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A survey of decision making analysis when MB2 cannot be located in maxillary first molars

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Introduction

One of the primary goals in endodontic therapy is the treatment of all accessible canals within the pulpal system by means of chemomechanical preparation. Morphology studies give the provider background information on the occurrence rate and location of canals within individual teeth; however, this information is a reference only as individual teeth have tremendous variability.

Treatment of the maxillary first molar is considered uniquely challenging, primarily in regard to location and subsequent instrumentation of the second mesio-buccal canal (MB2). There is significant variation within morphology studies on the occurrence rate of MB2. While complete negotiation and obturation of MB2 may be challenging, it is generally accepted that a second mesio-buccal canal is present approximately 90-95% of the time [1] [2]. Many consider the instrumentation of MB2 as a critical component of NSRCT success in maxillary molars. Several studies have advocated techniques to aid in the location and instrumentation of MB2.

CBCT imaging has proven useful in aiding providers in detecting missed canals. The 2015 AAE / AAOMR Joint Position Statement recommends the use of limited FOV CBCT pre-operatively in teeth with potential for extra canals and includes maxillary molars. Additionally, if a preoperative CBCT was not exposed, the AAE/AAOMR position statement recommends an intraoperative limited FOV CBCT for identification and localization of calcified canals [3].

With the aid of the dental operating microscope, ultrasonics, access modification, and EDTA, a second MB canal should only be absent in approximately 5% of maxillary first molars [1]. Since the prevalence of MB2 is so high, when a provider is not able to initially locate MB2 with the aforementioned techniques, a clinical decision point arises. Ultimately the provider is presented with the following options: 1) before continuing, expose intra-operative CBCT to verify the presence/absence of MB2 prior to completion of NSRCT, or 2) stop looking for MB2 and proceed with case as usual. The provider may also recommend a change to their typical recall schedule to evaluate healing or resolution of symptoms. Several factors are hypothesized that may influence the provider's decision point including: preoperative diagnosis, presence of apical periodontitis, and a previously treated tooth with missed canal anatomy.

The aim of this study is to evaluate how endodontists' pre-operative diagnosis and radiographic findings relate to their decisions regarding treatment in maxillary first molars where MB2 cannot be located.

Methods

A link to a web-based survey was emailed to active members of the AAE. Data was collected from July 2018 to August 2018. The survey instrument included simple demographic characteristics such as clinical experience, primary practice setting, and typical patient load. Additionally, the survey included questions designed to assess each provider's access to and comfort level using CBCT to determine presence or absence of MB2 in maxillary first molars.

Descriptive statistics were used for frequency of responses and where appropriate cross-tabulations were applied. Multiple comparisons were accomplished using the Kruskal-Wallis test with Dunn-Bonferroni post-hoc comparisons used to elucidate significant results. The chi-square test of independence was used for pairwise comparisons. The Shapiro-Wilk test was used to assess the normality of the data distribution for survey completion time. Consequently, measures of central tendency and dispersion for time are reported as medians with associated interquartile ranges. Significance was declared at $P < 0.05$ for all tests. All data was analyzed by using SPSS version 25.0 (SPSS, Chicago, IL).

Results

A total of 376 individuals initiated the survey with a 335 completing the survey; an 89.1% completion rate. Excluded from the analyses were incomplete surveys as well as 2 respondents who completed the survey in under 60 seconds. Thus 333 respondents were retained for analysis. The median time to complete the survey was 144 seconds (IQR 104-184).

Table 1 illustrates the respondent characteristics. The majority of respondents completing the survey reported their primary practice setting to be a group private practice (48.9%) followed closely by individuals in a solo private practice (43.8%). Thus less than 10% of the respondents indicated they practiced in either a corporate dental setting (3.3%) or military setting (3.9%).

Regarding experience in endodontics, the majority of individuals in solo private practice (64.4%) and in group private practice (57.7%) reported more than 15 years of experience in endodontics. Conversely, corporate dental (54.5%) and military providers (84.6%) largely reported practicing endodontics for less than 5 years.

Regarding the availability and use of CBCT images. The majority of providers (81.1%) reported having access to CBCT in their practice setting. No differences were observed in CBCT familiarity based on providers' practice type ($P = 0.05$). Most (79.6%) reported being comfortable using CBCT and only 3.6% indicated they were not comfortable using CBCT.

When asked "If two canals join and have one portal of exit, how important for success do you believe it is to instrument and obturate both canals separately?" the majority of respondents indicated that it was important to obturate both canals separately, regardless of CBCT comfort level ($P > 0.05$).

Table 2 illustrates provider's views on the importance of locating the MB2 canal given various pulpal and apical diagnoses. The vast majority of providers (all >95%) indicated that finding the MB2 canal was important regardless of diagnosis.

Next, respondents were presented with two scenarios and asked about their likely course of action. The first scenario dealt with initial NSRCT, and the second scenario dealt with re-treatment/ revision NSRCT. In both scenarios the respondents were given three options 1) take a pre-op CBCT before access 2) expose intra-operative CBCT to look to MB2 before continuing 3) stop looking for MB2 and continue treatment as normal. In each scenario the respondents were asked to give their chosen action for the various possible combinations of diagnosis.

Scenario 1 Prompt: "During initial treatment on a maxillary first molar, you are unable to locate MB2 even after using an operating microscope, access modification with burs, ultrasonics to explore grooves and color changes, ETDA, and other intra-oral methodologies you typically employ. What is your next likely action?"

Scenario 2 Prompt: "During non-surgical re-treatment on a maxillary first molar your interpretation of the pre-op PA radiographs is that MB2 was not instrumented/obturated. You are unable to locate MB2 even after using an operating microscope, access modification with burs, ultrasonics to explore grooves and color changes, ETDA, and other intra-oral methodologies you typically employ. What is your next likely action?"

Table 3 illustrates a summary of responses to these scenarios. Regardless of diagnosis, in both scenarios individuals who reported being comfortable with CBCT were more likely to take a pre-op CBCT before access (all $P < 0.001$) and less likely to "Stop looking for MB2 and continue treatments as normal" (all $P < 0.001$) compared to those who were only moderately comfortable or not comfortable using CBCT. No treatment differences were found based on providers' practice setting or endodontic experience (all $P > 0.05$).

Finally, we examined the effect of case load on the decision to take a pre-operative or intra-operative CBCT. The data revealed no differences with regard to the choice of pre-operative CBCT as a function of patient load, (all $P > 0.05$). Similarly, no relationship was found between a provider's patient load and their willingness to expose intra-operative CBCT (all $P > 0.05$).

Table 1. Respondent Characteristics				
	n		%	
Primary practice setting				
Sole provider	146		43.8	
Group private practice	163		48.9	
Corporate dental practice	11		3.3	
Military provider	13		3.9	
Average treatment encounter per day				
1 - 3	49		14.7	
4 - 6	191		57.4	
7 - 10	86		24.8	
>10	7		2.1	
Years since completing endodontic residency				
1 - 5	49		14.7	
6 - 10	32		9.6	
11 - 15	61		18.3	
>15	191		57.4	
Level of CBCT access				
CBCT in office	270		81.1	
Refer patients offsite for CBCT	54		16.2	
Do not have access to CBCT	9		2.7	
Perceived aptitude using CBCT to determine presence or absence of MB2 in maxillary first molars				
Comfortable	265		79.6	
Moderately comfortable	45		13.5	
Not comfortable	12		3.6	
N/A, no access to CBCT	11		3.3	

Table 2. Importance of locating the MB2 canal given various diagnoses				
Diagnosis	Not important		Important	
	n	%	n	%
Vital	11	3.3	322	96.7
Necrotic	2	0.6	331	99.4
Absence of apical periodontitis	11	3.3	322	96.7
Presence of apical periodontitis	2	0.6	330	99.1

Table 3. Summary of likely actions given different presentations, n (%)			
Patient presentation	Take a pre-op CBCT before access	Expose intra-operative CBCT to look for MB2 before continuing	Stop looking for MB2 and continue treatment as normal
Scenario 1: During treatment on a maxillary first molar, you are unable to locate MB2 even after using an operating microscope, access modification with burs, ultrasonics to explore grooves and color changes, ETDA, and other intra-oral methodologies you typically employ. What is your next likely action?			
Vital pulp (Normal apical tissues or symptomatic apical periodontitis)	68 (20.4)	99 (29.7)	166 (49.8)
Necrotic Pulp / Normal Apical Tissues	70 (21.0)	118 (35.4)	144 (43.2)
Necrotic Pulp/ Apical Periodontitis present- (PARL not associated with mesial root) (to include: AAP, SAP, CAA, AAA)	76 (22.8)	120 (36.0)	137 (41.1)
Necrotic Pulp/ Apical Periodontitis present-(PARL associated with mesial root) (to include: AAP, SAP, CAA, AAA)	79 (23.7)	133 (39.9)	121 (36.3)
Scenario2: During non-surgical re-treatment on a maxillary first molar your interpretation of the pre-op PA radiographs is that MB2 was not instrumented/ obturated. You are unable to locate MB2 even after using an operating microscope, access modification with burs, ultrasonics to explore grooves and color changes, ETDA, and other intra-oral methodologies you typically employ. What is your next likely action?			
Prev. Treated / Normal Apical Tissues (Re-tx conducted due to failing restorative not due to symptoms)	190 (57.1)	64 (19.2)	79 (23.7)
Prev. Treated/ Apical Periodontitis present- (PARL not associated with mesial root) (to include: AAP, SAP, CAA, AAA)	197 (59.2)	64 (19.2)	71 (21.3)
Prev. Treated/ Apical Periodontitis present- (PARL associated with mesial root) (to include: AAP, SAP, CAA, AAA)	206 (61.9)	70 (21.0)	56 (16.8)

Discussion

Advanced imaging modalities such as CBCT have become integral in modern endodontic treatment. CBCT has been demonstrated to be both accurate and useful in assessing root morphology [4]. Previous studies have discussed the prevalence of MB2 in maxillary first molars to be as high as 95% [5] [1]; however, retrospective studies have indicated that MB2 is only located and treated in approximately 60% of cases on maxillary first molars [6]. Recent studies have further demonstrated the effectiveness of CBCT specifically in detection and location of the MB2 orifice [7] [8]. Maxillary molars are the most common tooth to undergo re-treatment, and the presence of an untreated MB2 is considered by many the primary etiology of post endodontic disease.

In cases where MB2 cannot be located utilization of CBCT imaging could improve treatment outcomes if its utilization aids in locating a missed MB2. In one study, Parker et al. found that MB2 was located 70% of the time after access in maxillary first molars. Of the remaining teeth, an intra-operative CBCT was exposed and the overall ability to locate MB2 was elevated to 86% [9]. This study illustrates the potential benefit of an intra-operative CBCT in locating MB2.

Non-surgical Root Canal

The results of this study demonstrated that during initial treatment, respondents choose to expose a CBCT (either pre-operative or intra-operative) 50.1-63.7% of the time. If a CBCT was exposed it was more likely to be exposed intra-operatively. This finding is reasonable as the provider could potentially be following the ALARA principle, and thus avoid exposing the patient to radiation if MB2 was easily located. If MB2 was not located the provider could expose an intra-operative CBCT as needed. The remainder of the respondents, 36.3-49.8%, would elect not to expose a CBCT even though MB2 was not located. Respondents were more likely to expose a CBCT (either pre-operative or intra-operative) as opposed to “continue treatment as normal” for every diagnosis except when the pulp was vital ($P>0.05$). This could indicate that respondents are less concerned with treatment failure on vital cases than other diagnosis.

Non-surgical Root Canal Re-treatment

Respondents choose to expose a CBCT (either pre-operative or intra-operative) 76.3-83.2% of the time. Possibly the most interesting finding is that during re-treatment, 16.8-23.7% of respondents would choose not to expose a CBCT at any point. This indicates that they would obturate and complete the case without locating MB2, and without any CBCT confirmation of MB2 absence. Furthermore, when the PARL was specifically identified as “associated with the mesial root” 16.8% of respondents choose to proceed and complete the case without any imaging. It is interesting to note that the vast majority of providers indicated they believed locating and instrumenting MB2 was important regardless of diagnosis (96.7-99.1%) yet approximately 20% of the time they would complete a re-treatment without locating MB2. Given the high likelihood of an MB2 presence this finding would seem in conflict.

It is worth mentioning that while CBCT is a valuable treatment aid there are limitations to the technology. While the long term impact of dental radiation is minimal, providers must balance minimizing patient exposure to ionizing radiation with the benefit obtained from the CBCT.

Another consideration for re-treatment is the potential reduction in clarity due to beam hardening.

Conclusion

Overall, the pre-operative diagnostic factors studied had no effect on treatment decisions in individuals who reported being comfortable with CBCT. Individuals who were only moderately comfortable or not comfortable using CBCT were less likely to take an intra-operative CBCT. This reflects the continued need for more education any training in CBCT. The results of this study also indicate that a vast majority of endodontists believe that locating and treating MB2 is important and utilize CBCT imaging to aid in locating it when they deem it necessary; however, during both initial therapy and re-treatment many cases are being completed without locating MB2, and without the use of CBCT evaluate the presence or absence of MB2.

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