4	x2	p
Gender	Male	N	19	20	88	14		
		%	38.00%	69.00%	40.00%	66.70%		
		Z	-.9-	2.8	-2.2-	2.2	13.869a	0.003
	Female	N	31	9	132	7		
		%	62.00%	31.00%	60.00%	33.30%		
		Z	0.9	-2.8-	2.2	-2.2-		

5. Discussion

The current study was conducted in vitro with the use of cone beam computed tomography to identify the R and RCA of maxillary third molars in a sample of Yemeni people using the CBCT method; the single R present with (15.6%) This aligns with other global research involving diverse people(Ahmad et al., 2016) that was 13.5 and not similar with (MUNIR et al., 2022) that was (44%), (Rawtiya et al., 2016) that was(31.0%), (Zhang et al., 2018a) that was 51.5%, (Razumova et al., 2018) that was 33.7%. Two Rs (9.1%) This result is consistent with the findings of (Ahmad et al., 2016) that was 5.6%, (MUNIR et al., 2022) that was (12%), (Rawtiya et al., 2016) that was(13.0%). And not similar to (Zhang et al., 2018a), which was 19.2%, was not found in (Razumova et al., 2018). the three Rs was (68.8%) This result is consistent with the findings of (Ahmad et al., 2016), which was (74.2) and not similar to (30%), (Rawtiya et al., 2016) (55.2%), (Zhang et al., 2018a) 25.4%, (Razumova et al., 2018)47.9%. Four Rs (6.6%) This result is consistent with the findings in (Ahmad et al., 2016) (6.7%), nearly (MUNIR et al., 2022) (14%), and didn't found in (Rawtiya et al. 2016), (Zhang et al., 2018a), (Razumova et al., 2018). The types of roots illustrate the distribution of R shapes in a sample of 320 cases. Within this sample, 41.6% (133 out of 320) of cases exhibit separated Rs, while 42.8% (137 out of 187) display fused Rs, and in 50 cases, 15.6% showed a single R.

6. Conclusion

Within the confines of the present investigation, the subsequent conclusions were drawn: Regarding maxillary third molars, Yemenis possess three Rs, which comprise the majority of the sample, followed by one R, two Rs, a lesser percentage, and four Rs, the smallest rate. The gender differences in the R distribution are significant. More males than anticipated displayed two Rs, and more females displayed three Rs. On the other hand, fewer females than expected had one and four Rs, while fewer males than expected had one R. There are different types of roots: single, fused, and separated. The fused R had a higher frequency of R form or type.

7. Author's Contribution

Waleed al-hajj collected data, data analysis, wrote article, (Basheer Hamed Hamood Al-Shameri, Mohsen Al-Hamzi) contributed to the design and reviwing, Abdulwahab Al-kholani, Mohammed Al-baili additting, Salah Hafedh additting and analysis.

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