

Use of Microscopes and Other Magnification Devices

Background

The AAE is dedicated to excellence in the art and science of endodontics and to the highest standards of patient care.

Successful endodontics depends on several factors. The abilities and knowledge of the endodontist, including training and experience, are of primary importance. Endodontic procedures are performed in the realm of fractions of millimeters, demanding high precision of observation and operation. Clinical and fine motor skills are enhanced by use of appropriate lighting and magnification devices that improve visualization of all aspects of the operative field.

Advances in endodontics in the past two decades have given endodontists critical new means to save the natural dentition. In the early 1990s, operating microscopes (OM) were introduced into endodontic practice and endodontic residency programs (1-3). By providing both intense focused light as well as high magnification, the OM has become an important part of the armamentarium for endodontists. The OM enables endodontists to resolve treatment challenges previously unrecognized or untreatable (4,5). For instance, the detection of hidden or calcified canals, such as in maxillary and mandibular molars, both *in vitro* (6-9) and *in vivo* (10), is enhanced.

Since the early 1990s, training in microscopes has become an essential component of endodontic education, and their use is now universally taught in all Commission on Dental Accreditation-approved advanced education programs in endodontics. A 2007 survey of 1,091 endodontists (11) indicated that 90 percent of endodontists have access to and use the OM in their practice,

a dramatic increase from 52 percent in use in 1999 (12). According to a recent national survey, current residents are all using the OM during their residency programs (13).

The AAE was an early proponent of training in microscopes for endodontic residents and successfully advocated that CODA include a microscope proficiency standard (4.9.j) to the CODA educational standards for endodontic programs in 1998. Standard 4.9.j was revised by CODA in 2005 by substituting “use of magnification techniques” for the previously phrased “use of microscopes,” and adding an intent statement that the standard is designed “to ensure that residents are trained in use of instruments that provide magnification and illumination of the operative field beyond that of magnifying eyewear, including operating microscope, orascope or other developing technologies.” The standard (4.8.k) also raised the “level of knowledge” that a program must provide in magnification from “understanding” to “in-depth” which is the highest of the three levels of knowledge.

Outcomes Studies: Magnification Techniques

While it was long uncertain if the use of higher magnification resulted in improvements in endodontic treatment outcomes (14-17), there is now emerging evidence confirming it. A study by Monea et al. (18) assessed the impact of the operating microscope on the outcome of nonsurgical root canal treatment of a consecutive series of 184 comparable teeth diagnosed with pulp necrosis and chronic apical periodontitis.

After both 6 and 18 months follow-ups there were significant differences between the group of teeth treated with the aid of higher magnification and the control groups, with 94.8% versus 87.5% (healed and improved) at 6 months, and 95.9% and 91.9% at 18 months. At 18 months, 89% of cases available for follow-up in the microscope group were classified as completely healed. For endodontic surgery, several meta-analyses highlighted the impact of higher magnification exceeding (10x and higher; 19,20). Setzer et al. (20) described a significantly higher cumulative outcome of 94% for endodontic microsurgery (EMS) utilizing high- power magnification in form of dental operating microscopes and endoscopes (with the endoscope used during root-end preparation and the microscope for the remainder of the procedure) compared to a cumulative outcome of 88% for studies that used identical techniques, but replaced the high magnification devices with loupes. Tsesis et al. (21) also confirmed a statistically significant difference in successful outcomes of both microscope and endoscope-assisted procedures compared to loupes.

Nevertheless, it would be beneficial if additional large-scale randomized clinical trials could be conducted. The challenge of designing such studies, however, lies in the many variables encountered in performing non-surgical endodontic procedures.

These variables include the skill of the practitioner, the morphology of the tooth, the type of irrigant used, the size of the lesion present, various anatomical aberrancies that may exist within the tooth, and many other complicating factors.

Use of Microscopes in Endodontics: General

The following procedures benefit from the use of the microscope:

- locating hidden canals that have been obstructed by calcifications and reduced in size (6-9);
- removing materials such as solid obturation materials (guttapercha, silver points and carrier- based materials), posts or separated instruments (22,23);
- removing canal obstructions; confirm canal cleanliness or post or obturation material removal during NS retreatment;
- assisting in access preparation to avoid unnecessary destruction of mineralized tissue (24),
- repairing biological and iatrogenic perforations (25,26);
- locating cracks and fractures that are neither visible to the naked eye nor palpable with an endodontic explorer (27); and
- facilitating all aspects of endodontic surgery, particularly in root-end resection and placement of root-end filling materials (28);

Additional benefits of the OM include the facilitation of enhanced photographic documentation (29), enhanced communication with referring dentists, and improved positioning ergonomics for the operator.

Conclusion

The OM is an important addition to the armamentarium of modern endodontics. It helps set the bar of excellence at the highest level. The AAE mission statement encourages its members to pursue professional advancement through “the implementation of technological advancements into clinical practice as they are introduced to and accepted by the specialty.”

Any introduction of new technologies into any area of health care involves a transition period where individual practitioners evaluate the cost and benefit of integrating the new technology into their practices. For endodontists who had been trained without microscopes, this varied based on a number of factors, including the stage of their career and the time required for training in the new technology. Current graduates of endodontic residency programs immediately employ the use of OM's upon their transition from education to clinical practice.

Recognizing these differences, the AAE expects that all practicing AAE members continue to recognize and validate the use and benefits of microscopes in patient care.

Advances in endodontics over the past 20 years have been widespread and far-reaching.

Endodontists now help patients retain teeth that would have been extracted in the past. The AAE expects that advances in magnification technologies and other treatment modalities will continue to improve endodontic outcomes in the years to come.

The position of the AAE is that the microscope is an integral and required device for the performance of modern endodontic techniques.

Higher magnification, especially with the use of the operating microscope, is improving endodontic outcomes, and should be the standard to which all dentists strive in performing endodontic procedures.

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The guidance in this statement is not intended to substitute for a clinician's independent judgment in light of the conditions and needs of a specific patient.

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