The Use of the Operating Microscope in Endodontics

Gary B. Carr, DDS[a,b,c,d,*], Carlos A.F. Murgel, DDS, PhD[a,e,f,g]

KEYWORDS

• Operating microscope • Magnification • Endodontics

Endodontists have frequently boasted that they can do much of their work blindfolded simply because there is "nothing to see." The truth is that there is a great deal to see with the right tools.[1]

In the last 15 years, for nonsurgical and surgical endodontics, there has been an explosion in the development of new technologies, instruments, and materials. These developments have improved the precision with which endodontics is performed. These advances have enabled clinicians to complete procedures that were once considered impossible or that could be performed only by talented or lucky clinicians. The most important revolution has been the introduction and widespread adoption of the operating microscope (OM).

OMs have been used for decades in other medical disciplines: ophthalmology, neurosurgery, reconstructive surgery, otorhinolaryngology, and vascular surgery. Its introduction into dentistry in the last 15 years, particularly in endodontics, has revolutionized how endodontics is practiced worldwide.

Until recently, endodontic therapy was performed using tactile sensitivity, and the only way to see inside the root canal system was to take a radiograph. Performing

[a] Pacific Endodontic Research Foundation, 6235 Lusk Boulevard, San Diego, CA 92121, USA
[b] Department of Endodontics, University of Texas Health Science Center, 7703 Floyd Curl Drive, San Antonio, TX 78229, USA
[c] Department of Endodontics, University of Southern California, 925 West 34th Street, Los Angeles, CA 90089-0641, USA
[d] Private Practice, San Diego, CA 92121, USA
[e] Brazilian Micro Dentistry Association, Brazil
[f] Department of Endodontics and Microdentistry, Campinas Dental Association, Rua Francisco Bueno de Lacerda 30, Pq. Italia, Campinas - SP 13030-900, Brazil
[g] Private Practice, Rua Dr Sampaio Peixoto, 206, Campinas, SP, Cep 13024-420, Brazil
* Corresponding author. Pacific Endodontic Research Foundation, 6235 Lusk Boulevard, San Diego, CA 92121.
E-mail address: gary@tdo4endo.com

Dent Clin N Am 54 (2010) 191–214
doi:10.1016/j.cden.2010.01.002
dental.theclinics.com
0011-8532/10/$ – see front matter

endodontic therapy entailed "working blind," that is, most of the effort was taken using only tactile skills with minimum visual information available. Before the OM, the presence of a problem (a ledge, a perforation, a blockage, a broken instrument) was only "felt," and the clinical management of the problem was never predictable and depended on happenstance. Most endodontic procedures occurred in a visual void, which placed a premium on the doctor's tactile dexterity, mental imaging, and perseverance.

The OM has changed both nonsurgical and surgical endodontics. In nonsurgical endodontics, every challenge existing in the straight portion of the root canal system, even if located in the most apical part, can be easily seen and competently managed under the OM. In surgical endodontics, it is possible to carefully examine the apical segment of the root end and perform an apical resection of the root without an exaggerated bevel, thereby making class I cavity preparations along the longitudinal axis of the root easy to perform.

This article provides basic information on how an OM is used in clinical endodontic practice and an overview of its clinical and surgical applications.

ON THE RELATIVE SIZE OF THINGS

It is difficult, even for a scientist, to have an intuitive understanding of size. Specifically, a dentist must have an accurate understanding of the relationship between the gross dimensions involved in restorative procedures and the dimensions of deleterious elements that cause restoration failure, such as bacteria, open margins, and imperfection in restorative materials. A filling or a crown may appear well placed, but if bacteria can leak through the junction between the tooth and the restorative material, then treatment is compromised.

A brief review of relative size may be helpful. Cell size is measured in microns (millionths of a meter, μm), and a single bacterial cell is about 1 μm in diameter. One cubic inch of bacteria can hold about a billion cells. A typical human (eukaryotic) cell is 25 μm in diameter, so an average cell can hold more than 10,000 bacteria. By comparison, viruses are so small that thousands can fit within a single bacterial cell. Simple calculations show that 1 in^3 can contain millions of billions of viruses.These calculations do not end there. For example, the size of macromolecules (eg, bacterial toxins) is measured in nanometers, or one-billionth of a meter (**Fig. 1**).

Some of these bacterial toxins are so potent that even nanogram quantities can cause serious complications and even death. Clearly, dentists are at a severe disadvantage in their attempts to replace natural tooth structure with artificial materials that do not leak, in view of the virtually invisible microbiologic threats to restoration integrity.[2]

THE LIMITS OF HUMAN VISION

Webster defines resolution as the ability of an optical system to make clear and distinguishable 2 separate entities. Although clinicians have routinely strived to create bacteria-free seals, the resolving power of the unaided human eye is only 0.2 mm. Most people who view 2 points closer than 0.2 mm will see only 1 point. For example, **Fig. 2** shows an image of a dollar bill. The lines making up George Washington's face are 0.2mm apart. If the bill is held close enough, one can probably just barely make out the separation between these lines. If they were any closer together, you would not be able to discern that they were separate lines. The square boxes behind Washington's head are 0.1 mm apart and not discernible as separate boxes by most people. The