

Prevalence of Second Mesio Buccal Canal in Maxillary Molars among Population of Makkah

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ABSTRACT

Introduction: One of the major causes of treatment failure is the impossibility of locating and treating the entire root canal system, a result of the lack of knowledge of the dentists about internal or external anatomy of the tooth and the high complexity and variation of the root canal system, with accessory, secondary, recurrent, apical delta canals, and type of canals under (Vertucci et.al. 1984) classification. Recently, Cone-beam computed tomography (CBCT) has the ability to recognize the anatomy in a detailed manner and reconstruction of the anatomical part in a 3D image, from axial, transverse and sagittal planes, and gives clear image and specification about pulp tissue inside the canals in different dimensions with no anatomical superposition. (Betancourt et.al. 2015).

Purpose: The aim of the present study is to determine the prevalence of second mesio buccal canal in maxillary permanent molars and investigate root canal configuration in the maxillary permanent molar teeth using cone-beam computed tomography (CBCT) in population from Makkah.

Materials and methods: Cone-beam computed tomography (CBCT) images were examined in this study. 300 samples were obtained from individuals attended to Umm Qura University dental teaching hospital. The images were evaluated for the present of second mesio buccal canal in maxillary permanent molars. Images were examined by a radiologist, endodontist and two dental interns. The collected data were tabulated and statistically analyzed with p value ≤ 0.05 .

Results: 300 samples were taken from Cone-beam computed tomography (CBCT) images of regular dental patients who took CBCT images for other purposes, 152 females (50.7%) and 148 males (49.3), with age range from 18 to 50 year old. 129 samples showed second mesio buccal Canal in maxillary molars with percentage of (43%). 76 male samples out of 148 total male samples had second mesio buccal canal with percentage of (25.3%). 53 female samples out of 152 had second mesio buccal canal with percentage of (17.7 %). Occurrence of Second mesio buccal canal in maxillary molars was significantly higher in males relative to females, $p = 0.004$.

Conclusions: Second mesio buccal canal in maxillary molars appeared in 43% of the samples. It can be concluded that the CBCT images are noninvasive and clinically efficient tool in understanding root canal anatomy and configuration, so it can improve the outcomes of root canal treatment.

Keywords: MB2: Second mesio buccal canal, CBCT: cone beam computed tomography.

INTRODUCTION

The most important goals of the root canal treatment are shaping and cleaning of all pulp canals and its complete obturation with a biocompatible material. Therefore, dentists should be aware of common root

canal configurations and possible anatomic variation. (Kalender et.al. 2015).

One of the major causes of treatment failure is the impossibility of locating and treating the entire root canal system, a result of the lack of knowledge of the dentists about internal or external anatomy of the

tooth and the high complexity and variation of the root canal system, with accessory, secondary, recurrent, apical delta canals, and type of canals under Vertucci et.al. 1984 classification. (Betancourt et.al. 2015).

Recently, endodontic treatment is always an effective and important method because it preserves the tooth rather than extraction. Thorough knowledge of the anatomy of the tooth and root canal is a necessary precondition for success treatment. Without knowledge of anatomy of the pulp after wrong diagnosis and treatment are the second leading causes of failure treatment. So acquaintance of the internal morphology is necessary to debridement, root canal filling and better prognosis. (Abed et.al. 2013).

Successful root canal therapy depends on identification and negotiation of all the canals, their subsequent cleaning and shaping and finally three-dimensional obturation of the pulp space. A major reason for endodontic failure is when extra roots or root canals are present and not detected. Traditionally, the maxillary first molars are generally described to have 3 roots, 1 palatal and 2 buccal, with each root having 1 canal, except MB root which has 2 canals 90% of time. (Nayak et.al. 2015).

Maxillary molars are the teeth that contain the greatest number of roots, with diverse shapes and configuration, which is why their internal canal system is so variable. (Badole et.al 2012).

Maxillary second molar has the most complex root canal system of all the molars. A high percentage of treatment failures in maxillary second molars is due to the difficulty in locating, instrumenting and obturating the second mesiobuccal canal (MB2), which is located in the mesiobuccal root (Weine et.al 1969).

In addition, there are another factors determine the anatomical variation and frequency of the MB2 canal such as age, gender and race. (Betancourt et.al 2014).

Understanding the complexity of the root canal system is mandatory for understanding the problems of shaping and

cleaning, for determining the apical limits and dimensions of canal system. (Zheng et.al 2010).

Many methods have been made to assess the anatomic characteristics of maxillary second molars because of their complex root canal system. (Zheng et.al 2010; Silva et.al 2014).

Various number of techniques, such as dye penetration, radiography, sectioning and clearing, post-treatment clinical evaluation, to cone beam computed tomography (CBCT), have been applied in studies on the root and canal morphologies of different populations. (Vertucci et.al 2005).

Although tooth clearing methods and modification of these techniques have been generally considered the gold standard for analyzing root canal morphology, introduction of cone beam computed tomography into the dental field has many endodontic applications, including identification of the canal morphology. (Kim et.al 2012; Tachibana et.al 1990; Baratto et.al 2009)

CBCT is effective method for initial identification of canal morphology. CBCT can also provide personal data, such as age, gender and tooth position, which are important in the preoperative evaluation of canal morphology for root canal treatment. (Zheng et.al 2010; Sert et.al 2004; Fogel et.al 1994).

To the best of our knowledge, there are no reports on the root canal morphology of maxillary molars in the Saudi population. Thus, the aim of this retrospective study is to determine the prevalence of second mesiobuccal canal in maxillary permanent molars and to investigate root canal configuration in the maxillary permanent molar teeth using cone-beam computed tomography (CBCT).

MATERIALS AND METHODS

Study design and subjects

A written permission from the Institutional Ethical Review Board at Faculty of Dentistry, Umm Qura University

(UQU Dent-IRB) to start the study was obtained early before the conduction of any step of this research. All patients' information was kept confidential and was not accessed except for the purpose of the scientific research.

A retrospective study designed to assess prevalence of second mesio buccal canal in maxillary permanent molars among individuals whom attended to Umm Al-Qura university dental teaching hospital in Makkah will be carried out.

Cone-beam computed tomography (CBCT) images were examined in this study. 300 samples were obtained from the individuals whom attended to Umm Qura University dental teaching hospital. The images were evaluated for the present of second mesio buccal canal in maxillary permanent molars. Images were examined by a radiologist, endodontist and two dental interns.

The following technique was used for taking all CBCT images taken in dental clinic, Faculty of Dentistry, Umm Al Qura University, using the iCAT Cone Beam 3D imaging system (Imaging Sciences International, Hatfield, PA, USA) using different fields of view as individually prescribed for each patient:

The patient is properly positioned in the Head Support Positioner Mechanism for each patient for all application in order to have the focal spot to skin distance as large as possible. Minimum filtration (at 120 kVp) (mm of aluminum equivalent): 10 mm or greater. Field of View: (standard) 6.50 inches diameter x 5.33 inches height (maximum) (16.5 cm diameter x 13.5 cm height (maximum). **Extended Field of View:** (optional) 9.15 inches diameter x 6.67 inches height (maximum) (23.2 cm diameter x 17 cm height (maximum)

Technical Specifications X-ray Source:
tube voltage: 120 kVp tube current:
3-7 mA, Voltage Wave Shape: constant potential focal spot: 0.0197 inches (0.5 mm) duty cycle: 3%

Source to sensor distance: 28.1 inches (71.4 cm),

Source to patient distance: 19.5 (49.53 cm) (center of rotation).

Careful assessment for all images was done. All maxillary molars were analyzed by using three planes (sagittal, axial, and coronal), and the following anatomical features were evaluated and recorded: (Kalender et.al. 2015).

1. Number of the roots.
2. Number of the canals for each root.
3. Canal configuration in each root using Vertucci's classification as follows:

-Type I: One canal from the pulp chamber to the apex.

-Type II: Two separate canals from the pulp chamber, joins together to form one canal to the apex.

-Type III: One canal from the pulp chamber, and then gets divided into two within the root, and then joins at the apex.

-Type IV: Two separate canals from the pulp chamber to the apex.

-Type V: One canal from the pulp chamber and then gets divided into two separate canals with two separate apical foramina.

-Type VI: Two canals from the pulp chamber and then joins at the middle of the root to form one and then gets divided into two at the apex.

-Type VII: One canal from the pulp chamber to the middle third of the root and then gets divided into two separate canals and then rejoins into one and then gets divided into two canals at the apex.

-Types VIII: Three separate canals from the pulp chamber to the apex.

Sample selection

The following criteria should be considered during the selection of the study sample. The case should include the following to be included in this study:

Inclusion criteria:

1. Age: from eighteen to fifty years old.
2. First and second maxillary permanent molars.

3. With fully developed roots and mature apices.

Exclusion criteria:

1. Age: below eighteen and above fifty years old.
2. Open apices.
3. Root resorption.
4. Calcification or extensive coronal restorations.

Statistical analysis

All the collected data were recorded, tabulated and statistically analyzed. Statistical analysis was carried out using SPSS (Version 15, Statistical Package for the Social Sciences) on the collected data to test for its significance. The level $P \leq 0.05$ was considered the cut off value of significance. The Chi-square test was used to compare the frequency of Second Mesio Buccal Canal in Maxillary Molars among different gender predilection (male or female).

RESULTS

300 samples were taken from Cone-beam computed tomography (CBCT) images of regular dental patients who took CBCT images for other purposes, 152 females (50.7%) and 148 males (49.3), with age range from 18- to 50 year old. 129 samples showed second mesio Buccal Canal in maxillary molars with percentage of (43%). 76 male samples out of 148 total male samples had second mesio Buccal canal with percentage of (25.3%). 53 female samples out of 152 had second mesio Buccal canal with percentage of (17.7 %). Second mesio Buccal canal in maxillary molars showed statistically significant difference between male and female subjects with predomination in males, $p= 0.004$, table (1).

According to the findings of the present study, there were statistically significant difference between canal configuration and presence of second mesio Buccal canal, $p= 0.000$, 71 samples out of 129 samples of second mesio Buccal canal were type II with percentage of (23.65%) out of the total percentage of

second mesio Buccal canal (43%) which is considered (55%) from the total percentage of second mesio Buccal canal. 58 samples out of 129 samples of second mesio Buccal canal were type I with percentage of (19.35%) out of the total percentage of second mesio Buccal canal (43%) which is considered (45%) from the total percentage of second mesio Buccal canal, table (2). Although 71 samples with type II canal and 58 sample with type I, there was no significant difference between canal configuration and gender, $p= 0.280$. In this study CBCT images were very convenient in locating the second mesio Buccal canal, in (figure1) second mesio Buccal canal are present in first and second maxillary molars, while in (figure 2) sagittal cut showing previously treated first maxillary molar with apical radiolucency related to mesio Buccal root and in (figure 3) axial cut for the same tooth in (figure 2) showing obturation with missed second mesio Buccal canal, (figure 4) showing axial cut for same tooth in (figure 2) with apical radiolucency related to mesio Buccal root.

Table 1: The percentage distribution of Second mesio Buccal canal in maxillary molars between different genders.

Groups	Second Mesio Buccal canal		Total
	Positive	Negative	
Male	76 (25.3%)	72(24%)	148 (49.3%)
Female	53 (17.7%)	99 (33%)	152(50.7%)
Total	129 (43%)	171(57%)	300 (100%)
$\chi^2 = 8.312, P = 0.004$			

χ^2 : Chi square
P-value is significant if $P \leq 0.05$

Table 2: The percentage distribution of canal configuration in presence or absence of second mesio Buccal canal.

Groups	Canal Configuration		Total
	Type I	Type II	
Presence of MB2	58 (19.35%)	71 (23.65%)	129 (43%)
Absence of MB2	171 (57%)	0 (0%)	171 (57%)
$\chi^2 = 123.296, P = 0.000$			

χ^2 : Chi square
P-value is significant if $P \leq 0.05$

Table 3: The percentage distribution of canal configuration and gender.

Groups	Canal Configuration		Total
	Type I	Type II	
Male	109 (47.6%)	39 (55%)	148
Female	120 (52.4%)	32 (45%)	152
Total	229 (100%)	71 (100%)	300
$\chi^2 = 1.165, P = 0.280$			

χ^2 : Chi square
P-value is significant if $P \leq 0.05$



Figure 1: CBCT axial cut showing second mesiobuccal canal in maxillary molars .

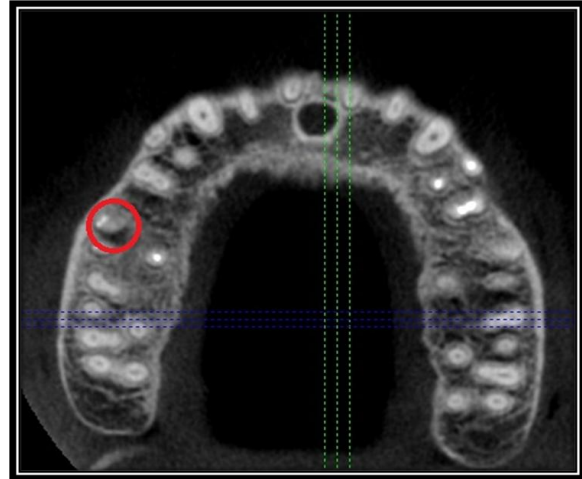


Figure 4: CBCT axial cut showing obturation of tooth No#16 with lesion related to mesiobuccal root.

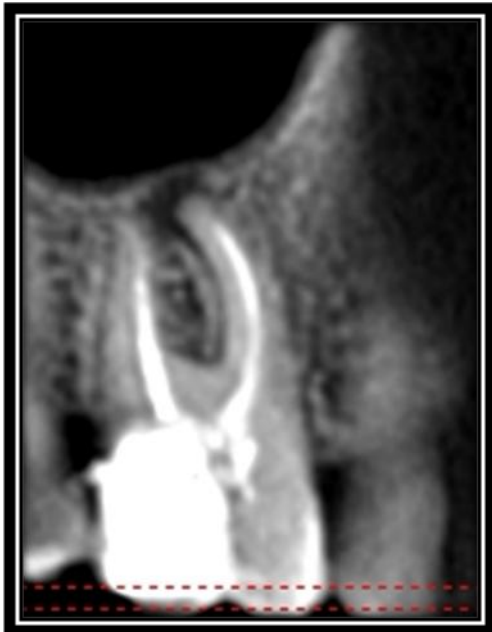


Figure 2: CBCT sagittal cut showing tooth No #16 previously treated with apical radiolucent lesion.

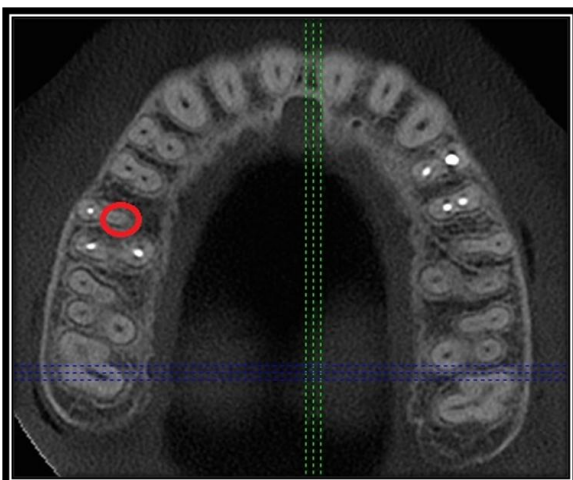


Figure 3: CBCT axial cut showing missed second mesiobuccal canal obturation of tooth No#16.

DISCUSSION

Cone beam computed tomography is an essential method which supplies the clinician with detailed information that conventional periapical or panoramic images are not able to, due to its ability to demonstrate anatomic features in three dimensions. It has gained great popularity in the field of Endodontics regarding the identification and the management of difficult conditions. These include the determination of abnormalities in tooth morphology or extra canals in a root canal system. (Estrela et.al 2008).

The present study was based on retrospective radiographic study of a group of population in Makkah to explore subjects with second mesiobuccal canal in maxillary permanent molars and investigate root canal configuration in maxillary permanent molars.

Subjects included in this study were above the age of eighteen years old. The selected sample also should be below the age of fifty years old aiming to excluded calcifications that progress with age. Based on this study there is a significant difference between different genders, males are more likely to exhibit second mesiobuccal canal than females, although no significant difference in canal configuration occurred between genders.

In accordance with the results of Hartwell et.al. 1982 and Kulild et.al 1990; the mesiobuccal root of the maxillary first

molar is usually a double root canal system more than a single canal. First and second mesiobuccal canals usually exist through one foramen (type II) according to Vertucci's classification.

In the present study, CBCT was used in order to provide information about the presence or absence of the second mesiobuccal canal in the mesial roots of maxillary permanent molars in Saudi population.

Recent information from the research field provides evidence that CBCT can be considered as an equally reliable method in detecting the MB2 canal. (Blattner et.al 2010;Domark et.al 2013).

In our study, it was shown that the majority of upper permanent molars present 3 roots, which is in accordance with previously reported studies (Hartwell et.al. 1982 and Kulild et.al 1990).

The incidence of the MB2 canal in our study was 43% .This finding is regarded to be a great indication that the CBCT imaging technique can be a useful tool towards identifying or confirming the presence of additional canals in roots. Additionally, regarding the configuration of the canal's system in the mesiobuccal root, we found that the majority of MB2 canals merge in a single apical foramen (55%) with no correlation to the position of the tooth.

As mentioned before, even though CBCT imaging technology plays a significant role in the field of Endodontics, it cannot be routinely used in everyday clinical practice. The clinician should keep in mind that the patient is still exposed to ionizing radiation and ought to assess the relative risk. It is of vital importance for the patient the radiation exposure to be kept as low as judiciously feasible (White et.al 2009).

CONCLUSIONS

Under the limitation of the present study, it can be concluded that:

- Second mesiobuccal canal in maxillary molars was represented in 43 % of the samples.

- Second mesiobuccal canal in maxillary molars showed statistically significant difference between male and female subjects with predomination in males, $p=0.004$

- There was statistically significant difference between canal configuration and presence of second mesiobuccal canal, $p=0.000$.

- There was no significant difference in canal configuration between gender, $p=0.280$.

- It can be concluded that the CBCT images are noninvasive and clinically efficient tool in understanding root canal anatomy and configuration, so it can improve the outcomes of root canal treatment but it cannot added as a routine investigations during Endodontic treatment.

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