3D Apical Cork – part 3

In the third article of this series, Dr. Wyatt Simons reviews the technological breakthroughs of the Cork technique and system of obturation with emphasis given to the revolutionary 3D plugger

Introduction

Michelangelo eloquently outlined the axiom of a sculptor when he said, "Every block of stone has a statue inside it, and it is the task of the sculptor to discover it." So too is the mission of an endodontic practitioner to sculpt, disinfect, and seal the unique pulpal anatomy present within each tooth. Endodontic beauty is discovered in this final phase of endodontic treatment. Three-dimensional (3D) obturation is when the uniqueness of pulpal anatomy is displayed and when the mindful efforts to three dimensionally expose and disinfect individual root canal systems are revealed. Adequately sealing the complexities of root canal systems has been an understood objective for sustained endodontic success for many years. The word *obturation* comes from the Latin word *obturat,* which means "stopped up." *Pathways of the Pulp* outlines that, "The aim of canal obturation is to fill the entire volume of the root canal space, including patent accessory canals and multiple foramina, completely and densely with biologically inert and compatible filling material."[1]

Figure 1: The statue of David. Michelangelo used tools available in 1504 to find the beauty and complexity of man's anatomy within a stone

Figure 2: The anatomic beauty and complexity of this maxillary molar was displayed upon 3D obturation with the Cork technique

Figure 3: The unique design of the Cork delivery device enables several new functionalities in clinical obturation

This is the third article of a series that reviews the revolutionary Cork technique of 3D obturation. The Cork technique stems from a pursuit to reproducibly obturate the vast array of anatomic possibilities present in nature. The first two articles introduced the technologic breakthroughs that the Cork technique employs, reviewed how these advances contribute to reproducible 3D obturation, and displayed clinical cases in an effort to highlight the benefits given to many clinical situations.[2-3]

It is worth mentioning that even though the technological breakthroughs of the Cork technique can contribute to higher levels of desired outcomes, it is the desire to reach higher levels of outcomes that matters most. Michelangelo's statue of David shown in Figure 1 is a great example of how passion and commitment to excellence influences individual achievements. One of the most impressive aspects of this work of art completed in 1504 was Michangelo's ability to accurately capture the anatomic beauty and complexity that lies within each of us. Appreciation for the beauty and uniqueness of pulpal anatomy can also be found when complexities are three dimensionally obturated. The Cork technique was used to reveal the beauty found within the maxillary molar in Figure 2. In this final article of the series, the technological breakthroughs of the Cork technique are reviewed, and the revolutionary 3D plugger is introduced.

Review of Cork technology

The unique design of the Cork delivery device, illustrated in Figure 3, gives rise to many of the technological breakthroughs of the Cork technique. The design consists of an apical gutta-percha "master-cone" wrapped in a thin silver sheath. This silver extends the full length of the delivery device and is removed as part of the technique. Having a thin sheath of silver wrap apical gutta percha and extending the entire length of the delivery device bring several new functionalities to clinical obturation.

First, the design of the Cork delivery device allows for the use of an apex locator to electronically verify the position of the gutta percha at the time of obturation.[4] Bringing apex locator technology to obturation decreases the typical need to radiographically verify the "master-cone fit," thereby saving time and decreasing unnecessary radiation exposure. Figure 4 displays the Cork obturation apex locator.

The second distinctive advantage of this design is that a precise, calibrated heat delivery can be achieved throughout the entire intracanal gutta percha. This is shown in more detail in the first article of this series.[2] In short, the Cork delivery device is able to overcome gutta percha's limited thermomechanical ability to transfer temperature more than a few millimeters. This precise heat delivery produces a uniform thermo-softening of the entire apical gutta percha. This calibrated intracanal heat delivery facilitates flow of gutta percha upon compaction. Producing such conditions assisted compaction into the four apical ramifications discovered in the maxillary second premolar shown in

Figure 4: The Cork technique brings apex locator technology to obturation

Figure 5A: An off-angle digital radiograph of a Cork delivery device and plugger in position for molding

Figure 5B: The postoperative straight view shows how calibrated temperature delivery contributed to the sealing of the four apical branches that where present in this maxillary second premolar

Figures 5A-5B. In addition, this reproducible warming of gutta percha for 3D molding is calibrated to control the temperature under phase-transition temperatures. Keeping gutta percha under these temperatures avoids potential shrinkage complications.[5]

The third advantage of wrapping the gutta percha is this allows for adding additional gutta percha and/or molding within the canal simultaneously as conditions are produced and verified to be ideal for reproducible molding.

Another advantage of the design is that the Cork delivery device can be pre-bent, which often facilitates placement under difficult clinical situations, such as when facing intracanal impediments, bifurcations, or sharp turns.

Finally, the revolutionary Cork 3D plugger produces more functional compaction forces. This new self-adjusting plugger has the ability to better fit the canal, which in turn helps to keep the softened gutta percha ahead of the plugger. 3D molding into secondary or accessory anatomy is promoted when the 3D plugger is utilized simultaneously as precise intracanal heat is delivered to apical gutta percha. For example, upon preoperative CBCT examination, a fairly large apical tributary was found to branch off of the main canal of the maxillary second premolar shown in Figure 7A. Compaction forces were applied in conjunction with the activated Cork delivery device to accomplish flow into this apical branch (Figure 7B). Additional activation, and removal of the delivery device left a dense fill of homogeneous gutta percha (Figure 7C).

Cork technique

The Cork technique starts with the placement of a Cork delivery device into a well-shaped, disinfected, and dried canal. The delivery device that matches the final shaping file is chosen and pre-bent as needed. A small amount of sealer is applied, and apex locator functionality confirms that the gutta percha and delivery device are positioned appropriately in relation to the periradicular tissues. Additional softened gutta percha is delivered into the canal, onto the delivery device in an initial phase of 3D molding. The delivery device is then removed as simultaneous molding occurs with the revolutionary 3D plugger (discussed more below). Successful 3D obturation is completed with an appropriate backfill and the placement of a bonded coronal restoration.

Introducing the Cork 3D Plugger

3D obturation is influenced by the efficacy of pluggers to condense thermo-softened gutta percha. Establishing ideal conditions for molding has limited value if corresponding compaction forces are inadequate in transferring needed forces for 3D molding. Controlling thermal conditions for molding and transferring forces of compaction is where the art and science of sealing root canal systems come together. Dr. Herbert Schilder first qualified the physics of the forces of compaction encountered in vertical compaction of warm gutta percha.[6] He outlined the difference between a tri-axial type of compaction to a uni-axial type of compaction. A tri-axial system is analogous to a piston in which load is produced in a confined space. This is quite different from the uni-axial force produced, for instance, when a load is applied to a loose-fit plugger within a tapered root canal system. Although some forces of compaction do transfer apically and laterally, much of the moldable gutta percha is simply displaced in the path of least resistance around the plugger. Many clinicians attempt to "capture the maximum cushion of the softened gutta percha" to compensate for displaced compaction forces as conventional pluggers plunge through softened gutta percha.

The effort to increase molding efficacy within a narrowing, often oval canal gave rise to the design of Cork 3D plugger, illustrated in Figure 6. This revolutionary plugger addresses the need to better conform to individual canal morphology. The design allows for a more functional fit within individual root canal systems. It also has the capacity to adjust to the changing shape of the canal as it progresses and molds apically. This ability to better fit the canal helps to kept the soften gutta percha ahead of the plugger. This facilitates molding into the complexities of individual root canal systems upon compaction. The Cork technique was employed to produce forces of compaction in the maxillary premolar shown in Figures 7A-7B. Compaction forces transferred throughout this oval canal and ultimately contributed to the filling of the two apical branches that came off of the main root canal system.

Another benefit of the Cork 3D plugger over conventional endodontic pluggers is that most clinical cases only require one plugger. In addition to having better compaction forces, the need to pre-fit several pluggers is eliminated.

The Cork technique and 3D plugger will be demonstrated at the 2014 AAE Annual Session, in Washington D.C., as part of a hands-on workshop on May 1 from 2 p.m. to 5 p.m.

Closing comments

Michelangelo's description of a stone having an infinite array of possibilities within is a great analogy to root canal treatment. In his analogy, it is the sculptor who guides the resulting anatomy within each stone. In contrast, as endodontic practitioners, there

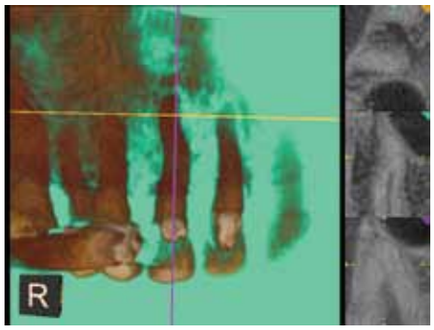

Figure 6A: Preoperative CBCT examination revealed the apical branch that came off of the main system

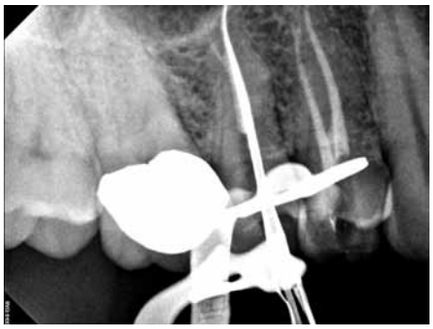

Figure 6B: The Cork delivery device established calibrated heat delivery to the apical gutta percha while the Cork 3D plugger was utilized to transfer compaction forces to fill the known secondary anatomy

Figure 6C: Postoperative digital radiograph after the Cork technique was completed, including the removal of the delivery device that facilitated accurate molding

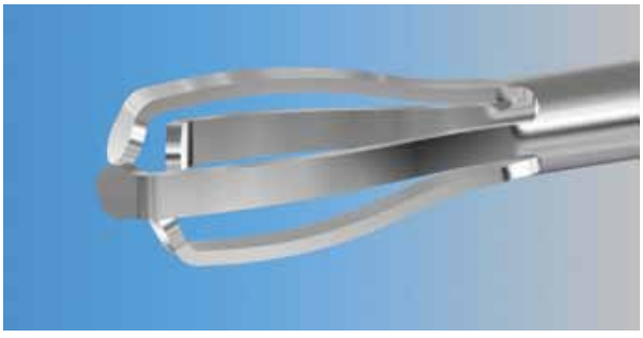

Figure 7: Illustration of the Cork 3D plugger. This functional plugger has the ability to conform to canal shapes between 0.6 and 1.2 millimeters in diameter and self-adjust to tapered canals as it molds apically

Figure 8A: Cork Delivery Device in position to help facilitate 3D molding in this maxillary second premolar

Figure 8B: The Cork 3D plugger has the capacity to better fit and transfer compaction forces within an oval canal. Compaction forces helped accomplish the 3D obturation of these apical branches

is value in allowing the natural anatomy of each root canal system to dictate how we sculpt, disinfect, and ultimately, seal. Successful clinical endodontic treatment starts with the way we mindfully sculpt the anatomy presented to us. Appropriate shape facilitates comprehensive disinfection and reproducible obturation. Once the stage has been set, successful endodontic treatment is influenced greatly by our ability to provide the three-dimensional seal of the root canal system. Although this objective is difficult, it is obtainable. This series of articles reviewed the Cork system of obturation, and how this technique serves to bring new treatment modalities to clinical obturation. From adding apex locator functionality and controlling apical temperature delivery to a single 3D endodontic plugger, the Cork system of obturation serves to modernize clinical obturation.

Today's endodontic armamentarium has greatly increased the efficacy of clinical endodontics. High levels of clinical results are obtainable with greater ease due to these technological breakthroughs. However, in the end, it is our individual passion that will guide our practice. Technology and tools will empower us, but it will be our desire that will dictate the level of treatment we render and ultimately define us. EP

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