Assessment of the Association between Gender and presence of root canal curvatures of the permanent mandibular first and second molars in a sample of Egyptian Population using CBCT (A Cross-Sectional Study)

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Abstract

Aim: Our study was undertaken to evaluate the association between gender and the presence of curvatures per root canals of mandibular 1st and 2nd molars in Egyptian patients using CBCT. **Materials and Methods:** In our observational study we assessed root canals of 106 mandibular first and second molars of Egyptian individuals using Planmeca Romexis® Viewer software on all orthogonal planes. The presence of root canal curves was detected and its relation to the gender of the patient was studied. Categorical data were reported as frequencies and percentages. They were examined for difference and relationships using chi-square test followed by pairwise comparisons utilizing multiple z-tests with p-value modification using false discovery rate method. The Cohen's kappa coefficient was used to assess their level of reliability. For all tests, the significance level was set at $p \leq 0.05$. R statistical software for Windows, version 4.2.3, was used for statistical analysis. **Results:** In most root canals of mandibular 1st and 2nd molars there was no significant association between gender of the patient and frequency of curvatures present in the root canals except for mandibular first molars with single canals located in the distal roots where **males** having significantly higher percentage of **multiple** curvatures than females (p=0.014). **Conclusion:** Gender has no significant effect on the variations in the frequency of curvatures present in the root canal system in most of the root canals of mandibular Egyptian molars and further studies are recommended to test this hypothesis.

Keywords: Gender, Frequency, Root, curves

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Introduction

Adequate knowledge of root canal morphological variations plays a crucial role in endodontic therapy's effectiveness. The difficulty of the spaces that must be accessed, cleaned, instrumented, and filled may result in missed opportunities for identification of all canals and worse treatment success [1]. Some studies to assumed that the root canal morphology is affected by X chromosome and the genes can influence canal complexity. Comparatively, just a few research have examined the effects of gender differences on the populations of different ethnic groups [2].

Studies evaluating root canal variations have been conducted both in vivo and in vitro tests and have used macroscopical sections, polyester resin impressions, clear samples, and radiographs [3]. In difficult cases, literature has demonstrated the value of CBCT in assessing the root canals of teeth with complex morphology in comparison to other imaging modalities using a small voxel size for higher spatial resolution and found CBCT to be more effective than two-dimensional (2D) imaging in detecting the root canals in the third dimension with more precise images and tolerable radiation exposure [4,5]. Additionally, narrowing the field of vision to the region of focus enables quicker scans and lower effective radiation doses [6,7,8]. The molars of Egyptian individuals are the primary subjects of this research as the frequent curvatures hinder the ease of instrumentation and obturation of root canals that`s why, the purpose of this study was to evaluate the difference of mandibular molars' root canal curve frequency between the Egyptian men and women using CBCT imaging technique [1,9].

Materials and Methods

Study design: An observational cross-sectional study

Data collection and study setting:

This trial was approved by the ethical committee of the faculty of dentistry- Cairo university, Egypt. After sample size calculation using Epi Info 7.2.2.2., scans including a total of 106 molars were collected from the CBCT data base available at faculty of dentistry, Cairo University, and private radiology centers located in Cairo, Egypt. The gender of these patients was accurately determined to study its effect on the variability in frequency of curvatures in root canals of mandibular 1st and 2nd molars.

Eligibility criteria

CBCT Scans of molars with closed root apex, adult individuals and with no root canal treatment were included. Calcified root canals, apicectomy and presence of internal or external root resorption were excluded for the accuracy of canal assessment.

Radiographic analysis

Radiographic taking of included individuals in our study was carried out using Planmeca ProMax® 3D Mid (Planmeca OY, Helsinki, Finland) CBCT machine and CBCT scans were analyzed using Planmeca Romexis® Viewer (Romexis version 4.6.2.R; Planmeca OY, Helsinki, Finland). CBCT scans were of 0.2 mm voxel resolution [10], different fields of view, and we adjust slice thickness to enhance visibility. CBCT images were analyzed in reconstructed planes where the long axis of the roots was adjusted in all corrected cuts and the whole path of the root canal was well observed starting from the base of the pulp chamber till the apex of the root to examine the presence of curves and its relation to the patient gender **(figs.1 and 2)**. Image enhancement tools were used to improve curve detection and counting.

Blinding

All CBCT images were interpreted twice by a calibrated investigator, oral and maxillofacial radiology specialist. The investigator was blinded of the patient complains and the purpose for which the CBCT scan was taken. There was a 4-month interval between the two readings to check accuracy and reliability.

Statistical analysis

Frequencies and percentages were used to present categorical data. The chi-square test, pairwise comparisons with multiple z-tests, and p-value correction with the false discovery rate approach were used to assess differences and relationships. The Cohen's kappa coefficient was used to assess their level of reliability. For all tests, the significance level was set at p less than or equal 0.05. R statistical software for Windows, version 4.2.3, was used for the statistical analysis. (R Core Team 2023. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria).

Results

Association of frequency of root curvatures and gender in mandibular first molar:

Association of root curvature and gender in mandibular first molar is presented in **(table 1)** and in **(figures 3 and 4).** Within **coronal** view, there was **no significant association** in all canals between gender and root curvature (p>0.05). Within **sagittal** view, the **association was statistically significant** in the **distal** canals with **males** having significantly higher percentage of **multiple** curvatures than females, and with females having significantly higher percentage of single curvatures than males (p=0.014).

Association of frequency of root curvatures and gender in mandibular second molar:

Association of root curvature and gender in mandibular second molar is presented in **(table 2)** and in **(figures 5 and 6).** Within both views, there was **no significant association** in **all canals** between gender and presence of root curvatures (p>0.05). There was a good agreement between the two readings.

Discussion

Mandibular molars are well known of their high variability in root canal configuration and curvatures among different population which results in high rate of missed canals, perforations, broken instruments and vertical root fracture during root canal treatment [11,12,13,24]. The discrepancies in reported root canal studies may be caused by a variety of variables, including gender, age, ethnicity, and the method used to examine the morphology of the root canals [2]. This study was created to examine the gender effect on the frequency of curvatures in the root canals of these teeth because there are so few articles that discuss gender relation to root canal variations in this tooth group.

Authors have utilized different techniques to study root canal system including canal impressions, macroscopic examination, and dental imaging [3]. Two- dimensional imaging was used for a long period of time but it has showed many limitations that interfere with adequate assessment as superimpositions and missing the important third dimension of the root canal [12]. CBCT imaging approach with three-dimensional reconstruction was a useful and noninvasive way in this morphologic study even though other methods have been developed for the evaluation of root canal morphology [14,25]. Neelakantan et al. [16] have compared various techniques for assessing root canals. Their findings showed that the CBCT imaging technique is equally accurate as the clearing method for determining the variations of the root canal. Some authors have used micro-CT for studying curvatures and have found CBCT to be comparable to micro-CT in terms of accuracy [17,18,19, 20].

Regarding the permanent mandibular first molars we found a non-significant association of gender with the presence of multiple curves except for distal roots which have only one root canal where they showed high prevalence of multiple curves in male patients compared to females which was statistically significant. Searching the previous research studies, we found no studies that give a concern for the effect of gender on the number of curvatures on the mandibular permanent molars which need further research in the future. Yet, we found studies assessing the relation between gender and different variables in the roots of these teeth as number of roots, number of root canals and severity of canal curvatures along the root pathway. Alhujhuj et al. [21] have assessed the relation between gender and number of root canals and their configuration in mandibular first molars and found no significant difference between male and female patients. Moreover, Fu et al. [22] Have studied the association between gender and severity of curves present in the root canals of mandibular first permanent molars and have found no significant difference between male and female patients regarding this variable. Similarly, Fuentes et al. [12] have assessed the relation between the gender and degree of

angulation in the root canals in mandibular first and second molars and found no significant difference between male and female patients.

Regarding the permanent mandibular second molars we found no effect of the gender of the patient on the frequency of curves in almost all root canals. Almansour et al. [23] have studied mandibular second molars and assessed the relation between gender and number of roots and have found no statistically significant difference between both genders. Gomez et al. [18] have studied the association between gender and root canal variations and have found no significant difference between the two variables. Like wise, Pawar et al. [11] have found that the prevalence of two-rooted mandibular second molars did not statistically differ between the male and female patients as well as the prevalence of c- shaped canals in mandibular second molars ($p > 0.05$). Yet, they have found that males had more three-rooted mandibular second molars than females that was statistically significant ($p= 0.01$). As the evidence discussing this concern is scarce, we recommend further assessment of the association between gender and presence of root canal curvatures in mandibular molars to reach a certain consensus about this hypothesis.

Conclusion

From our study we can conclude that the patient gender has no clinically significant association with the presence of curves along the path of the root canal system in most root canals of mandibular Egyptian molars.

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Conflict of Interest: The author declares that there is no conflict of interest.

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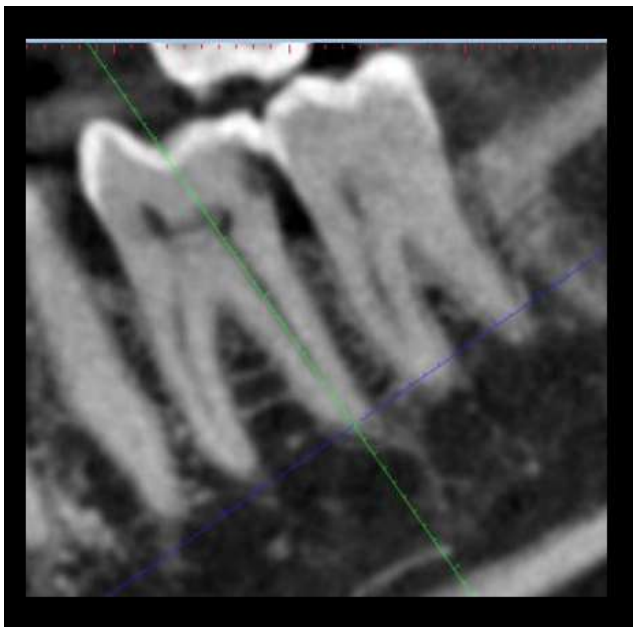

Fig.1 : Adjusting the long axis of the root to inspect the root canal along its path

Fig.2 : Detection of the presence of curvatures in the root canal and its association with the patient gender

Table (1): Association of root curvature frequency and gender in mandibular first molar.

Canal	Root curvature	Coronal view					Sagittal view				
		Male		Female		p-value	Male		Female		p-value
		N	%	n	%		n	%	N	%	
MB (n=50)	No	0	0.0%	0	0.0%	0.371ns	1	3.6%	0	0.0%	0.519ns
	Single	1	3.6%	0	0.0%		4	14.3%	5	22.7%	
	Multiple	27	96.4%	22	100.0%		23	82.1%	17	77.3%	
ML (n=48)	No	0	0.0%	0	0.0%	0.440ns	0	0.0%	1	4.8%	0.238ns
	Single	3	11.1%	4	19.0%		3	11.1%	5	23.8%	
	Multiple	24	88.9%	17	81.0%		24	88.9%	15	71.4%	
DB (n=43)	No	1	4.3%	2	10.0%	0.703ns	2	8.7%	0	0.0%	0.168ns
	Single	2	8.7%	1	5.0%		2	8.7%	5	25.0%	
	Multiple	20	87.0%	17	85.0%		19	82.6%	15	75.0%	
DL (n=43)	No	0	0.0%	1	5.0%	0.234ns	3	13.0%	1	5.0%	0.316ns
	Single	2	8.7%	0	0.0%		9	39.1%	5	25.0%	
	Multiple	21	91.3%	19	95.0%		11	47.8%	14	70.0%	
D (n=6)	No	1	20.0%	1	100.0%	0.301ns	0	0.0%	0	0.0%	0.014*
	Single	3	60.0%	0	0.0%		0^{A}	0.0%	1^{B}	100.0%	
	Multiple	1	20.0%	0	0.0%		5^{A}	100.0%	0^{B}	0.0%	

Values with different superscript letters within the same horizontal row are significantly different, *; significant ($p \leq 0.05$) ns; non-significant ($p>0.05$).

Table (2): Association of root curvature frequency and gender in mandibular second molar.

Canal	Root curvature	Coronal view					Sagittal view				
		Male		Female		p-value	Male		Female		p-value
		N	%	n	%		n	%	N	%	
MB (n=56)	No	1	3.2%	0	0.0%	**0.359ns**	0	0.0%	0	0.0%	**0.147ns**
	Single	0	0.0%	1	4.0%		3	9.7%	6	24.0%	
	Multiple	30	96.8%	24	96.0%		28	90.3%	19	76.0%	
ML (n=52)	No	0	0.0%	0	0.0%	**0.420ns**	0	0.0%	0	0.0%	**0.264ns**
	Single	3	10.3%	1	4.3%		4	13.8%	6	26.1%	
	Multiple	26	89.7%	22	95.7%		25	86.2%	17	73.9%	
DB (n=19)	No	0	0.0%	0	0.0%	**0.943ns**	0	0.0%	2	15.4%	**0.209ns**
	Single	1	16.7%	2	15.4%		0	0.0%	3	23.1%	
	Multiple	5	83.3%	11	84.6%		6	100.0%	8	61.5%	
DL (n=19)	No	0	0.0%	0	0.0%	**0.485ns**	0	0.0%	1	7.7%	**0.132ns**
	Single	0	0.0%	1	7.7%		0	0.0%	5	38.5%	
	Multiple	6	100.0%	12	92.3%		6	100.0%	7	53.8%	
D (n=37)	No	2	8.0%	4	33.3%	**0.095ns**	1	4.0%	1	8.3%	**0.853ns**
	Single	16	64.0%	7	58.3%		6	24.0%	3	25.0%	
	Multiple	7	28.0%	1	8.3%		18	72.0%	8	66.7%	

Values with different superscript letters within the same horizontal row are significantly different, *; significant ($p \leq 0.05$) ns; non-significant ($p>0.05$).

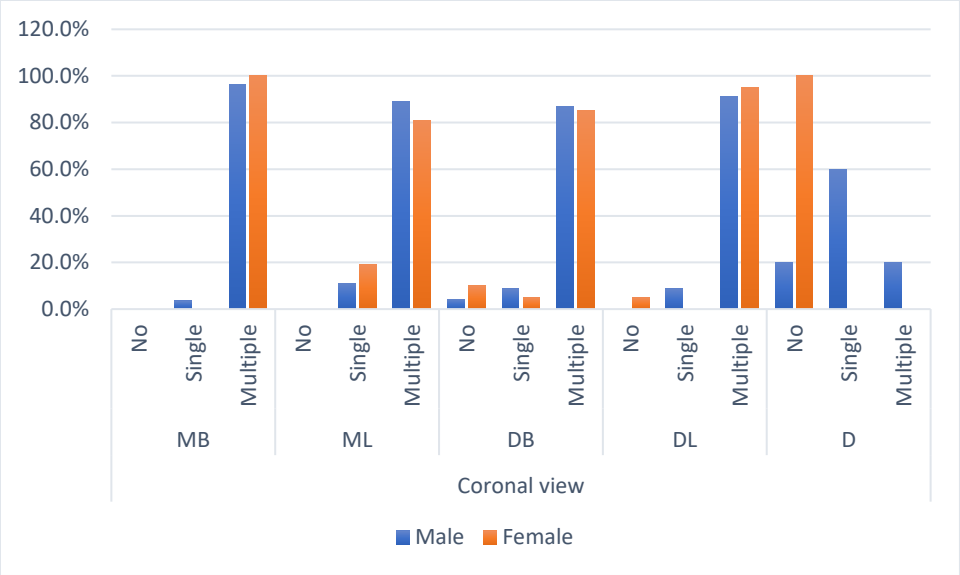

Fig.3: Bar chart showing the association of root curvature frequency and gender in mandibular first molar (coronal view).

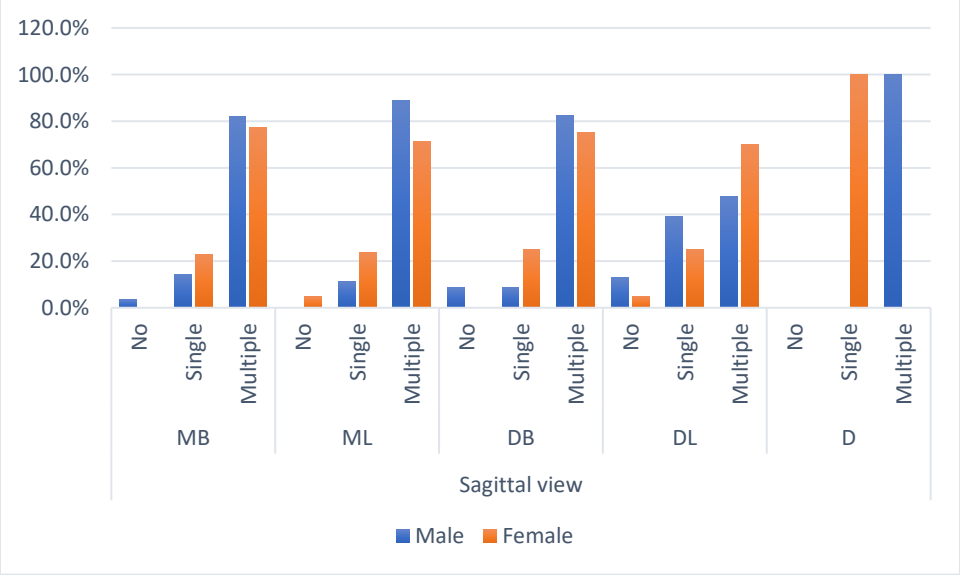

Fig.4: Bar chart showing the association of root curvature frequency and gender in mandibular first molar (sagittal view).

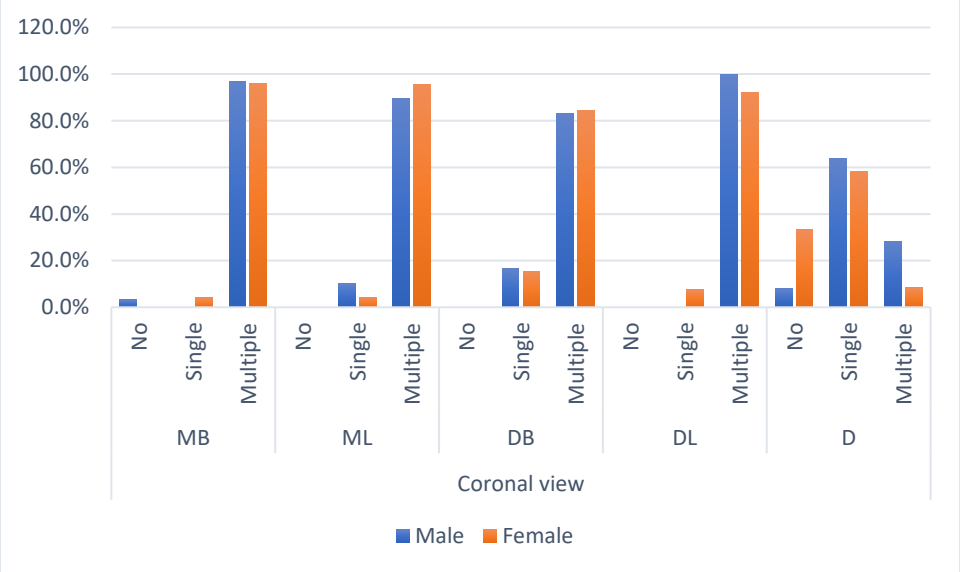

Fig.5 : Bar chart showing the association of root curvature frequency and gender in mandibular second molar (coronal view).

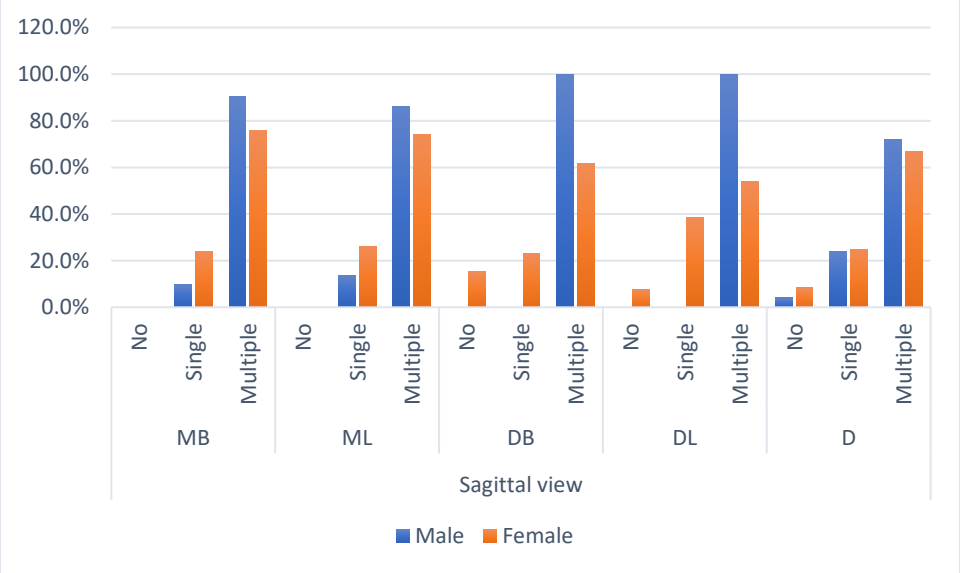

Fig.6: Bar chart showing the association of root curvature frequency and gender in mandibular second molar (sagittal view).