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AN IN VITRO COMPARATIVE STUDY FOR PREVALENCE OF SECOND MESIOBUCCAL CANAL IN MAXILLARY FIRST MOLAR

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: The root canal structure must be properly cleaned, shaped, and obturated for endodontic therapy to be successful. Clinicians need to be well-versed on root canal morphology to do this. The advent of visual enhancement in endodontics, along with the use of operating microscope has enhanced clinician's ability to locate all the canals.

Objective: The present research aims to evaluate the best method of detection of MB2 canals amongst direct vision (DV), Dental Operating Microscope (DOM) and Cone Beam Computed Tomography (CBCT).

Methods: Around 90 human maxillary first molar were used in this study, which were extracted due to caries or had to be extracted due to periodontally weakened condition, were collected from the department of Oral and Maxillofacial surgery, *School of dental science, KIMSDU, Karad*. Samples were made free of debris and calculus by scaling. All the samples were stored in 0.9% saline before use.

Results: In the present study, the detection of second mesiobuccal (MB2) canal was done using three different methods. The prevalence of MB2 by directed vision showed 33.33% cases. The use of operating microscope showed 56.67% presence of MB2 canals in maxillary first molar and use of Cone Beam Computed Tomography (CBCT) showed 86.67% MB2 canals. The prevalence of MB2 by directed vision showed 33.33% cases. Use of

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operating microscope showed 56.67% presence of MB2 canals in maxillary first molar and use of CBCT showed 86.67% MB2 canals. The present study showed the presence of MB2 was 56.67%.
Conclusion: On the bases of the present study one can conclude that CBCT is a promising modality to detect MB2 canals.

Keywords: MB2 canal; CBCT; operating microscope; endodontology; maxillary molars.

1. INTRODUCTION

The purpose of root canal therapy is to carefully clean, shape, and fill the root canal space. The construction of an appropriate access cavity, location, as well as identification of the root canal orifices are requirements for effective root canal therapy. It is crucial that the physician has a solid understanding of root canal morphology in order to do this. The positioning of the canals and correct cleaning and shape determine whether the root canal system will be successful or unsuccessful [1].

Numerous investigations and debates have focused on whether or not the mesiobuccal (MB) root of human maxillary molars has a second canal. In fact, it has been hypothesised that the second mesiobuccal canal exists in more than 96.1% of maxillary molars (MB2). Because the capacity to perceive the canal orifices was so severely constrained, the majority of endodontic canal identification techniques traditionally depended on the operator's tactile skill and mental picture of the canal system [2]. With the use of advanced vision systems in endodontics, this has altered.

If the radiography picture is carefully inspected, there are often indications of atypical root and/or canal forms, such as those brought on by alterations in the root surface or root canal architecture. A three-dimensional picture or an off-centre exposure may provide additional useful information. In 6% of all first maxillary premolars, for instance, three roots are seen on a premolar [3]. The mandibular first molar's middle mesial canal and the second molar's C-shaped canals (7.6%) are two difficult anatomical variances, however. The second mesiobuccal canal, which is often difficult to identify and prepare in maxillary molars (16% as well as 78% in vivo), is unquestionably the cause of the greatest failure rate in first maxillary molars.

The shortcomings of traditional imaging are solved with the introduction of cone beam computed tomography (CBCT) scans because they provide precise and detailed information and boost the detection of MB2 by up to 87% [4].

The goal of this in vitro investigation was to identify the most effective technique for identifying MB2 canals in human upper maxillary permanent first molars. Clinical uses of CBCT in Endodontics: A Systematic Review was investigated by Khanna [5]. They come to the conclusion that CBCT may be useful in identifying root fractures and root canal architecture. Each instance should benefit from CBCT enough to offset the additional radiation exposure it causes. To ascertain the usefulness of CBCT on diagnosis, therapy, and treatment outcome, well-designed quantitative clinical trials are still required.

According to [6] CBCT analysis of the maxillary permanent first molar root and root canal morphology in the North American population, there was a statistically significant variation in the existence of the MB2 canal across the age groups.

An extra canal such as MB2 I maxillary molar is a regularly occurring clinical condition, according to research by Garg et al. [7] on the endodontic care of a maxillary first molar with an atypical position for the second mesiobuccal orifice. This extra canal is often found next to MB1, but in this case, it was discovered next to the palatal orifice. The use of an intraoral periapical radiograph made it feasible to validate this aberrant placement. The finality of finding the canal, particularly in difficult circumstances, supports the need for using cutting-edge, non-invasive technology like CT [8].

Dental CBCT was researched clinically by Dhillon [9]. Their study found that CBCT technology may balance inherent dangers in favour of its exceptional advantages. To guarantee intelligent use of CBCT technology, appropriate training and instruction were necessary.

1.1 Objectives

- To evaluate the best method of detection of MB2 canals amongst direct vision (DV), Dental Operating Microscope (DOM) and Cone Beam Computed Tomography (CBCT).

2. MATERIALS AND METHODS

2.1 Method of Sample Collection

Around 90 human maxillary first molar were used in this study, which were extracted due to caries or had

to be extracted due to periodontally weakened condition, were collected from the department of Oral and Maxillofacial surgery, *School of dental science, KIMSDU, Karad*. Samples were made free of debris and calculus by scaling. All the samples were stored in 0.9% saline before use.

Inclusion criteria:

1) Teeth extracted due to caries
2) Periodontally weakened teeth,
3) Age group 18-45 years

Exclusion criteria:

1) Root resorption
2) Open apex
3) Teeth with previous restoration
4) Fractured teeth during extraction

Preparation of specimens:

All the teeth were divided into three groups containing thirty teeth each (Figure). Each group was examined by three different techniques.

1) Group I (n=30) -Direct Vision,
2) Group II(n=30)- Operating Microscope and
3) Group III(n=30)- Cone Beam Computed Tomography (CBCT)

2.2 Group I - Direct Vision

In this method, 30 teeth were placed on a wax rim that resembled the maxillary arch, and all of the teeth had access cavities prepared. Initial access preparation was completed using a high speed airotor and a round diamond (BR-46) point (Mani, Japan) under the direct view of the overhead dental chair side halogen light. After the first dip, a straight fissure (SF-11) diamond point (Mani, Japan) was utilized to widen the access cavity and provide access to the mesiobuccal, distobuccal, and palatal main canals of the root canal system.

Using a spoon excavator, all of the coronal pulp and debris were taken out of the pulp chamber, irrigated with 5% NaOCl for a minute, and flushed with 2ml of regular saline. EDTA (Glyde, Dentsply) gel was used in conjunction with no. 10, no. 15, and K-files no. 10 and 15 to navigate the canals. Using 5% NaOCl, all of the pulp as well as debris were removed from the canal. Once all of the canals had been traversed, the operator attempted to identify the MB2 canal by moving a total of 10 K-files in the subpulpal grove from the MB1 orifice to the palatal canal. If any obstructions were discovered, a DG16 endodontic explorer was inserted to clear them.

A no. 10 K-file that was pre-curved and coated with EDTA (Glyde, Dentsply) attempted to enter the canal before being resisted by a no. 15 K-file. The canal was watered with a large quantity of 5% NaOCl and then 2ml of ordinary saline. Even after thorough inspection, if the MB2 canal was not visible, the dentinal shelves that cover the predicted MB2 canal were removed using a slow speed, contra-angled hand piece and no. 4 Moller bur (Brasseler, Savannah, GA). Following the removal of the dentinal shelves, the pulpal floor was cleaned of all the debris and necrotic pulp using 5% NaOCl, which aids in the Champagne action's ability to locate the MB2 canal. After the orifice area was cleaned, the DG16 endodontic explorer was moved along the pulp chamber's floor from the MB1 to the palatal canal. If any catches were discovered, the probe was gently inserted to remove the overhanging dentin. A no. 10 K file (Mani, Inc., Japan) was then used to negotiate the MB2 canal, and if successful, the area was prepared for a no. 15 K-file.

Fig. 1. Teeth mounted for CBCT

2.3 Group II - Operating Microscope

As with Group I, all teeth in (Group II, n=30) were prepared for access cavities, and specimens were examined under a microscope at a 16X magnification (Surgical Microscope - OPTO Fine Bliss LED). The microscope included five stage adjustments and a 4X to 25X magnification range.

The placement of the MB2 canals was started using a pre-curved no. 10 K-file while the access cavity was being examined under the operating microscope. A deeper Moller bur (Brasseler, GA) was used to trephinate the floor in order to remove additional dentinal shelves that had been calcified and blocked. Even after trephination, the clogged second mesiobuccal canal orifice could not be found. A D G 16 instrument penetrates the floor and makes it simple by putting the instrument into the canal.

2.4 Group III - Cone Beam Computed Tomography (CBCT)

In this technique (Group III, n=30) all the teeth were cleaned of any adherent soft tissue, bone fragment and calculus by scaling and polishing. A "U' shaped template was prepared, mimicking the natural arch form with the use of modeling wax. Ten teeth were embedded in each arch with roots inside the wax rim and occlusal surface exposed. Three such samples were prepared to be mounted on extra-oral imaging system.

The base of the wax encasing was formed into a flat surface enabling the plate to sit stationary on top of the plastic bite plate. Roughly centered in the focal trough area and CBCT images were taken. The parameters used for CBCT was (iCAT 17-19 CBCT scanner and data were provided by Insight CBCT, a 3D maxillofacial unit, Pune) voxel size: 0.2mm, Beam diameter: 16x13cm, scan time: 26.9 sec.

3. RESULTS

The results of the present study showed the presence of MB2 canal in Group I was 33.33%, in Group II was 56.67% and in Group III had MB2 canals in 86.67%. Group I refers where direct vision was used; Group refers where operating microscope was used and Group III refers where cone beam computed tomography was used. Graph I shows the percentages of prevalence of MB2 canal in maxillary first molar teeth between three groups. The statistical analysis was done by Annova, Chi-square test.

Table 1. Frequency of MB2 canal in maxillary molars

Tooth	Direct vision	Operating Microscope	CBCT
1	0	1	1
2	0	0	1
3	1	1	1
4	0	1	1
5	0	0	0
6	0	1	1
7	1	1	1
8	0	0	0
9	0	1	1
10	1	1	1
11	0	0	1
12	0	1	1
13	0	0	1
14	0	1	1
15	1	1	1
16	0	0	1
17	1	1	1
18	0	0	1
19	0	0	1
20	1	1	1
21	0	1	1
22	1	1	1
23	0	0	0
24	0	0	1
25	1	1	1
26	0	0	0

Tooth	Direct vision	Operating Microscope	CBCT
27	0	1	1
28	1	1	1
29	1	1	1
30	0	0	1

Note: 0=absent, 1=present

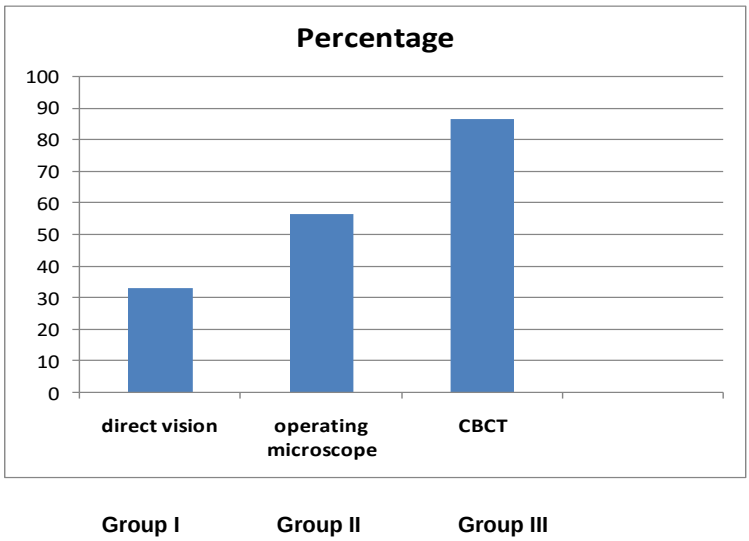

Fig. 2. Frequency of MB2 canals in groups

Table 2 shows MB2 detection rates in various Groups. In direct visualization group detection frequency was 33.33%, while in Operating Microscope and CBCT group detection frequency was 56.67% and 86.67% respectively.

In Table 3 CBCT group showed significantly higher rates of MB2 canal detection when compared with Operating Microscope group (p=0.009).

Table 2. MB2 detection rates in various Groups

Groups	Present	%	Absent	%	Total
Direct- Vision	10	33.33	20	66.67	30
Operating Microscope	17	56.67	13	43.33	30
CBCT	26	86.67	O4	13.33	30
Total	53	58.89	37	41.11	90

*Chi-square= 17.7152 p=0.0001**
*Kruskal Wallis ANOVA, H= 17.5186, p =0.0002**

Fig. 3. Presence of MB2 canal

Table 3. Rates of MB2 canal detection for Group II and III

Groups	Absent	%	Present	%	Total
Operating Microscope	13	43.33	17	56.67	30
CBCT	4	13.33	26	86.67	30
Total	17	28.33	43	71.67	60

*Chi-square= 6.6481, p=0.0099**
*Mann-Whitney U test, Z=-1.9959, p=0.0459**
**p<0.05*

4. DISCUSSION

According to [10], the rate of location in maxillary first molars may reach 93% by allocating enough clinical time, employing modern equipment aids for magnification and detection, and having a complete understanding of how and where to look for MB2.

Vamshi et al. [11] presented a root canal anatomy classification that is more therapeutically applicable than the one given by [6] for classifying frequent root canal morphology variants. However, there are several variances in each tooth, thus each case has to be assessed independently. Therefore, it is crucial that all of the canals be found and treated throughout the endodontic treatment process. Failure to detect and treat the second MB2 canal system will result in a decreased long term prognosis [12]. The results of our study showed 56.67% prevalence by use of surgical operating microscope, which is very low when compared to Schwarze T et al, 67 with prevalence of 93.7%.

Although there are several reports demonstrated the efficacy of the surgical operating microscope in locating MB2 canal, Su et al. [13] reported that 35% of maxillary first molar has negotiable MB2 canal as determines by use of surgical operating microscope which is very low compared to our study.

5. CONCLUSION

The results of the study showed that the prevalence of MB2 canal found were by direct vision 33.33%, use of microscope was 56.67% and CBCT was 86.67% respectively. The study concludes that use of CBCT imaging increase high benefit in identification of MB2 in maxillary first molar. The use of Cone Beam Computed Tomography gives the three dimensional image quality and enhance the operator's ability in identifying canal and increases the success rate of endodontic treatment. Even though the CBCT showed highest prevalence of MB2 in maxillary first molar but the surgical operating have more advantages in routine practice of endodontics. On the bases of the present study one can conclude that CBCT is a promising modality to detect MB2 canals, however more studies are required to obtain a reliable, more economic and easily available technique to detect MB2 canals.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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