Endodontic success and working length: thinking 5-dimensionally

By E. Steve Senia, DDS, MS, BS

I.

n the article "Endodontic success: it's all about the apex," (Endo Tribune, March 2008, pages 8-11), we introduced the term working length (WL). Don't be surprised if you have never heard this term — it's quite new. The term comes from the description. WL is the canal's preinstrumented diameter, adjacent and coronal to the apical constriction (Fig. 1), like this term very much, because it is a valuable reminder that WL is the dimension of the tooth. Instrumentation should address a working length and a working width. My last article focused on working width; this article focuses on working length.

Definition of working length

There is considerable disagreement regarding exactly where working length (WL) should terminate. Let's explore these issues and get a sense of what WL implies. The American Association of Endodontists' Glossary of Endodontic Terms states: "working length is the distance from a coronal reference point to the point at which canal preparation and obturation should terminate." Where is the disagreement? The definition doesn't tell us where WL should terminate. Exactly where should it be? Our forefathers hotly debated the question for many years, and the issue appeared to be resolved. Unfortunately, WL is once again embroiled in controversy.

Our forefathers concluded that instrumentation should end at the cementoenamel junction (CEJ) (Fig. 1), which is approximately colocated with the apical constriction. Most agree with that location, because the pulp makes dentin and the periodontium makes cementum. Instrumentation should remove pulp tissue and not invade the periodontium. That's not to say that I am against passing a patency file past the CEJ or even slightly beyond the foramen. However, remember that the area is six times the radius squared. This means that a #15 (0.15 mm) patent file tip occupies nearly 5 percent of the average foramen's cross-sectional area (0.60 mm) and only 21 percent of the average canal's cross-sectional area (0.30 mm)!

I suspect patency files are used more for warning of an impending ledge than for maintaining patency. The downsize is the likelihood of a file lacerating vital tissue beyond the constriction and possibly causing postoperative pain in an asymptomatic vital case. A clear cut of the pulp at its narrowest point (apical constriction) is a biologically acceptable approach. In necrotic cases it would likely push infected material into the periapical tissue and possibly cause a flare-up.

Termination Point

Where to terminate WL (our clinical target) requires two reference points. The first one is the coronal reference point on the crown, and the second is in the apical part of the canal. The AAE Glossary states that a root canal is: "a passage or channel in the root of a tooth extending from the pulp chamber to the apical pulpal foramen." Note that the foramen defines the end of the channel. Thisembrance of the choices for WL is somewhere between the foramen and the CDJ/constriction.

The Glossary positions the apical constriction usually 0.5 to 1.0 mm short of the center of the apical foramen, but positions the CDJ ranging from 0.5 to 5.0 mm from the apical anatomy.2 The last word, apex, is very important. If the CDJ can be as much as 3 mm from the apex, it means that the apex is not a precise reference point for WL determination and should not be used. Clearly, apex and foramen cannot be used interchangeably, and evaluating the quality of an obturation by its distance from the apex is wrong.

A meaningful discussion of WL can only take place when it is understood to be measured in millimeters from the foramen and not the apex. So, let's talk about the apex because it's irrelevant, and let's not pretend that WL is the same as the foramen. It's all about the foramen, which usually is not at the apex.3,5

Now, let's change the situation to where WL is perfect, but the apex is not (Fig. 2d). There is a dramatic difference between what happens to the bacteria in the foramen and the gutta-percha seal when the WL is perfect or 1 mm short of the "length." Same answer, the bacteria are attacked and destroyed by the PMN — the major circulating cell in the immune system, whose function is to kill bacteria. (In fact, when the body encounters infection, the production of PMN increases tenfold.) Another body defense cell is the macrophage, whose function is to clean up the debris — a task it does very well — as evidenced by the rapid disappearance of extruded root canal seal.

Fig. 2c: Distal canal of mandibular molar cross-sectioned mm from apex. WL was correct but not was not because the body's defense size was too small. The case failed.

After several endodontic treatments, the teeth were extracted or viewed during surgical retreatment, the dead-on's were overfills of most of the time. I had to constantly remind students of this fact (and proved it during their training) on obstructions. Clinical experience through the constriction to or slightly beyond the foramen and obturating to that point for an aesthetically pleasing X-ray is not scientifically justified.

Knowing the limitations of radiographs for WL determination, let's see how electronic foramen locators provide greater accuracy. As with all electronic devices, carefully read the instructions. But, if they say that the activation of the "hells, lights or whistles" tells you that the tip is at the apex, then I suggest you have never heard this term. In fact, the apical area is not the end of the canal, exactly where is the tip? How do we solve this dilemma and make EFLs clinically useful? Unfortunately,
we have to do what the manufacturers should have done. If the alarms indicate the tip is at the apex, but we think it’s at the foramen, we should subtract 0.5 mm to 1.0 mm from the file insertion length to get WL. If the alarm is indicating apex but we believe the tip is actually at the constriction, then we should use that for WL. And finally, if the manual says that the bells, lights or whistles go off at the constriction, you will have to confirm the accuracy of that statement. You may have to do some fine-tuning as you gain practical clinical experience with your specific device. A little practice and careful observations while using your EFL will be required.

The good news is that in spite of their shortcomings, EFLs provide consistently better accuracy than X-rays. They also should help resist the temptation of indulging in ‘aesthetodontic’ contests. In our lectures and writings we could show X-rays of cases that appear ‘short’ (but are not without worry about our work being judged inferior. All we would have to do is advise the audience beforehand that all WL were 0.5 mm to 1.0 mm from the end of the canal using the accuracy of an electronic foramen locator rather than the inaccuracy of an X-ray.

Alternative technique for WL determination

I give credit for this technique to Bill Wildey, the co-inventor of Light-Speed™ instruments (Discus Dental Inc., Culver City, Calif.) to fine-tune WL. He starts with the estimated length given by the EFL; he then goes 1-2 mm beyond that length with the LSX rotating in the handpiece. The short blade of the LSX #20 (Fig. 3a) usually passes easily through the constriction, because the diameter of the constriction is roughly #50. Depending on the actual diameter of the constriction (if one exists), the LSX #25 or #50 usually engages the walls of the constriction and a ‘popping’ sensation is felt when the blade goes through the constriction. This tactile feedback gives the exact location of the constriction and the desired location of WL. The key is to advance the instruments very slowly to feel what’s happening in the canal. If a constriction is not present, the popping sensation will be felt passing through the foramen.

Large LSX sizes, if advanced slowly (recommended technique) to the same WL, will allow for the development of an apical stop (matrix). Once developed, the LSX would have to be pushed hard to force it past the stop. Of course, destroying the constriction where the stop is located (the WL) is not recommended. The apical stop confines our fills to the WL and helps minimise the incidence of over-fills.

Notice the length marking rings on the shank of the LSX (Figs. 3b, 3c). I can assure you that significant time savings (and greater accuracy) is possible if you use the rings in lieu of rubber endo stops. In fact, Bill Wildey recommends you have your assistant remove the stops before bringing them chairside to force yourself to make the transition.

Conclusion

In our subconscious minds, we are aware there is a biologic tolerance to WL. Cases obturated a little short (or a long time), are usually successfully when everything else is done correctly. WL need not be perfect for a successful outcome (biologic tolerance), but the tolerance for an inaccurate WL is not so generous. Avoid the temptation of indulging in ‘aesthetodontic’ contests. The endodontic community should agree to a WL that ranges 0.5 mm to 1.0 mm from the foramen (not apex) and move on to more important issues.

I recommend all manufacturers use the term electronic foramen locator (EFL) rather than apex locator to describe these devices. EFL manufacturers should eliminate ambiguous markings on their devices and simply pin-point only the foramen. Dentists would then do the rest, thereby choosing a termination point that is either 0.5 mm or 1.0 mm short of that location. And finally, emphasis should be placed on cleaning the main canal as well as possible (correct WW) close to the constriction/CDJ. Doing so closes the door, prevents bacteria/toxins from contaminating apical tissues and increases the chances of endodontic success.

Smart Endodontics™ offers many helpful tips. To learn more, please call Discus Dental at (800) 817-3636. Request the free CD showing what Smart Endodontics is all about.

I wish to thank Steven S. Senia, BSIE, MBA, for his valuable contribution to this article.

References


Endo Tribune

Fig. 3a: LightSpeed.LSXX™ NITI Rotary instruments with a very short blade and noncutting shaft.

Fig. 3b: Length marking rings on the shank can be used as an alternative to rubber endo stops (1.5 mm LSX).

Fig. 3c: Length marking rings on 21 mm LSX.

Surgery design - We offer you:-

• Site visits) to determine client requirements, floating dimensions and current service layouts.
• Full brief – including client appointments at our showroom.
• Demonstration of extensive variety of products based on ergonomics, specification, aesthetics and types of dentistry.
• Create and discuss several concepts leading to final solution and CAD plans and elevations.
• Provision of service plans and requirements.
• Full project management and QA from start of project to completion with dedicated Project Engineer to manage and provide customer support.
• Experienced building and service crews available to keep ‘down time’ and disruption to a minimum whilst maintaining a high level of quality.
• Friendly, knowledgeable service from trained and experienced staff.

Hague Dental Supplies offer sales, design and engineering services to the dental industry.

In London, Hague have one of the largest showrooms in the UK. Viewings are available by appointment (inc out of hours).

Hague also offer engineering and maintenance service packages on your equipment at agreed intervals to suit your needs. At the depot in surrey, Hague stock a huge selection of parts and equipment – in order to get you back up and running fast in an emergency.

Engineering solutions – We offer you:-

• Typically a "one call out" solution from our own engineers.
• Full diagnostic and repair facilities with trained, experienced engineers.
• Service packages for new and existing equipment at agreed intervals.
• A vast stock of parts and equipment available from our depot in surrey – in order to get you back up and running fast in an emergency.
• Full telephone support and out of hours servicing.

Hague Dental Supplies Ltd, Trident Business Centre, BB Bickentstch Road, Tooting Broadway, London SW17 9SH
0800 298 5003
www.haguedental.com

About the author

Dr. E. Steve Senia

earned a DDS degree from Marquette University in 1963. He entered the Air Force (previously served as a pilot) and completed a GPR residency. In 1969, he received a MS and Certificate in Endodontics from the Ohio State University. He served in the Air Force and retired in 1981 as a Colonel and Chairman of Endodontics at Lackland AFB, Texas. He then became Professor and Director of the Endodontic Postdoctoral Program at the University of Texas Dental School at San Antonio. He retired in 1992. Dr. Senia is a Diplomate of the American Board of Endodontics. He is a former member of the Editorial Board and the Scientific Advisory Panel of the Journal of Endodontics, an editorial advisor for the Journal of Endodontic Practice and a consultant for the NASA Space Program. He has lectured and published extensively and is the co-inventor of the Light-Speed.LSXX™ root canal instrumentation and SimpliFill® obturation systems. You may contact Dr. Senia at DrSteveSenia@aol.com.

Endo Tribune