

Use of the Microscope in Endodontics: A Report Based on a Questionnaire

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A survey regarding operating microscope (OM) usage and training was mailed to 3356 active members of the American Association of Endodontists (AAE) in the United States. Data from 2061 questionnaires indicate that 52% 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: <5 yr, 71%; 6 to 10 yr, 51%; and >10 yr, 44%. The OM was used most often for retrieval of separated instruments, root-end preparations, and root-end fillings. Of the respondents who use the OM, 36% report they do not use it as often as anticipated. The most common reasons reported were positional difficulties, inconvenience, and increased treatment time. The information collected from the survey reveals that the more training the operator has on the microscope, the more likely he or she is to use it for all procedures.

The use of the operating microscope (OM) in endodontics has become the focus of many meetings, continuing education seminars, and courses. The benefits gained by enhanced illumination and magnification were advocated by Bellizzi and Loushine as adjuncts for posterior surgery (1). Carr (2) discussed surgical and nonsurgical applications for the OM and stated that the introduction of the OM has revolutionized the practice of endodontics. The use of the OM in endodontics was also supported by Pecora and Andreana (3), who recommended the use of the OM to enhance the efficacy of surgical 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. As of January 1, 1998, the American Dental Association standards for advanced specialty education programs in endodontics were revised to include microscope training. The guidelines state that educational programs must provide instruction at the understanding level and clinical training at the competency level using microscopy to perform surgical and nonsurgical endodontic procedures.

The method and degree of training varies considerably among operators. Training methods include self-study, residency training,

and attendance at formal training courses. Many self-taught operators were the early users of the technology before the development of formal courses. Berezniak (4) stated that the process of mastering microsurgical techniques is best accomplished in a laboratory before use in the operating room. A variety of formal training courses are now available throughout the country.

The reported advantages of using the OM for conventional endodontics include enhanced visualization of root canal intricacies, which enables the operator to investigate the root canal system and to clean and shape it more efficiently (5). Increased visualization also enhances the ability of the operator to remove separated instruments lodged in canals and to see minute fracture lines, thereby assisting in diagnosis. An assessment of canal dryness and sealer distribution can also be made (5). In surgical endodontics, the major reported advantages include smaller osteotomies, shallow bevels, and the ability to identify apical anatomic details, such as isthmi, canal fins, and lateral canals (6).

The purpose of this study was to determine how the microscope is currently being used, the specific treatment procedures, amount of formal training, and the most commonly reported difficulties with its use. This data can additionally serve as a base line to identify future trends in microscope usage.

MATERIALS AND METHODS

A one-page letter and survey (Table 1) was mailed to all 3356 active members of the American Association of Endodontists (AAE) in the United States. The roster and addresses were obtained from an AAE mailing list. To encourage unbiased data, no identification of the participant was requested, and a self-addressed return envelope was included.

The questionnaire was limited to one page to encourage further participation. In a pilot trial of local endodontic residents, the average time for completion of the form was <5 min. The responses were then recorded, and the χ^2 test for associations between groups was calculated using two statistical packages: SPSS version 7.0 for Windows and JMP version 3.1.

RESULTS

A total of 2237 (68%) responses were received from the mailed questionnaires. Due to incomplete data, 142 surveys were not used

TABLE 1. Questionnaire mailed to all active and student members of the AAE in the United States

MICROSCOPE USAGE
(a benchmark survey)

1. Do you use a surgical microscope in your practice? (circle one) Yes / No
2. Please circle your age group. <35 / 35-50 / >50
3. Please circle the number of years since completing your endodontic training.
<5 years / 6-10 years / >10 years
(If you answered *no* to question 1, please stop here and return the survey.)
4. Please circle your primary practice setting.
Private practice / Academia / Military / Resident
5. How many days of formal training have you received with the surgical microscope?
0 days / 1 day / 2-5 days / 6-10 days / 11-15 days / >15 days
6. To ascertain a correlation between degree of usage and training, please mark the appropriate box with an **X**.
(Please mark a box for all procedures.)

Procedures	Microscope Usage			
	Never	Occasionally	Frequently	Always
Nonsurgical treatment				
Access				
Locating canal orifices				
Instrumentation				
Obturation				
Restorations				
Retrieval of separated instruments				
Negotiating calcified canals				
Surgical treatment				
Flap reflection				
Osseous resection				
Root-end preparation				
Root-end filling				
Closure				

7. Do you use the microscope as often as anticipated? (circle one) Yes / No

If *no*, please check reasons: (mark one or more)

- ☐ Restricted field
☐ Positional difficulties with the microscope
☐ Inconvenience
☐ Increased treatment time
☐ Lack of auxiliary support

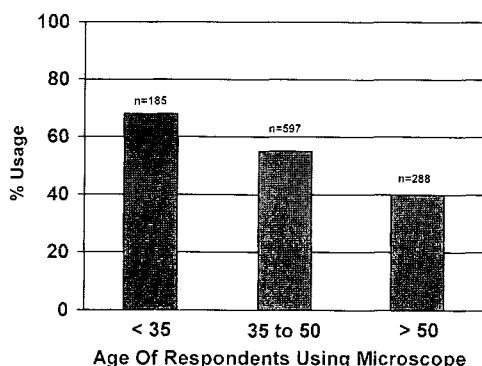


FIG 1. Microscope usage: age distribution.

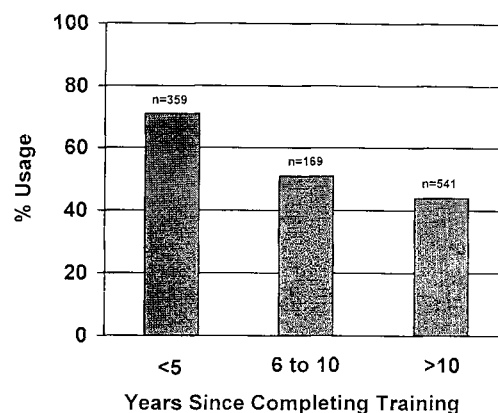


FIG 2. Microscope usage: years since residency completion.

in the analysis. In addition, associate member data was not included in the analysis. Usable surveys totaled 2061 (64%).

The first question on the survey inquired whether the respondents used the OM in their practice. Data revealed 1070 (52%) use the OM and 991 (48%) do not use the OM.

The second question examined the relationship between the age of the respondent and microscope usage (Fig. 1). The χ^2 statistic was 71 with 2 degrees of freedom ($p < 0.001$), indicating that younger dentists are more likely to use the OM.

The third question examined the association between number of years since completion of training and microscope usage (Fig. 2). The 2×3 table χ^2 test of association produced a value of 102, with 2 degrees freedom ($p < 0.001$), indicating that recent graduates are more likely to use the OM.

It was determined that the four original categories of frequency of OM usage could be combined into two categories to provide appropriate cell counts for testing associations. Additionally, the six categories (days of formal training) were collapsed into two categories: <5 days of training (818) and >5 days training (252). Frequency of OM usage for each of the 12 procedures as a function of days of training were analyzed. Table 2 shows respondent numbers and percentages for each procedure. Frequency of usage was not significantly different between the <5 days and >5 days of training groups for five procedures in the "Never/Occasionally" category (denoted by an asterisk). All other comparisons revealed significantly greater usage with more training. Differences were tested for significance at the ($p < 0.05$) level by a χ^2 test of association and are noted by the exact value in the adjoining column in Table 2.

Data from the 1070 respondents who use the OM revealed 683 (64%) reported using the OM as often as anticipated, whereas 387 (36%) reported they did not use it as often as anticipated. The reasons they did not use the OM as often as expected were restricted field 131 (34%), positional difficulties with the microscope 232 (60%), inconvenience 225 (58%), increased treatment time 197 (57%), and lack of auxiliary support 97 (25%). Percentages do not total 100% as respondents were free to indicate multiple reasons for not using the OM.

DISCUSSION

Although the OM has been used for >75 yr by medical specialists, its introduction into dentistry is very recent. The results of this survey revealed a significant adoption of the technology by many endodontists, with $>50\%$ reporting they have access to and use the OM in their practice. Other visual enhancers being used by

respondents that were added to the questionnaire included loupes, loupes with headlamps, and the endoscope. The respondents who reported that they had recently ordered microscopes were not recorded as using a microscope for the purposes of this report.

The percentage of recent graduates (<5 yr) who use the OM is significantly higher than the percentage for those trained >5 or 10 yr ago. Microscope usage, however, should not be interpreted as a trend solely among recently trained dentists, because a substantial percentage of those who graduated 6 to 10 yr and >10 yr ago (51% and 44%, respectively) reported usage. The more prevalent usage among the <5 yr group may be due to the recent increase in emphasis during training, as well as a higher percentage of this group designing and opening new offices in which the OM is an integral part of the operatory design.

Use of the OM seems to be prominent in both nonsurgical and surgical endodontics. Kim (7) recently stated that endodontics has changed fundamentally in the last 5 yr after introduction of the surgical microscope. He points out that apical resection techniques are totally different than before, and orthograde procedures that were once very difficult can be done with much more certainty (7). These changes in techniques are also in part the result of other technologies (ultrasonic instrumentation, microinstruments) often incorporated with the microscope. The procedures with the highest reported usage are retrieval of separated instruments, root-end preparation, placing root-end fillings, negotiating calcified canals, and locating canal orifices. Procedures in which microscope usage was less prevalent include surgical closure, placement of restorations, instrumentation, obturation, and flap reflection. This pattern of usage suggests that the microscope is most often used when increased light and visualization may provide the greatest advantage, which supports the recommendation that the microscope be used predominately for osteotomy, curettage, apicoectomy, apical preparation, retrofilling, and documentation (8).

The results of the survey suggest that increased training results in an increased frequency of OM usage for all procedures. There was a wide range of training experience across respondents, from none to >10 yr. There also seemed to be little standardization in the method of training. Some of the methods referenced on the questionnaire included self-training, formal courses or seminars, research experience, and residency training.

Whereas 64% of respondents reported that they use the OM as often as they anticipated, 36% found that it did not meet their expectations. The most commonly reported reasons were positional difficulties, inconvenience, and increased treatment time. Operating positions of the patient head, dental chair, surgeon, and

TABLE 2. Microscope usage as related to training

Procedure	Never/Occasionally			Frequently/Always		
	<5 Days Training	>5 Days Training	p Value	<5 Days Training	>5 Days Training	p Value
Access	659 (81%)	149 (59%)	0.008	159 (19%)	103 (41%)	0.001
Locating canal orifices	401 (49%)	77 (30%)	0.001	417 (51%)	175 (70%)	0.001
Instrumentation	694 (85%)	173 (68%)	0.07*	124 (15%)	79 (32%)	0.001
Obturation	696 (85%)	171 (69%)	0.053*	122 (15%)	81 (31%)	0.001
Restorations	717 (88%)	198 (78%)	0.33*	101 (12%)	54 (22%)	0.002
Retrieve separated instruments	296 (36%)	30 (12%)	0.001	522 (64%)	222 (88%)	0.001
Negotiating calcified canals	395 (48%)	70 (28%)	0.001	423 (52%)	182 (72%)	0.003
Flap reflection	686 (84%)	192 (76%)	0.74*	132 (16%)	60 (24%)	0.001
Osseous resection	513 (63%)	104 (41%)	0.001	305 (37%)	148 (59%)	0.001
Root-end preparation	273 (33%)	37 (15%)	0.001	545 (67%)	215 (85%)	0.02
Root-end filling	288 (35%)	41 (16%)	0.001	530 (65%)	211 (84%)	0.022
Closure	756 (92%)	198 (79%)	0.23*	62 (8%)	54 (21%)	0.01

assistant are critical to the successful utilization of the microscope, and are discussed in a recent publication (8). Some respondents reported that the difficulty of trying to manipulate the microscope to see clearly discouraged its use, whereas others reported they did not have a microscope in all operatories, and this lack of accessibility was a limitation. If the operator desires to look continuously through the OM during the procedure for maximum efficiency, additional auxiliary support may be necessary. It has been suggested that efficient use of the OM may be compromised if only one assistant is available (5). At a minimum, communication between the operator and the assistant is more critical with the narrower operator field of vision. Increased treatment time was a major factor in discouraging some operators from using the OM extensively. Although some practitioners feel that the learning curve may be steep when the microscope is first used they believe procedures could be completed more efficiently once experience was gained.

It was apparent from the responses that there is not a universal agreement on how the OM should be used or if it is necessary. Among the 48% of practitioners who reported that they did not use the OM, there was a common theme that a good knowledge of anatomy, tactile sense, and experience was more important in their practice than increased visualization. On the other hand, many who use the OM reported that it is an invaluable tool that is essential to their practice. Most of the information on the OM currently available is empirical or intuitive. Further research and long-term success-failure studies are needed to determine the full impact of microscope usage on treatment results.

The opinions or assertions contained herein are the private ones of the authors and are not to be construed as official or as reflecting the views of the United States Army or the Department of Defense.

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