Successful endodontic treatment depends upon maximal debridement and disinfection of the entire root canal system. The root canal system must be shaped to a convenience form that permits adequate cleaning and disinfection by elimination of microbes.

The literature is clear that as much as 35 percent or more of the root canal system remains untouched by any instrumentation technique. Essentially no filing technique allows instruments to sculpt all canal walls and remove infected dentin. To decrease the bacterial load and achieve better debridement, irrigation protocols are used prior to obturation.

The efficacy of the irrigants to decontaminate canal walls has seen significant improvements recently. Both negative and positive apical pressure irrigation techniques have been surpassed by ultrasonically activated irrigants, photo-activated disinfection and laser-activated irrigants in their ability to improve cleanliness of the canal system.

In 2005, the Er:YAG (Lightwalker, Er:YAG Na:YAG dental laser, National Dental Inc. Barron, Ontario) has shown to be effective at removing debris and the smear layer from canal walls. A final application of the Er:YAG laser to the sodium hypochlorite already present within the canal, after standardized instrumentation, can result in improved cleaning of the canal walls with a higher quantity of open tubules (Fig. 1) compared with results with the use of the laser.

Using extremely short bursts of peak power, laser energy is directed down into the canal and the action actively pumps the tissue debris out of the canals while cleaning, disinfecting and sterilizing each main canal, lateral canals, dentinal tubules and canal anastomoses to the apex. This movement of fluid is achieved without the need to place the radial and stripped laser tip (PIPS tip, Fig. 2) into the canal itself, unlike with other conventional hand and ultrasonic systems.

The tip is held stationary in the coronal aspect of the access preparation only. With the irrigant occupying the entire root canal system, the shock wave created by PIPS travels in all directions distal activating and effectively debrides and removes organic tissue remnants. Through this laser-activated turbulent flow phenomenon, clinicians following the PIPS protocol can strip the smear layer from the tip into each canal, thus eliminating the need to enlarge and remove more tooth structure to deliver standard needle irrigation to the smaller and more delicate apical anatomy, commonly seen in the apical one-third. The results are canal convenience forms that are more conservative, minimally invasive and biomimetic (Fig. 3), preventing the unnecessary removal of tooth structure.

Unlike other laser-activated irrigation techniques, PIPS is not a thermal event, rather subclinical. Properly executed, PIPS creates turbulent photoacoustic agitation of irrigants that move fluids three dimensionally throughout the root canal system even as far as the apical terminus, distant from the radial stripped tip location. By activating the tip in the access cavity and outside the root canal system, the extremely low energy needed to activate the unique PIPS tip (20 mJ/s or less) is below the threshold of ablation for dentin. Lodging and thermal effects that have plagued the widespread use of other laser systems is completely avoided at the energy levels used by the PIPS technique.1,4

Recent testing, performed at the University of Washington by the chairman of the department for endodontics, objectively confirmed the improved cleaning and debridement of organic and inorganic tissue left by instrumentation. Microcomputed tomography scans were used to assess before and after volumetric change in the internal inaglio of lower first molars treated with PIPS protocol (Fig. 4). Sequential slicing beginning at 6 mm from the apex and moving down to the last 2 mm demonstrated that all slice images showed significant improvements after PIPS.

The importance of these findings is far reaching. PIPS now offers the dentist a less technique-sensitive, minimally invasive and time-reducing method for irrigating and preparing endodontic root canal systems. Because PIPS has demonstrated its ability to decontaminate and debride areas that files and instrumentation cannot reach, success rates rise and retreatment for past failures is possible.2

PIPS is also helpful in locating and helping negotiate calcified canals. PIPS is a valuable additional tool in the treatment of endodontics regardless of the shaping and obturation system used.

Laser technology is used in endodontics during the past 20 years has undergone an important evolution. Research in recent years has been directed toward producing laser technologies (such as improvements of reduced length, radial firing and stripped tips) and techniques (such as LAI and PIPS) that are able to simplify laser use in endodontics and minimize the undesirable thermal effects on the dentinal walls, using lower energies in the presence of chemical irrigants. EDTA has proved to be the best solution for the LAI technique that activates the liquid and enhances its cleaning of the smear layer. The use of a laser (PIPS) to activate sodium hypochlorite increases its antimicrobial activity.

Finally, using the correct protocol, the PIPS technique reduces the thermal effects and exerts both a stronger cleaning and bactericidal action, because of its streaming of fluids initiated by the photonic energy of the laser. Further studies are currently underway to validate LAI and PIPS techniques as innovative technologies in modern endodontics.

References


Editor’s note: See case study on page 18

About the author

Dr. Enrico DiVito formed his dental prac- tice in 1980 in Scottsdale, Arizona. In 2004, he formed the Arizona Center for Laser Dentistry. He is the founder and director of the state-accredited Arizona School of Dental Aiding (ASDA). In addition to teaching at ASDA, Divito is also a clinical professor at the Arizona School of Dentistry and Oral Health and is helping to create its department of laser dentistry. He earned his undergraduate degree from Arizona State University in 1980 and is a graduate of the University of the Pacific, Arthur A. Dugoni School of Dentistry with honors, receiving several clinical excellence awards. He can be reached at edivito@azcld.com.

Photocatalytic shockwave with irrigant debris areas of root canal files can’t reach

By Enrico Divito, DDS

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...more details...