The canal system within teeth is a complex array of accessory and lateral canals, fins, and other anatomical areas inaccessible to endodontic files (Figure 1). The principle that only one thing can occupy a space at a time is key to endodontic success. This is dependent on disinfection and debridement of the canal system as well as how well the system is sealed during obturation. Irrigation has been long accepted as a key part of treatment to achieve those goals.

Yet, complete clearing of residual bacteria, especially in the apical portion of the canal system, has been difficult to achieve with traditional methods, using even sodium hypochlorite (NaOCL) solutions (Figure 2). Studies have demonstrated that the addition of a Er:YAG laser to activate the irrigation solution greatly increases not only the efficiency of the irrigation solutions advocated (NaOCL and EDTA) but also improves disinfection of the canal system (Figure 3).

Laser-Enhanced Irrigation

The LiteTouch Er:YAG Laser (AMD LASERS) creates hydrodynamic pressure following cavitation bubble expansion and collapse when the irrigation solution is activated in the chamber. Its energy is set at a subablative power level, which allows its use without structural changes to the hard tissue within the tooth, eliminating the risks of ledging and perforation of the pulpal floor. When activated, a heat pulse is generated by laser radiation delivered via a sapphire tip into an absorbing liquid (irrigant). This results in tensile stress and cavitation being induced in front of the tip at a distance far below the optical penetration depth of the laser radiation. Bubble expansion and collapse cause the surrounding fluid to flow at a speed of up to 12 m/s while traveling throughout the canal system. This causes rapid displacement of intra-canal fluid via radial and longitudinal pressures sufficient to drive irrigant into the canal anatomy and clean dentinal walls significantly. The photomechanical activation of the irrigant includes a temperature rise in the irrigant, increasing its effectiveness in debridement of dentinal walls and increasing the chemical properties of the irrigants.

LightTouch-Induced Photomechanical Irrigation

Endodontic treatment is initiated with access to the pulp chamber, which may be performed by traditional methods using burs or by ablation of the enamel and dentin with the LiteTouch. As it is ineffective in removal of ceramics and metals such as those used in fixed prosthetics and also amalgam, carbides and diamonds are needed to create access through these materials. Once dentin has been reached, the LiteTouch may be utilized to unroof the pulp chamber (hard-tissue mode). An additional benefit of the LiteTouch to access the pulp chamber is that it provides decontamination and removal of bacterial debris and pulpal tissue to yield a cleaner chamber, aiding its identification of the canal orifices (soft-tissue mode).

Once the canal orifices are identified, hand files are utilized to establish a glide path to the apical working length in each canal. Canals are then enlarged to the desired ISO canal size with either hand or rotary files (Figure 4A). Laser-assisted canal irrigation requires canal preparation to an apical preparation ISO 25/30. A taper of 0.04 or 0.06 for the final instrumentation is recommended. NaOCL is utilized within the chamber and canals during instrumentation both as a pulpal tissue dissolvent and to lubricate the files within the canal, decreasing the potential of file separation that can occur when instrumenting a dry canal (Figure 4B).

Photo-activation of the irrigant within the canal system using the LiteTouch with a 0.4/17- or 0.06/17-mm tip assists in removal of the debris created by the files. Between each rotary file, the chamber is filled with NaOCL, and the laser’s tip is placed into the chamber and the solution laser-activated at 40 mJ at 10 Hz with an average power of only 0.5 W for 20 seconds (Figure 4C). The chamber is suctioned, fresh NaOCL is placed into the tooth, and the next file is used for instrumentation. It is unnecessary to place the lasers tip into the canal since activation of the solution within the chamber transmits down the irrigant in the canals to the apical aspect of the roots. Laser activation may also be performed with 17% EDTA solution alternated with NaOCL. The benefit of EDTA solution is its chelation effect opening canal anatomy so that the next round of NaOCL can reach more pulpal tissue not accessible to the files in fins as well as accessory and lateral canals. Following final instrumentation of the canals with rotary files, the chamber is filled with NaOCL, and the Er:YAG tip is placed into the chamber again and activated for a minimum of 60 seconds. This allows the photo-activated irrigant to clear debris and remaining pulpal tissue from the complete canal system. The irrigation solution is suctioned from the chamber, fresh irrigant is placed, and photo-activation is repeated until no visible debris (cloudiness) is noted in the chamber fluid. Any remaining solution is suctioned from the tooth, and the canals are dried with paper points. Obturation is then accomplished using the practitioners preferred method and materials, allowing obturation of anatomy inaccessible by instrumentation with files (Figure 5).

For more information, call AMD LASERS at (XXX) XXX-XXXX.

Gregori M. Kurtzman, DDS

Figure 1: Anatomy of the canal system demonstrating accessory canals, fins, and lateral canals, which are not accessible with endodontic files as shown in cleared teeth.

Figure 2: SEM showing bacteria and pulpal debris in the apical one third that was not able to be fully removed using standard irrigation protocol. (Photo courtesy of Professor Georgi Tomov, Plodiv, Bulgaria.)

Figure 3: SEM showing complete removal of bacteria and pulpal tissue in the apical one third after irrigation using the LiteTouch-Induced Photomechanical Irrigation (LT-IPI) protocol. (Photo courtesy of Professor Georgi Tomov, Plodiv, Bulgaria.)

Figure 4: The LT-IPI protocol. Establishment of glide path with hand files (A), canal and chamber filled with NaOCL (B), and placement of the LiteTouch tip into the irrigant in the chamber and activation of the Er:YAG laser (C). (Illustrations courtesy of Dr. Parvan Voynov, Plodiv, Bulgaria.)

Figure 5: Accessory anatomy evident in the apical that has been filled with sealer, accessible due to use of the LiteTouch Er:YAG laser. (Photo courtesy of Dr. David Guex, Lyon, France.)