ENDODONTIC ADVANCEMENTS GAME-CHANGING TECHNOLOGIES

by Clifford J. Ruddle, DDS

There was more change in clinical endodontics from about 1985 to 1995 than in perhaps the previous 100 years combined. In these ten years, clinical endodontics changed forever with the emergence of four game-changing technologies.[1] First, superior vision became attainable with the integration of the dental operating microscope (DOM). Second, piezoelectric ultrasonic energy, in conjunction with the DOM, drove microsonic instrumentation techniques that were minimally invasive, efficient, and precise. Third, canal preparation procedures became more predictably successful with the emergence of NiTi files. Finally, this decade of extraordinary change concluded with the introduction of mineral trioxide aggregate (MTA). This remarkable and biocompatible restorative material has become the standard for pulp capping and has salvaged countless teeth that previously had been considered hopeless.

With the advent and integration of these four technologies, education commenced, was initially met with resistance, then became what many clinicians recognized they must do. During the next ten years, scientific evidence validated improvement in many endodontic procedures and outcomes. Education continued, training improved, and research results led to an ever-increasing number of dentists integrating these technologies into clinical practice. Virtually each and every procedural step that comprises start-to-finish endodontics was re-examined, refined, and could be performed at a remarkable skill level. Recently, considerable attention has focused on lasers, CT imaging, and devices to radically improve disinfection. Just as the technologies of the previously mentioned decade led to the birth of a new kind of endodontics, these newer technologies hold great promise to improve the future care we provide patients.

Perhaps the greatest international attention in recent years has focused on methods to improve endodontic disinfection in an anatomically complicated space. Although there are many devices purported to enhance disinfection, the method selected should be readily affordable, easy to use, safe, and must fulfill its intended purpose. The EndoActivator System (*Dentsply Tulsa Dental Specialties; Tulsa, Oklahoma*) represents a new technology and has considerable scientific evidence validating its use in several commonly performed endodontic procedures (***Figure 1***).[2]

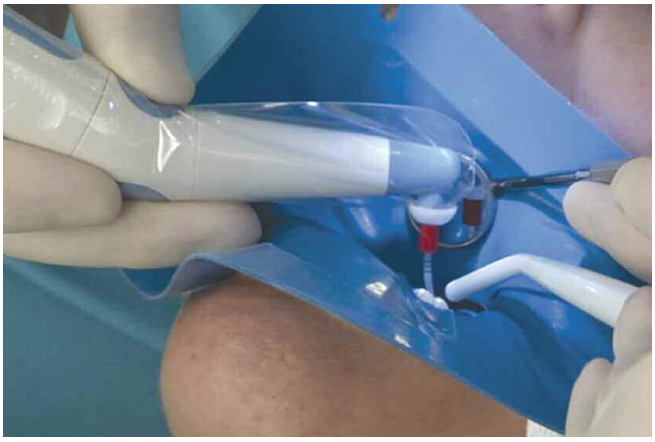

Figure 1. *The EndoActivator System may be utilized to perform a variety of endodontic procedures easier, safer, and more effectively.*

This article will briefly describe the EndoActivator and how to use this device to improve disinfection, adapt and remove calcium hydroxide, predictably move MTA into root defects, and more effectively remove residual obturation materials in the retreatment situation.[3]

Endoactivator System

The EndoActivator System is comprised of a cordless, contra-angled, three-speed, battery-operated handpiece. The handpiece produces sonic energy to drive variously sized EndoActivator tips. The EndoActivator tips have an easy snap-on/snap-off design and are color-coded yellow, red, and blue, closely corresponding to sizes 15/02, 25/04, and 35/04, respectively. The tips are made from a medical-grade polymer, are strong, and are appropriately flexible. When activated, these polymer tips will not cut dentin and create a smear layer. Importantly, an activated polymer tip will not break, internally ledge, externally transport a foramen, or perforate a canal. The following will identify the increasing role of the EndoActivator to improve treatment in four commonly performed endodontic procedures.

DISINFECTION

The EndoActivator represents a clinical breakthrough in clinical disinfection.[4] In the context of this article, the word "disinfection" or "cleaning" will be used interchangeably and will refer to debridement, the elimination of the smear layer, and the disruption and removal of microorganisms (biofilm), when present, from all aspects of the root canal system.

Factors Influencing Disinfection

In a previously referenced article entitled "Endodontic Disinfection: Tsunami Irrigation," I described those factors which, singularly or in combination, serve to influence disinfection.[2] A brief review of the more important factors would include preparing a complete access cavity, a prerequisite for successful endodontics. Skillfully negotiating the full length of any given canal is fundamental prior to initiating safe, efficient, and predictable shaping procedures. Well-shaped canals promote the exchange of irrigant and the three-dimensional cleaning and filling of root canal systems (***Figure 2***).[5] Fully shaped canals hold a larger volume of irrigant that can potentially circulate, penetrate, and clean into all aspects of the root canal system. Disinfection will also be influenced by the preparation technique selected. The step-back, crown-down, and pre-enlargement preparation techniques have been described in different ways, each has something to offer, and each method can theoretically produce the same final shape.[6] However, the preparation technique selected will influence the exchange of irrigant and hence, each method will differ in its potential to clean a root canal system.

The cross-section of a file is another factor that influences cleaning a root canal system. Evidence is emerging that demonstrates radial landed files burnish and trap more lateral debris than do active cutting files. Additionally, the dimensions of the final preparation also serve to influence disinfection. Great debate continues regarding how large in diameter to prepare the foramen, with apparent little appreciation for how the taper of the final preparation and the exchange of irrigant serve to actually clean a root canal system.[7] The most important reagents used to promote disinfection include a 6% solution of NaOCl and a 17% solution of EDTA. Regrettably, there is little agreement regarding the ideal temperature of the irrigant, the frequency of irrigation, or the volume of irrigant dispensed. Additionally, there is no consensus as to the required time for any given reagent to complete its intended purpose. Other factors that serve to influence disinfection are the gauge of the canuli, its depth of insertion, and whether the irrigant is delivered laterally or through the end of the canuli.

Disinfection with the EndoActivator

Perhaps the most important aspect of disinfection is choosing to utilize an active versus a passive irrigation method. Active irrigation is intended to initiate fluid hydrodynamics. There is increasing evidence to support that fluid activation in well-shaped canals plays a strategic role in cleaning into all aspects of the root canal system, including into dentinal tubules, lateral canals, fins, webs, and anastomoses.[2,7] The greatest focus today is on how to safely activate any given solution to maximize its exchange and hydrodynamic phenomenon.

The EndoActivator System provides a safe, easy, and affordable method designed to clean a root canal system. In clinical use, the efficacy of the EndoActivator is immediately appreciated. During use, the action of the vibrating tip frequently produces a "cloud" of debris that can be clinically observed in a fluid-filled pulp chamber. This hydrodynamic activation serves to improve the penetration, circulation, and flow of irrigant into the more inaccessible regions of the root canal system (***Figure 3***). Cleaning root canal systems is the opening for three-dimensionally filling and long-term success.

Figure 2. *This post-treatment film demonstrates the result of shaping canals, cleaning root canal systems utilizing fluid activation, and three-dimensional obturation.*

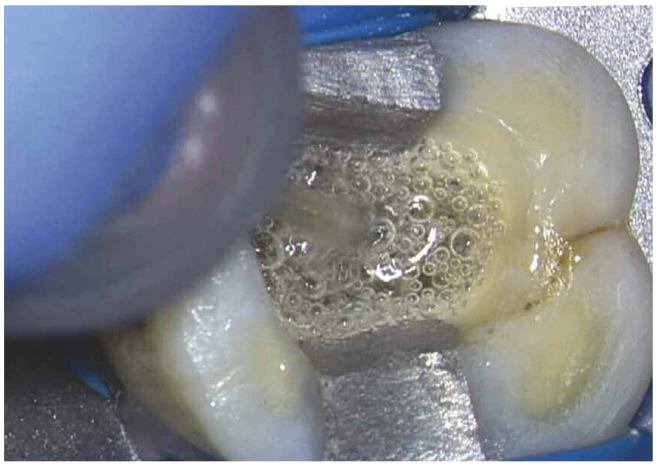

Figure 3a. *This clinical image shows the EndoActivator System in use. Note the powerful activation of fluid and appreciate the potential for enhanced 3-D cleaning.*

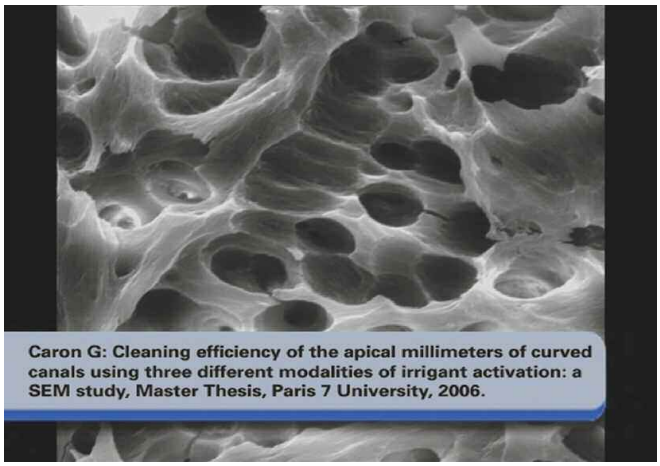

Figure 3b. *An SEM image at 2,000X reveals deep lateral cleaning with the EndoActivator System and that the dentinal walls are clean, devoid of a smear layer or biofilm. (Courtesy of Dr. Grégory* ***Caron; Paris, France)***

CALCIUM HYDROXIDE

When properly scheduled, the vast majority of endodontic treatment procedures can be accomplished in one visit. However, certain cases require a second visit to satisfactorily accomplish the endodontic goals. In these instances, calcium hydroxide has been advocated and widely utilized as an interim intracanal medicament. Radiopaque calcium hydroxide may be placed into a prepared canal using a syringe system with a screw plunger and an appropriately sized dispensing canuli. Once this reagent has been loosely placed within a canal, this material can be readily adapted to the canal walls using a pre-selected EndoActivator tip. The loose vibrating tip will readily adapt calcium hydroxide against the shaped dentinal walls, the eccentricities off the rounder aspect of canals, and into root defects. The international peer-reviewed literature consistently states that perhaps the only way to completely remove calcium hydroxide from the root canal system is to use active irrigation. The EndoActivator's strong, flexible, and non-cutting tips provide a safe way to both adapt and remove calcium hydroxide from the root canal space.

MTA

Over the years, since its introduction into routine clinical endodontics, MTA has been used for a variety of purposes. After mixing, picking up, and delivering MTA into any given tooth, the challenge is to move and tightly adapt this material, as an example, into a root defect.[3] Traditionally, laboratory procedures, performed in conjunction with prosthetic dentistry, have used vibrating energy to effectively move dental stone into an impression mold, precisely replicating the detail while eliminating voids. Utilizing this analogy, MTA can be readily adapted apically and laterally into any given root canal or defect using vibrating sonic energy from the EndoActivator.[3] As an example, it is profoundly safer and more predictable to vibrate MTA below the orifice, around a canal curvature, and into a root defect using flexible and noncutting polymer EndoActivator tips. In simulation, it is easy to visualize how MTA slumps, moves, and adapts within any given region of a canal when this material is activated with the appropriately sized EndoActivator tip (***Figure 4***).

RESIDUAL OBTURATION MATERIALS

For many endodontists, a great deal of each clinical day is spent nonsurgically retreating failing endodontically treated teeth. During endodontic retreatment, it is normal to encounter teeth whose root canals were previously filled with gutta percha, carrier-based obturators, silver points, or paste fillers. After removing the bulk of a previously placed obturation material from the endodontic space, residual obturation material/sealer is routinely visualized and present within the eccentricities off the rounder aspects of canals, including grooves, fins, web, anastomoses, dentinal tubules, and lateral canals. These residual obturation materials serve to block the exchange of solvents and cleaning reagents,

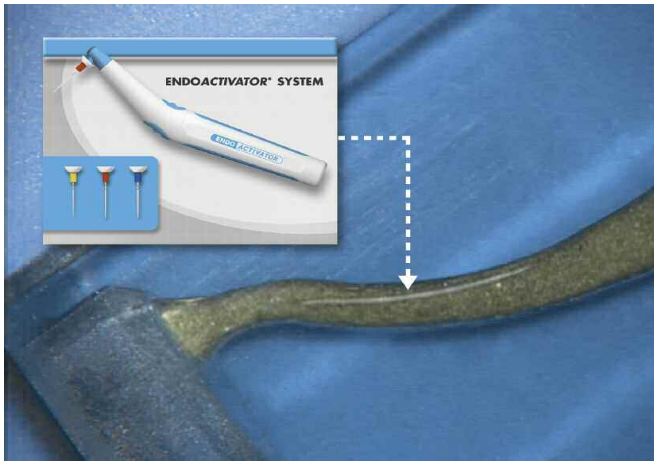

Figure 4. *In this simulated root canal system, the Activator tip is used to move and adapt MTA around coronal curvature and into the apical one-third defect.*

Figure 5. *In the retreatment situation, the vibrating EndoActivator tip may be used with a solvent to move residual obturation materials into solution.*

and compromise retreatment disinfection and success. Fortunately, the EndoActivator's single-use polymer tips may be activated and used within a solvent-filled pulp chamber to enhance the removal of residual obturation materials. Placing a vibrating polymer tip into a solvent-filled canal will encourage the disruption and removal of residual obturation materials, which in turn will promote the more effective exchange of irrigant. Clinically, this phenomenon is readily appreciated by observing remnants of obturation materials moving into solution and the subsequent discoloration of the clear solvent fluid within the pulp chamber (***Figure 5***).

Future

The greatest improvements that have occurred in clinical endodontics can be directly related to the phenomenal advancements in technology. In the future, procedural breakthroughs, like in the past, will be largely driven by continued advancements. Many of the new technologies hold great promise to make endodontics easier, better, and faster. With genius, imagination, and hard work, the field of endodontics is moving ever closer to fulfilling its promise to the general public that, when properly performed, endodontic treatment is painless, can frequently be done in one visit, and is predictably successful. ▲

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