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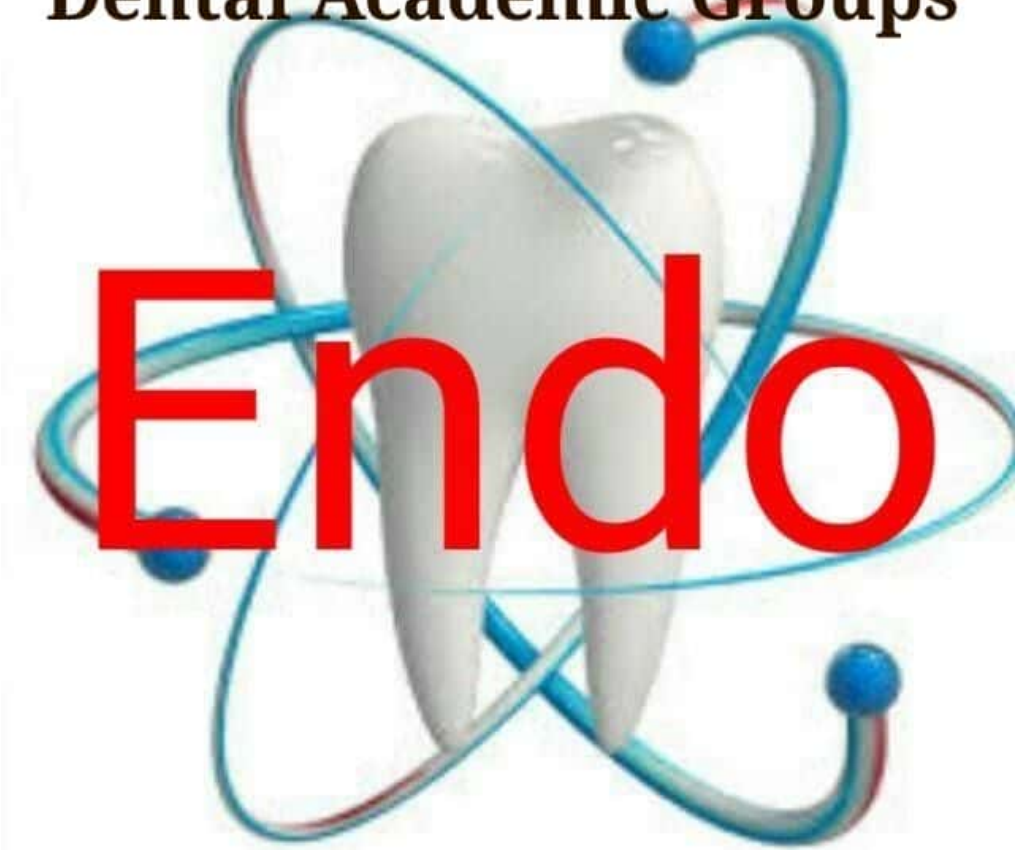

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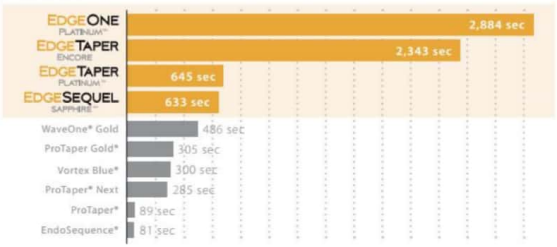

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INTRODUCTION

Evolving clinical intuition and professionalism: knowing when to swing at the pitch

Knowing where a pitch will ultimately cross the plate remains a critical skill for major league hitters. Variations in pitchers (right- and left-handers), pitching styles, and pitching speed, amid a host of variables — all ultimately challenge hitters. Having an intuitive sense about when to swing at a pitch takes time, practice, and humility. A batter needs experience and patience. A player who can learn from his mistakes will certainly improve. Clinicians are subject to the same phenomena as we also face a host of common, and also anomalous, variables that present themselves every day. How we address these variables will ultimately determine our professional satisfaction and success.

As clinicians, an infinite set of clinical and human variables confront us on a daily basis. For example, from the clinical side, tooth No. 5 can have two canals or three canals, and within those, roots canal system variations are substantial. From the human side, our patients and staff are all unique individuals with conflict and communication difficulties providing inevitable variables, challenges, and opportunities. Even our equipment presents challenges. Radiographic interpretation is highly sensitive to interpretation and, depending on the condition, can present often atypical features. Such variation needs to be expected. No matter how long we practice, we will see new things and expand our clinical viewpoint, deepening our knowledge.

Therapeutic disparity among treatment outcomes remains another variation providing growth. Similar treatment protocols can yield variable responses among our patients. For example, certain patients under almost identical circumstances may benefit from a medication, while others do not. Why the difference? Another common dissimilarity is that some teeth remain tender after treatment, while others treated in the same manner become rapidly asymptomatic.

Treatment plan decisions are best evaluated on the considerable variation we see in radiographic interpretation, osseous integrity, subjective, and objective examination findings. Our professional diagnostic acuity becomes enriched and developed through the process.

Nonclinically, schedule discrepancies are a considerable variation challenging our office systems. We must learn to channel this variation into an appropriate therapeutic response, which may range from immediately seeing a patient with an acute infection, writing a prescription, or giving the situation a tincture of time.

We are asked to make continuous decisions throughout our careers that will affect our patients' well-being. Aside from clinical practice, these decisions are influenced by variation in dental research, product development, marketing, and material enhancements. We study professional journals, visit conventions, attend study groups, and other forms of continuing education to keep abreast of the variation being driven by progress in materials science and clinical techniques.

Experience is a significant variable in and of itself. Inexperience and its co-partner, enthusiasm, can lead us into consternation early in our careers, as we have not seen enough inconsistency to evaluate complexity when presented. With time though, the cumulative benefits of addressing an almost infinite variation in experience, circumstances, and stimuli certainly will begin to amalgamate, molding our professionalism, if we remain open to change. Professionalism in this sense might be knowing which patients to treat and which to refer. Such wisdom often amounts to having a sixth sense, understanding what clinical pitches to swing at, and when to take a pitch.

Like the baseball batter who embraces the variation and matures from experiences and environment, as clinicians we have a fundamental choice to learn and develop, or conversely stagnate and grow irrelevant. In essence, we must allow variation and its benefits to quietly drive our professional enhancement and wisdom.

Enjoy the journey!
Dr. Jeffrey Krupp

Jeffrey Krupp, DDS, MS, a board-certified Diplomate of the American Board of Endodontics, has been in full-time endodontic practice for more than 35 years in San Jose, California. He earned his dental degree at UCLA dental school and received his postgraduate endodontic certificate and MS at Marquette University. His passionate interest in education and sharing knowledge is the energy behind "Success In Endodontics 2.0" an endodontic interactive self-study CE program created by Dr. Krupp at www.successinendodontics.com.

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Foreground image courtesy of Drs. Martin Trope, Ken Serota, and Gilberto Debelian. See article on page 14.

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Surgical treatment of persistent apical periodontitis and external root resorption

Drs. Melissa Esther Rivera-Peña, Murilo Priori Alcalde, Clóvis Monteiro Bramante, Marco Antonio Hungaro Duarte, and Rodrigo Ricci Vivan discuss periradicular surgery with simultaneous root canal filling and apical plasty

Abstract

Introduction

Periradicular surgery is an appropriate treament option for teeth with persistent periapical lesions. Among a variety of surgical techniques, simultaneous root canal filling and apical plasty are alternatives for cases with persistent exudation and periapical lesions that cannot be resolved through conventional therapy. Photodynamic therapy (PDT) is an auxiliary treatment that consists of the usage of a nontoxic photosensitizer and a soft laser application.

Objective

The purpose of this publication is to present a case in which these techniques were applied.

Methods

A clinical and radiographic evaluation was conducted on a 44-year-old male patient with a history of pulp necrosis in the upper right central incisor and of an endodontic failure in the left lateral incisor. The patient was scheduled for endodontic therapy. During the endodontic treatment of the right central incisor, the presence of continous exudate was observed throughout the appointments. Then periradicular surgery was indicated with simultaneous instrumentation and root canal filling. In the left lateral incisor, a curettage and apical plasty were performed.

Results and conclusions

Periradicular surgery with simultaneous root canal filling and apical plasty have proved to be effective modalities for the treatment of persistent periapical lesions, offering satisfactory results.

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Disclosure: Authors deny any conflict of interest or financial disclosure.

Introduction

Despite the evolution of endodontics in the past few decades, sometimes it is not possible to obtain success through conventional endodontic therapy or retreatment. These cases are classified as endodontic failures.[1,2] As described by Lieblich,[2] causes of endodontic failures can be associated with biologic issues, such as persistent infection, or with technical factors, such as perforations or ledging of the root canal. Consequently, periradicular surgery is an appropriate treatment option for cases that could not be resolved through conventional therapy or retreatment.[2,3] Therefore, endodontic surgery should be considered as the last treatment option with the purpose of certainly resolving the pathologic issues related to the affected teeth in order to maintain their function, esthetics, and the sanity of the periradicular tissues.[2,3] As a result, periradicular surgery involves meticulous treatment planning and factors that should be analyzed.[2-4] Among this procedure, there are a variety of approaches and modalities for different conditions, depending on the diagnosis, anatomical structures, and prognosis. Hence, the presence of persistent periapical lesions or continous exudate, perforations, or anatomical variations are some of the indications for this procedure. Nevertheless, some aspects such as local anatomical factors, periodontal support, the possibility of restoring the tooth's function, and the patient's medical history should be carefully considered during the treatment planning.[2-4,6] The success of this procedure also depends on the quality of the root canal filling, that should be performed with techniques and materials that can promote an ideal sealing of the root canal system.[3] Lastly, among the diversity of surgical techniques, the simultaneous root canal filling is an alternative for unsolved cases with persistent exudation that cannot be resolved through conventional therapy.[2,7,8] Photodynamic therapy (PDT) is an alternative treatment, which consists of the application of a nontoxic photosensitizer and a soft laser application, resulting in a highly reactive oxygen species and oxygenated products, inducing the injury and death of pathologic microorganisms. PDT has been studied as a promising approach to eliminate endodontic microflora.[8-13] In this present case, these techniques were applied.

Materials and methods

Case report

A clinical and radiographic evaluation was conducted in a 44-year-old male patient. In the clinical and radiographic examinations, a history of pulp necrosis in the upper right central incisor (Figures 1 and 2) and a periodontal pocket with a bony defect was detected in the left lateral incisor, which was already endodontically treated (Figures 3 and 4). Therefore, the patient was scheduled for endodontic therapy in the right central incisor. After rubber dam isolation, the provisional restorative material was removed with a diamond bur, and the canal was accessed by manual instruments (K-files, Dentsply Maillefer, Ballaigues, Switzerland).

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The root canal was prepared with K-files applying a crown-down technique starting with a size 80 K-file and using a size 120 K-file as the last instrument (Dentsply Maillefer, Ballaigues, Switzerland); 3 mL of 1% of sodium hypochlorite was used between each instrument. Subsequently, the root canal was irrigated with sterile saline, but the presence of continuous exudate was observed. Consequently, the root canal was medicated with formocresol moistened in a sterile cotton pellet. Temporary restorations were filled with glass ionomer cement (Maxxion R, FGM, Joinville, SC, Brazil). This was observed during different appointments, hindering the conclusion of the treatment. Because of the persistence of the clinical signs, periradicular surgery was indicated, considering an apical plasty with simultaneous retro root filling of the right central incisor. In the same way, a curettage and apical plasty were suggested on the left lateral incisor because of the presence of an osseous defect surrounding the tooth. Lastly, the filling of both surgical cavities with calcium sulfate as an osseous graft was proposed.

Figures 1-4: 1. Clinical aspect of the right central incisor. 2. Radiographic image of the right central incisor. 3. Clinical aspect of the left lateral incisor. Note the presence of purulent exudate within the gingival sulcus (arrow). 4. Radiographic image of the left lateral incisor

Surgical procedures

An extraoral and intraoral cleansing with 0.12% chlorhexidine was done to lower surface bacterial load, and local anesthesia was performed with 4% articaine (1:100,000 epinephrine). A full-thickness intrasulcular rectangular flap was reflected, made with two vertical incisions extending from the maxillary right lateral incisor to the maxillary left canine by the means of a No.15c blade scalpel (Figure 5). During the surgical procedures, the presence of a bone defect in the buccal plate was observed, being used for making the ostectomy with the aid of chisels (Lucas-Triangular, Wedelstaedt, Ochsenbein/Millenium-Golgran, São Caetano do Sul, Brazil), under copious irrigation with sterile saline.

A curettage of the exposed area was executed, as well as the instrumentation of the root canal, made with K-files under copious irrigation with sterile saline. The root canal filling was performed with gutta-percha and AH Plus® endodontic sealer (Dentsply, Detrey, GmbH, Germany), using Tagger's hybrid obturation technique. For this purpose, a master cone and two accessory gutta-percha points (XF, Dentsply Maillefer USA, Oklahoma) were placed into the root canal while performing an initial lateral compaction. Afterward, a gutta-percha condenser (No. 80, Dentsply Maillefer, Ballaigues, Switzerland) was coupled to a low-speed contra-angle handpiece and passively placed into the root canal. The gutta-percha condenser was inserted 5 mm short of the working length next to the gutta-percha cones, being activated for 3 seconds. The condenser was removed from the root canal with the contra-angle handpiece still operating while maintaining gentle pressure against one of the root canal walls. Finally, an apical plasty with the aid of an apical file (Bramante, Golgran, São Caetano do Sul, Brazil) was performed with the purpose of removing areas of roughness and smoothing the surface of the root apex.

Simultaneously, a periradicular curettage was executed on the left lateral incisor in order to remove the pathologic tissues surrounding the tooth (Figure 8). Lastly, an apical plasty was performed.

Both surgical cavities were disinfected through photodynamic therapy (MMOptics, São Carlos SP, Brazil / λ= 660 nm, P = 40 mW for 3 min, E = 7.2J) using methylene blue (Chimiolux DMC, São Carlos SP, Brazil) as a photosensitizer[10] (Figure 6). Subsequently, the surgical cavities were filled with calcium sulfate (Figure 9), and the suture was done. Clinical and radiographic controls were made. Twelve months after the surgery, new bone formation could be observed radiographically, and the patient was asymptomatic (Figures 7 and 10). In the same way, cone beam computed tomography (CBCT, i-CAT™, Hatfield, Pennsylvania) images were acquired, confirming the healing of the periapical tissues, 2 years and 8 months after the surgery (Figures 11 and 12).

Results and discussion

As described by Velvart,[14] the main objective of surgical treatment is to provide conditions for the healing and repair of the periradicular tissues, which is also the focus of conventional endodontic therapy.

Periradicular surgery involves a strict treatment planning and factors that should be analyzed carefully. According to different authors,[2-5,7] an extensive clinical and radiographic analysis of the patients should be performed, including blood tests in order to study the case and proceed to treatment planning. Hence, anatomical structures, the presence of a periradicular lesion, and the teeth involved should be considered. Before surgery, all the potential risks should be explained to the patient in order to have his/her informed consent for all the needed procedures.[2,4] Therefore, it is essential to treat the patient and not just the teeth.[4]

As reported by some authors,[3,5,7] the selection of the flap design has an important influence under different aspects during the steps of the surgery, such as the visibility, anatomical structures, repositioning, suturing, and postoperative care.

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Figures 5-10: 5. Full-thickness flap divulsion. 6. Disinfection of the surgical cavity with PDT. 7. Radiographic follow-up of the right central incisor (12-month control). 8. Clinical aspect of the left lateral incisor after curettage. The presence of a bony defect surrounding the tooth and apical root resorption were observed (arrow). 9. Filling of the surgical cavity with calcium sulfate . 10. Radiographic follow-up of the left lateral incisor (12-month control)

The incision chosen for this case was a full-thickness intrasulcular rectangular flap because it promotes an excellent access to the operative area. Hence, this flap design has been recommended because of its clinical advantages.[2,3,7,14] Certainly, because of the variety of clinical conditions, the selection of flap design should always be made based on every individual case.[14,15] It is essential to preserve epithelial and connective tissue attachment at its original level and minimize trauma during the surgical procedures in order to maintain the attachment level.[16,17] For this reason, it is crucial to maintain the integrity of the papilla during restorative and surgical procedures because of the difficulty to predictably correct its height.[14,17] The papilla base incision (PBI) consists of a shallow incision at the base of the papilla and a second incision directed to the crestal bone, creating a split thickness flap in the area of the papilla base.[16,17] This technique has been suggested to prevent loss of interdental papilla height.[16,17] However, it could be infeasible in cases where an attachment loss condition such as gingival recession is already present, as observed in this case. Some authors, have described simultaneous filling of the root canal as a useful technique in cases with an uncertain prognosis related to the presence of persistent exudate[3,7,18] as well as in cases with the presence of apical resorption. This alternative has also been indicated in cases of teeth with open apex, extrusion of filling materials, anatomical variations, presence of intraradicular retainers, perforations, persistent periapical lesions, or fractured instruments within the root canal.[3,19-20]

According to some authors,[2,4,14] periradicular surgery success rates have significantly evolved over the past few decades, with the improvement of retrofilling materials, ultrasonic preparation, and the use of magnification during the endodontic procedures. Periradicular surgery also offers the opportunity to retrieve tissue for histologic and microbiologic analysis,[2] contributing to the diagnosis. Nevertheless, Lieblich[2] explains that in cases with an expected poor success rate, such as the presence of severe periodontal bone loss with furcation involvement, the decision to extract the tooth and place an implant may be a more efficient and predictable procedure.

PDT has been studied as a promising approach to eliminate endodontic microflora.[8-9, 21] In a clinical study, Juric, et al.,[22] randomly selected 21 patients with endodontically treated teeth with chronic apical periodontitis in order to analyze the antimicrobial efficacy of PDT as an adjunct to conventional endodontic retreatment. Their results showed that the combination of conventional endodontic retreatment and PDT was more successful in the eradication of both gram-positive and gram-negative bacteria species as well as facultative anaerobes and obligate anaerobes when compared to retreatment alone. Therefore, photodynamic therapy could be used as an adjunct to conventional endodontic treatment. In addition, photodynamic therapy has been used during surgical endodontic treatment, showing promising results. Garcez, et al.,[10] applied

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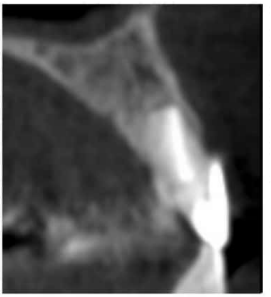
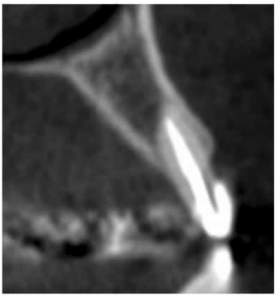
an aqueous solution of methylene blue and a diode red laser (λ= 660 nm, P = 40 mW for 3 min, E = 7.2J) in 22 patients undergoing periradicular surgery. The authors concluded that PDT associated with periradicular surgery showed superior results of microbial reduction when compared with other studies in which PDT was associated with conventional endodontic treatment.

Repair after periradicular surgery results in the formation of new tissue, involving cells and structures with the ability to react differently from the original ones. Regeneration consists of the replacement of the previous existing tissue by a new tissue identical to the former in cell composition, structure, and reactivity, implying the formation of new attachment structures.[23] Because of the limitations regarding autogenous bone grafting, bone substitutes could be used to enhance osseous healing.[24] The placement of calcium sulfate as a filling material in periradicular surgery has been studied by some authors,[23,24] showing different results. Murashima, et al.,[25] evaluated histologically and morphometrically under light and fluorescence microscope, the effect of calcium sulfate on various osseous defects in beagle dogs' teeth undergoing apicectomy. The authors concluded that the use of calcium sulfate was effective in bone regeneration on both large osseous defects and "through-and-through" osseous defects. On the other hand, it was less efficient in defects communicating with the gingival sulcus, confirming the presence of new bone completely filling the osseous defects after 16 weeks. In addition, Pecora, et al.,[23] demonstrated that the addition of calcium sulfate as a bone graft during conventional surgical treatment of through-and-through lesions improves the clinical outcome. According to the authors, further histological analysis should be done to investigate the quality of the tissues observed after the surgical procedures. In contrast to these findings, Apaydin and Torabinejad,[25] found that the placement of calcium sulfate in osteotomy sites after periradicular surgery did not significantly affect alveolar healing.

Ultimately, the patient's follow-up is crucial for evaluating the development of the case and to assess the healing of the soft and periradicular tissues. This would depend on the surgeon's ability to manipulate the tissues during the operative stages, on the patients care after the surgery, and on the patients' immune systems response. As described by Lieblich,[2] a proper follow-up protocol should be based on a radiographic and clinical evaluation 3 months after the surgery, comparing these findings with the immediate postoperative radiographic films. Documenting the case before and after with photographs should be an interesting approach as well, in order to compare the healing of the soft tissues. However, if significant bone formation has not been observed, another evaluation should be performed 6 months after the surgery. For this reason, it is of great importance to carefully choose the cases for this procedure as well as to select the best treatment modality for each case independently.[4]





Figures 11-12: 11. Tomographic follow-up of the rigth central incisor (2-year and 8-month control). 12. Tomographic follow-up of the left lateral incisor (2-year and 8-month control)

Conclusions

Periradicular surgery with simultaneous root canal filling and apical plasty have proved to be effective modalities for the treatment of cases in which it is not possible to execute the root canal filling during the conventional endodontic treatment (continous exudate, persistent periapical lesions), offering satisfactory results. Every case should be approached based on the clinical, radiographic and tomographic findings, considering the patient's overall health, and applying techniques supported by scientific sources. EP

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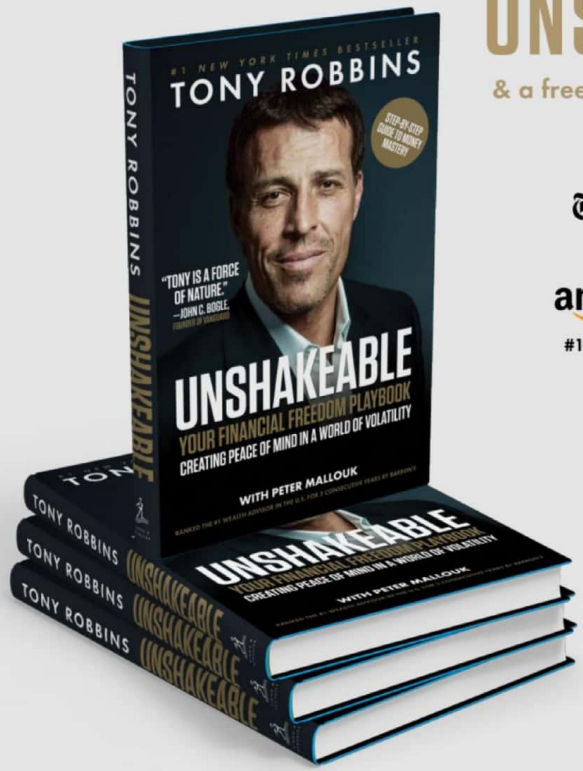

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Three-dimensional instrumentation — reaching the next level in endodontics

Drs. Martin Trope, Ken Serota, and Gilberto Debelian discuss ways to effectively instrument the natural shape of the canal and improve cleaning

The ultimate goal of the instrumentation phase of root canal therapy is to develop a sterile canal system before root filling while retaining as much healthy tooth structure as possible. To date, we have not achieved this goal. We strive for this ideal situation with each technological advance.

The introduction of nickel-titanium (NiTi) files was a major breakthrough that resolved many of the instrumentation challenges presented by stainless steel files. Ease of use is a major advantage to the practitioner, and curvatures that were previously considered impossible, or limited to highly skilled specialists, are now considered fairly routine. However, many challenges remain to achieve the ultimate goal of root canal instrumentation regardless of whether stainless steel or NiTi instruments are used.

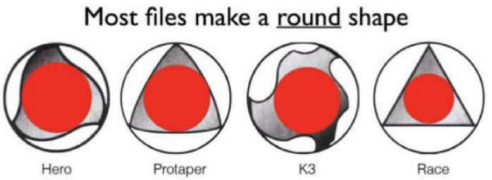

Figure 1A: Multiple file types with multiple cutting geometries ALL resulting in a final round shape in the canal

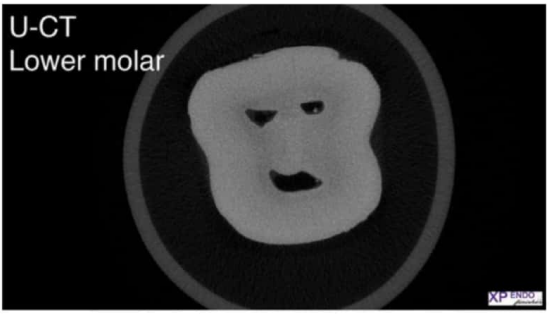

Figure 1B: CBCT cross section of a mandibular molar in the mid-root area. None of the canals are round

Challenges of traditional files

1. The major problem of today's files is that whatever the cutting geometry, they all produce a round shape ignoring the obvious; a root canal is not round (Figures 1A and 1B).[1]

Therefore, it is impossible to shape the interfacial dentin of the canal unless the file chosen corresponds to the largest diameter of the non-round canal. As the root shape mimics the canal shape, this is impossible to achieve. The small diameter of the root will invariably be severely compromised or even perforated with this approach (Figure 2).

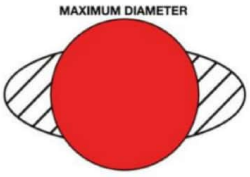

Figure 2: Because the root shape mimics the canal shape, making a round shape using the maximum diameter is clinically not practical

Historically, this limitation has been hidden from view (and consciousness) since

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Gilberto Debelian, DMD, received his dental degree from the University of São Paulo, Brazil, in 1987. He completed his specialization in endodontics at the University of Pennsylvania in 1991. He completed his PhD studies at the University of Oslo in 1997. He is an adjunct visiting professor in the postgraduate programs in endodontics at the University of North Carolina at Chapel Hill and the University of Pennsylvania. Dr. Debelian maintains a private specialist endodontics practice in Bekkestua, Norway.

Disclosure: Dr. Trope is a paid consultant for Brasseler. Drs. Serota and Debelian do not have a financial interest in sales from Brasseler.

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a typical periapical radiograph shows the narrower M-D dimension of the canal.[2] For this reason, cleaning to the narrower diameter appears adequate on the posttreatment radiograph. However, 3D axial radiographs using CBCT have brought this fact into clear view (Figure 1B). Mapping of the root canal space magnified by micro-CT analyses show that the typical round file used in this way touches less than 50% of the canal wall[3] (Figure 3).

2. Perhaps, one of the most underappreciated challenges of round files is that while in use, they create a large amount of dentinal debris. Traditionally, our focus has been on the debris pushed through the apex during instrumentation, assuming that the rest of the debris moves coronally and is flushed from the canal. It has never been appreciated that this debris is first pushed into all the non–round parts of the canal blocking these areas to further cleaning and disinfection by adjunctive cleaning methods and irrigation solutions[4,5] (Figure 4).

Additionally, when all these irregularities are compacted with debris, any further debris created will cause increased pressure on the root with the possible development of micro fractures. The current trend of fewer files and larger tapers exacerbates this potential fracture problem.

In summary, endodontic files have been used to make an artificial round shape in a non-round canal. Additionally, we fill the non-round parts of the canal with debris, further hampering our ability to control the microbes within the canal. The increasing pressure on the walls of the canal potentially predisposes the root to future root fracture.

Solving the challenges utilizing the properties of NiTi metals

Ideally, instead of creating an artificial shape in the canal, technology should be used to design a file that adapts to the natural anatomy of the root canal space.

Figure 4: Irregular canal after instrumentation with a round file. Note the debris pushed into the irregularities of the canal (Courtesy of Dr. G. De Deus)

Preparation of Oval-shaped Root Canals in Mandibular Molars Using Nickel-Titanium Rotary Instruments: A Micro-computed Tomography Study

Frank Paqué, Prof. Dr. med dent,* Marc Balmer, med dent,* Thomas Attin, Prof. Dr. med. and Ove A. Peters, DMD, MS, PhD†

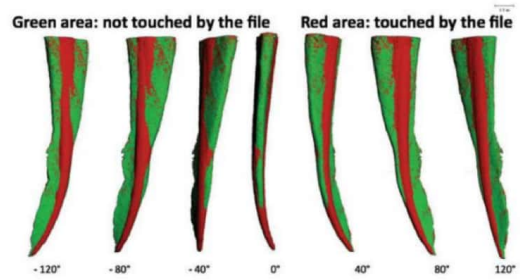


Figure 3: Walls touched when a round file to the minimum diameter is used. Less than 50% of the canal walls are touched. Green is original canal. Red is the wall touched

The breakthrough instrument that showed this potential was the Self-Adjusting File (SAF, ReDent Nova, Ltd., Ramat Gan, Israel). This file is made of NiTi metal according to the principles used in a medical stent. If squeezed in one direction, it expands in the other direction. As the canal is narrow in the M-D dimension and wider in the B-L dimension, this principle works in the root canal space as well.[6]

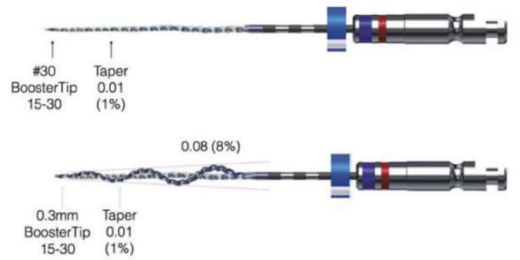
Recently, instruments developed to remove canal contents three dimensionally have been included into the endodontic armamentarium. In addition, these revolutionary instruments remove as little healthy tissue as possible. (XP-3D Shaper™/Finisher, Brasseler USA®, Savannah, Georgia).

The XP-3D Shaper was designed to create a basic shape in the canal while respecting the original anatomy of the root canal space without packing debris into untouched areas. The XP-3D finisher has a "reach" of at least 3 mm, thereby touching even the widest canal diameters while not changing the original shape of the canal.

XP-3D Shaper

The Shaper file has a diameter of 0.30 mm at the tip and 0.01 taper (#30/01). The small taper makes the file highly flexible and resistant to cyclic fatigue (Figure 5A).

The file has a Booster tip (BT) that allows it to move from a glide path of 15/02 or 10/04 immediately to a minimum diameter of 0.30 mm. At room temperature, the file has a slight serpentine shape, and it is the



Figures 5A and 5B: (top) The basic dimensions of the file. (bottom) The file at body temperature in the full Austenite form with no resistance. The file has a serpentine shape with a 0.08 taper

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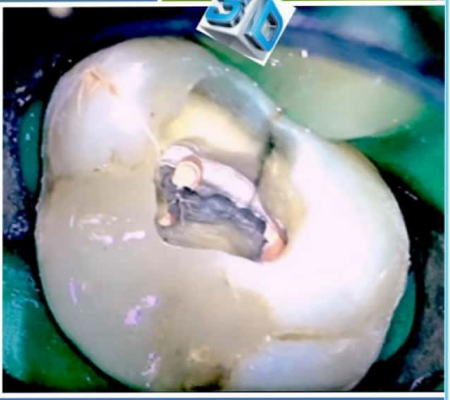

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Figure 6: The file at room temperature in the Martensite phase. The file is malleable and bendable, so it can be pre-bent to assist in placing in the canal

Martensite form that allows it to be bent and manipulated to any desired shape. However, at body temperature in the canal, it changes to the Austenite form and has the expansion capacity to create a 0.08 taper when no resistance is met (in air) or when working to overcome the resistance of the dentin (Figures 5A and 5B).

In tight canals, the XP-Shaper will be squeezed down close to its minimum diameter of 30/01 and then dependent on the time that it works inside the canal, it will expand its taper to the needs or requirements of each individual practitioner.

To better explain the unique properties of the file, the following should be understood:

1. At room temperature, the Shaper is in the Martensite phase, enabling it to be bent and more readily placed in the canal (Figure 6).
2. The Booster (BT) tip is analogous to a very finely sharpened lead pencil (Figure 7).

The "lead" non-cutting section enters the canal into the pre-established narrow (15/02 or 10/04) glide path, ensuring precise guidance and centering of the instrument. There are no cutting flutes on this section, and the instrument slips into the prepared apical component of the glide path to a depth of ¼ mm. The next ¼ mm section of the Booster tip is configured with six cutting flutes at a pre-set angle. Rotation of these flutes sizes the next ¼ of a mm of the canal space from a 0.15 mm to a 0.3 mm diameter. Going from the glide path sizes to size No. 30 should require no more than 3 to 5 easy long up/down strokes.

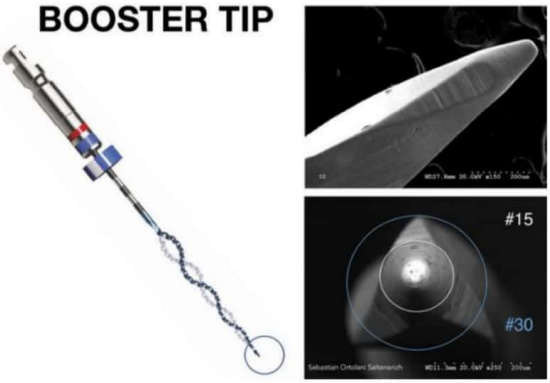


Figure 7: SEM picture of the booster tip. (top) The first 0.25 mm comes to a sharp point and is non-cutting. The next 0.25 mm has six cutting flutes at a pre-set angle. (bottom) View looking down at the BT tip. The tip is extremely small and is used as a glide file. The six cutting flutes start at 0.15 mm and end at 0.3 mm

The 0.3 mm diameter has been chosen in order to enable a No. 31 gauge irrigating needle to reach the working length, thereby maximizing irrigation efficiency and the creation of a shelf for seating the GP point when filling the root canal.

3. The file has the capacity to expand from taper of 0.01 to 0.02/0.04/0.06/0.08 while still maintaining the flexibility of the original 0.01 taper (Figure 8).

At body temperatures, the file attains its Austenite characteristics and attempts to achieve its 0.08 taper. However, it has to overcome any resistance that may be present in the canal in order to do this. Therefore, in a very tight canal, approximately every 10 long strokes will achieve a 2% increase in taper. As we want to maintain as much healthy tissue as possible, it is recommended that when the working length has been achieved in the first 3 to 5 strokes, an additional 10 long strokes will achieve a 0.04 taper, which is sufficient to adequately disinfect the canal. In naturally larger canals, the file easily reaches larger tapers without having to overcome dentin resistance. As a function of its serpentine shape, light brushing and up to 30 long strokes will result in over 90% of the walls being touched in these larger non-complex canals (Figure 9).

4. The file is adaptive to the original shape of the canal. As described in Figure 5, the file has a serpentine shape. The space available for this shape in motion enables a light

Figure 8: Illustration showing the decreased flexibility of files with the same tip size but increasing tapers. The XP Shaper maintains the flexibility of the 0.01 taper but has the cutting capacity of 0.04 or above

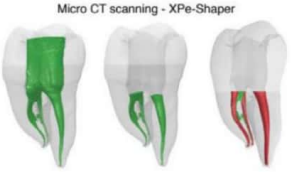


Figure 9: In small canals (mesial canals), the file will first reach a diameter of 0.3 mm and then in time increase the taper of the canal while maintaining the original anatomy and not packing debris. (See No. 5 on next page.) However, in the distal canal, little resistance is encountered by the file. Now the serpentine shape and flexibility of the file result in more than 90% of the canal wall being touched

brushing to touch 90% or more of the walls in larger non-complex canals (Figure 9).

5. Round files packing debris into the canal irregularities is a major problem in sufficiently cleaning a canal. One of the major advantages of the Shaper is that the serpentine shape and 0.01 taper of the file allows space in the canal for the debris to be maintained in solution and effectively irrigated and removed from the canal (Figure 10).

The debris is NOT pushed into irregularities; rather, it is effectively removed from the canal. This enables additional adjuncts to work maximally after the initial shape is achieved. Tests show that pressure is not built up using the Shaper (Figures 11A and 11B). The concern about micro-cracks disappears with the use of this file.[7]

In summary, the XP Shaper first creates enough space in a canal to effectively and quickly irrigate dentinal and microbial debris from the root canal space. Second, while touching more walls than any round file design, it will maintain the original shape of the canal, not pack debris into the irregularities of the canal, and thus maximize the effectiveness of cleaning adjuncts.[8]

Retreatment effectiveness

The serpentine shape of the file (hollow or virtual core) and its resistance to cyclic fatigue make it ideal for the removal of the core gutta percha for retreatment procedures. It is recommended that a "starting point" is achieved with a narrow ultrasonic tip or round file and then with the aid of a solvent. The file is used at higher speeds than recommended for primary endodontic treatment. The core GP will often be completely removed, thus decreasing the amount that is pushed into the interfacial dentin and irregularities of the canal space (Figure 12).

XP-3D Finisher

The XP-3D Finisher is a unique instrument with a larger "reach" than the Shaper. This enables it to touch and scrape areas that exceed the reach of the Shaper. Additionally, it will not cut dentin but rather scrape the walls, thus not changing the original shape of the canal.

The dimension of the Finisher is 0.25 mm in diameter (No. 25) with a 0.00 taper.

Again, like the Shaper, in the Martensite form at room temperature, its shape can be manipulated to suit the practitioner. When at body temperature, it immediately achieves a sickle shape in the last 10 mm of the instrument with a depth of 1.5 mm. Thus, when the file is spinning, it has a diameter of 3 mm. However, if the bulb is squeezed, the tip can expand up to 6 mm. Also, if the tip is squeezed, the bulb has the capacity to expand much more than the 3 mm (Figure 13).

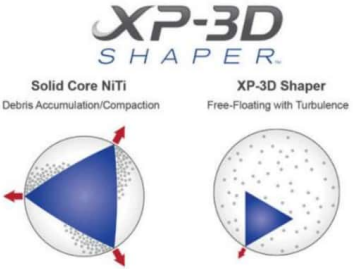


Figure 10: (left) An illustration of cutting with a traditional round file. There is little space for the debris so it will pack into canal irregularities. (right) An illustration showing the Shaper. Here most of the canal is empty so that the debris can stay in solution and NOT be packed. Subsequent irrigation will remove the debris from the canal

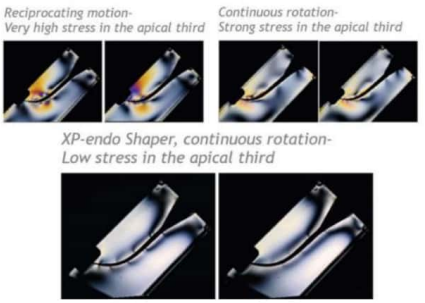


Figure 11A: Plastic blocks with light filters in order to show pressure buildup during instrumentation with different file types. The colors show that reciprocating motion files create the most pressure followed by one-file systems with continuous rotation. The lower picture shows instrumentation with the Shaper file showing no pressure buildup

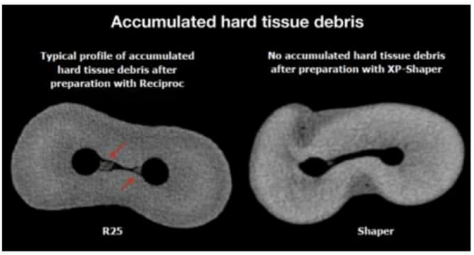


Figure 11B: Micro-CT picture showing debris packing for reciprocating files on left while on the right the Shaper results in no debris packing at all. This could explain the superior effectiveness of the adjunct instruments after the use of the Shaper and the increased pressure build up for reciprocating files vs the Shaper file

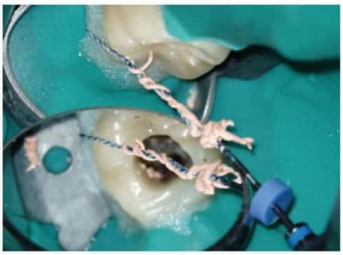


Figure 12: Illustration of the entire gutta-percha core material removed with the use of the 3D-XP Shaper. The serpentine shape of the instrument facilitates the removal of the entire core at once. (Courtesy Dr. K Laudebach)

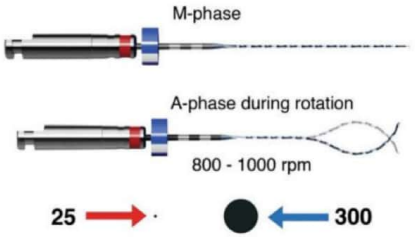
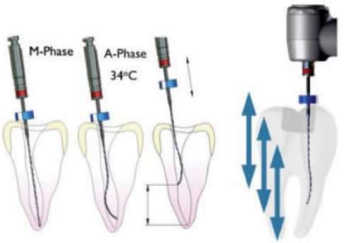


Figure 13: (Top) The dimensions of the XP-3D Finisher are 0.25 diameter and 0.00 taper. (Bottom) When at body temperature in the Austenite phase, the last 10 mm of the instrument achieves a sickle shape with a depth of 1.5 mm



Figures 14A and 14B: When placed in the canal and moved up and down, the anatomy of the canal will cause the file to expand and contract, thus entering small indentations that cannot be reached by any other file

Figure 15: Picture of a transparent tooth with the XP-3D Finisher cleaning an indentation within the canal due to its sickle shape

When placed into a typical canal and moved up and down, the natural expansion and contraction created by the anatomy of the canal wall will ensure that the tip and bulb can expand and contract into all the irregularities of the canal while not being strong enough to change the original shape before the Finisher is used (Figures 14A and 14B).

In addition, the Finisher creates a robust turbulence of the irrigating solution further enhancing disinfection.

Research indicates that the Finisher is particularly beneficial in the apical third of the canal and is extremely effective in removing dentinal debris. Most importantly, studies show it to be the most effective adjunct in removal of microbes in the main canal and up to 40 microns into the tubules.[9-11]

Retreatment effectiveness

A retreatment Finisher is available with a core of 0.30 in diameter making it more robust in removing residual gutta percha and debris from the irregularities of the root canal space.

A study by Alves, et al., showed a 69% reduction of debris after initial retreatment with standard round files[12] (Figure 16).

In summary, the XP-3D Shaper and Finisher are instruments that can effectively instrument the natural shape of the canal and decrease residual microflora prior to filling the root canal. Equally as important, this improved cleaning is performed without sacrificing healthy root structure, thus maintaining the strength and integrity of the tooth and ultimately its functionality.

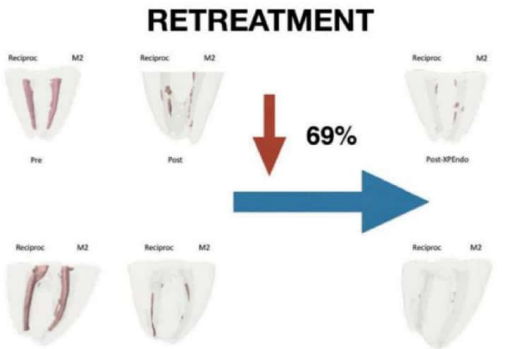


Figure 16: Sixty-nine percent reduction of debris found with the use of the XP-3D Finisher R after standard retreatment with round files

The next paper will address slight modification of the shape of the canal to synchronize the fitting of a gutta-percha point and post if required. EP

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Cellerant "Best of Class" Technology Awards 2017

With a barrage of emerging technologies in the dental marketplace, clinicians seek expert advice to guide them toward the most innovative, impactful products that can provide significant benefits for their practices, their teams, and their patients. For the past 9 years, the prestigious Cellerant "Best of Class" Technology Awards have been doing just that — distinguishing outstanding products and services from the competition and establishing true leaders in their categories.

The awards have received acclaim for their integrity and have been recognized by every major dental journal in North America and the American Dental Association. The winners are decided by the Best of Class Advisory Board, comprised of respected experts in dental technology, Paul Feuerstein, DMD; John Flucke, DDS; Marty Jablow, DMD; Parag Kachalia, DDS; and creator and founder of the award, and president of Cellerant Consulting Group, Lou Shuman, DMD, CAGS. Each year, at the Chicago Dental Society's Midwinter Meeting, the board convenes to review innumerable hours of research they have compiled regarding practice-changing technologies over the past year. The rigorous process is unbiased and non-profit. If a technology is not considered exemplary, then no winner is chosen for that category. Any panelist with a consulting relationship with a company is exempt from voting in that specific category.

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Treatment of a maxillary second molar

Dr. L. Stephen Buchanan discusses cleaning with apical negative pressure and obturating in three dimensions using the Continuous Wave of Obturation technique

This case report demonstrates how root canals accessed in a minimally invasive manner can be successfully cleaned with apical negative pressure irrigation and then obturated in three dimensions using the Continuous Wave (CW) filling technique with elements™free Downpack and Backfill devices.

Access

In Figure 1, we see the case: an upper second molar (No. 2) with a full PFM crown and little or no pulp chamber due to the extensive calcification that occurred before the pulp became necrotic. Cutting access cavities into calcified pulp chambers is no fun for several reasons; it is difficult,[1] it requires a lot of patience, and it is easy to look as though a free-range bur was used with need-less tooth structure cut and lost rather than the desired paths heading straight into each canal.[2]

Recently, a new type of CT guidance has been introduced for implant surgery; optically-driven dynamic CT guidance.[3,4] Dr. Charles Maupin (Lubbock, Texas) and I have been experimenting with one such system (X-Nav Technologies, Lansdale, Pennsylvania) to help guide endodontic access procedures.

The result is a minimally invasive access preparation (Figure 2). At the end of each drill path, a No. 15 K-file dropped into each orifice. A rotary 25/.08 orifice opener was then used to smooth the transition path from access to the orifice. Each of the access cavities directly met each of the canals at the cementoenamel junction (CEJ) level of the tooth.

Figure 1: Maxillary second molar with total pulp chamber calcification

Figure 2: Minimally invasive access cavities — the left opening is for the palatal canal; the ovoid opening on the right side of the occlusal surface is actually the intersection of the two openings for the MB and DB canals

Treatment of canals

All three canals with lubricant (gel) in place were negotiated entirely with a single rotary glide path file. An apex locator was used with that same file to determine canal lengths. Switching to 17% liquid EDTA, the palatal (P) canal gauged slightly smaller than a No. 30 K-file, while the mesiobuccal (MB) and distobuccal (DB) canals gauged slightly larger than a No. 15 K-file. With this data in mind, I cut final shapes in the MB, DB, and P canals (slightly larger than the gauged diameters) with .06 tapered rotary files.

Figure 3: Working radiograph showing a tapered diamond bur placed in the guided access path for the MB canal

NaOCl irrigation was activated ultrasonically at low power for 1 minute in each canal to break loose and remove any particulate matter. This is important as it helps eliminate clogging of the apical negative pressure (ANP) MicroCannula evacuation needles (EndoVac™, Kerr Endodontics). The EndoVac's MicroCannula evacuation needles are 30 GA (0.30 mm outside diameter), so its tip reached very close to the terminus of the

L. Stephen Buchanan, DDS, FICE, FACD, Dipl. ABE, serves as an assistant clinical professor at the University of Southern California School of Dentistry and the University of California at Los Angeles School of Dentistry. He also maintains a private practice limited to endodontics and implant surgery in Santa Barbara, California. He began pursuing three-dimensional anatomy research early in his career. In 1986, he became the first person in dentistry to use microcomputed tomography technology to show the intricacies of root structure. In 1989, he established Dental Education Laboratories and subsequently built a state-of-the-art teaching laboratory devoted to hands-on endodontic instruction where he continues to teach. Through Dental Education Laboratories, he has lectured, conducted participation courses around the world, published numerous articles, and produced the award-winning video series "The Art of Endodontics."

In addition to his activities as an educator and practicing clinician, he holds a number of patents for dental instruments and techniques. Most notably, he was the first to introduce variable-tapered instruments for use in endodontic therapy and pioneered a system-based approach to treating root canals. He is a Diplomate of the American Board of Endodontics and a Fellow of the International and American College of Dentists.

Disclosure: Dr. Buchanan is the inventor of the Continuous Wave Technique and has licensed associated IP to Kerr Endodontics.

Watch Dr. Buchanan's video tutorial on the Continuous Wave of Obturation technique at:
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palatal canal and within 2 mm-3 mm in the MB and DB canals. This irrigation method is especially effective in minimally invasive endodontic cases. Each canal was irrigated in this manner for 5 minutes with 8% NaOCl.

Matching AutoFit™ Greater Taper .06 Gutta Percha points (Kerr Endodontics) were initially trimmed with a blade and a gutta-percha gauge to a 0.2 mm tip size for the MB and DB canals and a 0.35 mm tip size for the palatal canal. Then after seating them to place in each of the canals, they were further adjusted to fit 0.5 mm short of working length. Continuous Wave Electric Heat Pluggers (Kerr Endodontics) — a .10 taper plugger for the P canal and a .06 taper plugger for the MB and DB canals — were fit to a binding point 4 mm-6 mm short of working length in each canal. Kerr Pulp Canal Sealer™ (Kerr Endodontics) was hand mixed to a viscosity that allowed it to string an inch above the mixing pad and just hang there — ideal for the Continuous Wave of Obturation filling technique. This viscosity helps hold the master cones in place when the plugger is withdrawn after the downpack. All canals were dried and their master GP cones cemented into place.

The .06 plugger was mounted in the elementsfree (Kerr Endodontics) Downpack handpiece (Figure 4). The 360-degree ring switch was activated, causing the plugger tip to reach 200ºC almost immediately. The plugger tip was then used to sever each of the GP cones at the orifice levels after which the larger stainless steel end of the No. 1 (red) CW Hand Plugger (Kerr Endodontics) was used to fold the warm gutta percha into each orifice in preparation for downpacking. The MB and DB canals were downpacked with a separation burst of heat in preparation for syringe backfilling, and the apical masses of gutta percha were condensed with the nickel-titanium end of the same #1 CW Hand Plugger used previously.

Before downpacking began, however, a gutta-percha cartridge was placed in the elementsfree Backfill device and was switched on to preheat so that it could be ready when needed later. After preheating, the Backfill extruder was "primed" by double tapping the actuator button which moves its internal piston forward until freshly heated gutta percha advanced through the end of the needle. The priming procedure is ended by hitting the button again.

Once the downpacking procedure was completed in all canals, the elementsfree Backfill device's needle was placed to its binding point in the buccal canals, a

Figure 4: Cordless elements™ free Obturation System (Kerr Endodontics)

5-second pause was counted out, and the actuator button was pushed and held until the extruded GP bumped the needle back, and it was removed. The small NiTi end of the No. 2 (blue) CW Hand Plugger is 0.7 mm, and the extruder needle is 0.65 mm. When the needle bumped back, the 0.7

Figure 5: Post-op radiograph showing a very three-dimensional filling result, a testament to the efficacy of negative pressure irrigation and Continuous Wave Obturation in minimally invasive endodontic preparations. Note the filled apical bifurcation of the MB canal and the two apical lateral canals; one off the MB canal and one off the DB

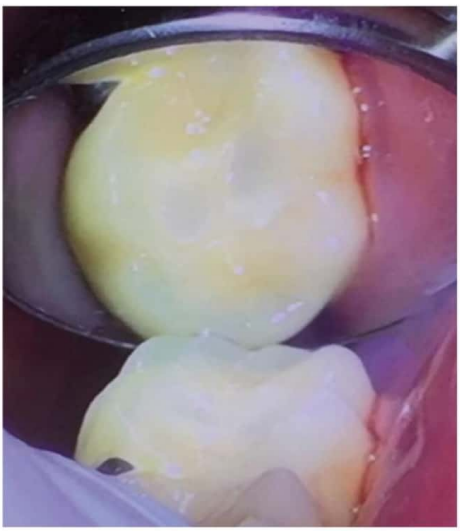

Figure 6: Photograph of finished post-endodontic restoration

mm plugger end fit the canal at that level perfectly, so only a single sustained push was needed to eliminate any backfilling voids between the apical mass and the extruded GP. After that, the needle was returned to the remaining space to complete the backfill. The needle was placed directly onto previously extruded GP to soften it. Then after another 5-second wait, gutta percha was extruded back to the orifice level, then condensed with the larger stainless steel end of the No. 1 (red) CW Hand Plugger, thus finishing the backfill procedure.

The palatal canal was downpacked in a similar fashion as the buccal canals, yet with the intention of using a single-cone backfill. For this the electric heat plugger was held in place for 10 seconds to allow the plugger to cool, the plugger was pushed apically (without reheating) and was rotated to break the plugger loose from the condensed gutta percha. The plugger was then teased out of the canal, leaving the condensed gutta percha in place with what is essentially an impression of the .10 taper plugger used in this canal. Autofit Backfill Gutta Percha Points (Kerr Endodontics) come in five sizes, matching the tapers of the pluggers, so when single-cone backfilling is to be done the same size backfill cone is chosen. It cemented in place with sealer, severed with the heated plugger, and condensed with the larger end of the #2 CW Hand Plugger. The postobturation radiograph is shown in Figure 5.

Restoration of the access cavities was done as follows:

1. Air abrasion was used to clean the filling materials off the access walls.
2. A 2 mm layer of glass ionomer was placed in each of the orifices.
3. Bonded composite material was placed and carved to the occlusal surface contours, then light-cured.
4. The restoration is polished and checked for occlusal interferences (Figure 6).

Conclusions

This case demonstrated that it is possible to find all orifices, effectively instrument and, with negative pressure irrigation, to clean complex root canal systems through minimally invasive access openings, and that the Continuous Wave of Obturation Technique, using cordless elementsfree obturation devices is very capable of delivering a dense 3D fill through these tiny access cavities as evidenced by the multiple lateral canal fills (Figure 5). EP

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Repair of furcal iatrogenic perforation with MTA

Dr. Claudio Peru presents a case study on the repair of furcal iatrogenic perforation with mineral trioxide aggregate with a 4-year follow-up

Educational aims and objectives

This clinical article aims to discuss the repair of furcal iatrogenic perforation with mineral trioxide aggregate, including a 4-year follow-up.

Expected outcomes

Endodontic Practice US subscribers can answer the CE questions on page 35 to earn 2 hours of CE from reading this article. Correctly answering the questions will demonstrate the reader can:

- Realize the successful endodontic treatment of furcal iatrogenic perforation with reparative materials such as mineral trioxide aggregate.
- Visualize the concept through viewing the case report.
- Realize some properties of MTA and its benefits.
- Realize a possible cause of furcal perforation.

Mineral trioxide aggregate (MTA) has been frequently used as material of choice for perforation repair, pulp capping, and apexification since its introduction in 1993 (Lee, Monsef, Torabinejad, 1993; Osorio, et al., 1998; Torabinejad, et al., 1995).

MTA is a mineral powder that consists of hydrophilic particles, which comprises principle components of tricalcium silicate, tricalcium aluminate, tricalcium oxide, and other mineral oxides. It has a pH of 12.5 and sets in the presence of moisture in approximately 4 hours (Torabinejad, Pitt Ford, 1996; Torabinejad, Chivian, 1999). The repair capacity of MTA can be attributed to the antimicrobial properties and high pH (12.5) of MTA. These characteristics of MTA promote growth of the cementum and formation of bone (Roberts, et al., 2008).

Furcal perforation is usually an undesired complication that can occur during preparation of endodontic access cavities or exploring canal orifices of multirooted teeth (Bargholz, 2005). These undesirable situations, such as excess removal of tooth structure or perforation, occur during attempts to locate canals or as a direct result of failing to achieve straight line access to the canals (Frank, 2002; Unal, Maden, Isidan, 2010).

The aim of this long-term follow-up case report is to present a successful treatment of iatrogenic furcal perforation by MTA.

Case report

A healthy 60-year-old man attended Chiswell Green Specialist Centre for evaluation of his upper right first molar (UR6). He reported having a recent root canal treatment carried out by his general dental practitioner. Since the time the work was completed, he was experiencing "an intense burning sensation in the gums around that tooth."

Our examination found UR6 sensitive to palpation and tender to percussion. This tooth was restored with a composite filling. The mean probing pocket depth was within normal level. The radiographic examination showed a large extrusion of gutta percha through a perforation in the pulp chamber.

Various treatment options were discussed with the patient. The patient wished to retain his natural tooth and decided to opt to have the UR6 re-root canal treated while accepting its guarded prognosis. A written informed consent was obtained before commencing the treatment.

Radiographic examination of the UR6 revealed an extrusion of gutta percha through a perforation in the pulp chamber and a large periapical radiolucency (Figure 1).

The developments in the form of reparative materials (MTA), as well the use of the operative microscope, can enhance the positive outcome and promote greater success in endodontic cases that are considered to have a poor prognosis.

Figure 1: Preoperative radiograph of UR6 showing a large extrusion of gutta percha (GP) through a perforation in the pulp chamber

Figure 2: Preoperative photograph of UR6

Dr. Claudio Peru qualified from Cagliari University in Italy and completed a master's in 2003 at Guy's Hospital, London. He is included on the GDC specialist list in endodontics. Dr. Peru is familiar with the latest advances in endodontics and has a wide range of experience, having worked in Italy and England. He has been a clinical teacher in endodontics at Guy's Hospital in London and is committed to postgraduate education and holding lectures in endodontics to referring practitioners. He sits on *Endodontic Practice's* editorial board and currently practices at Chiswell Green Specialist Dental Centre.

Figure 3: Mesiobuccal canal obturated and two GP cones extruded through a perforation on the floor of the pulp chamber

Figure 4: The extruded GP was carefully removed

Figure 5: The perforation on the floor of the pulp chamber was disinfected using 2.2% sodium hypochlorite

Figure 6: The perforation was repaired using mineral trioxide aggregate (MTA)

Figure 7: A layer of glass ionomer cement (GC Fuji IX) was used to seal the pulp chamber

Figure 8: Four root canals were cleaned using sodium hypochlorite 2.2% and shaped using ProTaper Universal

Figure 9: The root canal system was medicated using calcium hydroxide

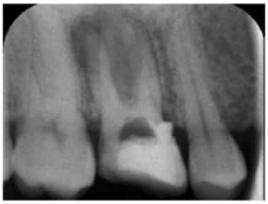

Figure 10: The access cavity was temporarily filled with glass ionomer cement (GC Fuji IX)

Figure 11: Second visit — the root canals were filled using the warm vertical condensation technique (System B, Obtura 2, and AH sealer)

The tooth was anesthetized (4% articaine hydrochloride containing 1:100,000 epinephrine) and isolated with rubber dam. The endodontic treatment was performed using an operative microscope (Global Surgical Corporation).

The restorative material was removed, and a large perforation was detected clinically on the floor of the pulp chamber. It was noticed that only the mesial canal was obturated, and two GP cones extruded through a perforation created on the floor of the pulp chamber (Figure 3). The hemorrhage was controlled with copious irrigation with 2.2% sodium hypochlorite. The extruded GP was carefully removed (Figure 4). The perforation on the floor of the pulp chamber was disinfected using 2.2% sodium hypochlorite and repaired using MTA (Figures 5 and 6). A layer of glass ionomer cement (GC Fuji IX, GC America) was used to seal the pulp chamber (Figure 7).

Four root canals were cleaned using 2.2% sodium hypochlorite and shaped using ProTaper® (Dentsply) (Figure 8). The root canal system was medicated using calcium hydroxide (Figure 9), and the access cavity was temporarily filled with glass ionomer cement (GC Fuji IX, GC America) (Figure 10).

During the second appointment a week later, the root canals were obturated using the warm vertical condensation technique with System B™ (SybronEndo), Obtura™ II (Obtura Spartan) and AH Plus® sealer (Dentsply Maillefer) (Figure 11). The access cavity was permanently restored using composite resin (Figure 12). A composite core was prepared (Figure 13), and the tooth was restored with a temporary crown (Figure 14). The tooth was finally restored with a permanent crown by the patient's general dental practitioner. At the 3-month recall, the tooth remained asymptomatic (Figure 15). The patient was discharged to the care of his general dentist who was asked to inform us of any signs of symptoms of periapical pathology associated with this tooth.

The patient returned to our specialist center 4 years later for the endodontic treatment of another tooth. A re-assessment of UR6 was then carried out. Radiographic examination confirmed periapical healing, and the patient was completely asymptomatic (Figures 16 and 17).

Figure 12: The access cavity was restored using composite resin

Figure 13: A composite core was prepared, and the tooth was restored with a temporary crown

Figure 14: Postoperative radiograph

Figure 15: Three-month review appointment — tooth restored with a permanent crown following completion of endodontic therapy

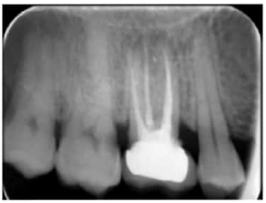

Figure 16: Four-year review

Conclusion

It is almost always the patient's wish to retain his/her natural tooth. In this particular case, all the treatment options were thoroughly evaluated and discussed with the patient before commencing the treatment. The patient fully understood that the prognosis of this tooth was guarded but still decided to try to save his natural tooth.

The developments in the form of reparative materials (MTA), as well the use of the operative microscope, can enhance the positive outcome and promote greater success in endodontic cases that are considered to have a poor prognosis. EP

Figure 17: Four-year review

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Endodontic retreatment of a maxillary first molar

Dr. Satnam Singh Virdee discusses the endodontic retreatment of a maxillary first molar in this award-winning case

Award-winning case: Dr. Satnam Singh Virdee won the Young Dentist Endodontic Award 2016 for this case. Find out more at bit.ly/2jiuSLd.

DS, a 36-year-old photographer, was referred from his general dental practitioner (GDP) to the local restorative department for endodontic retreatment of a previously root-filled maxillary first molar. This report aims to discuss the examination, treatment planning, and endodontic management of this tooth, which present several complicating features.

Educational aims and objectives

This clinical article aims to discuss the examination, treatment planning, and endodontic management of a maxillary first molar presenting several complicating features.

Expected outcomes

Endodontic Practice US subscribers can answer the CE questions on page 35 to earn 2 hours of CE from reading this article. Correctly answering the questions will demonstrate the reader can:

- Describe the examination and assessments used in the patient case.
- Recognize the prognosis and treatment plan of the patient case.
- Understand the treatment protocols followed during the patient's first and second appointments.
- Realize the strategy used to manage the complications in this case and the value of using the literature to overcome challenges and develop clinical skills.
- Realize that the definition of success or failure in a case may not be representative of the dynamic healing process that is occurring.

History

Presenting complaint

Patient DS presented with persistent dull pain arising from the upper right area of the mouth.

History of complaint

Patient DS complained of a well-localized, moderate but constant dull ache arising from the right maxillary first molar (UR6). This started 9 months prior following an acute episode that was managed by his general dentist with antibiotics and is exacerbated only by masticatory forces with no sensitivity to thermal stimuli. The pain, which fortunately does not disturb his sleep, was being managed by over-the-counter analgesics.

He recalls that the tooth in question had previously undergone root canal therapy approximately 9 years ago as a result of extensive caries. This was allegedly completed over a single visit with no recollection of rubber dam use and, upon completion, was coronally restored with a direct restoration.

Relevant dental and social history

DS regularly attends his general dentist and has adopted an excellent oral hygiene regime, a low cariogenic diet, has never smoked, and presents little to no anxiety or parafunction.

Relevant medical history

No relevant medical history or known drug allergies reported.

Examination

Extraoral assessment

An extraoral assessment concluded a right submandibular lymphadenopathy.

Intraoral assessment

- Soft tissues — nothing abnormal detected
- Hard tissues — a moderately restored dentition with no evidence of caries (Figure 1)
- Periodontal — BPE all 0s with very good oral hygiene and no mobility, recession, or furcations
- Occlusal — Class I incisors and group function on lateral excursions with no interferences

Right maxillary first-molar assessment

- Visual — a moderately sized mesio-occlusal amalgam restoration with an intact mesial contact, but marginal ditching on the occlusal aspects. There was no evidence of caries, cracks, periodontal pocketing, or mobility; and approximately 60% of natural tooth structure remained. (Figure 2)

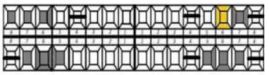

Figure 1: Dental charting

Figure 2: Clinical photograph of UR6

Dr. Satnam Singh Virdee qualified from the University of Birmingham in 2013 with several distinctions and honors points. During his dental foundation training, he developed a keen interest in all aspects of restorative dentistry, particularly in endodontics. He is currently in a restorative dental core-training post at the Cardiff Dental Hospital and works as a part-time general practitioner in a mixed NHS and private practice on weekends. Dr. Virdee has published several articles in peer-reviewed journals and won several postgraduate national prizes, including the British Endodontic Society Academic Harty Prize 2014, British Endodontic Society Clinical Foundation Dentist Prize 2015, the British Society of Periodontology Audit Prize 2015, British Endodontic Society GDP Prize 2016, and the Harley Street Young Dentist Endodontics Award 2016. He won the English Kickboxing Championship in 2012.

Figure 3: Preoperative long-cone periapical radiograph of UR6

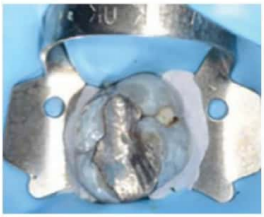

Figure 4: Single tooth isolation of UR6

Figure 5: Endodontic access

- Pulpal — repeated negative readings to electrical and thermal sensibility testing
- Periodontal — no pocketing, mobility, recession, or furcation involvement
- Apical — moderate tenderness to apical percussion, particularly on the mesiobuccal cusp tip. Although there was no apical swelling or sinus tract, on palpation there was tenderness on the attached buccal mucosa adjacent to the UR6.
- Radiographic — an intraoral periapical radiograph taken using a long cone paralleling technique revealed a well-corticated apical radiolucency greater than 5 mm, associated with a significantly curved mesiobuccal root (>40°) and no evidence of MB2 instrumentation. Additionally, the coronal restoration extends to the floor of the pulp chamber. Assessing against the quality guidelines, the previous root filling could be improved as it was poorly condensed and not extended to the appropriate length (European Society of Endodontology, 2006). Furthermore, there was a close anatomical relationship between the root apices and maxillary sinus (Figure 3).

Diagnosis

Using the classification system set out by Abbott and Yu (2007), the diagnosis was chronic apical periodontitis with a previous but infected root canal filling (Abbott, Yu, 2007).

Prognosis and treatment plan

Ng, et al., 2011, reported the presence of a preoperative periapical lesion, considerably reduced periapical healing, and this is a significant prognostic factor, which is consistent with landmark Toronto studies (Ng, Mann, Gulabivala, 2011; Farzaneh, Abithol, Friedman, 2004). Additionally, it was found that the size of the apical lesion also had a statistical significance on treatment outcomes, with those less than 5 mm healing more favorably as opposed to those that were larger (Ng, Mann, Gulabivala, 2011).

Table 1: Estimated working length, zero length readings, and true working lengths of all four UR6 canals

Canal	Estimated working lengths (MM)	Zero length reading (MM)	True working lengths (MM)
Mesiobuccal one	19 mm to the MB cusp tip	20 mm to the MB cusp tip	19.5 mm to the MB cusp tip
Mesiobuccal two	19 mm to the MB cusp tip	20 mm to the MB cusp tip	19.5 mm to the MB cusp tip
Distobuccal	22 mm to the DB cusp tip	21 mm to the DB cusp tip	20.5 mm to the DB cusp tip
Palatal	25 mm to the MP cusp tip	25 mm to the MP cusp tip	24.5 mm to the MP cusp tip

Unfortunately, these features were all present in this case, reducing overall prognosis. However, the tooth also possessed several features that have been shown to improve treatment outcomes, such as the presence of a technically inadequate root filling, substantial natural tooth structure, and adequate periodontal health with the absence of any perforations, sinus tracts, or apically extruded root-filling material (Ng, Mann, Gulabivala, 2011; Farzaneh, Abithol, Friedman, 2004).

The preoperative prognosis, therefore, was deemed slightly more favorably as "guarded" and conveyed to the patient, as well as all relevant options, which included:

- Leave
- Orthograde retreatment
- Referral to specialist endodontist
- Extract and accept space
- Extract and fill space

DS still wished to retain the tooth and agreed upon the following treatment plan:

- UR6 orthograde endodontic re-treatment
- Direct composite core and coronal restoration
- Clinical and radiographic 12 monthly reviews

Treatment protocol: first appointment

Isolation and endodontic access

Upon achieving profound anesthesia, single tooth isolation was achieved using a winged molar clamp, rubber dam, floss, and a caulking agent (Figure 4). The absence of any leaks into the oral cavity on water application from the triple air syringe confirmed a hermetic seal. Prior to access, the preoperative radiograph was studied closely to estimate the depth of the amalgam core restoration (Figure 3). A basic outline of an orthodox access cavity was then scribed into the amalgam surface, and the predetermined depth was used to orientate a round-ended, tapered, cooled diamond bur during access to prevent causing iatrogenic injury. At the floor of the pulp chamber, a safe-ended tungsten carbide bur was used to remove the roof the pulp chamber, ensuring the minimally invasive access cavity permitted good visibility, was a reservoir for irrigants, and straight-line access to all canal orifices.

Identifying canals

Once access was gained, the pulpal floor was inspected for existing injuries and uninstrumented canals. Four canals were identified, three had been previously obturated, and the MB2 was left uninstrumented. Estimated working lengths for each canal were established using the preoperative radiograph, and then a glide path was established in the MB2 using ISO size 8-20 K-files and a ProTaper Universal Sx file (Dentsply) with lubricant (Figure 5, Table 1).

Figure 6: True working-length radiograph

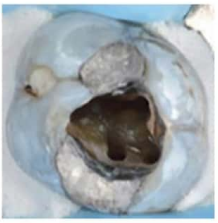

Figure 7: Gutta percha removed, and all canals shaped

Figure 8: Trial gutta-percha radiograph

Gutta-percha removal

The estimated length of gutta percha (GP) was established from the preoperative radiograph. Gross GP was initially removed by a combination of Gates Glidden burs and Hedstrom files set to the length of GP. Fine remnants were then retrieved by introducing solvents into each orifice and using large paper points in a "wicking" motion until all canals were patent and no further GP residue was visible on the terminal third of the paper points. Using an Electronic Apex Locator (EAL) and an ISO size 10 K-file, zero length readings for each canal were established. For each reading, 0.5 mm was subtracted to establish the true working length and then confirmed with a true working length long cone periapical radiograph (Table 1, Figure 6).

Chemomechanical debridement

All canals were shaped to length using the ProTaper Universal Rotary system (Dentsply) with the mesiobuccal one, mesiobuccal two, and the distobuccal canals shaped to an ISO 25 F2, and the palatal shaped to an ISO 30 F3. The varying taper of these files allowed the author to monitor shaping technique throughout the procedure. If carried out correctly, the shaper files should present with dentinal debris in the coronal aspect of the instrument, whereas this should be located in the apical region of finisher files (Figure 7). All shaping was conducted in the presence of copious irrigation (sodium hypochlorite 5.5%) to aid removal of debris from the canal, to lubricate files to prevent separation, and to chemically disinfect the root canal system, which is the critical component to a successful outcome. Following shaping, the tooth was temporized with non-setting calcium hydroxide paste and a distinctly colored glass ionomer temporary restoration.

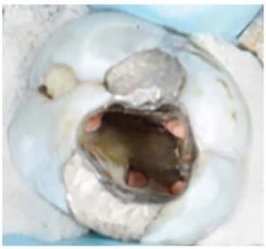

Figure 9: Obturated canals

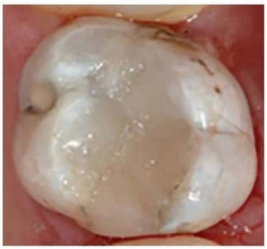

Figure 10: Direct composite coronal restoration

Treatment protocol: second appointment

Trial cone radiograph

After regaining access and single tooth isolation, canals were dried using paper points, and the respective GP cones were inserted to assess for tug back at the measured true working lengths. A trial cone periapical radiograph was then taken to confirm the shaping was completed to a satisfactory standard and to the correct length prior to obturation (Figure 8).

Irrigation activation

Regardless of its many favorable properties, sodium hypochlorite is still unable to dissolve the inorganic component of the smear layer (American Association of Endodontists, 2011). This mineral film, which covers instrumented walls, can harbor residual microorganisms and impede the ability of sodium hypochlorite to penetrate deep into the dentine tubules, reducing its overall antimicrobial effect (Violich, Chandler, 2010). Therefore, to achieve a more thorough disinfection, a 1-minute penultimate rinse of 17% EDTA was carried out upon completion of all mechanical instrumentation. This combination is a recognized technique and has shown to significantly improve the treatment outcomes of teeth undergoing endodontic retreatment (Ng, Mann, Gulabivala, 2011).

With the smear layer now effectively removed, a final rinse of 5.25% sodium hypochlorite was administered. For each canal, a corresponding GP cone was inserted for manual dynamic activation of the irrigant before the canals were thoroughly dried and then finally obturated. Throughout the procedure, any change in solution was preceded by a saline flush to neutralize the effects of the former irrigant.

Obturation

A warm vertical condensation technique was used to obturate the canals after the canals were thoroughly dried. Initially, the GP was coated with a calcium hydroxide based sealer (AH Plus®, Dentsply). When it was then inserted into the canal to length, the System B™ Tip (Kerr Dental) was activated to 5 mm short of the true working length. At this length, the tip was deactivated and the excess coronal GP removed on withdrawal. The remainder of the canal was then obturated with thermoplastic GP in 2 mm increments using the Obtura™ system (Kerr Dental) (Figure 9).

Coronal seal

A definitive restoration was immediately placed after obturation, as Chugal, et al., 2007, reported those of a temporary nature result in higher failure rates. Initially, 3 mm of flowable composite was used to seal the orifices of the canals, and then a direct hybrid composite restoration was used to restore the lost tooth substance (Figure 10). Although there was no mesial marginal ridge, a substantial amount of natural tooth structure was preserved, and the remaining cusps retained a critical thickness of 2.5 mm. Additionally, the tooth was not at the terminus of the arch and was occlusally protected against excessive axial forces during excursive movements. These are all features that have been shown to improve the healing and long-term survival of the tooth, and so a conservative direct composite coronal restoration was deemed appropriate (Polesel, 2011; Ng, Mann, Gulabivala, 2011). Following this, a postoperative periapical radiograph was taken to assess the quality of the endodontic root filling (Figure 11). This showed that the GP was obturated to the correct length; there were no voids, extrusions or overfills. Additionally, the radiolucency does not appear to have increased in size.

Review

At 6 and 12 months, DS presented with no symptoms and had stated that there had not been any postoperative acute episodes. The tooth was now functional as he was able to eat on this side without feeling any pain. Clinically, the coronal restoration was intact, and there was no evidence of active infection. Radiographic examination revealed the apical lesion had significantly reduced in size (Figure 12). Due to the absence of any symptoms and radiographic evidence of healing, the case was deemed as successful, and DS was discharged back to his general dentist and advised to be re-referred should any issues occur.

Discussion

If the aim of root canal therapy is to resolve infection, then it could be assumed that the strict definition of endodontic success is to achieve complete resolution of apical periodontitis. This would mean that even in the absence of clinical symptoms and the presence of a comparatively reduced radiographic apical lesion, this case would still be considered a failure. However, it is well recognized that healing is a dynamic process that can take between 2 to 5 years to occur, and an appropriate follow-up period is required to truly determine if success has been achieved (Eriksen, Ørstavik, Kerekes, 1988; Byström, et al., 1987; Ørstavik, 1996). This is echoed in the quality guidelines, which recommend an annual follow-up period for up to 4 years at which only then can failure be determined (European Society of Endodontology, 2006). Therefore, at this stage, describing outcomes dichotomously as a success or failure may not be representative of the dynamic healing process that is occurring.

Figure 11: Postoperative radiograph

Figure 12: Twelve-month postoperative radiograph

It is well recognized that healing is a dynamic process that can take between 2 to 5 years to occur, and an appropriate follow-up period is required to truly determine if success has been achieved.

However, one such classification system that does take this into account is the one set out by Friedman and Mor (2004) where endodontic outcomes are described as being either "healed," "healing," or "diseased." The most appropriate term for this case would be "healing" due to the absence of clinical symptoms and the significant reduction in the mesiobuccal periapical radiolucency at the 12-month review. This restoration of function would translate to an overall "good" outcome and will require further review to assess if the well-corticated apical lesion has completely healed, which would then become an "excellent" outcome. Technically, the outcome meets all of the desirable criteria outlined in the quality guidelines and would be considered an "excellent" outcome in this context (European Society of Endodontology, 2006).

Conclusion

Overall, this case encompassed a combination of several complicating factors that challenged the author's endodontic clinical skills and knowledge. The author has learned to be insightful and critical of his own work, to employ a systematic strategy to manage complications, and the value of using the literature to overcome challenges and develop as a clinician. EP

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Repair of furcal iatrogenic perforation with MTA

PERU

1. Mineral trioxide aggregate (MTA) has been frequently used as material of choice for perforation repair, pulp capping, and apexification since its introduction in _____.
   a. 1965
   b. 1978
   c. 1993
   d. 1999

2. MTA is a mineral powder that consists of hydrophilic particles, which comprises principle components of _____ and other mineral oxides.
   a. tricalcium silicate
   b. tricalcium aluminate
   c. tricalcium oxide
   d. all of the above

3. MTA has a pH of 12.5 and sets in the presence of moisture in approximately _____.
   a. 20 minutes
   b. 1 hour
   c. 2 hours
   d. 4 hours

4. The repair capacity of MTA can be attributed to the _____ properties and high pH (12.5) of MTA.
   a. antimicrobial
   b. rapid dissolving
   c. natural
   d. anticoagulant

5. These characteristics of MTA _____ the cementum and formation of bone.
   a. promote growth of
   b. inhibit growth of
   c. cause deterioration of
   d. have no effect on

6. Furcal perforation is usually an undesired complication that can occur during _____.
   a. preparation of endodontic access cavities
   b. exploring canal orifices of multirooted teeth
   c. both a and b
   d. restoration of carious lesions

7. These undesirable situations, such as _____ occur during attempts to locate canals or as a direct result of failing to achieve straight line access to the canals.
   a. excess removal of tooth structure
   b. perforation
   c. infection
   d. both a and b

8. (In the case study) The hemorrhage was controlled with copious irrigation with 2.2% _____.
   a. epinephrine
   b. ferric sulfate
   c. sodium hypochlorite
   d. calcium sulfate

9. (In the case study, after the hemorrhage was controlled) The extruded GP was carefully _____.
   a. repaired
   b. medicated
   c. removed
   d. disinfected

10. (For this case) The root canal system was medicated using calcium hydroxide, and the access cavity was temporarily filled with _____.
    a. zinc-oxide eugenol
    b. glass ionomer cement
    c. calcium sulfite
    d. zinc oxide/calcium sulfate

Endodontic retreatment of a maxillary first molar

VIRDEE

1. Regardless of its many favorable properties, _____ is still unable to dissolve the inorganic component of the smear layer (American Association of Endodontists, 2011).
   a. sodium hypochlorite
   b. citric acid
   c. phosphoric acid
   d. ammonium bromide

2. This mineral film, which covers instrumented walls, can harbor residual microorganisms and impede the ability of _____ to penetrate deep into the dentine tubules, reducing its overall antimicrobial effect.
   a. phosphoric acid
   b. citric acid
   c. sodium hypochlorite
   d. ammonium bromide

3. (In this case) To achieve a more thorough disinfection, a _____ penultimate rinse of 17% EDTA was carried out upon completion of all mechanical instrumentation.
   a. 1-minute
   b. 5-minute
   c. 10-minute
   d. 12-minute

4. (In this case) Throughout the procedure, any change in solution was preceded by a _____ flush to neutralize the effects of the former irrigant.
   a. water
   b. saline
   c. sodium hypochlorite
   d. Framycetin sulfate

5. (In this case) Initially, the GP was coated with a(n) _____ based sealer.
   a. zinc-oxide eugenol
   b. bismuth trioxide
   c. calcium hydroxide
   d. oleo resin

6. (In this case) The remainder of the canal was then obturated with thermoplastic GP in _____ increments using the Obtura™ system.
   a. 1 mm
   b. 2 mm
   c. 3 mm
   d. 4 mm

7. (In this case) Initially, _____ of flowable composite was used to seal the orifices of the canals, and then a direct hybrid composite restoration was used to restore the lost tooth substance.
   a. 1 mm
   b. 2 mm
   c. 3 mm
   d. 4 mm

8. (In this case) Although there was no mesial marginal ridge, a substantial amount of natural tooth structure was preserved, and the remaining cusps retained a critical thickness of _____.
   a. 1.0 mm
   b. 1.5 mm
   c. 2.0 mm
   d. 2.5 mm

9. However, it is well recognized that healing is a dynamic process that can take _____ to occur, and an appropriate follow-up period is required to truly determine if success has been achieved.
   a. between 2 to 6 weeks
   b. between 6 months to a year
   c. between 2 to 5 years
   d. between 6 to 7 years

10. This is echoed in the quality guidelines, which recommend an annual follow-up period for up to _____ at which only then can failure be determined.
    a. 1 year
    b. 2 years
    c. 3 years
    d. 4 years

Gain extra credit through educational opportunities

Jordan Reiss discusses the benefits of pursuing continuing education

Endodontists understand the power of "Continuing Education" with a capital CE. Licensed professionals who want to continue to practice in their state must earn a certain number of credits each year to keep up with the latest techniques and technology. However, I'm a passionate advocate of going above and beyond these required credits. Continuing education (lowercase, you'll notice) not only enhances the way you practice, but also makes the way you practice more enjoyable. If you look for opportunities to learn, you'll discover there are tips and tricks hidden within the systems and software you're already using that will help improve your diagnosis and treatment planning. Also, taking the initiative to pursue education on your own time, on your own terms, and based on what interests you (or meets the needs of your practice) puts a bit of "fun" back into learning. Other powerful benefits include:

Enhanced diagnoses

First and foremost, advancing your education should help you reach more efficient and accurate diagnoses. Lifelong learners are always in the know about the "next big thing." By seeking out educational opportunities, you not only improve the current way you make diagnoses, but you also gain unique insight into the latest techniques and technology that will benefit you and your patients. Seeking the guidance of expert trainers and/or networking with other doctors (if attending a hands-on course) lets you know what you're doing right in your practice and also what areas you may want to update and improve upon.

The competitive edge

Familiarizing yourself with new ways of practicing and advanced workflows ahead of other doctors gives you an edge when attracting patients and working with referrals. You can impress others with your knowledge and ahead-of-the-curve thinking while being able to market your skill and advanced technology.

A more collaborative team

A focus on education should extend to the entire team. Introducing new technology, such as a cone beam computed tomography (CBCT) system, can be viewed as a disrupter to practice workflow. However, providing continuing education for all team members, from the front office to the back, helps your staff understand how their roles relate to a new imaging system — yielding greater success.

Adopting a multidisciplinary approach

In a previous article, I discussed whether endodontists should be placing implants. Doctors I spoke with told me that they would, in fact, be open to the idea of doing so. Other endodontists would prefer to focus on more trauma cases or more complicated surgical cases. Even endodontists who aren't ready to take those next steps still ought to use their 3D software to work more seamlessly

Jordan Reiss is the national sales director of 3D imaging for Carestream Dental and assists practitioners in the transition to various digital technologies. He has spoken at numerous events on different facets of 3D imaging, conducted hands-on events for more than 1,000 clinicians, and has extensive knowledge of the vast landscape of 3D systems available in the market. He holds an MBA from Vanderbilt University.

with referrals. This multidisciplinary approach requires endodontists to stay up-to-date on technology, so they can expand the way they practice.

Considering these benefits, if you decide you want to pursue continuing education for yourself and your team, the following criteria will ensure you're getting the most out of your training. Continuing education should be:

Accessible

Many doctors' busy schedules leave them with the impression that continuing education, beyond what is required by the state, is out of the question. Fortunately, Carestream Dental has taken this into consideration and offers education in multiple formats to suit different schedules and learning styles. There's free online training that's open to everyone, as well as more comprehensive training for customers; free monthly webinars, in both basic and intermediate tracks; and hands-on training at many locations around the country. We also partner with various companies, such as implant manufacturers, or associations, such as the AAE, to provide hands-on courses. So it's easily accessible or timed to be in conjunction with another event.

Ongoing

Last year, I wrote an article about what to look for when purchasing a CBCT system. It may have surprised some doctors that I listed "ongoing training" as a must-have. CBCT manufacturers should all offer on-site training after a system has been installed. But if you limit yourself to only that initial training, you'll stop learning what CBCT can do for you the moment the company trainer leaves the practice. Instead, doctors should consistently expand upon what they have learned by seeking out training opportunities throughout the year, such as a 3D hands-on course.

Consumable

In today's digital age, learning has evolved beyond the traditional classroom or lecture-style format, which doesn't fit everyone's learning style. And, since this is education you're pursuing on your own time, it doesn't need to be as formal as a course designed to earn CE credit. I recently developed a series of four short — only about 2 to 4 minutes each — videos for CS 3D Imaging software users to specifically learn how to share and report on 3D cases with patients and referrals. They're concise and to the point — yet addictive. I like to think of them in terms of those silly YouTube® cat videos: You have a few minutes of free time and tell yourself, "I'm going to watch only one," but before you know it, you've watched 10 (or more). They're engaging, easy to "consume" in short "bites," and usually lead you to similar videos. But unlike cat videos, these educational videos leave you with tips and tricks for making your software work harder for you.

First and foremost, advancing your education should help you reach more efficient and accurate diagnoses.

State-mandated CE credits are vital for demonstrating that doctors are treating patients using the latest, safest techniques and technology. Endodontists who want to further enhance their diagnoses, provide state-of-the-art patient care, expand the treatments their practices can offer, and give their teams the knowledge they need to succeed and work better with referrals will find there are many accessible, ongoing, and consumable learning opportunities available if they just know where to look. Whether you're a Carestream Dental user or not, you can find learning opportunities such as the ones mentioned previously at carestream-dental.com/learn3D. EP

How social media can help your SEO performance

Ian McNickle, MBA, discusses the impact of search engine optimization

By now most people are aware of social media and its prevalence in the world. Over 70% of U.S. adults who are online use Facebook®, and around 30% use other popular channels such as Instagram®, Pinterest, Twitter®, and LinkedIn®. As I lecture around the country, one of the most common questions I encounter focuses on the actual benefits of social media for a practice.

Social media itself can have numerous benefits for a practice, but the focus of this article is on the impact of search engine optimization (SEO). SEO commonly refers to the set of activities that affect how a website will rank on Google® and the other search engines. Google looks at over 200 variables to determine how highly to rank a website for a given set of terms and geography.

Google says social media is not a ranking factor

What is interesting about social media is that Google has stated that social media is not a ranking factor. However, many SEO agencies have done studies and found a high correlation with certain aspects of social media and search rankings. If you create interesting posts, and lots of people interact with your posts, then the shares create links back to your social media pages and to your website. Incoming links to your website are a well-known factor to help SEO rankings.

In the dental industry, the most important social media channel is clearly Facebook due to its large audience and useful business tools (boosted posts, geo-targeted ads, and engagement dashboard). A well-designed Facebook campaign would include a large percentage of "personal"-type posts, which highlight the personality and human side of the practice.

Ian McNickle, MBA, is a national speaker, writer, and marketer. He is a Co-Founder and Partner at WEO Media, winner of the 2016 Cellerant Best of Class Award for Online Marketing and Websites. If you have questions about any marketing-related topic, please contact Ian McNickle directly at ian@weomedia.com, or by calling 888-246-6906. For more information, you can visit online at www.weodental.com.

For example, let's say it's Sally's birthday, and you're all in the break room having some birthday cake. Someone feeds Sally a piece of cake and smears it on her face. Everyone laughs! Since you caught this on video with your phone, you can easily post it to your practice Facebook page. This type of post will generate FAR more engagement (and potential SEO benefit) than your clinical posts. While you should have clinical topic-type posts, please remember the personal posts will generate much more engagement.

The key is to create frequent and interesting content on Facebook in order to generate positive SEO benefit.

What about YouTube

While most people understand Google is the largest overall search engine, many find it surprising to learn YouTube is the second largest search engine. The major difference is, of course, people searching on Google are in "research/buying" mode, whereas searchers on YouTube are in "social" mode. This means despite the massive search volume on YouTube, people are not using YouTube to search for a dentist or specialist.

So how does YouTube help with SEO? The best strategy for using YouTube is to create a series of videos that are hosted on YouTube and also reside on other online properties such as your website, Facebook page, etc. Google and other search engines look at videos as high-quality content (assuming they are properly optimized with a title and description). Therefore, embedding videos into your website should help the website SEO and search rankings.

Since Google purchased YouTube years ago, Google has integrated YouTube videos into their search results. Let's say you have 10 videos on your YouTube channel. If you properly optimize these video titles and descriptions, then there is a chance some of these videos can appear in search results just like your website. This essentially multiplies your online presence.

While there are many aspects of social media that can help your online marketing efforts, we highly recommend posting frequent, interesting content on Facebook, and leveraging videos on YouTube, Facebook, and your website. These simple strategies can yield nice results indeed.

Marketing consultation

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MATERIALS & EQUIPMENT

Palmero announces X-Ray Apron Recycle/Trade-In Program

Palmero Healthcare, a subsidiary of Hu-Friedy, is pleased to announce its latest green initiative, Palmero's X-Ray Apron Recycling Program. The new eco-friendly and environmentally responsible program rewards participants for supporting greener dentistry. According to the EPA, recycling lead aprons is the preferred method since it keeps lead out of landfills. All materials will be responsibly disposed of, and all lead liners will be properly distributed for processing back to base material.

Here is how to recycle: RECYCLE 1 X-Ray Apron Receive 1 Free Apron Hanger

1. Purchase a new Palmero X-Ray apron.
2. Collect old or unwanted X-Ray apron of any brand.
3. Contact Customer Service for a Return of Authorization Number (RA#) to register for recycling.
4. Submit invoice with RA# via Fax 203-377-8988, or email customerservice@palmerohealth.com. Include ship-to address, phone, and email.
5. Ship your old apron with RA# for responsible disposal to:
   Palmero Healthcare LLC
   Attn: X-Ray Recycle/Trade-In Program
   120 Goodwin Place
   Stratford, CT 06615
6. Acquire a new X-Ray apron hanger, an $18.00 retail value for your participation.

For more information, visit www.palmerohealth.com.

Dentsply Sirona expands and extends relationship with Pacific Dental Services, LLC

The Dental Solutions Company™ announced that the Company has again extended and expanded its relationship with Pacific Dental Services, LLC (PDS). The new, larger 5-year agreement between Dentsply Sirona and PDS will provide PDS and the more than 1,600 dentists they support with access to new technologies, and unique marketing, sponsorship, and training opportunities, in addition to the entire Dentsply Sirona consumables offering. In 2012, the two companies set an industry record that resulted in CEREC® CAD/CAM technology being integrated into every PDS-supported practice. The latest agreement continues providing PDS-supported practices with leading Dentsply Sirona equipment and technology such as CEREC and the entire consumables portfolio. PDS supports over 580 dental practices in seventeen states.

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Vista Dental Products introduces the VALIANT™ LED curing light that produces uniform, high-intensity light in the 395-500 nm wavelength range. As a multi-spectral curing light, VALIANT™ is capable of polymerizing nearly all light-cured dental materials, making it one of the most versatile curing lights on the market. The VALIANT™ combines an optimized clover-shaped LED arrangement with precision optics to provide a uniform beam through three curing modes (standard, ramp, boost) for user preference. The irradiance is 1,200 mW/cm² for standard and ramp modes, and 2,500 mW/cm² in the boost mode. The VALIANT™ also has a transilluminator for detecting fractures, cracks, and residual caries. The VALIANT™ is ergonomic in style and lightweight, weighing just 72g/2.5oz, and its one-button operation is intuitive and makes it easy to use. It is cordless and contains an inductive-charging removable battery provides >= 150 - 20 second-curing cycles. The VALIANT™ curing light starter kit comes with the handpiece, two rechargeable batteries, a charging base, 100 protective sleeves, and a light-attenuating shield.

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A new expandable NiTi file for residual canal debris removal

Drs. James Bahcall and Stephen Weeks discuss how to efficiently aid in the mechanical removal of residual canal debris

Residual canal debris is organic and/or inorganic material that remains on the dentinal wall after conventional endodontic chemomechanical canal preparation is complete.[1]

This residual canal debris is also referred to in the literature as the smear layer. This organic and/or inorganic substance is derived from ground dentin, pulpal remnants, and in the cases of infected root canal systems, bacteria.[2]

A possible explanation for the residual canal debris after chemomechanical canal preparation is the fact that NiTi rotary files stay centered in the canal and, in turn, will not make contact with all the dentinal walls due to various invaginations and irregularities.[3] An in vitro study by Chuste-Guillot demonstrated that whichever NiTi rotary file system a clinician uses to prepare an infected root canal system, the root dentin that remained was infected and not bacteria-free.[4] Lin, et al., report that the major factors associated with endodontic failures are the persistence of bacterial infection in the canal space and/or the periradicular area.[5]

Another explanation of the presence of residual canal debris after canal instrumentation and irrigation may be due to a clinician not being vigilant in using EDTA (ethylenediaminetetraacetic acid) and sodium hypochlorite.[6] Lastly, canal morphology can be complex, making it difficult for the chemomechanical canal preparation to be effective in removing all the canal debris.[7]

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Disclosures: Drs. James Bahcall and Stephen Weeks have no financial interest in any of the products mentioned in this article and received no compensation for writing this article.

Figure 1: XP-3D Finisher file (ISO #25)

Figure 3: XP-3D Finisher file is malleable at room temperature

Figure 2: XP-3D Finisher file in A-phase, allowing up to a hundredfold expansion. Permission for reprinting of image granted by Brassler USA®

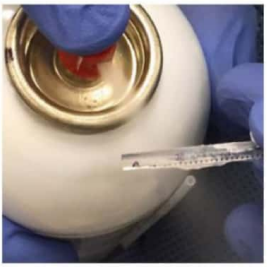

Figure 4: Spraying Endo Ice® over the XP-3D Finisher file casing

The three main factors in removing residual canal debris are irrigation activation plus mechanical and chemical debridement. Irrigation activation with an ultrasonic, polymer finishing file, polymer ultrasonic tip, positive pressure syringe, and negative pressure device have all demonstrated various abilities in removing residual canal debris.[7,8] The basis of irrigation activation is to create fluid motion and dentinal wall shear stress to enable the removal of residual canal debris from the dentinal walls. An in vitro study by Koch, et al.,[9] found that the fluid shear stress observed from static position and cyclical axial motion of ultrasonic, a polymer finishing file, and positive pressure needle irrigation does not activate the irrigant powerfully enough to clinically remove residual canal debris alone after conventional endodontic chemomechanical treatment. They also reported that cavitation is not achieved during this type of irrigation activation, but rather non-inertial cavitation.

Mechanical removal of residual canal debris is performed through the physical contact of a file or irrigation activation instrument with the dentinal wall. Chemical removal of residual canal debris is achieved with the use of the sodium hypochlorite (NaOCl) and ethylenediaminetetraacetic acid (EDTA). The use of EDTA, as a chelating agent (removes calcium ions), in conjunction with NaOCl has been shown to aid in the removal of some, but not all of a canals residual debris.[10]

Although all three factors (irrigation activation plus mechanical and chemical debridement) can aid in removing residual canal debris, mechanical contact with the dentinal wall is the most direct and efficient method in the removal of dentinal wall residual debris.

Clinical usage of the XP-3D Finisher™ file

The introduction of a new expandable NiTi file, the XP-3D Finisher™ file (Brasseler USA®) (Figure 1), offers an innovative instrument for mechanically cleaning the dentinal walls after chemomechanical canal preparation.

The XP-3D Finisher file comes in ISO #25 and #30 sizes with a zero degree taper. It

is made of a proprietary alloy that, at room temperature, exists in a Martensitic phase (M-Phase) and at body temperature exists in an Austenitic phase (A-phase). In the M-phase, the file is straight.[11] In the A-phase, the file changes it shape to allow the instrument to expand its reach to 6 mm in diameter or hundredfold when the file tip is squeezed while in rotational motion[12] (Figure 2).

Since the XP-3D Finisher file is in the M-phase at room temperature, it is malleable (Figure 3), and therefore, a clinician may find it difficult to initially place into a canal. By using Endo-Ice™ (Coltene® Group, Altstätten, Switzerland, with American headquarters in Cuyahoga Falls, Ohio) and spraying it over the casing that the file comes in (Figure 4), it will cause the file to become stiffer, making it easier to guide into a canal. A dentist can also directly wipe the file out of the casing with an alcohol gauze, and it will provide the same stiffening effect as using Endo-Ice™.[13]

Prior to using the XP-3D Finisher file in a canal, set the working length, and make sure EDTA and/or NaOCl is in the canal. The optimal speed for the clinical usage of the XP-3D Finisher file is 800-1000 rpm with 1 Ncm of torque. It is recommended to be used as a single use file with up to four canals in one tooth.[11,12,14] The file should be used clinically by using slow and gentle 7 mm-8 mm lengthwise cyclical-axial movements to the full length of a canal while filing against the canal wall in a circumferential motion. After file usage, irrigate the canal with NaOCl and/or EDTA.[11]

Regenerative endodontics

The XP-3D Finisher file can also be used for regenerative endodontic procedures. It can aid in canal preparation without further enlarging a canal. Just as it "scrapes" pulpal canal debris off the dentinal walls in conventional endodontic treatment, it will do the same in regenerative endodontic treatment. The file can also help stimulate apical bleeding in the apical region. After the removal of the calcium hydroxide or triple antibiotic paste at the second treatment appointment, the XP-3D Finisher file can be activated 1 mm outside the main canal portal of exit (POE) to stimulate bleeding within the canal.

Summary

The integration of the XP-3D Finisher file into your endodontic armamentarium will effectively and efficiently aid in the mechanical removal of residual canal debris. This file's ability to expand makes it better able to adapt to the various canal morphologies. The XP-3D Finisher file is also effective in removing canal wall debris without enlarging the canal and stimulating apical bleeding in regenerative endodontic treatment. EP

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Microscopes and ultrasonic preparation

Dr. Tony Druttman discusses the role of operating microscopes in conjunction with ultrasonics in the preparation of root canal systems

The purpose of preparation of the root canal system is well understood, and contemporary techniques involve the use of both hand and rotary instruments in conjunction with an irrigation regimen. However, the complexity and variability of root canal morphology can make effective preparation very challenging, particularly in canals with irregular cross sections.

Current techniques are not always completely effective, and it has been well recognized that while some parts of the root canal are overprepared with rotary instrumentation, other surfaces are not touched. One study concluded that at least 35% of the canal surface area had remained untouched by rotary preparation (Peters, Schonenburger, Laib, 2001). In another study, the results were even worse: 60%-80% untreated surfaces were left in the distal canals of lower molars, with 65%-75% in the apical 4 mm after preparation (Paqué, et al., 2010). Oval canals are particularly challenging as the debris collects in the extensions and in isthmuses (Figures 1A and 1B).

A review of preparation techniques states that "because of limited efficacy of irrigation in such recesses, debris and smear layer may accumulate and remain on these unprepared root canals walls, decrease the quality of obturation, and jeopardize the long-term treatment success" (Hülsmann, Peters, Dummer, 2005). A major cause of endodontic failure has been attributed to the presence of microorganisms persisting in the apical part of the root canal (Siqueira, 2001). Much attention has therefore been focused on preparation and obturation of the apical part of the canal, thereby depending on the apical seal to prevent toxins from leaking out into the periradicular tissues. While success rates of endodontically treated teeth without periradicular lesions is very high, there can be a significant reduction in success in both teeth with periradicular periodontitis and in retreatment cases (Ng, Mann, Gulabivala, 2011). This is due to the failure to remove microbes from the root canal system.

The quest is to find more effective irrigants and irrigation techniques, as well as rotary files and preparation techniques to overcome these difficulties.

Figure 1A: Debris left after root treatment in distal canal of a lower molar

Figure 1B: Radiograph of failed root canal treatment shown in Figure 1A

Figure 2: Oval-shaped canal in the apical third of the distal root of a lower molar

Figure 3: Debris accumulated after preparation in the isthmus between the mesial canals of a lower molar

Established preparation techniques

An ideal preparation shape with a rotary instrument can only be achieved in a canal with a matched cross section. Many canals are variable in shape. They may have irregular and oval cross sections, and while much of the debris is captured within the flutes of the instruments, some is compacted into those spaces between the instrument and the canal wall (Figure 2).

The incidence of isthmuses in both maxillary and mandibular first molars is very high (von Arx, 2005). They are particularly liable to have an accumulation of compacted debris after preparation, and the inability to clean these areas effectively has been implicated as a major cause of root canal treatment failure, particularly in both mandibular and maxillary first molars (Figure 3) (Hsu, Kim, 1997; Tam, Yu, 2002).

The more the debris is compacted, the more difficult it is for chemicals such as sodium hypochlorite and calcium hydroxide to penetrate through the interface. Paque, et al., 2010, reported that approximately half of the debris

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that accumulated during rotary instrumentation of the mesial canals of lower molars remained in the canal system after irrigation.

Failure of endodontic treatment in maxillary molars has often been attributed to the failure to locate and treat the MB2 canal (Weine, et al., 1969; Wolcott, et al., 2005). Various studies have shown the presence of the MB2 canal in up to 90% of maxillary first molars. A study by Somma, et al., 2009, showed that in 58% of teeth, the MB1 and MB2 merge apically into one canal. In a proportion of these failed cases, where the MB1 canal has been located, cleaned, shaped, and obtruded well, the question should be asked: 'was the failure due to inadequate treatment of the apical part of the MB1 canal, or because the MB2 canal and isthmus between the two canals had been missed?'

In these cases of joined MB canals, identification and treatment of the MB2 canal with concommitant retreatment of the MB1 canal often leads to healing. This suggests that the seals are not always good enough to "entomb" the bacteria. Indeed, coronal microleakage has been implicated as a major cause of failure of endodontic treatment (Saunders, Saunders, 1990). Undoubtedly, tracts of debris running alongside root fillings are conduits for bacteria to cause failure by this method.

In an in vivo study by Nair (2005), the mesial canals of 16 lower molars with infected root canals were root treated by conventional techniques in a single visit, and the apical portions removed by flap surgery and evaluated by corrective light and transmission electron microscopy. In the majority of cases, residual microbes were located in inaccessible recesses, uninstrumented areas of the main canals, accessory canals, and intercanal isthmuses. If the lateral extensions feed into the apical part of the canal, then removing bacteria and nutrients from these areas reduces the bacterial load, and this has to be beneficial for the outcome of treatment.

A variety of techniques have been proposed to overcome the inadequacies of mechanical preparation in non-circular canals, including circumferential filing using both hand and rotary files and the use of a rotary file that adjusts to the shape of the canal. The self-adjusting file (SAF) system has been shown to be more effective in cleaning oval canals than conventional rotary nickel-titanium instruments. However, in the study by De Deus, et al., 2011, using mandibular canines, even this technique did not render the canals completely clean. They showed that rotary files were unable to access the recesses of oval canals and that sodium hypochlorite had a "limited ability to compensate for the inadequacy of the file itself."

They further suggested that "the common belief that 'the file shapes; the irritant cleans' is based more on wishful thinking than on experimental facts." In a review article by Metzger (2014), it was recognized that SAF was unable to prepare the narrow isthmus of less than 0.2 mm. In the case of the narrow isthmus, the challenge is to deliver sufficient quantities of irrigant effectively into a very small area in which debris has been compacted during preparation.

Instruments and research

Recently, new concept files — XP-3D Finisher™ (Brasseler USA®) — that change their shape with temperature have been developed with the expectation that they can deal with canal irregularities. While these may be helpful in removing soft tissue in non-circular canals, they may be of limited value in situations where tissue or root filling materials are strongly adherent to the root canal wall.

Among the numerous irrigation techniques that have also been proposed, there are those that include the use of ultrasonic energy.

Figure 4: Acoustic microstreaming patterns produced by an ultrasonically energized K-file

Figure 5: Inspection of a prepared oval-shaped distal canal of a lower molar reveals residual debris apically

Ultrasonics have played a role in endodontics for many years. Initially, ultrasonic canal preparation was introduced by Richman (1957) and in subsequent years, there was a vogue for using the ultrasonically energized file to cut dentin in root canals. The technique fell out of favor because lack of control produced ledges, apical perforations, and instrument separation (Lumley, Walmsley, 1992). In the 1980s, research showed that passive ultrasonic energy (PUI) rendered canals clean more effectively than ultrasonic irrigation with simultaneous instrumentation where the file is intentionally brought into contract with the canal wall (Weller, Brady, Bernier, 1980; Ahmad, et al., 1987a).

PUI uses an ultrasonically energized file to irrigate the canal and to remove debris utilizing a combination of acoustic microstreaming and cavitational energy (Ahmad, et al.,1987 and1988; Ahmad, Roy, Kamarudin, 1992) (Figure 4). PUI was found to be effective in the apical part of curved canals and in the isthmus area between two canals. The technique has been shown to remove tissue more effectively than hand irrigation and does not cause damage to the canal wall (Gutarts, et al., 2005). Variation in the efficacy of PUI reported in some studies was explained by difficulties in standardizing the position of the instrument in the center of the canal (van der Sluis, 2007).

Ultrasonic preparation technique

Since the introduction of the operating microscope, it has been possible to carry out endodontic treatment at varying magnifications up to approximately 25x with the aid of direct light that can penetrate into the depths of the root canal. This means that visual inspection of the prepared root canal is possible. Once the canal has been shaped by conventional techniques and dried, the canal can be visually inspected both apically and laterally into the extensions of the canal.

Straight canals can be inspected to the apical constriction. Since the rotary files straighten the coronal and middle thirds of curved canals, most of these prepared canals can be inspected to within a few millimeters of their full working length. Inspection through the microscope at about 10x and above can identify those parts of the canal system that have not been touched by the rotary files and contain residual tissue (Figure 5). These are usually the extensions of oval and flattened canals, isthmuses, and fins.

The challenge is to prepare these areas producing a smooth, predictable shape, without removing excessive tissue, allowing irrigants to penetrate into the canals more fully, and therefore producing cleaner canals. Our expectations are that delivery of irrigants and medicaments, using a variety of techniques into these parts of the canal anatomy will digest residual tissue material and entomb remaining bacteria, rendering them ineffective.

While they have undeniable advantages in the parts of the canal system that cannot be inspected under the microscope, a significant part of the bacterial load within the canal can be removed by the use of a cutting instrument directed towards a specific part of the root canal such as a fin or isthmus. In the coronal part of the canal, this can be done with either a long shank rosehead bur or a dedicated ultrasonic instrument.

Long shank burs are very limited in their use, however, because of the length of the shank, relatively large diameter of the bur, the lack of visual access. Also, they can only be used in the straight part of the canal. In the deeper parts of the canal, ultrasonically activated instruments can be used to great effect.

A very effective solution is to use an ultrasonically energized K-file (UEFK), the very instrument that was discarded after the problems identified with ultrasonic instrumentation in the 1980s. The difference between then and now is that in conjunction with the use of the operating microscope, the instrument can be used with a great deal of control. Also, power settings have been considerably reduced to minimize the possibility of instrument separation.

In many situations, the UEKF overcomes many of the limitations presented by other ultrasonic instruments. The file can be curved in multiple directions so that the head of the ultrasonic handpiece does not impair visual access, and the file can be shaped to follow the curvature of the canal.

When used in conjunction with the operating microscope, the file can be directed to the part of the canal that has not been prepared by the rotary files. A size 20 UEKF with a 2% taper is an optimal size (Mani U files), although occasionally, a larger file may be used. Because the file is relatively flexible and removes only 0.2 mm of tissue, unnecessary removal of dentin is kept to a minimum (Figure 6).

Figure 6: Ultrasonically energized K-file used to prepare an isthmus under the operating microscope

The file works in multiple ways; it can be easily pre-curved to follow the canal curvature and can be used as either a cutting instrument by engaging the tip or as a planing instrument by using the flutes along its working length. When used as a planing instrument, it can be used with variable pressure against the walls of the canal such as in an oval canal extension or in an isthmus. The greater the pressure applied, the more effectively the file cuts dentin in the same way as a hand file at the expense of the ultrasonic effect.

As the pressure on the file is reduced, so the ultrasonic effect is increased, achieving the benefits of PUI. The effectiveness of this technique is enhanced by both the flexibility of the K-file so that it can be pre-curved, and its rigidity so that it can cut efficiently into a targeted area. The instrument can be used in both modes interchangeably just by varying the lateral pressure placed on the ultrasonic handpiece.

In endodontic retreatment cases, both the UEKF and the dedicated ultrasonic tips can be used to great effect to remove endodontic obturation materials, separated instruments, and posts using minimally invasive techniques. While the UEKF has to be used at low power settings to minimize the possibility of fracture, it allows for excellent visual control.

The dedicated ultrasonic tips such as the Endo Success™ ET25 tip (Satelec) can be precurved to improve visual access and can be used at higher power settings. It is, however, only effective at its end. This tip is particularly useful for removing separated instruments. Other ultrasonic tips that cannot be pre-curved and can only be used in straight parts of the canal.

The removal of gutta percha from oval canals often presents a challenge as rotary instruments are not completely effective. A rigid ultrasonic tip is more like to plasticize the gutta percha, while the UEKF with its increased tip amplitude, fragments the material allowing it to be removed from the canal during irrigation.

Conclusion

Both ultrasonics and microscopes have become an essential part of the armamentarium in endodontics. When used together, they can produce minimally invasive preparations, and produce cleaner canals in both primary and retreatment cases. Conventional irrigation strategies should always be employed, particularly in those areas of the canal system that cannot be visually

inspected with the operating microscope such as in the curved apical third. However, the technique described previously requires little addition to the armamentarium an endodontic practice should already possess and can aid in the reduction of the bacterial load within the canal system, and this can result in more predictable outcomes. EP

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Making a path outside of the operatory: two inspiring stories

Dr. Rich Mounce discusses two companies that have had a positive clinical effect on endodontics

This column tells the inspiring stories of two innovative and visionary endodontists who are deeply impacting the present and future of our specialty. Coincidently, both are from Brazil.

Out of a passion to innovate, Dr. Alexandre Capelli began to grind ultrasonic tips in Brazil, which was the start of Helse tips. Starting with otherwise pedestrian commonly available tips, in my clinical opinion, he valued added features and benefits to produce the finest ultrasonic tips available anywhere, at any price. In the beginning, the going was so tough that he was forced to move his family in with his parents to make ends meet. Now, Helse grows exponentially in Brazil, the United States, and beyond.

Dr. Henrique Bassi's story is similar. Starting from a firm conviction that foreign firms were profiteering in Brazil with inferior nickel-titanium instruments, he bought a CNC grinding machine and started manufacturing NiTi instruments. Now, his company, Easy Odontologicos, is the largest manufacturer and seller of nickel-titanium instruments in Brazil, outpacing Dentsply, FKG, VDW, and others. In addition, Easy is one of the top producers of endodontic devices (motors, obturation units, etc.) in Brazil.

In my hands clinically, the ProDesign Logic instruments that Easy manufactures are the most efficient, safe, and technically advanced heat-treated endodontic files made globally.* Using the files as recommended is by definition minimally invasive, and the system represents a true one-file system. Coincidently, Logic is comparable in price to the least expensive competitor's file. The published scientific research on Logic and that submitted for publication is overwhelmingly favorable.

Drs. Capelli and Bassi share a number of similar characteristics. Both are tireless workers. There are few days off. Both also have extensive key opinion leader networks in Brazil to test prototypes, manufacture new designs, and take market feedback to provide constant improvement. Neither started with a lot of money, and neither had anything even remotely close to a guarantee of success. Neither ever cheated on anyone's intellectual property and/or cut corners. Both are educators and give many CE courses in their home country.

As an aside, endodontics in Brazil at the highest level is certainly equal to the quality of that practiced at the highest level in North America. I might also add that the Brazilians do endo with a certain flair and style that, despite the cliché, can only be described as very colorful and attractive (great documentation, video, photos, research, etc.). Brazilian research stands up to the best research done anywhere in the world. There are many immensely talented Brazilian clinicians. There is no place for sloppy products in Brazil because the market is too demanding, and the competition for endodontists is far more intense than in the U.S. with approximately 3 times the number of endodontists in Brazil to serve a much smaller population. Helse and Easy rise to the challenge in these conditions and are both commercially and clinically successful.

While it is true that the Brazilian market has economic barriers to products manufactured in the U.S., how many of us complain about our iPhones® or cars that are manufactured in Asia at much lower prices than if they were manufactured domestically? Perhaps the way to overcome the trade barriers for American manufacturers might be to develop new and improved manufacturing methods to compete in Brazil. Perhaps this is the opportunity for a future innovator who chooses to follow in the footsteps of these two emerging giants. EP

Rich Mounce, DDS, has lectured and written globally in the specialty. He owns MounceEndo.com, an endodontic supply company also based in Neskowin, Oregon. 605-791-7000. He can be reached at RichardMounce@MounceEndo.com, MounceEndo.com.

*Disclosure: Dr. Mounce is the General Manager of Easy Endo USA and has a commercial interest in ProDesign Logic Files. Easy Endo USA is the American arm of Easy Odontologicos, which is owned by Dr. Henrique Bassi. Dr. Mounce has no financial interest in Helse of any kind at this time; previously MounceEndo was a dealer for Helse.

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†Dr. Mario Tanomoro-Filho, São Paulo State University–UNESP, submitted for publication.

‡Coelho, et al. Braz Dent J. 2016 Mar-Apr; 27(2):217-22.

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What we don't know continues to hurt us

Dr. Joel C. Small discusses self-awareness and motivation to change

Extensive research into behavioral change has identified various stages that lead to purposeful and sustainable behavior modification. The transtheoretical model (Prochaska and Velicer, 1997) of behavioral change describes an initial stage of "precontemplation" in which people are unaware that a behavioral problem exists and, therefore, fail to recognize the consequences of their behavior.[1] Such individuals show little interest in changing their behavior because they are simply clueless that their behavior is creating a problem. Abraham Maslow, a noted American psychologist, is attributed with another similar finding that deals with the development of competence. His four stages of competence describe an initial phase of "unconscious incompetence" in which the individual fails to recognize, or is unconscious of his/her own incompetence and, therefore, is unreceptive to learning a new and useful skill that will likely move him/her toward the competence that he/she so desperately needs.

What Maslow describes is, in my opinion, the leading cause of suffering, dissatisfaction, and burnout in the healthcare industry. As a healthcare coach, I spend much of my time helping clients come to the awareness that we are often our own worst enemies by failing to recognize our behaviors that create personal and professional barriers to our fulfillment. This significant blind spot leaves us in a state of limbo — chronically suffering the symptoms of a curable malady yet lacking the capability to acknowledge its existence.

Furthermore, our formal education, while teaching us to be masterful technicians, has failed us in the arena of entrepreneurship and leadership competence. Michael Gerber, in his bestselling book, *The E Myth*, describes a technician as someone who eventually suffers disillusionment with his/her chosen profession because he/she lacks awareness of the necessary entrepreneurial skills that are essential ingredients for long-term success and fulfillment.

I see this problem often in the healthcare industry because, as technicians, healthcare providers create systems to manage and use them as a substitute for entrepreneurism and leadership. Gerber uses the analogy of a juggler with too many balls in the air. Eventually, the juggler is overcome by the task, and the first ball falls, creating a domino effect as the remaining balls follow suit. This, in my opinion, is what happens when healthcare technicians adopt a systems management approach rather than an entrepreneurial and leadership philosophy. Systems management is burdensome and tedious, and unless properly delegated, it becomes overwhelming. No wonder we are prone to disillusionment and burnout. We adopt a systems philosophy that is incompatible with our desired success and fulfillment.

Quite simply, we are not suffering because we lack intelligence or even financial success; we are suffering because we lack self-awareness and the motivation to change. Because we suffer from unconscious incompetence, we fail to recognize the real cause of our suffering and tend to blame external forces for our disillusionment. We lack the awareness that we are the ultimate arbiter of our "emotional success." Our suffering and frustration are both caused by and resolved by us. Once we come to this awareness, we can begin the process of turning frustration into fulfillment, finding passion, and creating energy where burnout once existed. By acknowledging that a problem exists and that we are the cause, we become motivated to acquire the knowledge and skill that will lead to sustainable behavioral change.

It goes without saying that we cannot solve a problem when we fail to acknowledge its existence. Some of us accept our suffering and dissatisfaction with our profession because we have come to believe that it is part and parcel of our job. We see no realistic resolution to our pain, and we begin to feel trapped and helpless. Metaphorically, we become captives in a cage with no bars.

The greatest and saddest irony of all is that our chosen profession is unique in that it offers us the greatest freedom to purposefully create our ideal environment. Many of us chose the healthcare profession for this very reason; we are our own boss. No one can fire us except our regulatory boards. We can work when we want, how we want, and for as long as we want. We can create a large mega practice or find our fulfillment in a small boutique clinical practice. The choice is and always has been ours.

Trust me when I say that many of those working in a corporate environment envy us for our degree of freedom and would gladly trade places. Currently, the level of disillusionment in corporate America is approaching epidemic levels[2] as budget restraints require more work from fewer people, and corporate layoffs along with the need for retraining have left many loyal workers unemployed with no prospect of a bright future.

The good news is that we are not meant to suffer from disillusionment and burnout. With proper guidance and the implementation of some basic entrepreneurial skills, we can find sustainable joy, fulfillment, and financial reward in our clinical practices.

If you are currently experiencing frustration or burnout with your chosen profession, seek answers now. Acknowledge that a problem exists and that you likely are the cause of the problem. Also acknowledge that you hold the key to resolving the problem. Seek help, and never accept the false narrative that pain and suffering go with the territory. With the proper mindset and the motivation to change, a better future awaits you. EP

Joel C. Small, DDS, MBA, ACC, FICD, is a practicing endodontist and the author of *Face to Face: A Leadership Guide for Healthcare Professionals and Entrepreneurs*. He received his MBA, with an emphasis in healthcare management, from Texas Tech University. He is a graduate of the University of Texas at Dallas postgraduate program in executive coaching and limits his coaching practice to motivated healthcare professionals. He is a nationally recognized speaker on the subjects of leadership and professional development. Dr. Small is available for speaking engagements and for coaching healthcare professionals who wish to experience personal and professional growth while taking their practices to a higher level of productivity.

**To receive a free copy of my "Core Values Exercise," please contact me at joel@joelsmall.com. I am also available for a complimentary coaching session to discuss your practice-related issues.

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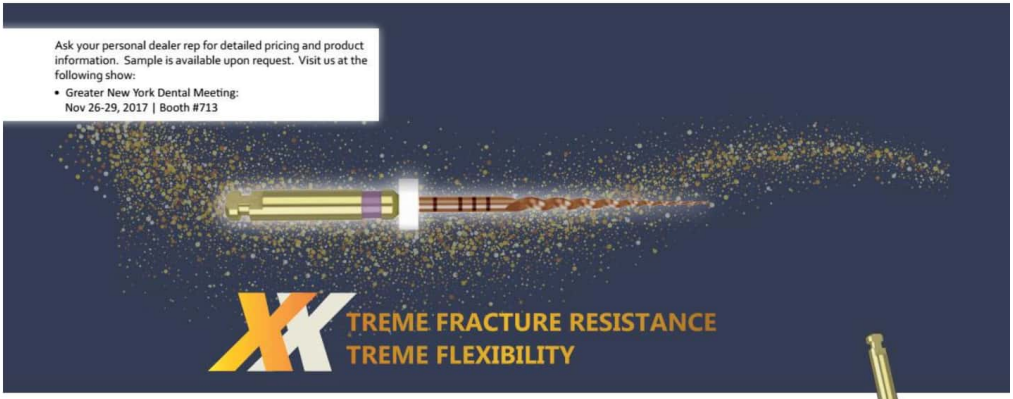

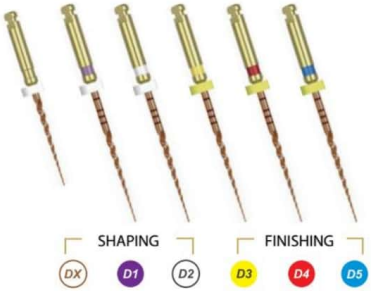

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