The Use of the Operating Microscope in Endodontics

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INTRODUCTION

Endodontists have frequently boasted they can do much of their work blindfolded simply because there is “nothing to see.” The truth of the matter is that there is a great deal to see if only we had the right tools.1

In the last fifteen years for both non-surgical and surgical endodontics, there has been an explosion of new technologies, new instruments and new materials. These developments have improved the precision with which endodontics can be performed. These advances have enabled clinicians to complete procedures which were once considered impossible or which could be performed only by extremely talented or lucky clinicians. The most important revolution has been the introduction, and then the widespread adoption of the operating microscope.

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

Until recently, endodontic therapy was performed using our tactile sensitivity, and the only way to “see” inside the root canal system was to take a radiograph. To perform endodontic therapy entailed “working blind,” in that most of the effort was done using only tactile skills with a minimum of visual information available. Before the introduction of the operating microscope we could “feel” the presence of a problem (a ledge, a perforation, a blockage, a broken instrument), and the clinical management of that 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 introduction of the operating microscope has changed both non-surgical and surgical endodontics. In non-surgical 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 managed competently under the microscope. 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.

The purpose of this chapter is to provide the basic information of how an operating microscope is used in a clinical endodontic practice and to give an overview of its clinical and surgical applications.

ON THE RELATIVE SIZES 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 those deleterious elements that cause restoration failure: bacteria, open margins, imperfection in restorative materials, etc. In other words, a filling or a crown may appear to be well placed, but if bacteria can leak through the junction between tooth and restorative material, then treatment is compromised.
A brief review of relative size may be helpful. Cells are measured in microns (millionths of a meter) and a single bacterial cell is about one micron in diameter. One cubic inch of bacteria can hold about a billion cells. A typical human (eukaryotic) cell is 25 microns in diameter so that 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 one cubic inch can contain millions of billions of viruses. Unfortunately, the calculations do not end there. For example, macromolecules (e.g., bacterial toxins, etc.) are measured in nanometers, or one billionth of a meter (Fig. 32.1). Some of these bacterial toxins are so potent that even nanograin 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.5

THE LIMITS OF HUMAN VISION

Webster defines resolution as the ability of an optical system to make clear and distinguishable two separate entities. Although clinicians have routinely strived to create bacterial-free seals, the resolving power of the unaided human eye is only .2 mm. In other words, most people who view two points closer than .2 mm will see only one point. For example, Figure 32.2 shows an image of a dollar bill. The lines making up George Washington’s face are .2 mm apart. If one holds the bill close enough, one can probably just barely make out the separation between these lines. In fact, 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 .1 mm apart and are not discernable as separate boxes by most people. They are beyond the resolving power of the unaided human eye. For comparison sake, it would take about 100 bacteria to span that square. Clinically, most dental practi-