

Use of the Microscope in Endodontics: Results of a Questionnaire

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Abstract

The purpose of this study was to investigate the frequency and characteristics of operating microscope (OM) utilization among endodontists in the United States. The study also investigated how OM use has changed since a similar study was published nearly a decade ago. A web-based survey regarding OM usage was e-mailed to 2340 active members of the American Association of Endodontists (AAE) in the United States. Data from 1091 questionnaires indicated that 90% of the endodontists surveyed have access to and use the OM in their practice. The frequency of use as a function of years since completing endodontic training was as follows: <10 years, 95%; 10–15 years, 90%; 16–20 years, 82%; >21 years, 78%. Previous studies found that shorter operators needed to adopt a strained position to view mandibular molars. Our results indicated with strong correlation ($r = 0.90$) that shorter endodontists used the microscope more often than taller endodontists. The OM was used most frequently for root-end inspection, locating canal orifices, and root-end filling, respectively. Of the practitioners who used the OM, 59% used it without limitation, 86% used it equally between the maxillary and mandibular arch, and 84% used it as often as anticipated. The most common limitations to OM use were positional difficulty, limited field of view, and inconvenience, respectively. The use of the OM by endodontists increased from 52% in 1999 to 90% in 2007. (*J Endod* 2008;34:804–807)

Key Words

Age, endodontics, height, limitations, operating microscope, usage, utilization, web survey

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The use of the dental operating microscope (OM) in endodontics has progressed from sporadic use in the early to mid-1990s to use by most endodontists today. Carr (1) stated that the introduction of the OM has revolutionized the practice of endodontics. The evolution in dentistry from using loupes and headlamps to the use of the microscope parallels a similar transition in various medical specialties such as ophthalmology and neurosurgery.

Although it experienced a relatively slow acceptance (2), the OM is now recognized as a valuable instrument in nonsurgical and surgical endodontic treatments (3–7). The OM provides the clinician with superior lighting and magnification and the ability to treat cases that previously might have been deemed untreatable or resulted in a compromised prognosis (1). The reported advantages of using the OM for conventional endodontics include improved ability to investigate the root canal system and to clean and shape it more efficiently (8), locating canal orifices (9–13), removing separated instruments (14), and assessing canal dryness or sealer distribution (8). The major reported advantages for using the OM in surgical endodontics include smaller osteotomies, shallow bevels, identifying apical anatomic details such as isthmi, canal fins, and lateral canals (15), placing root-end filling material (16), and inspecting the resected root end for cracks (17).

Despite the reported advantages of microscope usage, not all endodontists use the microscope. In the microscope use survey by Mines et al. (18) from 1999, the microscope was used by 52% of endodontists. The most common reasons reported for not using the microscope were positional difficulties, inconvenience, and increased treatment time. Kinomoto et al. (19) found that it took longer to observe the mandibular molars than maxillary molars in every group of operators, and shorter operators had to adopt a strained position for mandibular observation in a standard setup but were more comfortable using angled optics or a short objective lens.

The purpose of this study was to determine whether the age of operator, years since residency training, or height of operator correlated with use of the microscope. The study also investigated whether the OM is used more on the maxillary or mandibular arch, the most commonly reported difficulties with its use, and how the use of the OM has changed since the previous study nearly a decade ago.

Materials and Methods

In July 2007, a QuestionPro.com web link to a 10-question survey (Table 1) was e-mailed to 2340 active members of the American Association of Endodontists (AAE) in the United States. All active AAE members with e-mail addresses were included in the survey. The e-mail informed the participant that the survey was a resident research project. To encourage unbiased data, no identification of the participant was requested. To further encourage participation, a reminder e-mail was sent to those who had not responded 3 weeks after the first message.

The questionnaire was limited to 10 questions. To ensure all questions were completed, if a participant did not answer a particular question, a reminder message would advise the participant to complete the response. The survey would not progress until the answer was entered. In all questions except the final question, only 1 answer was allowed. In the final question, multiple answers and personalized write-in responses were allowed. The exception was that if participants indicated they used the OM without limitation, the survey would not allow them to contradict that response by also indicating a limitation to OM use. An operator was considered to not utilize the OM for

TABLE 1. Web Link to This Questionnaire E-Mailed to 2340 Members of the AAE

1. What is your age group?
 a. ≤ 35 b. 36–45 c. 46–55 d. 56–65 e. ≥ 66

2. What is your height?
 a. 5'3" or less b. 5'4"–5'5" c. 5'6"–5'8" d. 5'9"–5'11" e. 6'0"–6'1" f. 6'2" or more

3. How many years has it been since your residency training?
 a. ≤ 0 –5 y b. 6–10 y c. 11–15 y d. 16–20 y e. ≥ 21 y

4. What is your primary practice setting?
 1. Private practice 2. Academia 3. Military 4. Resident

5. During nonsurgical endodontic cases, which dental arch do you use the microscope more often?
 1. Maxillary 2. Mandibular 3. Same amount 4. I do not use a microscope

6. During the following procedures, which of the following best represents the percentage of time you spend looking through the microscope?

	0%	25	50	75	100%
Nonsurgical root canal therapy					
Surgical root canal therapy					

7. How often during these nonsurgical procedures do you use the microscope?

	Never	Rarely	Occasionally	Frequently	Always
Access					
Locating canal orifices					
Instrumentation					
Obturation					

8. How often during these surgical procedures do you use the microscope?

	Never	Rarely	Occasionally	Frequently	Always
Incision					
Flap reflection					
Osseous resection					
Root-end preparation					
Root-end inspection					
Root-end filling					
Flap reposition/suture					

9. Do you use the microscope as often as anticipated?
 1. Yes
 2. No
 3. I do not use a microscope

10. What are your significant limitations to microscope usage? (Mark all that apply)
 1. Maintenance problems
 2. Restricted field
 3. Positional difficulties
 4. Inconvenience
 5. Increased treatment time
 6. Lack of auxiliary support
 7. Not applicable; I use the microscope without limitation
 8. Other

a nonsurgical (NS) or surgical (S) procedure if they indicated in question #6 of the survey that they are looking through the microscope 0% of the time during each respective procedure.

In a pilot trial of local endodontic residents, the average time for completion of the web survey was less than 2 minutes. The responses were electronically recorded on the Questionpro.com website. The raw data were downloaded into a spreadsheet (Microsoft Excel, Redmond, WA). Chi-square ($P = .05$), Pearson product moment correlation (r), and regression analysis ($P = .05$) were calculated.

Results

All 2340 surveys (Table 1) were distributed by e-mail. One thousand ninety-one respondents completed the entire survey by electronically submitting their answers. This represented a 46% response rate. The website electronically recorded that participants spent an average of 2 minutes completing the survey.

The first question examined the relationship between age of operator and OM utilization (Fig. 1). The χ^2 test (Table 2) indicated a

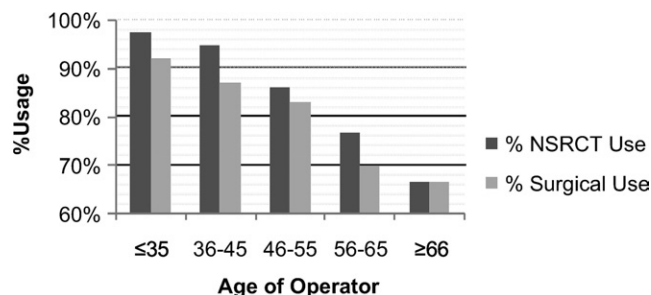


Figure 1. Microscope usage: age distribution.

statistically significant relationship ($P \leq .001$). Correlation analysis (Table 3) indicated a high correlation ($r = 0.98$) between age and OM usage (NS and S). As the age of the operator increased, the use of the OM decreased for both NS and S use. The frequency of OM use in NS procedures as a function of age of operator was as follows: ≤ 35 years, 97%; 36–45 years, 95%; 46–55 years, 86%; 56–65 years, 76%; ≥ 66 years, 67%.

The second question examined the relationship between height of operator and OM usage. The χ^2 test (Table 2) indicated a statistically significant relationship with NS procedures ($P = .045$) but not with S procedures ($P = .636$). Correlation analysis (Table 3) indicated a high correlation between height and NS utilization ($r = 0.90$). The association of height with S utilization was comparatively lower ($r = 0.80$). Shorter operators used the OM more frequently than taller operators for NS procedures.

The third question examined the relationship between years since residency training and OM utilization (Fig. 2). The χ^2 test (Table 2) indicated a statistically significant relationship ($P \leq .001$). Correlation analysis (Table 3) indicated a high correlation between years since training and NS ($r = 0.96$) or S ($r = 0.98$) OM utilization. As the number of years since training increased, use of the OM decreased. The frequency of OM use in NS procedures as a function of years since completing endodontic training was as follows: <10 years, 95%; 10–15 years, 90%; 16–20 years, 82%; ≥ 21 years, 78%.

The fourth question examined the primary practice setting of participants. The response rates for the respective settings were 95% private practice, 4% academia, and 1% military or resident.

The fifth question examined whether participants used the OM equally in the maxillary and mandibular arches. The responses indicated that 77% use the OM the same amount in either arch, whereas 12% use the OM in the maxillary arch more frequently. Less than 1% of participants indicated they use the OM more frequently in the mandibular arch.

The sixth question examined what percentage of time during an S or NS procedure the participant spent looking through the microscope. These data are summarized in Table 4.

TABLE 2. Chi-Square Associations

	χ^2	P Value
Age category, % OM use		
NS	99	<.001
S	54	<.001
Height, % use		
NS	31	.045
S	17	.636
Years since training, % OM use		
NS	116	<.001
S	65	<.001

NS, nonsurgical; OM, operating microscope; P value, the calculated value of being wrong in concluding that there is a true linear association between the variables.

TABLE 3. Regressions/Correlations

	r	r^2	P Value
Age category, % OM			
NS	0.98	0.96	.003
S	0.98	0.95	.004
Height, % use			
NS	0.90	0.82	.036
S	0.80	0.44	.055
Years since training, % OM use			
NS	0.96	0.93	.008
S	0.98	0.96	.003

NS, nonsurgical; OM, operating microscope; S, surgical; r , correlation coefficient; r^2 , the proportion of variability that is explained by the relationship (coefficient of determination); P value, the calculated probability of being wrong in concluding that there is a true linear association between the variables.

For NS procedures, 27% of participants indicated they use the OM throughout only 25% of the procedure. This was closely followed by 25% of participants who indicated that they use the OM throughout 100% of a NS procedure. Ninety percent of participants indicated they use the OM for at least 25% of a NS procedure, whereas 83% of participants indicated they use the OM for at least 25% of an S procedure.

The seventh question examined how likely a participant was to use the OM throughout different stages of a NS procedure. To better analyze the data from this question, the 5 respective answers were assigned an increasing numeric value, with a range from a “never” response at a 1 to the “always” response at a value of 5. Participants indicated that they most frequently use the OM while locating canal orifices (4.1), whereas the OM was only occasionally used during access procedures (3.0).

The eighth question examined how likely a participant was to use the OM throughout different stages of an S procedure. Once again, the responses were assigned a numeric value to better analyze the information. Participants indicated that they most frequently use the OM while performing root-end inspection (4.1) followed by root-end filling (3.9) and root-end preparation (3.8). Participants indicated that they almost never use the OM for incision (1.9) and rarely for flap reflection (2.0) or flap reposition/suture (2.1).

The final 2 questions examined whether the participants use the OM as often as anticipated and what they consider significant limitations to its use. Within the participants who use an OM, 84% indicated they use it as often as anticipated, and 59% indicated they use it without limitation. Positional difficulty was reported among 32% of all OM users. Other commonly reported limitations included restricted field (18%), inconvenience (17%), and increased treatment time (16%). The write-in response (12%) had a significant proportion of participants who indicated they prefer loupes, and the cost of the microscope was a limitation. The least commonly reported limitation among the list was maintenance problems ($<1\%$).

Discussion

Although the OM has been used for more than 80 years by medical specialists, its introduction into dentistry is relatively recent. The results of this survey revealed a majority of endodontists have adopted the OM

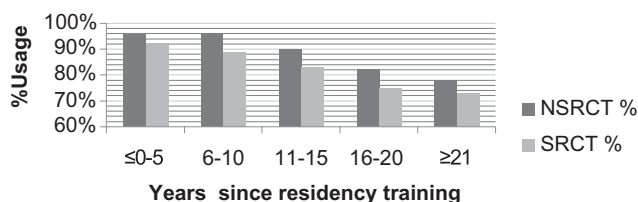


Figure 2. Microscope usage: years since residency training.

TABLE 4. Percent of Procedure Looking in OM

	% of Total Response	
	NS	S
0	10	17
25	27	21
50	19	17
75	19	24
100	25	21

NS, nonsurgical; OM, operating microscope; S, surgical.

into their practice. The use of the OM by endodontists in the United States increased from 52% in 1999 (18) to 90% in 2007. How often it is used for a given procedure is widely variable. For example, during NS procedures 1 of 4 participants indicated they use the OM during only 25% of the procedure, whereas a different 1 of 4 participants indicated they use the OM during 100% of the procedure.

The percentage of younger endodontists (<35 years) or recent graduates (<10 years) who use the OM is significantly higher than for older endodontists (>55 years) or those who were trained more than 15 years ago. Nonetheless, OM usage should not be interpreted as a trend solely among recently trained endodontists because 78% of the oldest trained group (>21 years) use the OM in their practice. The more prevalent usage among the most newly trained group might be due to an increased emphasis of OM use during training during the past decade as well as a higher percentage of this group opening new offices in which the OM is an important aspect of operator design. Other visual enhancers being used by respondents that were added in the write-in space included loupes, loupes with headlamps, and the endoscope.

The pattern of OM use suggests that it is perhaps most frequently used when increased light and visualization might be perceived to provide the greatest advantage. Locating canal orifices was the highest reported use during NS procedures. During S procedures the most frequently reported use included performing root-end inspection, root-end filling, and root-end preparation. The microscope was least used in activities in which perhaps there is perceived to be a minimal benefit from increased light and magnification. This list included incision, flap reflection, and flap reposition/suture.

Our results indicated that although 77% of operators use the OM the same amount in either arch, 12% use the OM more frequently in the maxillary arch. This finding corresponds with that of Kinomoto et al. (19). They found that it took longer to observe the mandibular molars than maxillary molars in every group of operators. One operator wrote comments in our last question stating that they were more comfortable working in the microscope with indirect vision, but with direct vision they had positional difficulties.

One of the more surprising findings is that shorter operators utilize the OM more often than taller operators. This was unexpected because Kinomoto et al. (19) found that shorter operators had to adopt a strained position for mandibular observation in a standard setup but were more comfortable using angled optics or a short objective lens. Perhaps shorter operators, once familiar with their microscope positioning, are using angled optics for mandibular molars and are indeed very comfortable in this position. Another potential explanation is the height discrepancy between genders. Perhaps the finding is result of training more female endodontists in recent years.

Despite an overall increase in use of the OM, limitations to its use correspond almost exactly as they were reported nearly a decade ago

(18). The most commonly reported limitation was, and remained, positional difficulty (32%) distantly followed by inconvenience (17%) and increased treatment time (16%). The 2007 survey differed in that more operators perceived a restricted field (18%) as a limitation to OM use compared with the previous survey.

Although it was apparent from the responses that the OM received widespread acceptance during the past decade, there is not a universal agreement on how the OM should be used or how frequently it should be used during a given procedure. Some experts believe that outcomes are improved when the clinician uses the OM (20). However, most of the information on the OM currently available is empirical or intuitive. Further research and long-term outcome studies are needed to determine the full impact of microscope usage on treatment results.

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