

Author:

- Please note we added "a, b, c" under the images in Figure 3. Please review and verify. Thank you!
- Please also review legend for Figure 6.
- Dr. Senia: can you trim your bio by about 30 to 40%? Also, contact information is needed for Dr. Wildey to include with his bio.

Thank you!

What's New in Ni-Ti Rotary Instrumentation

Part 1



E. Steve Senia,
MS, DDS

With most things in life, change is inevitable, and endodontics is no exception. However, our commitment to a higher success rate for root canal treatment has never changed. What has changed—and rather dramatically—are the materials and techniques now available. Endodontics is getting “smarter” every day in terms of equipment and materials and the ways they are being used. *Smart* endodontics is a commitment to science, microbial control, apical cleaning, results, and techniques, all with the aim of increasing our success rates and improving patient care.

CROSS-SECTIONING ROOTS: SEEING IT AS IT REALLY IS

More than 30 years ago, we began cross-sectional analysis of extracted root canal-treated teeth. What we observed proved to be a loud wake-up call. We saw canals that weren't clean, and some that were downright dirty. Like it or not, we had to accept the reality that existing instrumentation techniques

showed inadequate instrumentation, it also reminded us of the 2-dimensional limitations of radiographs. In spite of great-looking radiographs, the cross-sections frequently showed uninstrumented, dirty, and transported canals.

The radiographic and photographic comparisons showed that apical puffs of sealer did not correlate with canal cleanliness. Hydraulic forces were sufficient to push sealer past unclean areas and out the foramen, suggesting that excessive importance is given to radiographs in terms of their ability to evaluate the quality of treatment. Things may not be what they seem to be.

We also found that even when a pre-curved instrument was skillfully manipulated, existing canal curvatures had much to do with how it behaved rather than being totally controlled by the dentist's hand movements. Above the first curve the dentist has full control, but below the curve much of the control is lost. In addition, we noted that in curved canals rigid instruments leaned against one wall—often leaving other parts of the canal untouched and unclean.¹

Cross-sections confirmed what we have known for years. Apical anatomy—with deltas, multiple foramina, lateral canals, fins, and cul-de-sacs—is much too complex to instrument and clean predictably or adequately, and this is not likely to change any time soon. When this reality is accepted, our instrumentation goal becomes obvious—clean the main canal as best we can. We also have to accept the fact that our bodies' defense system makes many of our root canal treatments “work.” Neutrophils and macrophages are innately programmed to kill bacteria and cleanup debris. Our goal must be to give our defense system as much help as possible (clean the main canal).

Observing the real world of cross-sections provided the motivation to design a radically different instrument. We wanted sufficient flexibility to negotiate 3-dimensional canal curvatures. The desired flexibility was obtained by removing metal from the shaft and eliminating the taper. To this was added a short blade and noncutting pilot tip. The combination of Ni-Ti and a new design gave us an extremely flexible instrument that could prepare apical canals large enough (dic-

were not addressing the essence of successful endodontics...clean canals. Clearly, stainless steel instruments and outmoded techniques were not getting the job done.

These unexpected observations encouraged additional investigation of root canal-treated teeth. [Author: is above sentence correct as edited?] Extracted teeth were instrumented, obturated, and radiographed. Then the roots were cross-sectioned and photographed 1, 3, and 5 mm from the apex. The results were studied by projecting the radiographs and cross-sections side by side. This very valuable learning experience not only

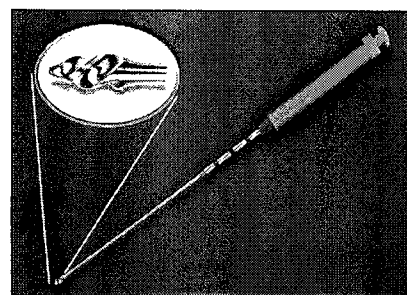


Figure 1. Original LightSpeed design (LS1). Note the flexible, nontapered shaft, short blade, and noncutting pilot.

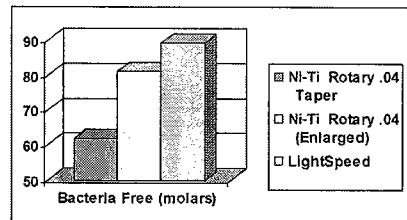


Figure 2. Results of 3 instrumentation protocols. As the apical preparation size increases, the bacterial count in the canal decreases.

tated by the original canal size) to clean all main canal walls without deviating very much from the original canal boundaries. Inspired by positive results with prototype testing, the basic design of LightSpeed was born nearly 20 years ago (Figure 1).

NI-TI TO THE RESCUE

As good fortune would have it, the very flexible and fatigue-resistant Ni-Ti metal was becoming available for making root canal instruments. Ni-Ti, compared to stainless steel, could withstand many more rotations before it failed, making it ideally suited for a dental handpiece. Clinicians quickly realized that rotary instrumentation was “easier and faster”—and thus began the Ni-Ti revolution that evolved to where we are today.

However, *easier and faster* did not always translate into *better*. Rotaries had their good points; they were faster and reduced the incidence of ledges, zips, and perforations. However, the benefits of Ni-Ti instruments did not necessarily result in cleaner canals.

Callout here

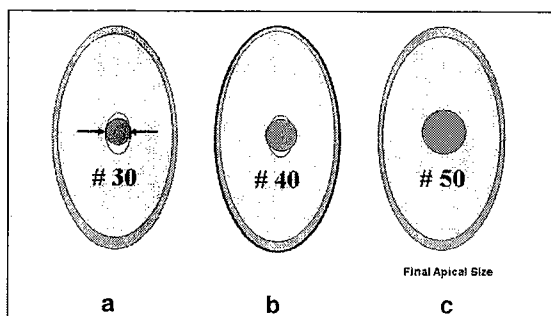


Figure 3. Cutting begins with the LSX No. 30 at the narrow diameter (a); more cutting with larger sizes (b); all walls are cut (greater diameter), determining the final apical size (c).

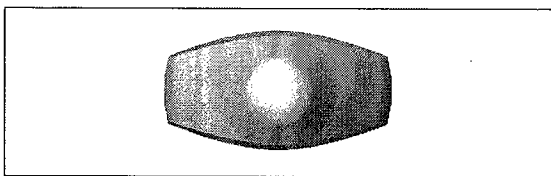


Figure 4. Front view of LSX spade blade with noncutting pilot.

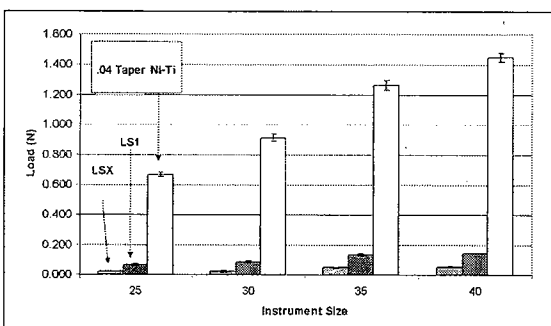


Figure 5. LSX is significantly more flexible when compared to tapered instruments with similar tip sizes. (Source: UCLA School of Engineering and Applied Science, Department of Bioengineering.)

Albrecht, Baumgartner, and Marshall showed that tapered Ni-Ti instruments did not clean any better than stainless steel hand files when the final apical rotary sizes were the same as the stainless steel instruments.² It makes sense that instrumenting to the same apical size shouldn't make much difference.

At a lecture given in 1999 (American Association of Endodontists), Martin Trope suggested that the reason rotaries didn't result in cleaner canals was because clinicians were not taking full advantage of the new technology. In other words, while instrument design may have progressed, the concepts of canal cleaning had not. Siqueira, et al³ and Card, et al⁴ found that canals instrumented to larger sizes result-

ed in greater bacterial reduction. Molars (Figure 2) that were only rendered 60% bacteria-free using a "normal" tapered instrument protocol were significantly improved to 80% when further enlarged with tapered Ni-Ti rotaries, and then to 89% when instrumented with LightSpeed instruments. They even suggested that larger apical preparation sizes may eliminate the need for 2-visit endodontic procedures (necrotic cases). In summary, larger preparations result in cleaner canals. Intuitively, this makes a lot of sense.

INTRODUCING THE LIGHTSPEED LSX NI-TI ROTARY SYSTEM

The original LightSpeed instrument was introduced in 1994. Since then, technological advances have made

improvements to the original design possible. After several years of testing, the improved version of LightSpeed, LightSpeed LSX, was introduced. It was so named because evaluators felt very safe using it, suggesting that the "X" be added (for extra safe). We will explain the safety features later.

The concept of cleaning canals by matching the final apical instrument size to that of the original apical canal size has not changed with the LSX. Figure 3 explains how this is done. The LSX begins to cut only when the blade touches 2 walls at the narrowest part of the oval canal (Figure 3a). Each larger instrument cuts more dentin (Figure 3b), and instrumentation ends with a size slightly larger than the canal's greater diameter (Figure 3c). [Author: is above sentence correct?] Since what was just described is not visible—the dentist knows what is going on by instrument feedback.

WHAT'S NEW ABOUT THE LSX? REDUCED NUMBER OF INSTRUMENTS

A major criticism of the original LightSpeed system (called LS1) was "too many instruments." Even though it was just as fast, if not faster, than many other rotary systems, "too many instruments" was an issue for many dentists. The reason for the additional instruments was that the LS1 could not easily and safely jump from one full size to another (ie, No. 35 to No. 40). Because the LSX is stronger, more efficient, and safer than the LS1, there is no need for the half sizes.

MORE PRECISE TACTILE FEEDBACK

The LSX blade design provides even better tactile feedback than the original. The spade-like shape is similar to an oval canal viewed in cross-section (Figure 4). One can actually "feel" the canal better with LSX than with LS1.

TAPERLESS DESIGN PROVIDES MAXIMUM FLEXIBILITY

The LSX is even more flexible than its predecessor, enhancing its ability to follow tortuous canals without much con-

cern for mishaps. Since research confirms that apical canal diameters are indeed larger than commonly believed, the ability to instrument to larger sizes is a great advantage. Flexibility is the key to keeping the instrument within the confines of the canal so that all walls are cleaned. The combination of a short blade, a thin shaft, and Ni-Ti makes the LSX an extremely flexible instrument (Figure 5).

LSX UNIQUE CUTTING BLADE DESIGN: "SPADE BLADE"

The spade blade (Figures 6a, 6b, and 6c) has several advantages: 1) There are no flutes to fill with debris. Clogged flutes cause a significant loss of cutting efficiency, encouraging a more forceful push and increasing the risk of instrument fracture. Therefore, flutes have to be cleaned frequently, wasting valuable time. The space on both sides of the LSX blade provides ample room for debris that is later flushed out of the canal with irrigant. 2) The spade blade has no helical angle (spiral thread) that accounts for a "self-threading" tendency. With the LSX blade the dentist controls apical advancement. 3) The blade design provides space for cut debris and for bypassing in the unlikely event of instrument separation.

As with all designs, there is a trade-off; the 2-blade design results in a bit more "chatter." Chatter indicates an oval rather than a round canal shape. Take advantage of this information and go to larger LSX sizes until it is eliminated. How do we handle this clinically? By being aware that chatter may occur and slowing the apical progression immediately when encountered.

ADDRESSING INSTRUMENT SEPARATION

A substantial number of dentists have not embraced the benefits of Ni-Ti rotaries, fearing instrument separation. While instrument abuse is by far the leading cause of separation, instruments can separate even when handled properly. We now understand why. Instruments are made by grinding the Ni-Ti, and in

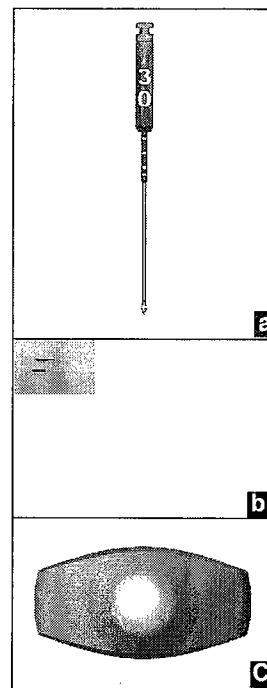


Figure 6. LSX with easy-to-read ISO size (a); closeup of blade; note the absence of flutes (b); head-on view of the blade and the spaces on both sides of the blade for debris and bypassing (c).

the process a defect (nick) can occur on the surface of the metal. Rotation in a curved canal bends the instrument back and forth, causing the defect to "grow." Failure occurs without warning or apparent reason from metal fatigue.

This concern was addressed with the LSX by using a stamping rather than grinding process. The LSX resists failure from metal fatigue because a grinding wheel does not touch any part of it. The Ni-Ti retains its natural state as received from the wire manufacturer. The instrument design is also part of the solution. All things being equal, a larger diameter instrument, with more metal, will fail from fatigue before a smaller one (seems illogical, but that's the science). Of course, all metals will eventually fatigue with usage, and LSX is no exception. The key is to track usage and avoid overusing the instrument (Figure 7).

TORSION OVERLOAD: ANOTHER REASON FOR

continued on page XX

What's New In...

continued from page

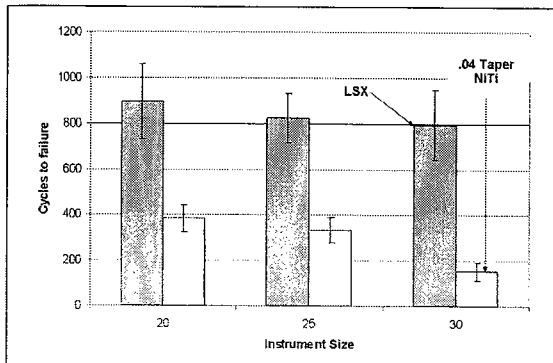


Figure 7. Cycles to failure: LSX versus .04 taper Ni-Ti. (Source: UCLA School of Engineering and Applied Science, Department of Bioengineering.)

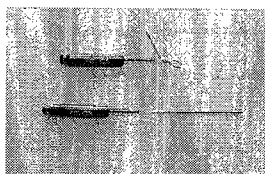


Figure 8. Examples of the "safe failure" design of the LSX. Top: twist-up; bottom: controlled separation at handle.

THE LSX: SIMPLIFIED TECHNIQUE

Besides having significantly fewer instruments, another big plus for the LSX is the simplicity of its technique. The advance and withdraw "pecking" motion previously required for the LS1 is a thing of the past. The LSX technique is much simpler. Slowly advance the instrument apically until a binding sensation is felt (indicating the instrument is beginning to cut)—pause for a moment—then slowly and gently push the instrument to the desired length. The previous pecking motion is no longer necessary because the LSX does not have flutes to fill with debris. The LS1 required the pecking motion to clear the blade of debris. ♦

CONCLUSION

This article has presented an overview of the LSX system. Part 2 will describe the technique and show some clinical examples of its use.

Acknowledgment

The authors thank Steven Senia, BSIE, MBA, for his contribution to this article.

References:

1. William L. Wildey, E. Steve Senia, and Steve Montgomery. Another look at root canal instrumentation. *Oral Surg Oral Med Oral Pathol* 1992; 74: 499-507.
2. Albrecht L., Baumgartner C., Marshall G. Evaluation of Apical Debris Removal Using Various Sizes and Tapers of ProFile GT Files. *J Endodon* 2004; 30: 425-428.
3. Jose F. Sequeira, Jr, Kenio C. Lima, Fernando A. C. Magalhaes, Helio P. Lopes, and Milton de Uzeda. Mechanical Reduction of the Bacterial Population in the Root Canal by Three Instrumentation Techniques. *J Endodon* 1999; 25: 332-335.

4. Card, Sigurdsson, Orstavik and Trope. The Effectiveness of Increased Apical Enlargement in Reducing Intracanal Bacteria. *J Endodon* 2002; 28: 779-783.

Dr. Senia has published in national and international journals and is the co-inventor of the LightSpeed root canal instrumentation and SimpliFill obturation systems. He is a Diplomate of the American Board of Endodontics, a former member of the Journal of Endodontics Editorial Board, and a consultant for the NASA space program. He has lectured extensively around the world. Dr. Senia received both a BS and DDS degree from Marquette University in 1963. After graduating in 1963, Dr. Senia re-entered the Air Force (he had prior service as a pilot) to take a GPR Residency Program at Chanute Air Force Hospital. In 1969 he received a certificate in endodontics and a master of science degree from The Ohio State University. He retired from the Air force in 1981 as a colonel and chairman of endodontics at Wilford Hall Medical Center, and accepted the position of Director of the Endodontic Postdoctoral Program at the University of Texas Dental School at San Antonio. He retired in 1992 as a professor and he presently holds the title of clinical professor at the University. For information about LightSpeed products and a schedule of hands-on courses call (800) 817-3636, e-mail Info@LightSpeedUSA.com, or visit LightSpeedUSA.com.

Dr. Wildey is presently in an endodontic practice in the Dallas/Ft. Worth area in Texas. He is the primary author of 2 articles published in a major national dental journal. He is the co-inventor of the LightSpeed root canal instrument and SimpliFill obturation systems. Dr. Wildey was in private practice in Oklahoma from 1980 to 1986. In 1988 he received a Certificate in Endodontics from the University of Texas Dental School at San Antonio, Texas. Dr. Wildey was in private practice in Oklahoma from 1980 to 1986. He earned his D.D.S. degree from Georgetown University in 1976 and after graduation served four years as a general dentist in the United States Air Force. He can be reached at...

INSTRUMENT SEPARATION

An instrument cutting dentin is subjected to torsional (twisting) stresses. To significantly reduce these stresses the LSX was designed with a short blade to be used at a high rpm (optimum is 2,500 rpm). Even though these two design features contribute greatly toward making the LSX resistant to failure, it can still be subjected to excessive torsional stresses when it is rapidly and forcefully pushed apically.

The good news is that the LSX was designed with a "safe failure mode," which means that if it is overstressed, there is an excellent chance that no part of the instrument is left in the canal. Figure 8 shows how this is accomplished. The LSX either twists-up or separates from the handle. The twisted instrument (Figure 8 [top]) comes out of the canal intact. The separated instrument (Figure 8 [bottom]) is usually easily and quickly removed from the canal with cotton pliers because the separation on average occurs 20 mm from the tip.

ADDITIONAL BENEFIT OF

continued on page ##