Improving endodontic success through use of the EndoVac irrigation system

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The endodontic triad

Long-term success endodontically is not due to a single factor but relates to three aspects of treatment, what you may call an “endodontic triad.” This is composed of instrumentation, disinfection and obturation. These three components of the triad are interwoven and required for success.

Instrumentation alone does not ready the canal system for obturation and disinfection is key to augmenting the process and optimizing the obturation process. But what is referred to when we mention disinfection of the canal system? Disinfection comprises removal of the residual tissue in the canal system and the associated bacteria through flushing the canal system with irrigating solution. The key is to remove as much residual tissue as possible. The more thorough the irrigation process, the lower the remaining bacterial level.

The intricacies of the canal anatomy, with its fins, lateral canals and apical deltas, make it impossible for the instrumentation of the canals to reach all of the fine aspects of the anatomy. Irrigation of the canal system thus permits removal of residual tissue in the canal anatomy that cannot be reached by instrumentation of the main canals.

Cleansing the canal

No matter what obturation material is used, how well the sealer adheres to the canal walls is important. Smear layer can play a factor, which may prevent sealer penetration into the dentinal tubules. The frequency of bacterial penetration through teeth obturated with intact smear layer (70%) was significantly greater than that of teeth from which the smear layer had been removed (30%). Removal of the smear layer enhanced sealability, as evidenced by increased resistance to bacterial penetration along the entire root length. The better the canal walls are prepared, the more smear layer and organic debris is removed, which is beneficial to root canal sealing.

Final smear layer removal is best achieved by irrigating the canals with NaOCL (sodium hypochlorite) followed by 17% EDTA solution.1 Whereas, the NaOCL dissolves the organic component of the smear layer exposing the dentinal tubules lining the canal walls. EDTA, a chelating agent, dissolves the inorganic portion of the dentin, opening the dentinal tubules. Utilization of the two irrigants following instrumentation will permit removal of more organic debris further into the tubules, increasing resistance to bacterial penetration once the canal is obturated.2 Studies suggest that regular exchange and the use of large amounts of irrigant should maintain the antibacterial effectiveness of the NaOCl solution, compensating for the effects of concentration.3 So it seems that volume is more critical to canal disinfection during treatment than the concentration of the irrigant.4

Fig. 1: Comparison of positive (left) and apical negative (right) pressure with regard to endodontic irrigation.
Positive pressure vs. apical negative pressure irrigation as it relates to endodontic treatment involves placement of an irrigating solution into the canal system and its evacuation from the tooth. Traditionally, this involved placement of an end-port or side-port needle into the canal and expressing solution out of the needle to be suctioned coronally. This creates a positive pressure system with force created at the end of the needle, which may lead to solution being forced into the periapical tissues. As some irrigating solutions such as sodium hypochlorite have the potential to cause tissue injury that may be extensive, when encountering the periapical tissue and its communication with tissue spaces, positive pressure irrigation has its risks. Chow was able to show as early as 1983 that positive pressure irrigation has little or no effect apical to the needle’s orifice.11 This is highlighted in his paradigm on endodontic irrigation, “For the solution to be mechanically effective in removing all the particles, it has to: (a) reach the apex, (b) create a current force and (c) carry the particles away.”

An apical negative pressure irrigation system, on the other hand, does not create a positive force at the needle’s tip, so potential accidents can be eliminated. In an apical negative pressure irrigation system, the irrigation solution is expressed coronally, and suction at the tip of the irrigation needle at the apex creates a current flow down the canal toward the apex and is drawn up the needle. But true apical negative pressure only occurs when the needle (cannula) is utilized to aspirate irrigants from the apical termination of the root canal. The apical suction pulls irrigating solution down the canal walls toward the apex, creating a rapid, turbulent current force toward the terminus of the needle. Haas and Edson found, “The teeth irrigated with negative apical pressure had no apical leakage. While the teeth irrigated with positive pressure leaked an average of 2.41 mL out of 3 mL.” 12 A recent study by Fukumoto found that [apical] negative pressure irrigation resulted in less extrusion of irrigant than did positive pressure irrigation when both needles were placed 2 mm from working length (Fig. 1).13

EndoVac endodontic irrigation system

Designed by Dr. G. John Schoeffel after almost a decade of research, the EndoVac irrigation system (Discus Dental, Culver City, Calif.) was developed as a means to irrigate and remove debris to the apical constriction without forcing solution out the apex into the periapical tissue. The system utilizes apical negative pressure through the office’s high volume evacuation system, permitting thorough irrigation with high volumes of irrigation solution.

The EndoVac system consists of a Hi-Vac adapter assembly that connects to the high volume evacuation hose in the dental operatory at one end and has a “T” connector at the other end (Fig. 2). The “T” connector permits a Master Delivery irrigation-suction tip with a disposable syringe filled with irrigation solution.

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Fig. 2: Hi-Vac hose assembly with connector to office high volume suction (black end) and “T” connector (red/white end).

Fig. 3: EndoVac Master Delivery (irrigation-suction) tip on a disposable syringe.

Fig. 4: EndoVac MacroCannula on the titanium handpiece.

Fig. 5: EndoVac MicroCannula in the fingerpiece and close-up showing the blunt end with multiple lateral micro holes.
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(Fig. 5) and either a MacroCannula (Fig. 4) or MicroCannula (Fig. 5) to be attached and used simultaneously during treatment. The plastic MacroCannula is placed on a titanium handpiece, which is attached to tubing that connects to the “T” connector. This is used for coarse debris removal. The MicroCannula is a metal suction tip available in either 25 or 31 mm lengths with 12 micro holes in the terminal 0.7 mm of the tip, permitting removal of particles that are 100 microns or smaller to the apical constriction. This tip fits into a metal finger piece and is connected to the “T” connector via tubing. The turbulent current forces developed by the MicroCannula rapidly flow to the micro holes at the terminus, which can be placed as close as 0.2 mm from the full working length. The vacuum formed at the tip of the MicroCannula is able to achieve each of Chow’s objectives in his irrigation paradigm.

The system comes packed in a single-use package that contains a Master Delivery Tip, a MacroCannula, a MicroCannula and tubing assembly (Fig. 6).

Nielsen and Baumgartner found that the volume of irrigant delivered with the EndoVac system was significantly more than the volume delivered with needle irrigation over the same amount of time.14 Further, they reported significantly better debridement 1 mm from working length for the EndoVac system compared with needle irrigation.

Since one of the laws of physics states “only one object can occupy a space at a time,” if the tissue remnants can be removed from the lateral canals, apical deltas and fins within the canal system, these areas can be filled with obturation material, providing a better seal and inhibiting bacterial migration throughout the canal system. The EndoVac irrigation system, as Nielsen and Baumgartner demonstrated, is able to better clean at the apex where other irrigation methods and systems have not been able to do as thorough a job (Figs. 7–9).

EndoVac technique

Following removal of the chamber roof and exposure of the pulp, the Master Delivery Tip is used to provide frequent and abundant irrigation as the orifices are identified and explored. During instrumentation, the Master Delivery Tip is placed coronally to provide fresh irrigation and debris removal.
solution and aid in debris removal that is brought coronally as the rotary file is used in the canal (Fig. 10). The benefit of the Master Delivery Tip is that with a single tip at the tooth’s access, visibility is not blocked and large volumes of irrigation solution can be utilized. The MacroCannula is utilized to remove coarse debris after instrumentation and is used in combination with the Master Delivery Tip, which delivers the irrigating solution. Apical negative pressure is created as irrigating solution is drawn down the canal toward the apex as it is expressed from the Master Delivery Tip and then drawn down to and through the MacroCannula (Fig. 11). The MicroCannula is taken to full working length and moved 2 mm with an up and down action every six seconds as each canal is flushed. This up and down action removes micro-gas bubbles formed during tissue hydrolysis. The MicroCannula is used with a combination of three rinses using NaOCL (6%) and EDTA (17%).

The EndoVac will work in any canal configuration shaped at least to a size 35 with a 0.04 taper or greater (Fig. 12). To prevent plugging of the fine holes in the apical terminus, do not use the MicroCannula until thorough irrigation has been accomplished with the MacroCannula and all instrumentation has been completed.

**Conclusion**

Instrumentation, disinfection and obturation are important aspects of rendering quality endodontic care. Yet, the instruments we use to prepare the canal, be they hand or mechanized are unable to reach all aspects of the canal system. Irrigation is key to cleaning and disinfecting those areas that the instrument cannot reach. The EndoVac irrigation system with its apical negative pressure is able to more thoroughly remove the micro debris at the apical constriction, thereby providing a better environment to be filled with sealer.

A complete list of references is available from the publisher.