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Radiographic Evaluation of the MB2 Canal in Permanent Maxillary Molars- An Original Study

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ABSTRACT

Introduction: The localization of the additional canal orifice is one of the primary factors influencing the success of endodontic treatment. To deal with this problem, several techniques that each has their own advantages and disadvantages have been discussed in the literature. Hence in the present in vitro study we evaluated radiographically of the MB2 canal in permanent maxillary molars using cone beam computed tomography (CBCT).

Material and Methods: The CBCT scans of 296 patients who were referred to the department of dentomaxillofacial radiology were included in the study. The presence of MB2 canals, the angle formed by the mesiobuccal, distobuccal, and palatal root canal orifices (*f* MDP), and the angle formed by the mesiobuccal, distobuccal, and MB2 canal orifices (*f* MDMB2) were evaluated on the axial section. Pearson correlation and multiple linear regression methods were used for all predictions. All of the analyses were performed using SPSS for windows version 22.0. A two-sided P value < 0.05 was defined as statistically significant.

Results: Of the 468 first molars, MB2 canals were observed in 296 subjects (141 females and 155 males). There were no statistically significant differences between females and males (P = 0.300). The *f* MDP and*f* MDMB2 were detected and evaluated. A moderate positive correlation was found between the *f* MDP and the *f* MDMB2. To predict the *f* MDMB2 values, it was shown that the *f* MDMB2 increased by 0.420 degrees when the *f* MDP

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increased by 1 degree. If the *f* MDP was greater than 90.95 degrees, there was a 78% probability that MB2 canals could be found.

Conclusion: The determination of the presence of MB2 in the maxillary first molars may be carried out using CBCT scans. If the *f* MDP was 91 degrees or greater, there was considered to be a higher probability that MB2 canals would be found in the endodontic cavity. Due to the positive correlation between the *f* MDP and the *f* MDMB2, the localization of MB2 canals may be easily performed in relation to the main MB canal.

Keywords: Cone Beam Computed Tomography, Root Canal Therapy, Endodontics.

INTRODUCTION

The meticulous cleaning, shaping, and filling of the root canal systems are the primary aims of root canal treatment (1). The maxillary first molar tooth has one of the most complex root and canal anatomies (2,3). Countless studies and discussions have been based on the existence of a second canal in the mesiobuccal (MB) root of the maxillary molars (4,5).

Several techniques have been used to detect MB2 canals in maxillary molars in both in vitro and clinical studies, including operating microscopes (6-11), ultrasounds (12), the use of a bur and explorer (10,13), and conventional or advanced radiographic techniques (14-18). Such approaches are commonly used to facilitate the detection of MB2 canals (10,19,20); however, the abovementioned methods cannot reliably detect MB2 canals (15). Cone beam computed tomography (CBCT) is a new technology in the field of endodontics that has several advantages, including the ability to perform three-dimensional (3D) imaging of root canal systems with lower radiation doses, higher resolution, and no super-imposition(26-28). Therefore, CBCT could be useful for several common endodontic fields, including endodontic surgery, dental trauma, internal or external root resorption, diagnosis of apical pathosis, and evaluation of the complex root canal configuration (29-32). Hence in the present in vitro study we evaluated radiographically of the MB2 canal in permanent maxillary molars using cone beam computed tomography (CBCT).

MATERIAL AND METHODS

This retrospective study included CBCT data from patients who were referred to the department of dentomaxillofacial radiology, faculty of dentistry, Gaziantep, Turkey, from 2011 to 2014. The CBCT data were recorded for several reasons, including implant surgery, pathological reasons, or orthodontic treatment. A total of 468 maxillary first molars were investigated from 296 patients (155 males and 141 females) with a mean age of 24.42 (11.29) years (range 7 - 68 years).

Maxillary first molar teeth with no caries or defects, filled materials, periapical lesions, root canal treatments, or root canals with open apices, resorption, or calcification were evaluated to prove that reliable, good quality CBCT images were available.

All of the images from 296 maxillary molar teeth were evaluated on the axial section. The first axial section where the angles formed by the canal orifices were seen from the axial plane was used to determine the angles used in the present study. The following parameters were recorded: the presence of MB2 canals; the angle formed by the mesiobuccal, distobuccal, and palatal root canal orifices (*f* MDP); and the angle formed by the mesiobuccal, distobuccal, and MB2 canal orifices (*f* MDMB2). The presence of MB2 was analyzed according to age, gender, and side (right or left) where the MB2 canals were identified. In addition, the *f* MDP and the *f* MDMB2 were analyzed and evaluated.

A consensus was reached between the radiologist and the endodontist as to how many canals were present in the MB root of the tooth in question, as well as to how the *f*MDP and *f*

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MDMB2 angles were measured on the CBCT scans (Figure 1).
All analyses were performed using SPSS for Windows version 22. A two-sided P value < 0.05 was considered as statistically significant.

RESULTS

Data were obtained from 728 patients, and 468 maxillary first molar teeth in 296 subjects (155 males and 141 females) were investigated in this retrospective CBCT-based study. The Age range of the subjects was 7 to 68 years, while the mean age was 24.42 years (±11.29). Of the 468 first molars, 205 MB2 canals were observed. Of those, 103 MB2 canals were in males and 102 were in females. The incidence of MB2 canals was found to be 43.80%. There were no statistically significant differences according to the gender of the patients (P= 0.300) (Table 1). The ICC scores of the observers, AMA and EK, were found to be 0.862 and 0.901 for the intra-observer agreements, and the ICC was also found to be 0.759 for the inter-observer agreement. The 6 MDP and the 6 MDMB2 were also detected and evaluated in the current study. The maxillary first molar teeth with MB2 canals had a statistically significant higher 6 MDP than the teeth without MB2 canals (Table 2). A moderately positive correlation was found between the 6 MDP and the 6 MDMB2.

Table 1.The Gender Distribution of the Presence or Absence of MB2 Canals According to Subjects and Teeth

	Presence or Absence	**Females (%)**	**Males (%)**	**Total (%)**
Subjects	MB2 Presence[a]	131 (62.68)	78 (37.32)	209 (100.00)
	MB2 Absence	95 (55.23)	77 (44.77)	172 (100.00)
	Total	141 (47.64)	155 (52.36)	296 (100.00)
Teeth	MB2 Presence	102 (49.76)	103 (50.24)	205 (100.00)
	MB2Absence	124 (47.15)	139 (52.85)	263 (100.00)
	Total	226 (48.3)	242 (51.7)	468 (100.00)
P value		0.300		

Abbreviation: MB2, second mesiobuccal canal.[a]MB2 was found on at least one side.

Table 2.Increase of *ƒ* MDP in the Presence of MB2 Canals

	N	***ƒ* MDP, Mean, Degree**	**Std. Deviation**	**P**	**r**
MB2 Absence	262	93.8606	11.29781	0.001	0.556
MB2 Presence	205	97.6326	8.37563		

Abbreviation: MB2, second mesiobuccal canal.

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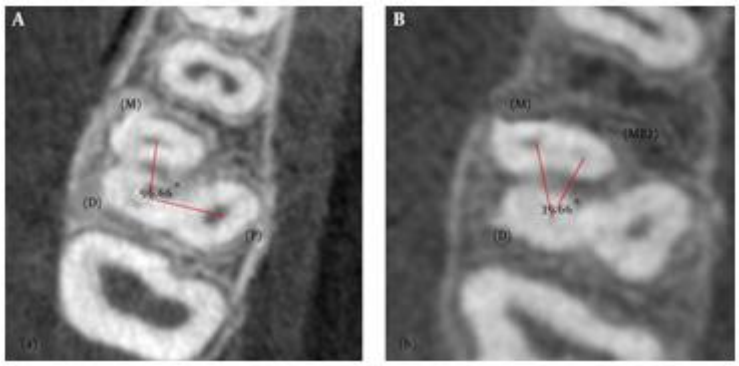
Figure 1.Illustration of the *f* MDP and the *f* MDMB2 in the axial slice of first molar teeth



DISCUSSION

One of the most important factors that lead to the failure of root canal therapy is the inability to effectively treat all canals in the root canal system (4). Failure to find and obturate the MB2 canals in permanent maxillary first molars has been proven to pose the greatest challenge to adequate endodontic treatment, and it will likely result in the failure of the treatment as a whole (9). In fact, the evidence to date suggests that more MB2 canals are found in laboratory studies (approximately 70%) than in clinical practice (approximately 40%), although microsurgical instruments such as magnifying loupes and dental operating microscopes are commonly used to increase the detection rate of MB2 canals in clinical situations (9). In a pilot study, Blattner et al. (4) assessed CBCT scans' ability to accurately confirm or disconfirm the existence of MB2 canals in maxillary first molars. They found that CBCT scanning is a reliable method of detecting MB2 canals. The results of the present study showed the detection rate for MB2 canals to be 44%, which is approximately consistent with the results of previous clinical studies (7).

The prevalence and factors affecting the identification of MB2 canals in maxillary molars have been examined in many studies (11). However, little research has been con- ducted on MB2 canal localization in relation to the main MB canal (5). Researchers found the mean distance of the MB2 canal and the mean distance of the MB2 orifice from the main MB orifice to be 2.31 mm and 1.82 mm, respectively. Gorduysus et al. (7,18) noted that the location of MB2 canals did not only vary in relation to the main MB canal, but rather that the palatal canal orifice could be used as another reference point. Moreover, Gorduysus et al. (4,12,7) investigated the location of MB2 canals and found these measurements to be 0.69 mm mesially and 1.65 mm palatally. These linear measurements of the abovementioned reference points suggest that the determination of the MB2 canal may be related to the success or failure of root canal treatment.

These results offer the opportunity to use the *f* MDP in order to predict the *f* MDMB2. To the best of our knowledge, only one study has previously been performed in relation to the *f* MDP (14,15). Here, the authors indicated that in teeth with an*f* MDP greater than 140 degrees, the MDMB2 orifice will be located closer to the line connecting the MB orifice with the palatal orifice (14-20). In the present study, it was suggested that the MDMB2 orifice could be found more easily via angular evaluation. This also supported Han et al.'s suggestion (14).

There were some limitations to the present study. The presence of MB2 in relation to the angles and, second, the reliability of the CBCT scans regarding the determination of accessory canal orifices could not be checked in this retrospective study, since it was not

based on clinical or in vitro conditions.

CONCLUSION

It could be concluded from the results that if the *f* MDP is more than 90.95 degrees, the possibility of MB2 canals in the endodontic cavity should be investigated. Due to the positive correlation between the *f* MDP and the *f* MDMB2, the localization of MB2 canals may be performed easily with reference to the main MB canal.

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