ENDODONTICS

Colleagues for Excellence

PUBLISHED FOR THE DENTAL PROFESSIONAL COMMUNITY BY THE AMERICAN ASSOCIATION OF ENDODONTISTS **Spring/Summer 2003**

Advances in Endodontic Surgery

Welcome to ***ENDODONTICS: Colleagues for Excellence…*** the newsletter covering the latest in endodontic treatment, research and technology. We hope you enjoy our coverage on endodontic surgery and that you find this information valuable in your practice. Future issues of ***ENDODONTICS*** will keep you up to date on the state of the art and science in endodontic treatment.

Nonsurgical root canal treatment is a highly successful procedure if practitioners are thorough with their diagnoses and proficient in performing their clinical treatments. The common belief that unresolved periradicular lesions should be corrected surgically is not always true. Retreatment can correct most persistent endodontic pathosis (see *ENDODONTICS: Colleagues for Excellence* Spring/Summer 1998). Scientific studies show that more than two-thirds of these cases can be retreated successfully.

Surgery is necessary in some situations to retain a tooth that would otherwise be extracted. This issue of *ENDODONTICS: Colleagues for Excellence* provides an update on advances in endodontic surgery. Lesions of endodontic origin that have not healed can have a second chance with recent improvements in endodontic surgical instruments, materials and techniques.

Indications for Periradicular Surgery

The main purpose of performing a periradicular surgery is to remove a portion of the root with undebrided canal space or to seal the canal when a complete seal cannot be accomplished through a coronal approach. Indications for periradicular surgery include complex root canal anatomy, irretrievable materials in the root canal, procedural accidents requiring surgery, persistent symptomatic cases, refractory lesions and biopsy. When previous root canal treatment is unsuccessful due to blockages, ledges, transportations and perforations of the root canal system, endodontic surgery may be the best choice to return the tooth to health and function.

What's Different Today?

Many advances in surgical technique and instrumentation have occurred over the past decade. Enhanced magnification and illumination opened the eyes of endodontic surgeons to the intricate and complex anatomy of the root canal system. This advancement resulted in the miniaturization of the endodontist's armamentarium.

Newer root-end filling materials with improved stability and biocompatibility accompanied these advances. Endodontic surgeries that were once completed with the naked eye and standard dental instruments evolved into truly microsurgical procedures. Treatment success increased as a result, and teeth that were once considered hopeless can now be saved.

Enhanced Illumination and Magnification

The art of dealing with delicate tissues in difficult locations is a popular description of root canal treatment.

Endodontists led the way in the use of advanced technologies to improve vision. Surgical binoculars providing 2 to 3.5 times magnification, operating headlamps and fiber optic illumination have been a part of the endodontist's

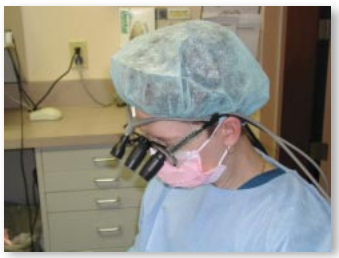


Fig. 1: Surgical binoculars and a fiber optic headlamp

Fig. 2: OM with built-in video projects magnified images on a computer monitor

armamentarium for many years *(Fig. 1)*. The operating microscope (OM) is the latest addition to this armamentarium *(Fig. 2)*.Further magnification (up to 32 times) of the surgical field can benefit the practitioner.

In addition, endodontists find that the quantity and quality of light in the working field is just as important as magnification. The coaxial lighting and improved optics of an OM provide better distinction between bone and tooth structure. In medicine, the OM is commonly used in ophthalmology, otolaryngology, as well as in neuro- and vascular surgery.

Structures that are barely detectable with the naked eye become more visible with the microscope. Identifying minute canal openings, incipient fracture lines and other important anatomical findings becomes routine. For example, an isthmus frequently runs between two canals in the mesial-buccal root of the maxillary first molar. These small isthmuses contain pulp tissue remnants and should be included in root-end cavity preparations and fillings during endodontic surgery. The magnification and illumination afforded by the OM makes it easier to locate these isthmuses, allowing them to be prepared and filled along with the main canals *(Figs. 3a, b and c)*.

Fig. 3a: Miniature ultrasonic handpiece cleans and shapes the root-end preparation

The American Association of Endodontists recognized the important role that the OM would play in endodontic surgery in 1998. Currently, the *Accreditation Standards for Advanced Education Programs in Endodontics* requires all students in advanced specialty education in endodontics to demonstrate clinical training at the competency level to complete nonsurgical and surgical endodontic procedures using microscopy.

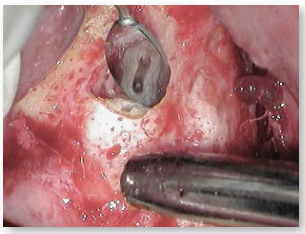


Fig. 3b: Completed preparation of a root with two canals and an intercanal isthmus

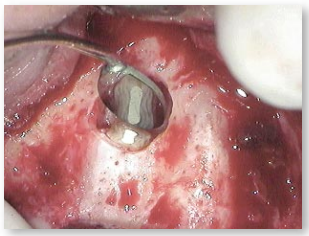


Fig. 3c: SuperEBA root-end filling sealing both canals and the isthmus

The microscope also serves as a useful educational tool. With potential for built-in video, the microscope provides students and practitioners with a tool to observe live procedures and to view videotapes at a later date. Patients are amazed when they have the opportunity to see the tiny, remote spaces in which dentists and endodontists routinely work. Patient education is enhanced when patients can see exactly what the practitioner proposes or has accomplished during pre- and post-treatment consultations. Patients not only appreciate the quality of service provided with the aid of high-level magnification but also find it much easier to perceive the value of such procedures.

A new device called an "endoscope" was introduced recently to endodontic surgery. Essentially, the endoscope is similar to the device physicians use to perform arthroscopic procedures to repair damaged knees, remove gallbladders and view the inside of the heart during open-heart surgery. Like the OM, the endoscope provides enhanced illumination and magnification during endodontic microsurgery.

Instrument Miniaturization

Magnification in endodontic surgery led to miniaturization of endodontic surgical instruments. The entire armamentarium of the endodontic surgeon improved to facilitate precise treatment on tooth structures at magnifications of 15 to 32 times. Many standard operative and surgical dental instruments are no longer useful or appropriate for surgery when using the OM.

Microscalpels used in ophthalmology have been introduced to facilitate more precise incisions and biologically sound flap designs that protect the anatomy and vascular supply to the reflected tissues. The microscalpels allow for proper contouring of the

incision in tight interproximal spaces. Better soft tissue management produces less trauma to the surgical site, as well as quicker and more esthetic healing of the surgical flap.

Today's **piezoelectric ultrasonic handpieces** are nearly one-quarter the size of the microhead handpieces once used for surgical root-end cavity preparation *(Fig. 4)*. A variety of stainless steel and diamond-coated tips, which are approximately 0.25 mm in diameter and 3 mm in length, are available to accommodate most situations. The ultrasonic tips are placed in the canal so that, when activated, the walls of the preparation will be parallel to the long axis of the root to a depth of about 3 mm. These instruments also allow easier access and better preparation and filling of intercanal isthmuses disclosed by enhanced magnification.

Fig. 4: Top: Standard RA handpiece; Middle: Microhead handpiece; Bottom: Piezoelectric ultrasonic tip

Another development in endodontic surgery was the introduction of the **surgical micromirror.** Available in a variety of shapes and sizes, this instrument makes it possible to visualize the prepared canal while using the OM and confirm the completeness of the apical preparation and seal.

Traditionally, practitioners dried apical preparations with paper points prior to placing root-end filling materials. A recently developed **microsurgical irrigator** now fits over the tri-flow syringe and allows for the directional microcontrol of air and water *(Fig. 5)*. This instrument allows the apical preparation to be completely rinsed, dried and inspected with microsurgical mirrors before placement of a root-end filling material.

Fig. 5: Microsurgical irrigator fitted over a tri-flow syringe

Today, practitioners can make apical preparations with a high level of confidence and accuracy with the combination of microscopic visualization, micromirrors, ultrasonic tips and microsurgical irrigators. Together with **miniature carriers, condensers and pluggers,** endodontists can now predictably identify and treat complex root canal anatomy, often overlooked in the past.

Root-End Filling Materials

Root-end filling materials seal the prepared apical cavities through which bacteria and their byproducts pass in and out of an infected root canal. The ideal root-end filling material should be biocompatible with periradicular tissues, resistant to absorption or breakdown by tissue fluids, and hermetically seal the canal. The apical seal is perhaps the most important factor in the success of endodontic surgery.

Fig. 6a: Irretrievable separated instrument in a mandibular first molar requires surgery

Practitioners utilized dozens of materials over the years in an attempt to create an ideal apical seal. For many decades, amalgam was the most popular material for root-end fillings. Amalgam is no longer considered an appropriate root-end filling material because long-term exposure of this material to body fluids results in corrosion and leakage. Researchers identified other materials superior in both biocompatibility and sealing abilities.

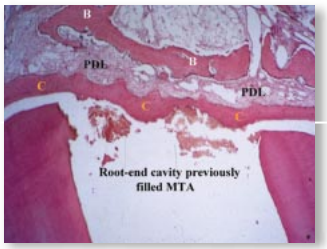
Fig. 6b: Root-end resection and MTA root-end filling of the mesial canals and intercanal isthmus

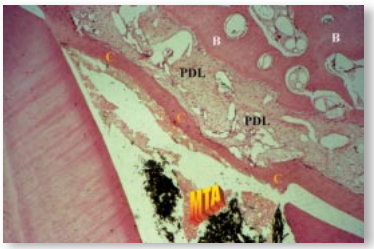
Modified zinc oxide-eugenol (ZOE) cements are popular for root-end filling procedures. Intermediate restorative material (IRM) and super ethoxybenzoic acid (SuperEBA) are two reinforced zinc oxide-eugenol cements used for filling the root-end cavity preparations. Both are more resistant to absorption and disintegration compared to ordinary ZOE cements, provide a better apical seal than amalgam, and are more biocompatible with the periradicular tissues. Composite materials may be considered when indicated and with proper isolation of the field.

Fig. 6c: One-year postoperative image showing complete healing

A new root-end filling material, mineral trioxide aggregate (MTA) is proving to be an impressive material for both root-end filling and perforation repairs. *(Figs. 6a, b and c)*

A tri-calcium compound, it provides excellent sealing properties and is extremely biocompatible with periradicular tissues. MTA provides a superior apical seal compared to other root-end filling materials and is not adversely affected by blood contamination. In several studies, histological sections demonstrate the regeneration of new cementum over the MTA root-end filling, a phenomenon that is not seen with other commonly used root-end filling materials *(Figs. 7a and b)*.





Figs. 7a and 7b: Histologic sections from two monkey teeth with MTA as root-end filling material showing formation of cementum (C). Adjacent to cementum that covers the entire resected root ends, normal periodontal ligament (PDL) and bone (B) are observed

Summary

Endodontic surgery is not "oral surgery" in the traditional sense. Rather, these procedures are actually "endodontic treatment–through a surgical flap." Simply cutting the apex off of a root and placing a filling in the vicinity of the canal does not accomplish the goals of surgical endodontic treatment. Endodontic surgery should seal all portals of exit of the root canal system and the isthmuses, eliminate bacteria and their byproducts from contaminating the periradicular tissues, and provide an environment that allows for regeneration of periradicular tissues.

To accomplish these goals, endodontists have developed new techniques, materials and instruments. Enhanced illumination and magnification have greatly improved what practitioners can perform. Developments in root-end filling materials have increased both quality and biocompatibility of apical seals. Together, these advances have significantly improved the state of the art and science of endodontic surgery, giving a second chance to a tooth that was considered for extraction.

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Did you enjoy this issue of *ENDODONTICS?* Did the information have a positive impact on your practice? Are there topics you would like *ENDODONTICS* to cover in the future? We want to hear from you! Send your questions and comments to the AAE at the address below:

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