The Operating Microscope Enhances Detection and Negotiation of Accessory Mesial Canals in Mandibular Molars

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Abstract

Introduction: Detection and negotiation of accessory mesial canals in mandibular molars was investigated with the aid of magnifying loupes or the operating microscope. **Methods:** First and second mandibular molars (n = 96) were mounted in mannequins. Three independent investigators (endodontists) prepared access cavities using 4.5× loupes, attempting to detect and negotiate accessory mesial canals with ultrasonic instruments. If detection or negotiation was unsuccessful, the procedure was continued using the microscope. The location of accessory mesial canals was mapped in relation to the main mesial canals, and their pathway shown with inserted files. The mesial roots were cross-sectioned at three levels to inspect for nonnegotiated accessory mesial canals. **Results:** With the microscope, the number of detected accessory mesial canals increased from 8 (16%) to 9 (18%) in first molars and from 8 (16%) to 11 (22%) in second molars. Negotiated accessory mesial canals increased from 6 (12%) to 7 (14%) and from 5 (10%) to 9 (18%) in the first and second molars, respectively. All 20 detected accessory mesial canals were located in the mesial subpulpal groove, closer to the mesiolingual canal (45%), in the middle (30%), or closer to the mesiobuccal canal (25%). All negotiated accessory mesial canals merged with one of the main two canals. Cross-sections of the roots confirmed that no accessory canals were present in addition to those negotiated. **Conclusions:** Within the limitations of this study, more accessory canals were detected and negotiated when using the microscope compared with loupes. This improvement was more pronounced in second molars than in first molars. All negotiated accessory canals merged with either one of the main mesial canals. *(J Endod 2010;36:1289–1294)*

Key Words

Accessory canals, magnifying loupes, mandibular molars, operating microscope

The recent influx of current technologies intended for endodontic treatment has been focused largely on improving the quality of treatment. The primary example of this trend has been the introduction to endodontics of the operating microscope, widely accepted as a beneficial aid in improving clinicians' ability to detect root canals (1, 2), particularly in teeth in which accessory canals are present. Several investigations have supported the advantage of the microscope over the use of no magnification (3–9). When compared with magnifying loupes, the microscope was either comparable (9) or superior (7). For the test model, researchers have used the frequently present but often elusive accessory canal in the mesiobuccal (MB) root of maxillary molars (4, 6–10). According to Gorduysus et al (6), clinicians did not detect more accessory canals in maxillary molars with the aid of the microscope, but their ability to negotiate the canals improved by over 10% when compared with no magnification.

One of the teeth with a complex root canal system is the mandibular molar, as shown in the early work of Hess and Zurcher (11) and in subsequent investigations (5, 12–25). The mesial root in mandibular molars is commonly considered to have two canals (11–13) with an isthmus in between (14, 16, 21, 24, 26–28). Within this system, the presence of an accessory mesial canal has been identified with a prevalence ranging from 0% to 17% (5, 12–22, 24, 25) (Table 1). The discrepancy between the studies has been attributed to ethnicity (29), age (28, 30), and sex (23). Although the location of the accessory mesial canal orifice has been reported closer to the mesiolingual (ML) canal (5), its pathway converges with either the ML(15) canal or the MB canal (17, 18). When explored with the aid of the operating microscope, an accessory mesial canal was detected in 17% of first molars and under 5% of second molars compared with 0% when no magnification was used (5). Apart from the prevalence, the ability to negotiate the detected accessory mesial canals, including the troughing depth required to enable negotiation, has not been well characterized.

The primary purpose of this study was to assess the ability to detect and negotiate the accessory mesial canals in mandibular first and second molars, with the aid of magnifying loupes and the microscope. The secondary goal was to characterize the detected canals with regard to prevalence, location, negotiability, and pathway.

Methods

This study methodology was modeled after a previous study on maxillary molars (6). Mandibular first and second molars were collected from oral surgery clinics in Istanbul, Turkey, and exposed on periapical radiographs in the buccolingual direction. After exclusion of molars with previous endodontic treatment, a deficient coronal

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TABLE 1. Summary of Studies on the Prevalence of Accessory Mesial Canals in Mandibular Molars

Study	Methodology	Number of molars (*n*)		Mesial accessory canals (%n)	
		First	Second	First	Second
Skidmore & Bjorndal, 1971	Plastic casts	45	40	0	0
Pineda & Kuttler, 1972	Radiography	300	300	0	0
Pomeranz et al, 1981	Clinical	61	39	11.4	12.8
Martinez-Berna, 1983	Clinical	1,418	944	1.3	0.2
Vertucci, 1984	Clearing	100	100	1	0
Fabra-Campos, 1985	Clinical	145	0	2.7	—
Fabra-Campos, 1989	Clinical	760	0	2.6	—
Goel, 1991	Clinical	60	0	15	—
Caliskan et al, 1995	Clearing	100	100	3.4	1.9
de Carvalho & Zuolo, 2000	Extracted teeth	93	111	17.2	4.5
Gulabivala et al, 2001	Clearing	139	134	7.1	0
Gulabivala et al, 2002	Clearing	118	60	5.9	1.7
Sert & Bayirli, 2004	Clearing	200	200	1.5	0
Ahmed et al, 2007	Clearing	100	100	4	0
Navarro et al, 2007	Micro-CT	27	0	14.8	—
	Scanning electron microscope	25	0	12	—

structure nonamenable to conventional endodontic access cavity preparation, aberrant anatomy, calcified canals, fused roots, single roots, and C-shaped canals, 48 first and 48 second molars were selected for the study. They were stored in 0.1% thymol solution until used.

The teeth were embedded in dentaforms and mounted in mannequins to simulate clinical conditions as best as possible. Conventional endodontic access cavities were completed in all teeth with the aid of 4.5× magnification loupes. Each of the first and second molars groups was randomly divided into three subgroups ($n = 18$). Three endodontists were assigned a subgroup of first and second molars each. Working independently, they set out to explore the mesial root canals in an attempt to detect accessory mesial canals using a standardized sequence as follows.

In the first stage, only loupes were used for magnification. The access cavity was refined with ultrasonic tips (Buc 1 and Buc 3; Sybron Endo, Orange, CA) to remove any dentin overhanging the mesial canal orifices and the isthmus. The mesial subpulpal groove was explored with sharp endodontic explorers (DG 16; Hu-Friedy, Chicago, IL, and Stewart probe; Premier Dental Products, Norristown, PA), and the number of canal orifices detected was recorded. Attempts were then made to negotiate detected accessory mesial canals with size 06 K-type hand files (Dentsply Maillefer, Balleigue, Switzerland). When negotiation was unsuccessful, the isthmus was troughed apically with the ultrasonic tips to pursue the accessory canal deeper into the root while repeating negotiation attempts. Irrigation with 1% NaOCl and a Stropko air irrigator (Sybron Endo) were used intermittently to optimize visibility. Troughing was continued apically until (1) the accessory mesial canal was negotiated, (2) it was considered too risky to continue troughing further apically, (3) the accessory mesial canal was no longer detectable, or (4) a perforation occurred.

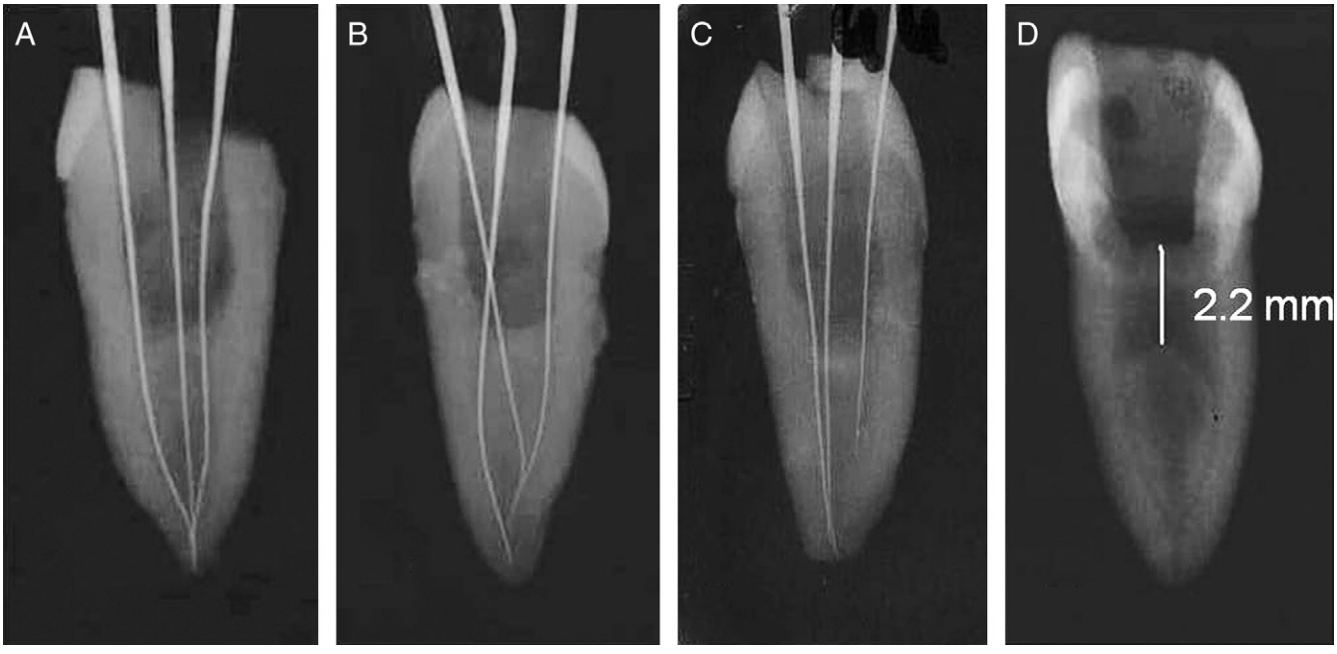

Figure 1. (*A-C*) Radiographs of mandibular molars exposed from the mesial direction (the distal roots were resected) showing the pathway of the accessory mesial canals. Files were inserted into the MB, ML, and accessory canals. (*D*) The depth of dentin removal while troughing to negotiate the accessory canal using the pulp chamber floor as a reference.