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# Detection efficacy of three different methods to locate second mesio-buccal canal in maxillary first molars: *In vitro* study

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**Abstract**
The aim of this study was to evaluate the detection efficacy of three methods frequently used in dental practice (Naked eye, use of microscope, and CBCT) to locate second mesio-buccal (MB2) canals in maxillary first molars. A total of 156 extracted human maxillary first molars were evaluated. Analyses were performed with Naked eye method and using a microscope. A third analysis was conducted using cone-beam computed tomography (CBCT) images. Teeth were sectioned horizontally into three parts (cervical, medial and apical thirds) to confirm the presence of MB2 canals (reference standard method). No statistically significant differences were observed in the frequency of MB2 found between CBCT and the reference standard. CBCT had higher diagnostic value than the other two methods. CBCT was the most accurate method for detecting the MB2 and it had a diagnostic efficacy similar to that of the reference standard method.

**Keywords:** Endodontics, cone-beam computed tomography, microscope

## 1. Introduction
Successful endodontic therapy relays on the accurate detection of root canals, satisfactory chemo-mechanical shaping and cleaning, coronal and apical seal [1, 2]. Nevertheless, exact position of root canals persists a dilemma that require talent and Knowledge from the dentist [3].

Root canal morphology of upper molars is extremely complicated and the mesio-buccal root exhibits a second canal in 95% of the first molars in the Syrian population [4]. The incompetence of dentist to detect MB2 could somewhat give a reason for the immense percentage of failure of endodontic treatment [5]. Moreover, the adaption of additional accessory can elaborate the higher detection percentage of supplementary canals [6].

The typical technique that has been used to detect root canals is Naked-eye examination [7]. Nonetheless, the competence of this technique is strictly reliable to the dentist's ability and expertise of root canal morphology [8]. In effort to expedite detection of additional canals and reduce therapy failure frequencies, advanced instruments such as microscopes and cone-beam computed tomography (CBCT) have been applied into endodontic practice [9, 10]. Microscopes are magnifying tools that can be used in the dental clinic, permits improved detection of canal orifices. Likewise, microscope improves the visualization of the pulp floor, contributing for accurate detection of extra canals [11]. On the other hand, the high expenses of this tool and expertise needed to be able to operate it can be reasoned as disadvantages [12].

CBCT present three-dimensional illustrations for the root morphology and it is an advantageous aid for better diagnosis system [13]. One of the main disadvantages of this method is that patients are exposed to an extra radiation dose. The American Association of Endodontists (AAE) recommend that the CBCT should not be used in the routinely in endodontics. Nonetheless, if mandatory, it is preferred to obtain radiographs with small FOV and voxel aiming to diminish the radiation dose [14].

Although many studies have reported the ability of various methods to detect MB2, not many have assessed the efficacy of these methods. Thus, the aim of this study was to evaluate the detection efficacy of three methods frequently used in dental practice (Naked eye, use of microscope, and CBCT) to locate MB2 canals in maxillary first molars.

## 2. Material and Methods

Institutional approval was obtained from Hama Research Ethics Committee. A sum of 156 first maxillary molars were collected and cleaned using a Gracey curette 15/16 (Hu-Friedy, Chicago, USA) to clear away tissues at the root surface. After that, the teeth were axenic in an autoclave at 121 ºC for 20 minutes, and were kept in distilled water at 4 ºC until further use. Access cavities for Maxillary first molars were conducted using an Endo Z bur (Millefleur, Germany).

The floor of the pulp chamber, where the MB2 was expected to be located, was refined using ultrasonic tips (T3-S, Schuster, Santa Maria, Brazil) with light apical pressure to remove any calcifications present at the canal orifices.

After cavity preparation, the teeth were examined for MB2 presence using three different methods as following: (CBCT, Naked eye, microscope). First, Molars were mounted in acrylic bases and were set on trays. CBCT images were obtained using a Pax-Uni 3D unit (Vatech, Gyeonggi-do, South Korea) operating at 85 kVp, 4.0 mA, 8 sec. Voxel size was 0.125 mm and the field of view was 8×5 cm.

Images of 156 maxillary first molars were analyzed by experienced endodontists. The presence of second mesio-buccal canal in each maxillary first molar was detected based on CBCT axial slides.

The next two inspections (Naked eye examination and microscope) were done for each molar by an experienced endodontist who was masked for CBCT results. The next two methods were implemented as following: 1) Naked eye examination 2) using Dental Optical Microscope (DOM) under 16× magnification (Zumax, China).

With each method, the floor of each pulp chamber was inspected to identify MB2 canals using a #10 K file (Dentsply Maillefer, Ballaigues, Switzerland) that penetrated the cervical third canal.

Finally, mesio-buccal roots were cross-sectioned into three thirds (cervical, middle and apical) using diamond discs at low speed. These sections were analyzed by an endodontist under a stereomicroscope at 10× magnification, to confirm the presence of MB2 (reference standard method). MB2 was defined as present if the canal was visualized in the three sections.

### 2.2 Statistical analysis

Intra-rater reliability was assessed by repeating all four analyses in 20% of the sample that were chosen randomly (31 molars).

Data were recorded and transferred into Excel sheets. Statistical analysis was done Using SPSS software v25.0 (Chicago, IL, USA). detection efficacy data were expressed as percentages with 95% confidence interval (95% CI). Differences in the frequency of MB2 between groups compared to cross-sectioning method were tested using McNamara test. The significance level was set at 0.05.

## 3. Results

MB2 was identified by cross-sectioning (reference standard) in (94.23%) of the samples, which was higher than the identification by naked eye (20.5%), microscope (67.3%) and CBCT (88.6%). (Table 1)

The accuracy of CBCT in detecting MB2 canal was 93.8% which was not statistically significant (P>0.05). On the other hand, naked eye and microscope showed accuracy of 21.7% and 71.4% respectively which was statistically significant (P<0.05) (Table2)

### 3.1 Tables

**Table 1:** Descriptive statistics of frequency of detection of MB2 in 157 molars

| Method of detection | Frequency of detection (%) |
|---|---|
| Naked eye | 32 (20.5%) |
| Microscope | 105 (67.3%) |
| CBCT | 138 (88.6%) |
| Cross-sectioning* | 147 (94.23%) |
| * Reference method | |

**Table 2:** Intergroup comparison in detection of MB2 between three detection method and reference group

| Method of detection | Accuracy of detection | P value** |
|---|---|---|
| Naked eye | 21.7% | P<0.0001 |
| Microscope | 71.4% | P<0.001 |
| CBCT | 93.8% | P = 0.861 |
| Cross-sectioning* | - | |
| * Reference method ** McNamara test | | |

## 4. Discussion

Different techniques are available to help dentists in locating MB2 canals, but there is little evidence about the detection efficacy of Naked eye examination, inspection using microscope, and assessment of CBCT images.

This study increases the knowledge about the efficacy of different method in detecting MB2 in first maxillary molar by reporting detection accuracy in comparison with root cross-sectioning (reference method). It was reported when a technique is used to assess its ability in diagnosis/detection, testing its detection accuracy is useful to evaluate the options and choose the best one [15].

This study showed that microscope method was more accurate than Naked eye method in the detection of MB2, however, in comparison to cross-sectioning, the difference was statistically significant. On the other hand, CBCT method showed high accuracy for locating MB2 canals in first maxillary molars, with detection accuracy similar to that of the reference standard method (P>0.05).

In comparison with CBCT, Naked eye and microscope methods yielded unsatisfactory results for MB2 canal detection, as their detection values were inferior to those found for CBCT. The present results showed the diagnostic accuracy of the microscope was higher to the Naked eye method. This contrary might be attributed to the dentist's experience. Studies have reported that investigator's ability to detect root canals is highly dependent on clinical expertise [16, 17].

Also, the removal of dentin excess from the canal entrances using ultrasonic tips also played a role to the difference of MB2 detection between naked eye and microscope methods [18, 19]. On the other hand, the light apical pressure applied by the ultrasonic tip may not had removed calcifications above the MB2 in all samples. However, Zhang *et al*, reported that 1 out of 4 of the MB2 detected by CBCT were not located at the cementoenamel junction [20]. This might justify the results of this study that reported better detection accuracy for the CBCT compared to microscope.

The high detection accuracy acquired for CBCT in the present study indicate to the use of this technique as a gold standard in-vivo studies which root cross-sectioning is impossible to achieve. In the same context, a previous trial reported that CBCT is a precise technique for locating MB2 canals in comparison with cross-sectioning of the roots [9, 21, 22]. CBCT permits definite visualization of the anatomy of the mesial

root of the maxillary molars, from the cervical to the apical third [23].

CBCT is considered a non-intrusive radiographic technique that generate 3D images. However, this method has undoubtable limitations. Such as the presence of metallic restorations which ultimately may compromise image quality. Furthermore, the radiation dose the patient is subjected limits its use in the endodontic routine and should be recommended with precaution [24, 25].

In vitro studies have some limitations and translating their results to the clinical situation seems to be inappropriate. However, the recent literature supports our findings and points out that CBCT is reliable tool for detecting missing canals in vivo [26, 27].

It is essential that dentists sanctify exertion, knowledge and time to detect and shape MB2 canals. Non-successful locating of this canal might cause pathological complications and a subsequent need for endodontic retreatment. In the present study, it was shown that Naked eye and microscope had low sensitivity, which could explain the high frequency of endodontic failure caused by undetected root canals [28]. However, CBCT, should be used as a helpful tool in situations in which MB2 is not detected using the traditional techniques available in the dental office.

## 5. Conclusion

Within the limitation of this study, CBCT was more accurate and reliable method for detecting MB2 canals than Naked eye and microscope methods. CBCT could be used as a reference method in future studies.

## 6. Conflict of interest

Authors declare they have no conflict of interest

## 7. Acknowledgment

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