IN CASE YOU MISSED IT: ENDODONTICS
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Chapter 1
New Trends in Endodontics and Treatment Planning

In an interview conducted by Dr. Damon Adams, Dentistry Today’s editor-in-chief, endodontist John West, DDS, MSD, candidly expresses his thoughts on current topics and trends affecting endodontics. Dr. West is founder and director of the Center for Endodontics in Tacoma, Wash, and director of endodontics at the Interdisciplinary Dental Education Academy (IDEA) in San Francisco.

Let’s talk about some of the current trends and future issues in endodontics, John, would you like to make some opening comments to set the stage for this interview?

Dr. West: That would be great, Damon. In endodontics, we have come to a moment of reckoning in diagnosis, treatment delivery, and treatment planning. The endodontists of the future—and the future of endodontics—are at the knee of the exponential curve of change. The only constant is change, and the future belongs to those who learn from the past and adapt to change in the future. American theologian Reinhold Niebuhr once wrote about change more poignantly and eloquently: “Grant me the serenity to accept the things I cannot change, the courage to change the things I can, and the wisdom to know the difference.” My goals in giving this interview are twofold: (1) to offer wisdom, based on 35 years of clinical experience and teaching, regarding rapidly and dramatically changing trends in endodontics, and (2) to help readers anticipate and adapt to the changing world of endodontics and therefore succeed in being the endodontic clinicians of the future.

How has endodontics changed in the past 20 years?

Dr. West: There have been 4 major influential changes. First, technology and the prompt dissemination of endodontic information have transformed endodontics forever. Endodontics is now safer, more predictable, easier, and therefore more enjoyable for the dentist and the patient. It is also more profitable for the endodontic clinician and a sound investment for the patient. Second, including endodontics in an interdisciplinary approach to dentistry has become an essential part of a comprehensive treatment planning process by facilitating the endodontist’s invaluable contribution to predictable patient outcomes. Third, increased longevity means patients are living longer, and their desire to look good, feel good, and be healthy is more essential than ever before. Fourth, the value of predictably treating and saving endodontically diseased teeth now rivals implant placement success rates. Throughout the duration of these 4 changes, the classic Endodontic Triad of “disinfection, preparation, and obturation” currently remains the proven protocol for long-term endodontic success. In the past 20 years, many new endodontic technologies have enabled dentists, who have understood and embraced these 4 changes, to improve all 3 domains of the Endodontic Triad.

At the 2016 Dentsply Sirona event, SIROWORLD, in Orlando, you were asked to present and represent endodontics in the gala opening ceremony. Your title was “Endodontics: From Dark to Dawn.” Can you tell us why you chose this theme, and how understanding it benefits our readers?

Dr. West: When you think about it, endodontics is the only dental discipline where we “do it in the dark.” Can you imagine cutting a crown prep, placing an implant, extracting a tooth, or simply taking a dental impression with your eyes closed? Well, that’s exactly what we do in endodontics. We cannot
In the last 2 decades, the following 6 endodontic technologies have allowed dentists to see what we could not see before:

1. **Microscopes** enable us to prepare a successful access cavity and find all the canals, as well as facilitate the diagnosis, such as observing hairline vertical fractures. The microscope brings the dentist closer to reality through a combination of illumination and magnification that in turn improves treatment planning. Dr. Gary Carr is often credited with pioneering this transformational trend.

2. **Tooth Atlas** (ehuman.com) offers interactive 3-D visualizations of real tooth root canal systems, and we can literally practice virtual endodontics before ever treating a patient.

3. **Digital imaging** helps us read images more clearly and in more detail.

4. **Apex locators** precisely identify the physiologic terminus.

5. **Nickel-titanium (NiTi)** endodontic shaping instruments have made mechanical shaping more predictable, safer, more efficient, and easier than ever before. With improved designs and metallurgy, almost all endodontic companies produce a satisfactory NiTi file, although some are higher quality and higher value than others.

6. **3-D CBCT** permits dentists to “see” inside the patient’s tooth. As dentists, when we can see it, we can do it.

These 6 eye-opening technologies have brought endodontics out of the dark, giving dentists a new level of competency, consistency, and confidence. Seeing yields improved results, which is important because the endodontic clinicians of the future will no longer be reimbursed by procedure, but instead, by their capacity to deliver documented endodontic quality, value, and patient outcomes. This value-added care approach will be driven by performance management systems (such as csats.com). New reimbursement models represent a gigantic shift in determining the value of endodontic treatment rendered, and dentists’ procedural outcomes will be evaluated through social media, data analysis, cloud computing, gap analysis, and artificial intelligence.

What do you see as the major trends in endodontics today? How did we get here, and where are we going?

**Dr. West:** First, advanced clinical technologies in conjunction with cutting-edge clinical education have made learning the time-tested Endodontic Triad possible and are available to any dentist who wants to learn and master them. The major new technology trends in the Endodontic Triad are as follows:

- **Cleaning** the complex root canal system using the EndoActivator (Dentsply Sirona), lasers, and ultrasonic cleaning.

- **Shaping** with special heat-treated files (such as ProTaper Gold and Wave-One Gold [Dentsply Sirona]) to produce appropriately sized, minimally invasive, smooth-tapered walled preparations that were previously rare and often unattainable. Only enough dentin is removed to facilitate cleaning and develop a gentle funnel shape for easy obturation.

- **Obturation** is trending toward precision, injection-molded micronized nanoflow gutta-percha as well as next-generation carrier-based obturation. The interface layer of master cone and root canal sealer will be first blurred and then eventually eliminated. Bonding obturation materials and techniques look promising but are without long-term proof of success.

Now for a moment, I invite you to use your wildest imagination. Given the increasing rate of dental and endodontic technology, in 10 to 15 years, we may well have a phone app or other device, a prescription pill, a vaccine, or a medicine to treat endodontic disease or even caries, the most widely prevalent malady in humans. Trends point to medical treatment versus surgical treatment of dental caries and, therefore, endodontics. Meanwhile, future regenerative tissue-engineered endodontic materials will involve “time-release growth factors” and will have “time-controlled resorbable” material matrix designs. Armed with these trends and potential, I took out my smartphone and asked: “When will tooth regeneration occur?” And the Web responded: “It already has.” We already have the science to grow teeth. Stay tuned! Meanwhile, back to the present...we have the tools to see and do endodontics with exceptional predictability, high profitability, and a sense of fulfillment that is the aspiration of all dentists. Are we fully taking advantage of this?

Second, mergers such as Dentsply and Sirona will benefit all of dentistry. Combining these 2 companies’ research and development has the capacity to support end-to-end clinical same-day solutions that advance patient care.

Third, acquisitions such as Sonendo acquiring the Pipstek laser company are defining the cutting edge of endodontic trends. The GentleWave System by Sonendo is a product of considerable research and development. Innovative companies and talent, in collaboration, will push technology even further, which will benefit all patients, endodontics, and dentistry itself.

The fourth trend in endodontics is how we market our practice. I define marketing simply as an “exchange of values,” as in dentists’ skills and...
education in exchange for the patient’s investment fee. Increase skills and you increase value.

**What are the major challenges facing endodontics today?**

**Dr. West:** “Shift happens!” Whenever there is change, there are challenges and opportunities. To me, change is either feared or adapted to and embraced. Again, change is the only constant. There are 3 major challenges facing endodontic change today: trivialization, endo versus implants, and group/corporate versus solo practice.

First, on trivialization, one endodontic company suggests you can retire early if you purchase their endodontic file, while another relentlessly suggests their file is twice as good as the competition for half the price. The next time an endodontic rep says this to you, ask that person to prove it! Endodontics is much more than a file—it is diagnosis; proper emergency care; interdisciplinary treatment planning; and finding, following, and finishing canals; as well as the restorative considerations of structure, function, biology, and aesthetics.

The second challenge is to answer the question of endo versus implants. The answer is simple. Dentists have discovered that if the root canal system can be predictably treated, which it can, and if the tooth has sufficient ferrule, dentists worldwide tell me that saving the tooth is desirable for the patient and the dentist, rather than removal and implant. *We still love teeth!*  

The third challenge in endodontics is a broader challenge than how we do endodontics. It is a challenge of practice structure and infrastructure. Managed group practices continue to expand at a rate of 20% per year and solo practices contract at 7% per year. How endodontics and endodontists will fit into group and corporate practices is unknown.

What we know for sure is that all 3 challenging elements will have an impact. The old days of doing endodontic business are over.

**What do you see as dentists’ greatest opportunity for the endodontic part of their practice in the next 5 to 10 years?**

**Dr. West:** Restorative dentists perform 70% to 90% of endodontic treatment in the United States. Learning new endodontic skills, technologies, and techniques is the fastest way for dentists to further increase their predictability and productivity. With no lab costs, endodontics can be highly productive as well as highly satisfying.

Dentists who want to look professional and build the confidence of their patients always put their patients’ needs and interests first. The successful interdisciplinary dentists have learned, for example, to call in their endodontist for nonsurgical and surgical endodontic retreatments, challenging diagnoses, and/or patient pain, *before* it is too late. Creating iatrogenic blocks in endodontic preparations, ledges, transportations, perforations, and broken files is also too late. Our patients have granted us trust, and we must earn it one procedure at a time.

**Are dentists evolving with endodontic technologies, techniques, and tools?**

**Dr. West:** Dentists by nature are gadget people. For endodontics, the microscope was a breakthrough technology. It gave us a head start on dental technology before the word *technology* ever became popular. The new dentist and
the dentist of the future are especially tuned into change. In fact, millennial dentists only know change, and that change is changing exponentially. Think about it. Humans and machines are evolving together. It is not humans versus machines; it is humans and machines.

Could you describe how you envision the evolving role of endodontics in interdisciplinary diagnosis and treatment planning?

Dr. West: The role of endodontics will expand and will be viewed with a confidence in endodontic predictability that has been proven. And we are getting even better! Instead of endodontics being considered the weakest or missing link in interdisciplinary treatment planning, it will be recognized as one of the strongest links. This endodontic optimism is the result of greater knowledge, mastered skills, and breakthrough technologies that make saving endodontic teeth more predictable, safer, and more cost-effective. The determinants of predictably successful endodontics have been demystified!

How does what you refer to as “the new endodontics” help the GP decide between endo treatment and an implant?

Dr. West: That’s simple! We are now able to predictably save endodontically diseased teeth that seemed previously hopeless. Complex and calcified anatomy or an underfilled root canal system used to be hopeless causes. If a dentist is willing to learn advanced technologies or has an endodontist as part of his/her interdisciplinary team, any endodontically diseased tooth has the capacity to be saved if the endodontic biology can be treated and the tooth is structurally restorable. Period. The question now is not endo versus implant; it is endo and implant. Both treatments have the same predictability. The question for the dentist to answer is which treatment option is more aesthetic, which is easier to restore, which is structurally more predictable, and which one makes the most economic sense for the patient.

Please update us on what’s new for dentists who want to learn the latest and most predictable endodontic concepts, technologies, and techniques. Short of a 2- or 3-year postgraduate endodontic program, what noteworthy educational sources are available?

Dr. West: Formal teaching centers, new media, and digital technology will transform and transcend endodontic education as we know it. Cohorts of newly and properly trained dentists, as well as endodontists, will receive training in leading-edge technologies and treatment planning (Figure 1). Dental school preparation, while providing information about less complex endodontic patients, simply cannot teach the level of education and training required by today’s aging and more technically challenging endodontic patients.

There are currently 5 significant endodontic training centers that are available for dentists and endodontists who desire to improve their endodontic skills: (1) Dr. John West, Interdisciplinary Dental Education Academy, San Francisco; (2) Dr. Tom McClammy, Horizon Dental Institute, Scottsdale, Ariz; (3) Drs. George Bruder and Sergio Kuttler, International Dental Institute, Palm Beach Gardens, Fla; (4) Dr. Cliff Ruddle, “One-on-One,” Santa Barbara, Calif; and (5) Dr. Steve Buchanan, Dental Education Laboratories, Santa Barbara, Calif (Figure 2).

While training centers will surely continue to be relevant in the future, travel and ability to meet individual and global needs has logistic limitations.

You have achieved the pinnacle of success in endodontics as a clinician, leader, teacher, and inventor: What’s next for you?

Dr. West: I have always considered myself as a clinician whose value is measured by my level of performance, one patient at a time. Producing successful endodontic results has been a source of endless pleasure. And I am still learning! It has also been satisfying mentoring clinicians who yearn to personally achieve what’s possible for them and calls them to action. Like measuring endodontic performance one patient at a time, teaching both mechanical and thinking skills has been similarly accomplished one student and one audience at a time. This dissemination process, however, is too slow to keep up with change. Endodontic global learning and teaching, for the first time, will soon be instantaneously possible due to epic changes in multimedia platform.

There is a huge opportunity ahead that will change how we learn endodontics, do endodontics, implement endodontics, and how we have fun in the process. I am referring to my upcoming participation in a weekly webcast production called the EndoShow, soon to be launched. We believe it will change everything.

The EndoShow is the longtime aspiration of the quintessential endodontic teacher, Dr. Cliff Ruddle, who is respected and revered throughout the world. The show teaches the dentists, endodontic specialists, educators, and industry leaders worldwide how to master endodontics by offering insights that drive continuous improvement as well as teaching technical skills that impact outcomes. The show is about the endodontic clinician of the future and the future of endodontics. And the ultimate beneficiaries are the people who are not reading this article: our patients!
How is the EndoShow different from other endodontic education for dentists?

Dr. West: The EndoShow is now—present tense. It is relevant and unbiased. It makes the endodontic world better as it becomes better. Its purpose is to improve and raise the global endodontic standard. No red tape, no print delays, no outdated information. New dentists, seasoned dentists, and specialists will learn what works from the collaboration of not just the world’s leading endodontists, but also from industry, research, engineers, and endodontic visionaries worldwide.

How do you see the EndoShow being used by dentists in practice worldwide?

Dr. West: The show will serve as a reference, a source, and a forum for controversies and the pressing issues of our time, shaping the narrative of a constantly unfolding future, and a roadmap for not only endodontic success for their patients, but also success for themselves. The EndoShow will be a library that is a current and freshly updated endodontic resource founded on timeless endodontic principles as well as current and future trends and techniques. Specifically, the show will consist of interviews, controversies, forums, study clubs, hands-on demonstrations, dental assisting, all things interdisciplinary, and the business of endodontics. The show will be hearing and sharing what matters to you. It is a show that belongs to us all. You are invited to join us in the conversation and to celebrate what makes endodontics different. We are listening, and we need your voice.

In closing, thanks so much for your time and vast experience and expertise! Before we wrap this up, if you were to offer one piece of advice to dentists who want to know how learning about new endodontic trends could benefit their endodontics, what would it be?

Dr. West: Adapt to the changing trends, embrace the changing trends, and take action. Remember, a goal without a plan is only a wish!

Disclosure: Dr. West is co-inventor of ProTaper, Wave One, ProGlider, GoldGlider, and Calamus Technology (Dentsply Sirona).

JOHN WEST DDS, MSD

As founder and director of the Center for Endodontics, Dr. West is recognized as one of the world’s premier educators in clinical and interdisciplinary endodontics. He received his DDS from the University of Washington, where he is an affiliate professor. He earned his MSD at Boston University Henry M. Goldman School of Dental Medicine while being educated by legendary Professor Herbert Schilder and where he has been awarded the Distinguished Alumni Award. He serves on the editorial boards for The Journal of Esthetic and Restorative Dentistry, The Journal of Microscope Enhanced Dentistry, and Dentistry Today and is associate editor of Endodontic Practice. He is a clinical visionary, an inventor, a teacher, an author, and an advocate for any dentist who wants to experience the successful possibilities of endodontics in his or her practice. He can be reached at (800) 900-7668, via email at the address johnwest@centerforendodontics.com, or by visiting centerforendodontics.com.
When one discusses clinical endodontic techniques, it often tends to involve a drill, an endodontic file, or an obturator. But a noninvasive procedure that must not be overlooked, and that which precedes the aforementioned, is that of diagnosing and treatment planning the case at hand.

In this article, the author will review diagnostic techniques in the form of very important fundamental questions that should be asked, along with clinical criteria to consider, prior to every potential endodontic case.

**QUESTION 1**

What Is the Origin of the Pain?

While a patient may have oral pain and point to the teeth, the clinician needs to determine if the pain is of an endodontic origin. Perhaps the pain is due to nonendodontic sources such as dentin hypersensitivity, occlusal trauma such as clenching/grinding, or is sinus-related. So, even if the patient points to his or her teeth, the clinician must always keep an open mind when diagnosing the symptoms. One cannot assume it is always endo-related.

**Criteria to Consider**

Pardon the obvious statement, but endo should be performed only if the clinician is certain that the pain is of an endodontic origin. Such pain should meet the fundamental criteria for pain of pulpal, or apical, origin.

This, at least in part, includes symptoms such as lingering pain to hot or cold, no response to pulp tests (with exceptions), and cases with apical pathology (Figure A in the Table). One of the simplest but most important techniques to should use in order to diagnose the pulpal state is a cold test with Endo-Ice (Hygenic) (Figures 1 and 2). To determine common signs of pain of neuromuscular or parafunction origin, one should perform and evaluate the following: palpate for tender or tense masticatory muscles (Figure 3) and look for occlusal wear facets (Figure B in the Table) or non-localized pain that either wakes the patient up at night or is present upon waking up in the morning.

**QUESTION 2**

Is the Tooth Worth Saving?

While the endodontic procedure may be a nonissue, as part of the routine diagnostic procedure, one must still ask if the tooth is worth saving.

More specifically, could the tooth be predictably and soundly restored? Obviously, there is no point in performing a root canal on a nonrestorable tooth or perhaps a wisdom tooth that serves no functional or restorative purpose with respect to occlusion. Is there sufficient tooth structure supragingivally to restore? Is the tooth in question significantly fractured? Is the cost of the procedure, including post-endo restorations something the patient can afford?
Criteria to Consider

The tooth in question would be worth saving if there is sufficient and sound coronal tooth structure to retain a restoration. At the very least, enough sound tooth structure (dentin/enamel) should be present for the preparation of an adequate (1.5 to 2.0 mm) ferrule (Figure C in the Table). One cannot rely solely on a post-and-core to retain a coronal restoration, no matter which restorative material and technique are used.

A vertical fracture may greatly affect the prognosis and the ability to save a tooth. A general rule of thumb is that if a vertical fracture extends to the pulp floor/cemento-enamel junction (CEJ), prognosis is poor (Figure D in the Table). Even if such teeth were to get a resin-bonded core and full-coverage restorations, they would still be very compromised. One cannot overemphasize the importance of looking for coronal fractures prior to every root canal. An easy way to do so is via transillumination (Microlux Trans-illuminator [AdDent]) (Figure 4) of the buccal or lingual aspects of the tooth.

Enhanced magnification with illumination, such as quality loupes with headlights (ie, Designs for Vision or SurgiTel) or a dental microscope (such as Carl Zeiss or Global Surgical), is key during your diagnostic procedure for examining hairline fractures (Figure 5).

Another indicator of a fracture is an isolated periodontal pocket (Figure 6) and/or a vertical isolated bony defect that could be seen in a 3-D scan (Figure 7). Vertical bone loss and/or an isolated periodontal pocket may not always be definitive of a fracture, but they are a very likely indication of one.

Dentistry is not like mathematics where 2 + 2 always equals 4. In other words, nothing is etched in stone, and having stated the above, there are always exceptions. An example may be in patients at risk of bisphosphonate-related osteonecrosis of the jaw resulting from an extraction. But the rule of thumb is this: do not save the tooth or perform endodontics if the tooth is not structurally salvageable.

Table. Questions and Criteria to Consider Prior to Root Canal Treatments (RCTs)

Q1: Is the pain of endodontic origin?

- YES
  - Irreversible pulps
  - Pulp necrosis
  - Apical periodontitis/pathology
  - Pulp exposure (caries, fracture)

- NO
  - Clenching/grinding
  - Sinus-related
  - Neuromuscular-related
  - Atypical facial pain

Q2: Is the tooth worth saving?

- There is sufficient coronal tooth
- No vertical fracture present
- Less expensive to keep than extract and replace

- Little tooth structure remaining
- Vertical fracture to CEJ or apical
- Less expensive and/or better prognosis alternative available

Q3: What is the overall prognosis?

- Good prognosis if:
  - Nonsurgical endo
  - Good coronal restoration
  - Structurally and periodontally sound

- Poor prognosis if:
  - Poor endo outcome (ie, complex retreat)
  - Poor perio status
  - Poor restorability

Q4: Can or should you perform the endo?

- You are proficient and capable
- You have the required instruments

- Too complex or difficult to treat
- Lacking necessary instruments

Perform RCT yourself
Refer to endodontist
Endo NOT recommended

QUESTION 3
What Is the Long-Term Prognosis of the Tooth?

Once it is determined that the symptoms and/or pathology are of endodontic origin and the tooth is worth saving, the clinician needs to ask if the long-term prognosis for the tooth is good. Instead of just considering the endodontic prognosis, we should also ask about the restorative and periodontal prognosis.

Criteria to Consider

The success for routine initial root canal treatment (RCT) in a tooth that is ideally and well restored is exceptionally high; easily a more than
90% success rate for a period of many years. We may be able to predictably and successfully perform the RCTs, but the tooth should also have a good long-term restorative and periodontal prognosis. One must always consider if it is worth performing the root canal on a tooth that is restorable but may be in a poor state of periodontal health (Figure 8 and Figure E in the Table).

If the combined prognosis for the tooth is not good, then perhaps alternatives such as a fixed bridge or an implant should be considered. Hence, if the long-term prognosis for a sound and cost-effective alternative is better than that for saving the tooth, the clinician needs to question whether it is worth proceeding with the endodontic treatment. We need to always think of the big picture and avoid focusing only on endodontics.

One should also consider the combined financial costs of saving the tooth (ie, endo, post, core, possible crown lengthening, and a crown) versus an alternative (ie, single dental implant). It is reasonable, if not expected, that you discuss the variety of possible and viable treatment options with every patient.

**QUESTION 4**

*Is This Endo Within the Clinician’s Expertise and Abilities?*

By the time we get to this part of the pretreatment analysis, we have determined that the patient requires endodontic treatment, the tooth is structurally and periodontally sound, and the overall prognosis and cost is better than any other options that may be available.

So, we must now ask, as the treating clinician, one more set of questions as part of the diagnostic procedure.

- Am I proficient in performing the endodontic procedure?
- Do I have the necessary instruments (Figure F in Table) required to perform the RCT at, or above, the standard of care?
- Is the procedure at hand, such as calcified and curved roots (Figure G in Table), endodontic retreatment or endodontic apical surgery, within the realm of a general dentist, or not?
- If this treatment was being done on a close family member, would I perform the root canal or would I refer to an endodontist?

**Criteria to Consider**

This, in part, is operator dependant, as some dentists may limit their RCTs to more simple anterior or premolar teeth. And others may be comfortable and capable of performing sound RCTs on molars, including ones with complex anatomy. One must know his or her own limits as a clinician. It is honest and honorable to tell patients that they would be better treated by an endodontist in certain cases.

For most endodontic procedures, one should have the right equipment, and there are many tools needed for proper endo treatment. However, there
are a couple of more important tools to consider. The first important tool is enhanced magnification with illumination. To locate calcified canals, the infamous but almost always present MB2 canal, or a hairline vertical fracture, one must be able to see inside that little endo access. At the very least, using quality loupes with a headlight (ie, Designs for Vision, SurgiTel, Orascoptic) would be the minimal equipment required (Figure 9). If loupes are used without illumination, then that little dark endo access of a hole in the tooth will appear larger, but it will still be a dark hole. If one wants to take endodontics to the next level to be able to perform more complex cases, and to see things better and with less effort, then using a dental microscope (ie, Carl Zeiss, Global Surgical) is a must (Figures 10 and 11). Several years ago, this may have sounded far-fetched for GPs, but that is not the case any longer.

The second main tool you need is the right endodontic file system for the case at hand. If you intend to treat a calcified and/or curved tooth (Figure G in Table), then you should have the appropriate files. These may include NiTi files that are of a narrower taper, very flexible, and designed to follow canal curvatures (such as ProGlider [Dentsply Sirona Endodontics], ESX Expeditor [Brasseler USA], or X-Plorer [CLINICIAN’S CHOICE Dental Products]) (Figures 12 and 13). Thanks to the improved materials and engineering of NiTi files, endodontic treatment is now easier, safer, and more predictable.

**CLOSING COMMENTS**

As dentists, it is in our sincere nature to get our patients comfortable and save their teeth. Often, this involves an endodontic procedure. But before we pick up a handpiece and start RCT, we must always stop for a moment and as part of our endo diagnostic procedure, analyze the bigger picture.

The simplest way is to pause and ask the following: Does the patient actually need endodontic treatment? If so, is the tooth even salvageable? If it is, then what is the combined endodontic, restorative, and periodontal prognosis for the tooth, and is there a better and/or less expensive alternative? Finally, if endodontic treatment is still necessary and recommended, are you the person to perform it or should it be referred to an endodontist? Remember, please think, what you would do if it was your own mother.

**Suggested Reading**


**Disclosure:** Dr. Haas reports no disclosures.

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**MANOR HAAS, DDS**

Dr. Haas is a certified specialist in endodontics and lectures internationally. He is a Fellow of the Royal College of Dentists of Canada and is on staff at the University of Toronto Faculty of Dentistry and the Hospital for Sick Children. He maintains a full-time private practice limited to endodontics and microsurgery in Toronto. He can be reached at (416) 787-5021 or via the website haasendoeducation.com.
The classic “Endodontic Triad” is founded on the 3 pillar principles of cleaning, shaping, and packing. More specifically, the historical triad was described as debridement, sterilization, and obturation. However, the best mental and technical process for actually achieving cleaning, shaping, and packing is best understood from the perspective of the proper 3Fs technical sequence.

The 3Fs of finding, following, and finishing canals focus on the biologic and mechanical objectives required in treating every endodontic canal. Once this simple thought process is recognized, the 3Fs guidelines become the watchwords for what to do when in endodontic treatment. The 3Fs also coach dentists on how to focus on the outcome they want, how to measure the milestones along the way, and what to do differently if they are not getting the desired result. In other words, dentists know where they want to go in endodontic mechanics, how to get there, and what, why, and how to do things differently if they are not getting there.

**FINDING**

For the restorative dentist performing endodontics, finding canals is one of the biggest technical problems that must be overcome in order to treat the patient’s endodontically diseased tooth. By understanding dentinal color maps, the typical location of orifices, and virtual rehearsing with the ToothAtlas (toothatlas.com), finding endodontic canals, while not always easy, can indeed make their location easier and even enjoyable.

I have listed 12 practical techniques to improve a dentist’s ability for successfully finding endodontic canals:

1. **Microscope and 3-D CBCT**—As clinicians, if we can see it, we can treat it. The operating microscope allows dentists to see at an unprecedented level of accuracy (Figure 1a). In daily dentistry and certainly endodontics, the endodontic microscope brings us closer to reality. In order to remain competitive and be at the top of his or her game, the dentist of the future will need to see with more precision. The microscope does just that; not just for the dentist but also the patient and the dental assistant. It is not a question of if the microscope will be part of every dental practitioner’s future, but when. To be ahead of the curve of excellence, dentists must be able to see and do dentistry as well as educate their patients, create perceived value, and reveal real value. If a picture is worth a thousand words, a live video feed of the patient’s very own dental procedure is worth 10,000 words. Predictable dental mastery is in the details, and the microscope provides the simultaneous magnification and illumination to achieve a “what you see is what you get” experience for the dental team and the patient.

Digital imagery, especially in endodontics, much like the microscope, brings the clinician closer to the reality of diagnosis, treatment options, and
treatment mechanics. The simple act of making images dozens of times larger on a monitor allows the dentist to identify root canal system anatomy and obstacles. CBCT digital imaging provides a 3-D blueprint of the same 2-D root canal system anatomy and can often give the information needed for the dentist to make the endodontic diagnosis and lead toward the proper treatment plan and sequence where a 2-D image may be insufficient or even misleading (Figure 1b).

2. Access Cavity—Successful shaping and cleaning begin with the ideal access cavity. The balance between the size and design of an access versus unimpeded and unfettered access cavities is a renewed conversation in the endodontic literature. Like many controversies, the pendulum swings back and forth often due to emerging structural and biologic determinants coupled with new technologies. These changes may disrupt traditional mechanics while still producing the needed biologic requirements for either healing or preventing lesions of endodontic origin. As structural technologies improve, such as new breakthroughs in bonding, the need for miniscule access designs is actually less and less important. In fact, the standard and proper endodontic access cavity has less importance than the restorative preparation in so far as structural integrity. The so-called notion of “minimally invasive endodontics” should take into consideration what Nature herself considers minimally invasive. Modern endodontic access cavities and appropriately shaped canals for facilitating shaping, cleaning, and predictable 3-D obturation do, in fact, perfectly mimic the natural root canal system both in access cavity (simply de-roofing the chamber) and radicular shaping. The only tooth structure that is removed in ideal endodontic accesses is the roof of the chamber and the dentinal triangles, neither of which “weaken” the tooth. Ideal radicular preparations also mimic Nature’s shapes by reproducing 7% to 10% tapers that travel from the minimal apical constriction to Nature’s coronal radicular width of between one fifth and one third the diameter of the coronal portion of the canal. No transformation of paradigm shift is needed here. No new articles about minimally invasive endodontics should be wasted on attempts to make endodontic preparations smaller than the ones that have genetically evolved for more than 900 human generations. Nature knew and still knows what she is doing. The term maximally appropriate endodontics is actually the desired “appropriate”
term and goal. Until one of the parts of the endodontic triad (cleaning, shaping, or obturation) experiences a radical change in technology such as sterilization without shaping, the current concepts of “maximally appropriate” cleaning, shaping, and obturation comprise the fundamental philosophy and methodology of today’s best practices.

3. **Microexplorer**—The classic DG 16 endodontic explorer is too large in diameter to identify and penetrate the entrance to endodontic canals that are undergoing calcific metamorphosis, calcific degeneration, or just plain shrinkage with time. The purpose of a narrower endodontic explorer is to pierce within the orifice of narrowing canal without simultaneously blocking it with collagen or “dentin mud” (Figures 1c to 1e).

4. **Chairside Reference**—Prudent clinicians laminate this chart from the author’s chapter in Michael Cohen’s 2008 Quintessence text, *Interdisciplinary Treatment Planning: Principles, Design, Implementation*, so that the reference is readily available during endodontic canal finding (Figure 2a).³

5. **ToothAtlas**—The best practicing endodontic clinicians preview ToothAtlas images prior to treating any particular tooth number. Becoming accustomed to both the trends and variables of any particular tooth produces knowledge and confidence. It also alerts the dentist to any specific tooth local knowledge and/or booby traps. Imagine that you plan to endodontically treat a patient’s maxillary lateral incisor. You say to yourself: “Maxillary lateral incisor…piece of cake! One canal and I can see it right in front of the patient’s mouth.” However, when you peruse the ToothAtlas, a maxillary lateral incisor common characteristic jumps out at you. Most canals end with an abrupt turn to the distal and often the palatal! This apical “hook” is often blocked during endodontic mechanics, a shelf is formed, and the lateral incisor ends up with an under-filled root canal system. The answer of treating the entire root canal system starts with awareness, and there is no better path to awareness than the ToothAtlas (Figure 2b).

6. **New Burs**—New burs are a must, not a luxury, for efficient access preparations.

7. **Mueller Burs and Ultrasounds**—Like the ultrasonic tip, the Mueller bur allows the clinician to see and do simultaneously, which results in control (Figure 2c). By having a long shaft, the head of the handpiece does not block the view of the bur, and therefore the bur can be precisely positioned for accuracy.
In addition, the bur cleanly cuts the dentin and reveals the canal entrance rather than smearing the dentin, concealing the canal orifice, as is the case with ultrasonics. The main value of ultrasonics in this endodontist’s experience is in endodontic disassembly, such as removing posts and broken instruments. Ultrasonics are excellent for removing dentinal triangles and refining the walls, as well as removing denticles and calcifications from the chamber and coronal orifice entrances.

8. **Calcify Crown-Down**—Pulps die and calcify crown-down. In other words, root canal system anatomy becomes wider when penetrating deeper (Figures 2d and 2e). Rather than thinking, “I can’t find the canal,” think, “The canal is not yet present at the current preparation depth. Go deeper.” Nature never does its own root canal. It only looks like it sometimes. Before the dentist is uncomfortably deep, however, it is important to bring in an endodontist before accidental root perforation in order to keep in the patient’s best interest and well-being.

9. **Dentin Roadmaps and Dentinal Triangles**—Stay away from white dentin areas because a perforation is soon to follow!

A bite-wing radiograph is essential before the endodontic access of posterior teeth to determine the occlusal-gingival width of the chamber. Sometimes a crown may block this measurement. In access of these teeth, if the dentist seems deep enough to have prepped through the chamber roof in a full crown tooth but has not, pause to take a right angle radiograph to avoid inadvertent perforation through the chamber floor versus the chamber roof (Figures 2f to 2k).

In addition, each posterior tooth should have 3 well-placed horizontal images before the access cavity: mesial, perpendicular, and distal. Some endodontists also want a CBCT image, especially in retreatment situations in order to keep in the patient’s best interest and well-being.

10. **Orifice Location and Root Shape**—If the canal is in the center of the chamber of a mandibular molar, there is only one distal canal. However, if there is a canal in the DL or DB of the mandibular molar, 100% of the time, there will be another orifice in the other corner of the access cavity. If you cannot find it, you simply cannot find it yet. It is there, waiting to be discovered. Remember, canals calcify crown-down. You need to follow the dentin color maps with the Mueller bur and go deeper.

11. **Q-Mix Trick for Narrow Orifice Location**—If you follow a narrow or calcified canal orifice with the Mueller bur but cannot yet slide a small file into the canal, irrigate with Q-Mix (DENTSPLY Tulsa Dental Specialties), which has a surfactant in it with the EndoActivator (DENTSPLY Tulsa Dental Specialties), for 10 minutes (Figure 2l). This technique removes the mineralized dentin (collagen plus hydroxyapatite), which is densely crushed and packed by the Mueller bur into the previous narrow porous space of the calcified canal. The now dentin “plug,” which appears as a white dot, will usually be patent after Q-Mix agitation and will allow a narrow manual file such as the No. 6 to slip and slide down the canal.

12. **Restraint**—The previous 11 specific tips and hints focus on products and technique in canal finding. The twelfth tip and hint concentrates on principle. Finding canals takes restraint as well as a thoughtful strategy using patience and intention. The expected canal is almost always present, and rather than “not being able to find the canal,” instead think that the canal is “simply not present at this access location.” Step back, take a deep breath, review and reorient yourself, look at cemento-enamel junction root anatomy for canal location clues and take a CBCT 3-D image if you are completely lost. The key here is to slow down and step back. Sometimes we cannot see the forest for the trees. It is true in endodontic canal finding as well. The canal is still there and waiting to be discovered!

**FOLLOWING**

First, remove all access dentinal triangles (Figures 3a to 3c). Manual “instrumentation” or glidepath validation and creation are the lost art of endodontics. Following canals from their orifice to their terminus is also the missing link of mechanical endodontics and represents, in many ways, the most difficult part of endodontics if certain rules and principles are not followed. The dentist must be vigilant to the certain manual mechanical motions and understand the skill of restraint.

Our survival of the fittest has largely been just that: the strongest of our species has survived. While that trait may have been useful to fight off predators, lack of food and water, and challenging elements, “fight or flight” does not work in endodontics. In fact, it makes things worse because when the dentist pushes then blocks, ledges and transportations result. Glidepaths are lost and so is the 3-D endodontic seal.

When following canals with small manual files, restraint and yield are the best watchwords allowing the file to literally “slide” down the existing walls of the canal. If the file does not easily navigate the canal, there are 4 reasons for this: (1) the canal is blocked with dentin mud, collagen, or previous endodontic
obturation material; (2) the angle of incidence and the angle of access are different—that is, the selected curve on the file does not easily mimic the curve of the canal and cannot easily follow; (3) the tip of the hand instrument is too wide for the canal; or (4) the shaft of the file is too wide for the canal, ie, restrictive coronal dentin is preventing the instrument to travel deeper into the root canal system. The dentist often thinks, “It is tight at the end of the canal” while in fact it is tight at the coronal portion of the canal.

I have listed 3 practical techniques to improve the dentist’s ability to follow canals from their orifice entrance to the radiographic terminus.

1. Carving Manual Files—Perhaps the number one trick in successful canal following besides restraint is to precure the endodontic file in 1 or 2 planes before every entry into a canal with the intention of following to the radiographic terminus (Figure 3d).


Follow has to do with gliding down the canal until the radiographic terminus. Following requires being gentle and patient. You cannot go further until this essential step is complete, so take your time here, stay mistake-free, and enjoy being successful.

Smooth has to do with vertical in and out strokes with increasing amplitude until the file can easily travel more than several millimeters of canal length. Remember, you are only wearing away or smoothing enough of the canal wall to guide NiTi shaping.

Envelope has to do with removing restrictive dentin with the hand file that does not easily progress to the radiographic terminus. One common and often forgotten reason that a file does not easily progress down a canal is restrictive dentin against the coronal part of the file shaft. Envelope motion is performed by following a precured file short of maximum resistance, and then simultaneously turning clockwise and removing the file in order to carve away the restrictive dentin. Then follow this motion until either repeating the envelope short of maximum resistance or following to the radiographic terminus. The envelope is the only form of dentistry that occurs as the dentist is withdrawing from or leaving the tooth.

Balance is used when a smooth No. 10 hand file glidepath is established but the clinician desires an enlarged glidepath prior to rotary. A No. 15 file can be used in this case safely and predictably by turning the file clockwise at the point of resistance, then counterclockwise with slight apical pressure and proceeding to radiographic terminus as long as the file easily progresses. If not, remove the file in a clockwise direction, clean file flutes, and repeat to the radiographic terminus followed by smoothing motion and then NiTi rotary.

3. Mechanical Glidepath—Many clinicians feel safer with an enlarged glidepath that is wider than the glidepath produced with a No. 10 loose file. Progressing to a size No. 15 runs the risk of blocking or ledging, since the No. 15 file is 50% wider at the tip than a No. 10 file. Some schools even teach the use of a No. 20 file at length or slightly short before rotary shaping. This, too, predisposes the dentist to blocking, ledging, or transporting since the No. 20 file is actually 33.3 wider at the tip than a No. 15 file! This is smooth glidepath sabotage in the making.

A safer, more predictable, and more efficient glidepath enlargement can be accomplished using a mechanical glidepath file such as ProGlider (DENTSPLY Tulsa Dental Specialties), which in essence is a baby ProTaper (DENTSPLY Tulsa Dental Specialties), meaning progressively increasing tapers. A single mechanical glidepath file makes all rotary and especially reciprocation easier and safer (Figure 3e).

FINISHING

Finishing is essential to endodontic predictability. Successful endodontic clinicians must finish as strong as when they start. The same time, energy, and concentration are needed during all 3 Fs. Finishing is divided into shaping, cleaning, conefit, and obturation.

1. Shaping—Shapers and Finishers are 2 distinct NiTi file designs and are novel to the ProTaper Gold concept of incrementally preparing shapes in delicate dentin versus “drilling out” shapes with fixed tapered NiTi files. Endodontic clinicians have control when they progressively shape canals by first removing restrictive dentin with shapers (in other words, roughing out the canal) and then finish the shape using finishers to connect the dots between the minimal apical constriction and the appropriate one fifth to one third the root with at its coronal termination.

Shapers are used in a brush/follow motion and finishers are used in a follow/brush motion. First, brush to the side of the canal, then let the shaper follow deeper, and then repeat to length. In other words, paint your way to the apex. Finishers are used with the same watchwords but in reverse order: follow/brush. So gently follow down the canal and then brush out. Then repeat to length.
A particularly useful technique with special heat treated, highly flexible NiTi rotary instruments is the precurving of the file before canal entry (Figures 3f to 3h). This curving enables the dentist to sneak into the access over the access cavity cavosurface versus approaching straight down the canal. Therefore, the patient does not need to open as far, and canal entry is more graceful and easy. In addition, the precurving creates an immediate NiTi file envelope of motion, which encourages the file to shape and clean into the intricacies of the root canal system as well as creating a shape slightly larger than the geometry of the file itself, which improves efficiency.

When is shaping completed? When the apical flutes are visibly loaded with dentin, the exact shape is finished, and the dentist can count on the corresponding gutta-percha cone to fit. The canal is then ready for vertical compaction of warm gutta-percha or carrier-based obturation.

When do you cone-fit? When the apical blades are loaded with dentin, the canal is ready for a predictable cone-fit.

2. Cleaning—Full-strength sodium hypochlorite is the ideal irrigant during following and glidepath preparation, as this solution digests detached collagen and removes dentin mud. If collagen is suspected apically, a viscous chelator such as ProLube (DENTSPLY Tulsa Dental Specialties) is useful in emulsifying the collagen. Ethylenediaminetetraacetic acid (EDTA) is useful during rotary as the indiscriminant chelator slightly softens glidepath walls for easier shaping and simultaneously removes smear layer. EDTA, or better yet Q-Mix, which has the benefit of a penetrating surfactant, should be agitated with the EndoActivator to remove any remaining smear layer before drying and obturation.

3. Cone-fit—Conefit is a lost art of endodontics. When I teach dentists endodontic techniques, cone-fit is one of the least understood aspects of treatment. Conefit is a skill in and of itself. To assume the matching cone will fit the matching file is inaccurate. While cone sizing is improving (NanoFlow Gutta-Percha [DENTSPLY Tulsa Dental Specialties]), root canal anatomy is never perfectly round in all canals (Figure 3i). Therefore, knowing how to fit a custom master cone is essential in order to produce the least gutta-percha/dentin distance by distorting the apical gutta-percha and, consequently, relying less on sealer, which still remains the weakest link in endodontic obturation. Although reported improved sealers are being introduced into the endodontic literature, very few reports have been published on their suitability for warm gutta-percha compaction.

4. Packing—The author’s thinking is that the clinician’s obturation technique preference may become less significant as our ability to clean and sterilize root canal systems increases. Nonetheless, a standard measurement of the quality of endodontic treatment remains the efficacy and thoroughness of obturation based on final radiographic images. It is paramount to remember the rationale of endodontic success is simply and profoundly still true: “If the root canal system is rendered inert through shaping, cleaning, and sealing the portals of exit, lesions of endodontic origin will be cured where they exist and prevented where they do not exist.” The final radiograph represents the metric of the clinician’s endodontic performance.

Obturation technique is a personal preference and may vary from single cone with sealer, lateral condensation, and vertical compaction of warm gutta-percha to carrier-based obturation. This author prefers the predictability and choices offered in the vertical compaction techniques (Figures 3j and 3k).

CLOSING COMMENTS

Many dentists start endodontic procedures without a clear goal in mind. This article summarizes a thought process and guide for dentists to follow during endodontics. The exact steps needed to perform predictable endodontics have been reviewed and explained. With a plan, the dentist can truly be in control.

The 3 Fs: Find, Follow, and Finish are presented as a roadmap to get where we need to go in endodontic success, mark the milestones along the way, and know what to do differently if we are not getting there. This is what gives the clinician the freedom of knowing and the feeling of mastery. It is a place where the dentist experiences as newfound level of competence, consistency, and confidence.

Endodontic problems are for overcoming, which in turn creates freedom for proving.

References
Dr. West is the co-inventor of ProTaper, WaveOne, and Calamus instruments (DENTSPLY Tulsa Dental Specialties).
Imagine the following scenario. In the middle of a busy day, a patient presents with a severe toothache or swelling. You may wonder if you could (or should) manage this with a prescription, or if you need to treat this problem invasively and immediately. In nearly all cases, a true emergency of endodontic origin needs to be managed right away. No pain medication and/or antibiotic will truly help.1

This article will review how you should manage an emergency of endodontic origin and, in addition, how to do so efficiently. This will be divided into the following key steps: diagnosis, anesthesia (especially of “hot teeth”), canal instrumentation, and post-op pain and infection management.

### Diagnosis
The first and obvious step involves figuring out what is and where is the source of the pain, and if it is tooth-related. Make sure to rule out non-endodontic symptoms (ie, periapical inflammation due to parafunction or pain of periodontal origin). Perform all the essential and routine diagnostic endodontic tests (ie, pulp tests, percussion, palpation, biting on a Tooth Slooth). If the emergency is found to be of endodontic origin and you have localized the problem tooth, then proceed with root canal treatment.1

### Anesthesia
This is often the most difficult and important aspect of the emergency. Without profound pulpal anesthesia, it is difficult to proceed. Insufficient or lack of anesthesia may turn the appointment into a memorable nightmare for the patient and be very stressful for everyone involved.

#### Maxillary Teeth
Traditional local infiltration will suffice for most cases in the maxilla. But, make sure to have the needle tip deposit the anesthetic superior to the apices of the involved tooth. For instance, if you are treating a maxillary first molar, try not to hit the zygoma with the needle. This may result in deposit of the anesthetic inferior to the site of innervation to the involved tooth and compromise pulpal anesthesia.

#### “Hot Teeth”
Arguably, the most difficult tooth to anesthetize is the infamous “hot tooth,” especially in mandibular posterior teeth. Such cases are well known to remain with feeling in the nerves after more than one carpule of local anesthetic, regardless of the kind of mandibular block technique employed. It has been shown by numerous clinical studies that [mandibular blocks will only provide pulpal anesthesia in about one half of the cases presenting with irreversible pulpitis](https://journals.very.org/). This is irrespective of the anesthetic type, amount, or time given for onset. So, if your patient presents with acute lingering pain to cold, there’s only about a 50% chance that any mandibular block will suffice.2 This means that in those approximate 50% of cases, you will require supplemental anesthesia (Table). These include the following:

1. **Periodontal Ligament (PDL) Injection, or Intraligamentary Injection**—This is performed using a 30-gauge (g) short needle that is placed at the mesial or distal line angles of the tooth’s periodontal crevice and with the bevel toward the tooth (Figures 1 and 2). Under pressure, a small amount of anesthetic is injected. Onset is quick, but the anesthesia is relatively short-lasting.
This injection is often uncomfortable, and patients may complain of the tooth feeling elevated postoperatively. PDL injections may be used as supplemental anesthesia for maxillary and mandibular teeth.3,4

2. Intraosseous—This type of injection has been shown to provide exceptionally high rates of immediate and profound pulpal anesthesia, including in hot teeth. It is used primarily for mandibular posteriors. It requires a pilot hole to be drilled with a special slow-speed instrument (perforator) into the cortical bone between the teeth at the base of the papilla and angled apically. Into the pilot hole, a corresponding short needle is inserted and the anesthetic is slowly deposited (Figures 3 to 5). Its duration is approximately 30 to 45 minutes. However, it is technique sensitive, especially when it comes to carefully drilling the pilot hole and avoiding the roots. Also, it is recommended that an anesthetic with little epinephrine (ie, 1:200,000 epinephrine) be used to minimize heart palpitations.4 The 2 options available are the Stabident (Fairfax Dental) and X-Tip (Dentsply Sirona) (Figures 6 and 7).

3. Intrapulpal—This is often considered the anesthetic of last resort. When performed properly, it is immediate but will only provide about 10 to 20 minutes of profound anesthesia. As with PDL injections, it is very painful in the moment it is administered.3 The needle should engage in the canal, and for this to work, you must obtain resistance/back-pressure when injecting the anesthetic (Figures 8 and 9).

At this point, I suggest pulp testing the tooth prior to the access procedure to make sure it is adequately anesthetized. There is nothing worse than a nervous emergency patient with a hot tooth jumping from more pain. And, once anesthetized, you must isolate the tooth with rubber dam prior to initiating root canal treatment.
SOFT-TISSUE ABSCESS OF ENDODONTIC ORIGIN

If your patient presents with a soft-tissue swelling that is fluctuant, you should perform an incision and drainage (Figures 10 to 14). You should use a sharp scalpel and penetrate the “pointing” part of the abscess until you hit bone. A curved hemostat should be used to expand the incision site and help provide a way for the purulence to drain. The site should also be irrigated with a Monoject (Medtronic) syringe. In the case of significant swelling, a drain should be placed. This can be accomplished by using a clean rubber dam cut in the form of the letter T with the top of the letter inserted into the incision site and sutured into place.

ROOT CANAL INSTRUMENTATION

By now you have diagnosed and identified the endodontic problem, anesthetized the patient, and accessed the tooth. Next comes the canal instrumentation. It may be difficult in the heat of the moment, but do make sure to locate and treat all the canals. This is much easier if magnification with enhanced illumination is incorporated. Dental loupes with a headlight, such as Designs for Vision or SurgiTel, or a dental microscope, such as Carl Zeiss or Global Surgical, are exceptionally helpful, if not priceless. This is especially the case in teeth with artificial crowns or teeth with calcified canals.

If endodontic treatment is not to be completed that day, it is very important to completely instrument each canal. Anything less means leaving behind inflamed or infected pulp tissues. That is why partial pulpectomy (ie, pulpotomy) is rarely recommended. By definition, a pulpectomy involves complete pulp extirpation and canal instrumentation. Furthermore, copious amounts of hypochlorite irrigation should be used, and the canals should be medicated with calcium hydroxide between appointments.

When one is managing an endodontic emergency, it is extremely helpful to utilize an instrumentation system that is simple, efficient, and easy to use. The trend in endodontic instrumentation has been to achieve the same or better clinical and biological outcomes, with fewer steps and instruments. Single-file mechanized NiTi instrumentation is a relatively recent addition to endodontics. Thanks to its simplicity and efficiency, it is well-suited for a variety of tasks, including emergency root canal treatments.

An example would be the WaveOne Gold (Dentsply Sirona) reciprocating NiTi file. This file system has been shown to be safer, simpler, and more efficient to use than many rotary NiTi systems (Figure 15). With respect to rotary NiTi files, there are newer systems that still require multiple files, but which work more efficiently and require slightly fewer NiTi files than older systems. An example is the ESX series of files (Brasseler USA).

POSTOPERATIVE MANAGEMENT

Occlusion

From a pain management perspective when possible (ie, not on crowned teeth), it is recommended to lighten (lightly reduce) the occlusion of the involved tooth. The intention is to prevent post-op occlusal trauma to the tooth and periapical area that needs to be left alone to settle, so to speak. This is especially important in patients with parafunction habits who may be more likely to traumatize the problem tooth (Figure 16).

Pain Management

As a rule of thumb, if a patient presents with preoperative pain (except for pain to cold and hot), they are likely to experience postoperative pain. In turn, you should prepare your patient for this, also providing the individual with analgesics suitable for his or her level of pain. For a healthy patient, these may range from 600 mg of ibuprofen every 6 hours for mild pain to one to 2 Tylenol No. 3 (with codeine) every 4 to 6 hours for more severe pain.

Infection Management

It is very rare that antibiotics will be indicated postoperatively for endodontic emergencies. When the etiology is managed properly endodontically, antibiotics will rarely be needed. That is, unless the patient presents with a space infection or systemic symptoms. For routine cases and patients, the antibiotic of choice is amoxicillin (500 mg, every 8 hours). For patients with penicillin allergies, clindamycin is recommended (300 mg, every 6 hours). Both antibiotics should be taken for a week.
CLOSING COMMENTS

One of the greatest challenges in clinical dentistry is managing endodontic emergencies. When performed, it should be done efficiently and under profound pulpal anesthesia. To facilitate locating and instrumenting the canals, enhanced magnification and efficient instrumentation systems should be used.

References

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