







Prevalence and Configuration of the Second Mesio Buccal Canal in the Permanent Maxillary First Molar in Jordanian Population Sample

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ABSTRACT

Introduction: Missing a root canal during endodontic treatment implicates the persistence of microbial infection within the root canal system. This study aims to evaluate the incidence and morphology of the second mesio buccal canal in the maxillary first molars in the Jordanian population. **Methods and Materials:** Consecutive cone-beam computed tomography (CBCT) scans taken at Jordan University Hospital were assessed in this retrospective study. A total of 200 scans that were examined, 111 were included in this study. The scans that were included had to have a full view of the maxilla with at least one permanent maxillary first molar. The following data were collected: the presence of a second mesio buccal canal, the configuration of the mesio buccal canals, the status of the apical area and the mesio buccal inter-orifice distance, if applicable. The prevalence and morphology of the second mesio buccal canal was determined and its association with biological sex and right or left sidedness was measured using the Chi-Square test. **Results:** The prevalence of the second mesio buccal canal in our sample of the Jordanian population was 87%, with the most common canal configuration being Vertucci type II. The average inter-orifice distance between first and second mesio buccal canals was 1.9 ± 0.4 mm. **Conclusion:** This retrospective study is the first in Jordan to document the prevalence of the second mesio buccal canal using CBCT, and it shows that the vast majority of teeth have a second mesio buccal canal. The proper location and negotiation of this canal is of dire importance for endodontic therapy.

Keywords: Anatomic Variation; Maxillary First Molar; Root Canal Therapy

Introduction

Aside from numerous procedural errors, missing the treatment of a root canal has been considered one of the major factors associated with root canal failure thus necessitating retreatment [1]. The prevalence of the second mesio buccal canal in the upper first molar has been quantified countless times in literature with notable variations [2-5]. Not all studies had the same detection modality. Having said all this, studies have shown that the second mesio buccal canal although commonly existent, is often missed [6, 7].

The second mesio buccal canal is most commonly located mesially or mesio palatally to the first mesio buccal canal (MB1) [8].

Two commonly recognized classifications are used to define the root canal configuration: Weine's and Vertucci's classification [9, 10]. The more detailed classification, Vertucci's, was used in this study.

Weine was one of the first to recognize that the inability to locate and fill the second mesio buccal canal is a cause of failure of root canal treatment and implicates retreatment [9]. This is condemned to the development of apical disease. The criteria proposed by Bender *et al.* [11] in 1964 associates the development, appearance or increase in the size of radiographic rarefaction after the completion of endodontic treatment with endodontics failure.

The use of cone-beam computed tomography (CBCT) in the detection of missed canals in endodontics has proven to be far superior to the use of magnification clinically [12]. When

comparing periapical radiography to CBCT, there was a significant difference between the results in terms of detection of a second mesiobuccal canal, with superior results provided by CBCT [13]. This is explained by the high resolution provided by cone-beam CT scans and the lack of superimposition provided by 3-dimensional (3D) visualization [14]; which is further explaining our use of CBCT in this study.

This study aims to evaluate the prevalence and morphology of the second mesiobuccal canal in the maxillary first molars in the Jordanian population thus improving clinical efficacy in treatment.

Materials and Methods

Consecutive CBCT scans that were taken at Jordan University Hospital from 1/1/2017 to 30/5/2018 were examined to be included in this retrospective study. The scans were taken for patients seen by different specialty clinics at the Jordan University Hospital, Amman, Jordan. The CBCT scans were justified and needed for their treatment or follow up. A total of 200 scans were examined, 111 were included in this study. Scans included had to have a full view of the maxilla with at least one permanent maxillary first molar. Scans with poor imaging technique, artifact or pathological features impeding visualization were excluded. The data consisted of (200) teeth (65 Males' and 135 Females'; age range, 19-95 years). With the approval from the ethical committee, CBCT scans for patients were exported from the radiology workstation for research purposes. The software used for the CBCT scans is the Carestream 3D Imaging Software (Carestream Dental, Rochester, NY, USA). Through this software, the following data were collected: The presence of a second mesiobuccal canal, the configuration of the mesiobuccal canals, the status of the apical area and the mesiobuccal inter-orifice distance, if applicable.

Table 1. Characteristics of 200 teeth

Characteristic	N (%)
Biological sex	
Female	135 (67.5)
Male	65 (32.5)
Sidedness	
Right	101 (50.5)
Left	99 (49.5)
Number	
1	26 (13)
2	174 (87)
Vertucci <i>et al.</i> classification	
Type I	24 (12)
Type II	159 (79.5)
Type III	3 (1.5)
Type IV	14 (7)

All CBCT scans were analyzed on the same workstation using a 27" monitor. Different views on the software were used, however, the axial view was used predominantly. Through the axial view, the prevalence of the second mesiobuccal canal was determined. If present, the configuration of the canals was defined according to Vertucci's classification. The status of the apical area whether the canals were joining or not was also checked. Finally, using the sagittal section, the level of the cemento-enamel junction was marked using visual assessment. This was followed by the measurement of the inter-orifice distance on the axial cut using a ruler integrated within the software. This distance was defined as the greatest distance between the vertex of each orifice.

Data was entered into the IBM SPSS Data Editor (IBM SPSS -SPSS Inc., Chicago, IL, USA). Data analysis was completed on the same software package using 200 participants ($n=200$). The Chi-Square test was used between; the biological sex and the number of mesiobuccal canals; the sidedness and the number of mesiobuccal canals. *P*-value less than 0.05 was considered as significant level.

Results

A total of 200 maxillary first molar teeth were included in the study. Totally 135 teeth (67.5%) belonged to females and 65 (32.5%) were in males. The 200 maxillary first molars were investigated using cone-beam computed tomography. One hundred one (50.5%) were maxillary right first molars, and the remaining 99 (49.5%) were maxillary left first molars. Of the 200 teeth investigated, 174 (87%) had a second mesiobuccal canal, 26 (13%) had a single mesiobuccal canal and all 200 teeth consistently had single distobuccal and palatal canals.

The classification by Vertucci *et al.* [10] was used to classify the type of mesiobuccal canal. Twenty-four (12%) maxillary first molars were type I. Type II which was present in 159 (79.5%) maxillary first molars, was the most common type. Type III which was found in three maxillary first molars (1.5%), was the least common. Fourteen (7%) maxillary first molars were type

Table 2. Association of the number of mesiobuccal canals with biological sex and sidedness based on $N=200$ teeth

Characteristic	Number (%)		<i>P</i> -value
	1	2	
Biological sex			0.515
Female	19 (14)	116 (86)	
Male	7 (11)	58 (89)	
Sidedness			0.635
Right	12 (12)	89 (88)	
Left	14 (14)	85 (86)	

IV (Table 1). The remaining types in this classification were not found in this study. The cumulative frequency of maxillary first molars with two mesiobuccal canals but a single anatomic apex was 162 (92%).

The number of mesiobuccal canals was not statistically significantly associated with biological sex ($P=0.515$) or sidedness ($P=0.635$) (Table 2). The mean horizontal inter-orifical distance was 1.9 ± 0.4 mm. The maximum and minimum values were 3.4 mm and 1.1 mm respectively.

Discussion

This study evaluated the prevalence and morphology of the second mesiobuccal canal in the maxillary first molars in the Jordanian population thus improving clinical efficacy in treatment. The vast majority of the maxillary first molars studied had a second mesiobuccal canal, and the most common morphology was Vertucci type II. In addition, there was no association between the number of mesiobuccal canals and biological sex or sidedness.

The prevalence of a second mesiobuccal canal (MB2) in the maxillary first molar has been reported in different populations all over the world. Numbers include 52.24%, 53.1%, 56%, 71.8%, 74.55% and 86.36% in the Chinese, Iranian, Taiwanese, Korean, Egyptian and Indian populations, respectively. Numbers varied in different populations. However, all referenced studies used cone-beam computed tomography for detection. In this study, the prevalence of MB2 was 87%.

The mean inter-orifice distance measured in this study is in concordance to numbers provided in similar studies [14, 15]. On the contrary, it was higher than the inter-orifice distance measured in some other studies, which is likely due to normal anatomic variation [13, 16, 17]. Further, the most common Vertucci classification (II) was coincident with the Iranian and Egyptian populations and incongruous with the Korean [2, 3, 18].

In a study by Plotino *et al.* [19] it was reported that in up to 30% of the cases, there is a variation in anatomical symmetry between opposite molars in the same patient. This asymmetry was reported in this study. However, no significant association between sidedness and the prevalence of MB2. Also, there was no significant association between gender and the prevalence of MB2. This was further supported by Zheng *et al.*, Ghobashy *et al.* and Khademi *et al.* [2, 3, 20].

As previously mentioned, the inability to locate and fill the second mesiobuccal canal could be implicated with the

failure of a root canal treatment entailing retreatment. In a study done on the Indian population, out of 100 scans, 77.19% had unfilled MB2 canal and 72.7% of the unfilled MB2 canals had periapical radiolucencies [6].

The average inter-orifice distance in the Jordanian population according to our study is $1.9 \text{ mm} \pm 0.4 \text{ mm}$. Measuring the average inter-orifice distance gives clinicians an insight into the approximate location to prevent over cutting of dentin. The second mesiobuccal canal as previously stated is most commonly located mesially or mesiopalatally to the first mesiobuccal canal. However, anatomic variations do exist [8].

From a radiological standpoint, the detection of a second mesiobuccal canal was proven to be more accurate using CBCT when compared to traditional radiography methods. *Ex vivo* studies have shown lower levels of prevalence of a second mesiobuccal canal in a sample of the same ethnicity as this study [4]. Another *ex vivo* study comparing magnification to CBCT showed that one in five cases a second mesiobuccal canal was not detected [12].

The use of CBCT for diagnosis must be justified. According to the updated joint position statement by the American Academy of Oral and Maxillofacial Radiology and the American Association of Endodontists, CBCT is the diagnostic method of choice for “evaluating the non-healing of previous endodontic treatment to help determine the need for further treatment” [21]. A study comparing the efficacy of four different methods for locating the second mesiobuccal canal concluded that the use of CBCT was the most accurate. [22] Missing a canal during root canal treatment, in most cases, will lead to non-healing periapical pathosis justifying CBCT and requiring retreatment [9]. Further, using CBCT to establish an endodontic diagnosis for retreatment was found to be more accurate (76-83%) than intraoral radiography (36-40%) [23]. Taking all the aforementioned into consideration, it is of dire importance to properly locate, negotiate and fill the commonly missed second mesiobuccal canal.

Conclusion

This study is the first in Jordan to document the prevalence of the second mesiobuccal canal using CBCT, and it shows that the vast majority of teeth have a second mesiobuccal canal. The proper location and negotiation of this canal is of critically essential for endodontics. Future studies should evaluate the prevalence of mesiobuccal canal to the maxillary second molar.

Conflict of Interest: ‘None declared’.

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