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ANATOMICAL STUDY OF THE MESIOBUCCAL ROOT IN MAXILLARY FIRST MOLAR WITH DIFFERENT METHODS IN EGYPTIAN POPULATION

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ABSTRACT

Aim: to study the canal anatomy and its variations of mesiobuccal root of maxillary first molar using visual, CT, CBCT, and staining and clearing.

Materials and Methods: Three hundred extracted permanent maxillary first molar teeth were selected for this study. Mesio-buccal roots were resected 1 mm coronal to the trifurcation level. The orifices of the canals were located with a size 10 K-type file which was passively advanced into the canals until the tip of the instrument penetrated the apical foramen for visual examination. The number of orifices and apical foramina in each root were recorded. All roots were embedded in a sheet of pink wax with vertical orientation and arranged in their numbers to facilitate three dimensional CT and CBCT scan and the data were stored on a magnetic optical disc. Both, CT and CBCT images were assessed by a calibrated dental radiology specialist blinded to the order of roots using Vitrea 2 V 3.8 imaging software. India ink was injected into the orifices of the root canals with a plastic disposable endodontic irrigating syringe with a 27-G needle with suction tip which was placed at the root apex to draw the ink through the root canal system. All roots were decalcified with 5% hydrochloric acid for three days, dehydrated in ascending concentrations of ethanol (75%, 85%, 96% and 100%) for four hours each, and transparent specimens were obtained by immersing the dehydrated roots in methyl salicylate solution, in which the roots were stored until they were examined. The data regarding root canal morphology of each sample from all evaluation methods were tabulated and compared statistically.

Results: There were significant differences between the four methods used for studying the root canal anatomy of mesiobuccal root of first maxillary molars as regarding the number of canals, number of orifices, number of apical foramina, presence of lateral accessory canals and intercanal communications. Roots with three canals and three orifices and opened apically with two foramina showed no significant differences between the four methods. Also, with Kappa test, there was good and fair agreement between CBCT & CT and CBCT & staining and clearing respectively.

Conclusion: the most detailed information can be obtained in-vitro by staining and clearing and high resolution CT and CBCT methods which are commonly used as a diagnostic aid in clinical endodontics.

KEYWORDS: CT, CBCT, Staining and clearing, canal anatomy

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INTRODUCTION

The first molar is the first tooth in need of endodontic treatment when it is exposed by decay because it is the earliest permanent tooth appeared in the oral cavity [1, 2].

The maxillary first molars have the most complex morphology. It is one of the most misunderstood teeth. The mesiobuccal roots of maxillary molars show greater variation in their root canal systems than distobuccal and palatine roots [3]. These systems communicate frequently along their lengths, and terminate separately in two or more portals of exit greater than 58 percent of the time. Therefore, it is assumed that all maxillary first molars have four canals until proven otherwise [4].

The majorities of the mesiobuccal roots have two canals for their broad buccolingual dimensions and associated concavities on their mesial and distal surfaces with high incidence up to 95% of cases [5-8]. There is a wide range of variation in the number of canals and incidence of fusion [9].

The exploration of the entire root canal system, thorough chemo-mechanical cleansing followed by obturation using inert filling materials and a sealant are the key of endodontic treatment success [10, 11]. Any existing root canals that remain undetected by the dentist during the entire course of endodontic treatment are a major threat to the failure of treatment. So, it is essential to know the detailed knowledge of root canals morphology [12].

Isthmuses and accessory canals are anatomical structures, when they are present in the root canal system, cooperate to the endodontic treatment failures, as they can act as reservoirs of bacteria and necrotic pulp tissues [13]. According to Weller et al. (1995) [14], an isthmus is defined as a narrow ribbon-shaped communication between two root canals containing pulp tissue.

The highest failure rates occur in maxillary first molars due to anatomy complexities, number of canals, difficulty to find and access the canals orifices, especially the second mesiobuccal (MB2) [15, 16]. Thus, the most predictable treatment outcome is achieved when the clinician has an accurate knowledge of root canal morphology to guide both surgical and non-surgical endodontic therapy.

It is essential to provide insight into root canal anatomy complexities through the knowledge from laboratory studies. Many investigators have used different methods to ascertain the number of canals, ramifications of the main root canal, localization and number of foramina and presence of apical deltas [1].

An ideal technique for studying the root canal anatomy would be accurate, simple, nondestructive, feasible and reproducible in an in vivo scenario [17,18].

Previous studies used many methods for studying the root canal morphology of the mesiobuccal root of upper molars including canal staining and tooth clearing, conventional radiographs, digital radiographic techniques, radiographic assessment enhanced by contrast media and recently computed tomography (CT) technique [17]. One of the most important studies was performed by Walter Hess (1925) [19], who injected the root canals with a specific ink and visualized the huge amount of variables and complexities of root canal systems.

Radiographic techniques have been used to obtain a two-dimensional image [20-22].

Three-dimensional methods for the morphological study of teeth are replacing the more limited two-dimensional techniques. It allows 3D reconstruction of root canal systems with the ability to distinguish details in each canal [17].

More recently, with Improvements in digital imaging systems, CBCT is introduced as a nondestructive method with capability of 3D imaging for in vivo evaluation of root canal anatomy, which has considerably lower radiation dose than conventional CT [23, 24].

Computed tomography (CT) was shown to be accurate for experimental endodontology. Their images can be formed from planar slices through objects which can be physical sections, optical sections or CT reconstructions [25]. With technological advances, using the operating microscope in clinical practice may facilitate the location and treatment of additional canals [26].

CBCT is a non-invasive technique which improves the detection of additional roots and root canals, including the second mesiobuccal canal of the mesiobuccal root of maxillary molars. It allows three-dimensional visualization of images, assisting in the identification of anatomical features and variations in the root canal system [15,17,26,27,28]. This technology produces excellent quality with a significantly lower effective radiation dose compared with conventional CT [29, 30]. Besides, its benefits are lower exposure time, higher resolution and accuracy [20, 21, 31].

Many studies were published on the internal anatomy of posterior teeth with very little information exist regarding the accuracy of clearing, CBCT and micro-CT methods to identify the morphology of the root canal anatomy [32-34].

The aim of the current study was to compare the efficacy of different methods, named visual, CT, CBCT and staining and clearing in studying the root canal anatomy in mesiobuccal root of maxillary first molar in Egyptian population.

MATERIALS AND METHODS

Selection of samples

Three hundred extracted permanent maxillary first molar teeth with fully formed apices that were not endodontically treated were collected from Endodontic Department teeth bank of Pharos University in Alexandria.

Preparation of samples

The sample teeth were washed under tap water for 30 minutes. Mesio-buccal roots were resected 1 mm coronal to the trifurcation level and immersed in 2.5% sodium hypochlorite for 30 minutes to remove adherent soft tissue. The roots were physically scraped using a scalpel blade and an ultrasonic scaler for cleaning from calculus and stains. The roots were immersed in 2.5% sodium hypochlorite for 24 hours to dissolve the organic debris and pulp tissue remnants from the root canal systems [35-37]. All roots were rinsed under running tap water for two hours and then, stored in normal saline until they used.

Visual evaluation

The orifices of the canals were located with a size 10 K-type file (Dentsply / Sirona, Ballaigues, Switzerland), which was passively advanced into the canals until the tip of the instrument penetrated the apical foramen. The number of orifices and apical foramina in each root were recorded in a schedule as regard the root number. For standardizing the data observed, this procedure carried out by a single operator.

CT scanning

All roots were embedded in a sheet of pink wax with vertical orientation and arranged in their numbers to facilitate three dimensional CT scan in its platform by Multislice CT device (Toshiba, Aquillion one 640 slices, Japan) and the data were stored on a magnetic optical disc.

CBCT scanning

The same roots in their wax platform with the same arrangement were submitted to CBCT scan (Veraviewepocs 3D R100, MORITA, Kyoto, Japan) and the data were stored on a magnetic optical disc.

Both, CT and CBCT images were assessed by a calibrated dental radiology specialist blinded to the order of roots using Vitrea 2 V 3.8 imaging software (Vitrea 2, Vital Imaging Inc.) from root cross-sections, axial and coronal images to view the internal root canal anatomy from various angles. The area of interest were magnified to make observations regarding root morphology (number of canal orifices, number of canal exits, number of canals, presence of second mesio-buccal canal, presence of apical deltas, complex apical ramifications, number and location of inter-canal communications) and tabulated.

Staining of roots

All roots got out the wax platform with their numbers were washed under running tap-water for two hours and placed on tissue paper and allowed to dry overnight.

India ink was injected into the orifices of the root canals with a plastic disposable endodontic irrigating syringe with a 27-G needle with suction tip was placed at the root apex to draw the ink through the root canal system and to be sure about the flow of the ink to all canals, communications, deltas, and ramifications. The appearance of ink at the apical foramen indicated the end of the process. The teeth were dried overnight again for 12 hours.

Clearing of roots

All roots were decalcified with 5% hydrochloric acid for three days, the acid solution being changed daily. Then, roots were again washed under running tap-water overnight and air-dried. The specimens were then dehydrated in ascending concentrations of ethanol (75%, 85%, 96% and 100%) for four hours each, and transparent specimens were obtained by immersing the dehydrated roots in methyl salicylate solution, in which the roots were stored until they were examined [38-40]. The transparent specimens were then examined by the naked eye as well as under stereomicroscope (Olympus SZ 1145 TR, Tokyo, Japan, and Mag.110 X) and digital micrographic images with their numbers were captured and saved for evaluation.

The data regarding root canal morphology of each sample from all evaluation methods were tabulated based on the number of root canals, number of root canal orifices, number of apical foramina, apical deltas, apical ramifications, presence of lateral canals, and inter-canal communications and compared statistically.

Statistical analysis of the data

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. Comparisons between groups for categorical variables were assessed using Chi-square test (Monte Carlo). Kappa (ϰ) for agreement was used. Significance of the obtained results was judged at the 5% level.

RESULTS

Visual observations

Out of three hundred mesio-buccal roots of maxillary first molar,

72 roots (24%) showed one canal with one orifice and open apically in one apical foramen. 228 roots (76.00%) showed two canals with tow orifices, 61 (20.33%) of them open apically in Two apical foramina and 167 roots (55.67%) joined together and opened apically in one apical foramen. **(Figure 1) (Table 1)**

Fig. (1) Visual observations of MB root of maxillary first molar with files

CT observations

Out of three hundred mesio-buccal roots of maxillary first molar, 117 roots (39.00%) showed one canal with one orifice, 73 (24.33%) of them open apically in one apical foramen, 32 roots (10.67%) open apically in apical deltas, 3 roots (1%) open apically in apical ramifications, and 9 roots (3%) open apically in one foramen with lateral accessory canals. 183 roots (61.00%) showed two canals with two orifices, 21(7%) of them open apically in two apical foramina, 99 roots (33%), the two canals joined together and opened apically in one apical foramen, 28 roots (9.33%), one of these two canals open in one apical foramen and the other canal open apically in apical deltas, 4 roots (1.33%) open apically in apical ramifications, 12 roots (4%) the two canals joined in one canal and open apically in one apical foramen with lateral accessory canals, and 19 roots (6.33%) the two canals joined in the middle third and opened apically in two foramina. **(Figure 2) (Table 1)**

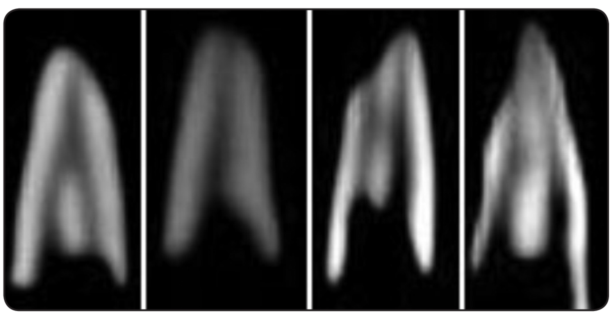

Fig. (2) CT observations of MB root canal anatomy of maxillary first molar

CBCT observations

Out of three hundred mesio-buccal roots of maxillary first molar, 97 roots (32.33%) showed one canal with one orifice, 44 (14.67%) of them open apically with one apical foramen, 38 (12.67%) roots open apically with apical deltas, 6 (2.00%) roots open apically with apical ramifications, and 9 (3%) roots open apically with one foramen and lateral accessory canals. 200 (66.67%) roots showed two canals with two orifices, 22 (7.33%) of them open apically with two apical foramina, 60 roots (20.00%), the two canals joint to one canal and open apically with one apical foramen, 47 roots (15.67%), one of the two canals open apically with one apical foramen and the other canal open apically with apical deltas, 6 roots (2.00%) opened apically with apical ramifications, 14 roots (4.67%) open apically with two apical foramina with lateral accessory canals, 34 roots (11.33%) open apically with two apical foramina and communications between the two canals in the middle third,10 roots (3.33%) open apically with two apical foramina after joining in the middle third, and 7 roots (2.33%) showed two canals joint to one canal, bifurcated to two and rejoined again to open apically with one apical foramen. 3 roots (1%) showed three canals with three orifices and open apically in two foramina. **(Figure 3) (Table 1)**

Staining and clearing observations

Out of three hundred mesio-buccal roots of maxillary first molar, 64 roots showed one canal with one orifice 26 (8.67%) of them open apically with one apical foramen, 22 roots (7.33%) open

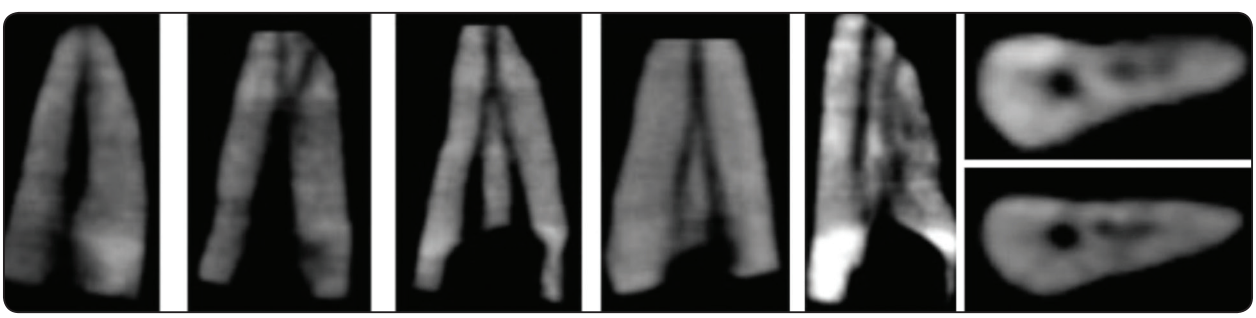

Fig. (3) CBCT observations of MB root canal anatomy of maxillary first molar apically with apical deltas, 6 roots (2.00%) open apically with apical ramifications, and 10 roots (3.33%) open apically with one apical foramen and lateral accessory canals. 236 roots (78.67%) showed two canals with two orifices, 22 roots (7.33%) of them the two canals open apically with two separate foramina, 119 roots (39.67), the two canals joined together and opened apically with one apical foramen, 48 roots (16.00%) one canal open apically in one apical foramen and the other canal open apically with apical deltas, 9 roots (3.00%) open apically with apical ramifications, 15 roots (5.00%) open apically with two apical foramina with lateral accessory canals, 7 roots (2.33%) open apically with two apical foramina and communications between the two canals in the middle third, and 16 roots (5.33%) open apically with two apical foramina after joining in the middle third. **(Figure 4) (Table 1)**

Comparison between visual, CT, CBCT, and staining and clearing procedures for detecting the canals configurations of the mesio-buccal root of maxillary first molar, it was found that, out of 300, 72 (24.0%), 117 (39.0%), 97 (32.3%), and 64 (21.3%) roots respectively showed one canal with one orifice with mean value of these percentages 29.17% and significant difference between them. Also, it was found that, out of 300, 228 (76.0%), 183 (61.0%), 200 (66.7%), and 236 (78.7) roots respectively showed two canals with two orifices with mean value of these percentages 70.59% and significant difference between them. **(Table 1) (Figure 1)**

Comparison between visual, CT, CBCT, and staining and clearing procedures either in one canal with one orifice or two canals with two orifices with their variation in apical opening (with one apical foramen, two apical foramina, apical deltas, apical ramifications, lateral accessory canals or communications between the canals) revealed significant statistically difference between them. **(Table 1) (Figure 1)**

Comparison between visual, CT, CBCT, and staining and clearing procedures, CBCT was the only procedure showing three canals with three orifices and opened apically in two foramina in 3 roots (1.00%) revealed no significant statistically difference. **(Table 1) (Figure 1)**

Evaluation of inter-method agreement between CT and CBCT in relation to canal anatomy in the mesio-buccal root of maxillary first molar (one orifice with one foramen, one orifice with two foramina, two orifices with two foramina, and two orifices with one foramen) showed a kappa coefficient of 0.622 which is good level of agreement revealing statistically significant difference ($P<0.001$). **(Table 2)**

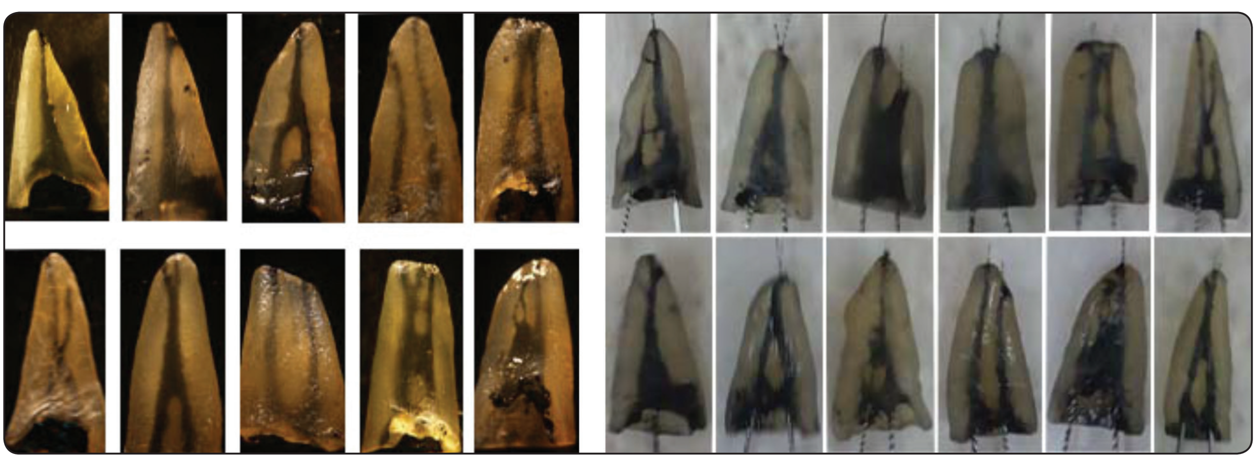

Fig. (4) Staining and clearing observations of MB root canal anatomy of maxillary first molar

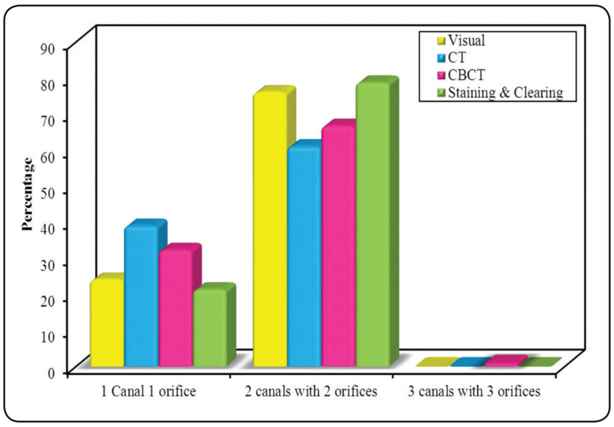

Fig. (5): Comparison between Visual, CT, CBCT, Staining and clearing percentage of observations in different root canal configurations in mesio-buccal root of maxillary first molar.

Table (1) Comparison between Visual, CT, CBCT, Staining and clearing percentages of observations in different root canal configurations in mesio-buccal root of maxillary first molar.

	Open apically with	Visual (n=300)	CT (n=300)	CBCT (n=300)	Staining & Clearing (n=300)	c^2	p
1 canal 1 orifice		**72 (24.0%)**	**117 (39.0%)**	**97 (32.3%)**	**64 (21.3%)**	28.284*	<0.001*
	1 Foramen	72 (24%)	73 (24.3%)	44 (14.7%)	26 (8.7%)	36.683*	0.001*
	Ap. Delta	0 (0.0%)	32 (10.7%)	38 (12.7)	22 (7.3)	39.366*	<0.001*
	Ap. Ramification.	0 (0.0%)	3 (1.0%)	6 (2.0%)	6 (2.0%)	7.682*	^{MC}p<0.048*
	Lat accessory	0 (0.0%)	9 (3.0%)	9 (3.0%)	10 (3.3%)	9.654*	0.022*
2 canals with 2 orifices		**228 (76.0%)**	**183 (61.0%)**	**200 (66.7%)**	**236 (78.7)**	29.166*	<0.001*
	2 Foramina	61 (20.3%)	21 (7.0%)	22 (7.3%)	22 (7.3%)	41.181*	<0.001*
	1 Foramen	167 (55.7%)	99 (33.0%)	60 (20.0%)	119 (39.7%)	84.931*	<0.001*
	Ap. Delta	0 (0.0%)	28 (9.3%)	47 (15.6%)	48 (16.0%)	54.886*	<0.001*
	Ap. Ramification	0 (0.0%)	4 (1.3%)	6 (2.0%)	9 (3.0%)	10.460*	^{MC}p<0.009*
	Lat Accessory	0 (0.0%)	12 (4.0%)	14 (4.6%)	15 (5.0%)	14.622*	0.002*
	With lateral communications	0 (0.0%)	0 (0.0%)	34 (11.3%)	7 (2.3%)	79.269*	<0.001*
	Joined in m.1/3 open in 2 Foramina	0 (0.0%)	19 (6.3%)	10 (3.3%)	16 (5.3%)	19.463*	<0.001*
	Joined, bifurcat, rejoined and open in 1 Foramen	0 (0.0%)	0 (0.0%)	7 (2.3%)	0 (0.0%)	13.725*	^{MC}p<0.001*
3 canals with 3 orifices	**2 Foramen**	**0 (0.0%)**	**0 (0.0%)**	**3 (1.0%)**	**0 (0.0%)**	5.076	^{MC}p= 0.064

c^2, p: c^2 and p values for* Chi square test *for comparing between the different groups

^{MC}p: p value for Monte Carlo for Chi square test for comparing between the different groups

****: Statistically significant at $p \leq 0.05$***

TABLE (2): Agreement between CT & CBCT

	CT								ϰ	p
	1 orifice 1 foramen		1 orifice 2 foramina		2 orifices 2 foramina		2 orifices 1 foramen			
	No.	%	No.	%	No.	%	No.	%		
CBCT										
1 orifice 1 foramen	92	30.67	7	2.33	5	1.67	0	0.0	0.622* Good agreement	<0.001*
1 orifice 2 foramina	14	6.67	0	0.0	0	0.0	0	0.0		
2 orifices 2 foramina	7	2.33	0	0.0	36	12.0	33	11.0		
2 orifices 1 foramen	5	1.67	0	0.0	5	1.67	96	32.0		

ϰ: kappa test

****: Statistically significant at p ≤ 0.05***

Value of K	Strength of agreement
< 0.20	Poor
0.21 - 0.40	Fair
0.41 - 0.60	Moderate
0.61 - 0.80	Good
0.81 - 1.00	Very good

Evaluation of inter-method agreement between staining and clearing and CBCT in relation to canal anatomy in the mesio-buccal root of maxillary first molar (one orifice with one foramen, one orifice with two foramina, two orifices with two foramina, and two orifices with one foramen) showed a kappa coefficient of 0.360 which is fair level of agreement revealing statistically significant difference (P<0.001). **(Table 3)**

TABLE (3): Agreement between staining and clearing & CBCT

	Staining and Clearing								ϰ	p
	1 orifice 1 foramen		1 orifice 2 foramina		2 orifices 2 foramina		2 orifices 1 foramen			
	No.	%	No.	%	No.	%	No.	%		
CBCT										
1 orifice 1 foramen	33	11.0	30	10.0	5	1.67	22	7.33	0.360* Fair agreement	<0.001*
1 orifice 2 foramina	8	2.67	0	0.0	10	3.33	0	0.0		
2 orifices 2 foramina	0	0.0	0	0.0	61	20.33	23	7.67		
2 orifices 1 foramen	0	0.0	0	0.0	38	12.67	70	23.33		

ϰ: kappa test

****: Statistically significant at p ≤ 0.05***

DISCUSSION

The clinical cause of failures in root canal treatment of mesiobuccal roots of maxillary molars might occur because of their anatomical complexities, multiple canals and occasionally difficulty of finding canals, especially the second mesiobuccal canal. Therefore, it is important to investigate root canal morphology of maxillary first molar [15]. So, it is important to know enough knowledge about the root canal anatomy and possible variations of the maxillary molars to achieve successful endodontic therapy.

There are many methods for studying the root and canal morphology of teeth including staining and tooth clearing, dental model preparation with clear resin, decalcification, dissecting and sectioning, direct examination or magnification and microscope surgery, loops with fiber optic, conventional radiography and recently 3D imaging with CT and CBCT [41].

This study examined the root canal morphology with its variations of mesiobuccal root of maxillary first molars in Egyptian population. Visual, CT, CBCT, and staining and clearing methods were used.

It has been reported that the most detailed information can be obtained ex vivo by staining and clearing which resulted in very clear specimens, allowing good visualization and photography of the canal anatomy [42, 43].

Nondestructive high resolution Computed tomography (CT) [44] and cone beam computed tomography (CBCT) [45] scanning techniques are commonly used as a diagnostic aid in clinical endodontics. They allow for the cross-sectional analysis of the specimens, allow the development of a more accurate and detailed 3D models of the root canal space and better imaging of inter-canal connections, accessory canals and multiple apical foramina which is not feasible with the clearing technique.

In the current study, the number of root canals in the mesio-buccal root of maxillary first molars in Egyptian population shows wide range of variations which agree with the report of Sempira and Hartwell (2000) [46].

In our study the mesiobuccal root contained single canal in 24% by visual, 39% by CT, 32.3% by CBCT, and 21.3% by staining and clearing with mean 29.2% and two canals in 76% by visual, 61% by CT, 66.7% by CBCT, and 78.7% by staining and clearing with mean 70.6% of cases. This results are in agreement with the results of Imura et al (1998) [47], who stated that, the graduate students found two mesiobuccal root canals in 52% of extracted maxillary first molar teeth, while the incidence of two mesiobuccal roots rose to 81% after the same root was made transparent. Also, our result was in agreement with Marroquin et al (2004) [48] who reported two foramina in approximately 70% of maxillary first molar mesiobuccal roots.

The wide variation in the frequency of two mesiobuccal roots canals (40–95%) may be related to the methods used for determining additional canals. For instance, two mesiobuccal root canals were identified significantly less frequently in clinical studies than in vitro [49].

Results of the present study showed that 29.2% of the roots had a single canal and 70.6% had two or more canals which were in disagreement with Habib (2014) [50] who found that, of the stained and cleared 95 maxillary first molars studied, 57 (60%) had a single canal in the mesiobuccal root, and 38 (40%) had two canals. Also, the results were in contrast to Cleghorn et al (2006) [1] and Grande et al (2008) [51] who reported that, a single canal in the mesiobuccal root of maxillary first molar was found in approximately two-thirds of roots, and two canals were present in one third of roots. But it was near to the report of Tam and Yu (2002) [52] who found that, there was a single canal in 36% of the roots and two canals in 64% of the roots in a cross-sectional study of the mesiobuccal root.

Also, the results of the current study were similar to the results of Alrahabi and Zafar (2015) [45] who concluded that, the occurrence of second (mesiopalatal) canal in the maxillary first molar in mesiobuccal root was very much likely more than 70%.

Intercanal communications may be poorly accessible to chemomechanical instrumentation and may act as bacterial reservoirs, resulting in persistent periapical pathosis. The present study found intercanal communications in 11.3% of the roots examined which were in disagreement with Vertucci (1984) [10] who reported a 52% incidence of transverse anastomosis, but, it is in agreement with other studies showing that, the inter-canal communications were located mostly in the middle third of the root [52, 53].

The present study showed a kappa coefficient of 0.622 which is good level of agreement between CT and CBCT revealing statistically significant difference ($P<0.001$) in detection of MB2 in mesiobuccal root of the first maxillary molars of Egyptian population. It was similar to the agreement of results between Zhang et al. (2011) [54] who reported that, MB2 were found in 52% of samples in Chinese population using CBCT and Rathi et al. (2010) [55] who evaluated the frequency of MB2 by CT and reported its percentage as 57%.

In the present study, the evaluation of inter-method agreement between staining and clearing and CBCT methods for determining the mesiobuccal root configurations in Egyptian population showed a kappa coefficient of 0.360 which is fair level of agreement revealing statistically significant difference ($P<0.001$). This result was in agreement with Zheng et al. (2010) [56] who found 50% of cases have MB2 in Chinese population using CBCT while Wasti et al. (2001) [38] used tooth staining and clearing technique and found the second mesiobuccal frequency in maxillary first molar as 52%.

CONCLUSION

Although staining and clearing was shown to be superior than other methods used in the present study, still it is impossible to be relied upon since it cannot be done clinically. Results of our study recommend using of CBCT and CT to study complicated cases, since they can be performed clinically.

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