"Own the Canal"–The Importance of a Reproducible Glide Path

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The principles of three dimensional cleaning, shaping and obturation of the root canal system which are the foundations for predictable endodontic success were outlined by Schilder over four decades ago and remain pertinent even with all the technological advances that have been made since the turn of the century[1,2] The preparation of the root canal system remains one of the most difficult tasks in endodontic treatment[3] due to the complex anatomy of root canals, with their irregular, non circular cross sections, multiplanar curves, bifurcations, trifurcations, fins, vagaries and cul-de-sacs. (Figures 1 & 2) They often present extreme challenges to clinicians who aim to create a conservative, predictable shape conducive to 3D obturation and a sound restoration. It does not take much to lose control of the root canal space, with subsequent iatrogenic mishaps such as apical ledges, or the packing of dentinal debris; both of which may jeopardize apical patency. Additionally, canal transportation can undesirably alter the diameter and special position of the apical foramen, as well as the working length, thereby adversely affecting the apical seal[4] and potentially causing irritation to the periapical tissues by extruded irrigants and irritants[5]

Mounce[6] outlined certain "Sound Principles" that must be adhered to, before treatment. This includes a comprehensive appraisal of the tooth being treated, canal numbers, location, length, curvatures at all levels, the presence of calcifications, anomalous anatomy, access difficulties, etc." Superior illumination and magnification, an adequate well designed access, good irrigation techniques and re-capitulation are all essential ingredients to gaining control over the canal being treated.

GLIDE PATH DEFINED

One guiding strategy that has also emerged as a critical part of endodontic success, especially when using rotary NiTi files, is the creation and maintenance of a Glide Path. This is necessary because many available NiTi rotary instruments for shaping canals have non- end cutting tips[7] and because of their extreme flexibility are not designed for initial negotiation of the root canal[8]. It has been demonstrated that the risk of instrument fracture can be reduced by first performing coronal enlargement of the root canal.[9,10] Blum et al[11] suggested that a glide path be initially created with small flexible stainless steel hand files to create or verify that within any portion of the root canal there will be sufficient space for the rotary instrument to follow. Berutti et al[12] recommended manual pre-flaring of the root canal to create a glide path before using NiTi rotary instrumentation and found that this reduced torsional stress and increased the lifespan of rotary NiTi instruments". The separation of NiTi rotary shaping files is a matter of concern for clinicians and Patino et al[13] also found that the separation rate of three different rotary NiTi instruments was significantly reduced when their use was preceded by glide path preparation. Recently Berrutti et al. reported that the preparation of a glide path allowed for better maintenance of canal curvature with a new NiTi reciprocating file.[14] The term "Glide Path" is very apropos as it describes what rotary files should do in the canal; GLIDE. Rotary shaping instruments must FOLLOW, not create the pathway of the canal. John West[15] defined the glide path as:

FIGURE 1.

FIGURE 2.

FIGURE 3.

FIGURE 4.

FIGURE 5.

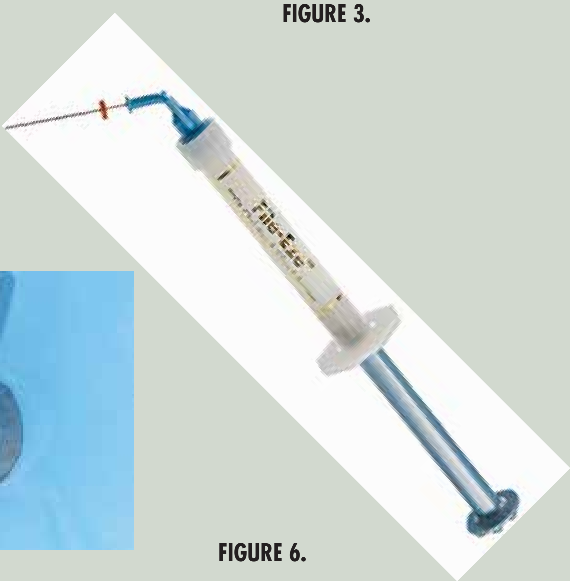

FIGURE 6.

a smooth, though possibly narrow tunnel or passage from the orifice of the canal to the radiographic terminus or electronic portal of exit and noted that a glide path is achieved when the file forming it can enter from the orifice and follow the smooth canal walls uninterrupted to the terminus. Once this is achieved that "path" is much more likely to be maintained with the larger rotary NiTi instruments.

However, it has also been observed that the use of stainless steel instruments to create this glide path can be problematic.[16,17] Because of the relative stiffness of stainless steel, there is the risk of canal transportation, which may lead to perforation, ledging, or apical zipping. These may complicate the entire cleaning and shaping procedure and change the anatomical shape of the apex which may create other challenges. In these cases, the canal now owns the practitioner, transforming the procedure into a negative and frustrating experience with success very much in jeopardy. So while it is acknowledged that creating a reproducible glide path is essential, the appropriate instrumentation is necessary to achieve the desired result.

MECHANIZED GLIDE PATH

Recently a few manufacturers have introduced "Glide Path" instruments, which are used with rotary endodontic motors. They are designed to be used to complete the glide path phase of instrumentation. One such series of files are the Xplorer files (Clinical Research Dental, London ON). (Figure 3 Xplorer file sequence). Initially, there was some hesitation on the part of clinicians to take such a small instrument to working length in a rotary handpiece. It must be emphasized that these instruments should not be taken into the canal, until a #10 stainless steel hand file goes easily to length.

To get to that point, stainless steel hand files should be used to initially negotiate the canal space to achieve working length with

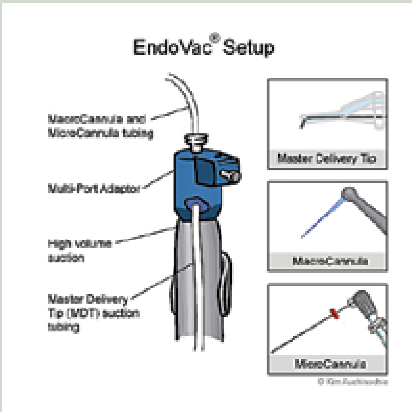

FIGURE 7A.

FIGURE 7B.

FIGURE 8A.

FIGURE 8B.

FIGURE 9.

FIGURE 10.

the #6, #8 and # 10 K files. These files should be stiff, cut well and be used once, ideally. This part of the procedure can be made more efficient with the use of the M4 handpiece (Axis/SybronEndo Coppel, TX) (Figure 4).[18] This is a contra angle that fits onto any E type slow speed handpiece as well as in the new TF Adaptive Motor, M4 Handpiece setting, (Axis/SybronEndo Coppel, TX), and mimics the watch-winding motion normally used in hand filing, with a reciprocating motion, 30 degrees in each direction. This contra angle will also fit on some endodontic motors, (check with the manufacturer to see if it is compatible and what RPM and reduction settings should be used). This handpiece is ideally used with the #6, #8, and # 10 files. Some clinicians report that negotiating these files by hand, leaving them in place in the canal, and then securing the M4 to the file while still in the canal is very efficient. As Kinsey et al stated in the above referenced article, "Reciprocation is inherently safe in that if it is performed correctly, it is very unlikely that an iatrogenic event (instrument fracture, ledging, etc.) might occur."

Having accomplished getting a #10 hand file easily to length, whether by hand or using the M4 Handpiece, the glide path may be completed with the Xplorer instruments rotating in an electric handpiece at 400 rpm. The sizes have been well thought out, as the first is a size 15 with a .01 taper. This is a unique file size and makes a great deal of sense, in that the transition from a #10 file to a #15, is often very difficult as this is a 50% jump in diameter. However the Xplorer 15/.01 is half the taper of a #15 hand file, and has a triangular cross section for added flexibility, so will glide down a canal, even with severe curvature, with relative ease if the #10 file has gone to length easily. Of course, as with any NiTi instrument, if any resistance is encountered, the file should be withdrawn, and patency should be re-established with a #10 file. The next file is a size 20, also with a .01 taper with a square cross section, followed by a size 20 with a .02 taper (Figure 5 20/.02 Xplorer in canal), also with a square cross section. One additional design feature is that there is a limited 10mm cutting zone. This obviously limits canal engagement, reducing instrument fatigue, a must with this small an instrument. The use of a chelator /file lubricant, such as FileEze

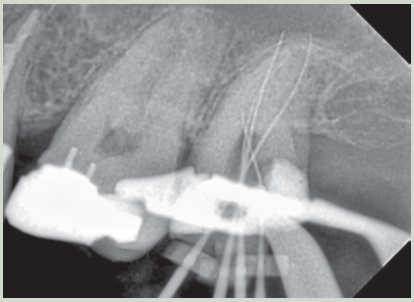

FIGURE 11.

FIGURE 12.

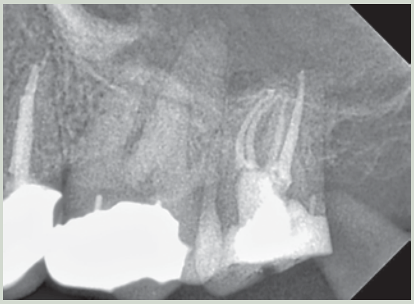

FIGURE 13A.

FIGURE 13B.

(Ultradent, South Jordan UT) (Figure 6, FileEze) or SlickGel ES (Axis/SybronEndo Coppel,TX) is optional. If they are used, the aforementioned are preferable as they are water based, and easily rinsed out of the canal. In some cases, these products help keep debris and tissue in suspension, allowing it to be easily flushed out of the canal. The use of abundant irrigation with sodium hypochlorite, is a must as this cleans, disinfects, transports and digests tissue, as well as effectively lubricating the instruments. Since tissue digestion is not limited to the root canal space, if sodium hypochlorite is forced beyond confines of the canal system, sequelae ranging from postoperative sensitivity[19] to life threatening events[20] are not uncommon. Accordingly, this is best accomplished with apical negative pressure via the EndoVac system (Axis/SybronEndo Coppel, TX). (Figure 7a and 7b). Not only has the EndoVac been demonstrated to be significantly safer than positive pressure irrigation,[21–23] but it also produces cleaner canal walls[24] and intracanal irregularities.[25] Most importantly, in a recent success/failure clinical study, the EndoVac system produced 96.57% long term healing in non-vital teeth treated in a single-visit,[26] compared to a 80.1% healing rate in teeth treated with traditional positive pressure.[27]

The above sequence results in an efficient, predictable glide path to a size 20. At this point, you are much more apt to "own the canal", proceeding in a crown down fashion with your rotary system into the beautiful true path you have just created. While any system can be used, TF Twisted Files (Axis/SybronEndo, Coppel,TX) (Figure 8a) the Typhoon Infinite Flex files (Clinical Research Dental, London ON) (Figure 8b), dovetail nicely with this predict-

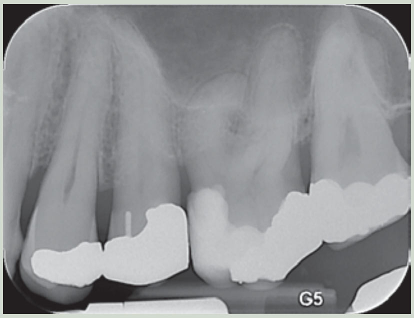

FIGURE 14.

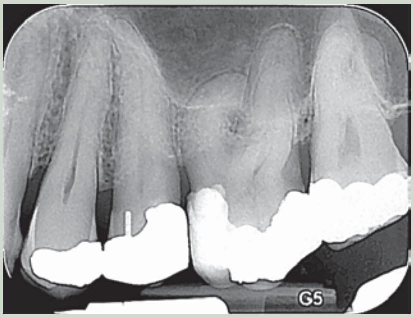

FIGURE 15.

FIGURE 16A.

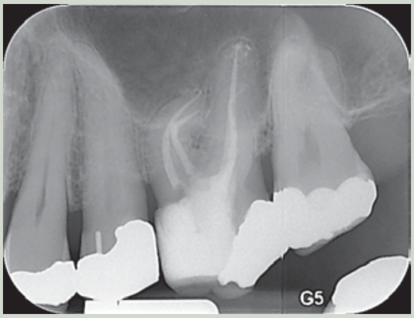

FIGURE 16B.

able glide path. As the glide path created with flexible NiTi results in much less canal transportation, Typhoon files, made with CM NiTi™ have virtually no memory, so will obediently follow the canal path you have just created with maximum cutting efficiency, also with little or no canal transportation and drastically reduced instrument fatigue.[28,29]

CASE REPORTS

Case 1

A 62-year-old male patient presented with irreversible pulpitis in tooth #27. He reported that the restoration on the tooth fell out three months previously. A preoperative radiograph revealed a large carious lesion into the pulp, sharp mid-canal curvature of the mesial root and calcified canals (Figure 9) After pre-endodontic build up and access cavity preparation, ultrasonic troughing with a CT4 diamond coated tip (Axis/SybronEndo, Coppel, TX) was carried out to locate the orifice of the MB2 canal (Figure 10). Root canal patency and working length were established using size 10 K -files (Figure 11) Figure 12 shows the impression of the MB2 canal on a size 10 K-file after removing it from the canal demonstrating the extent of the tortuous midroot canal curvature. Glide path preparation was undertaken using the M4 Handpiece with a #8 and #10 handfiles, then X-plorer 15 0.1, 20 0.1 and 20 0.2 files. The canals were further prepared using the WaveOne primary (25 0.8) (Dentsply, Tulsa OK) and the palatal canal was finished up to a 35 0.6 using a Flexmaster file (VDW, Munich) after apical gauging. A size 10 K-file was used to ensure patency between file insertions and copious irrigation with 3% Sodium hypochlorite in a 31 gauge Navitip side port needle (Ultradent). Once final shaping was completed the canals were irrigated with 17% EDTA(smear clear) to remove the smear layer and then a final rinse with 3% Sodium hypochlorite was done. The canals were obturated with gutta percha and AH Plus sealer (Dentsply) and Microseal condensers (Axis/SybronEndo, Coppel,TX) were used to thermomechanically condense the root filling. Figures 13a & 13b show the post-operative radiographs, note the maintenance of the natural curvature of the canals and minimal coronal enlargement required for preparation of the curved anatomy.

Case 2

A 63-year-old man was referred for consultation of tooth 2.6. The patient's medical history was non-contributory. Chief complaint was extreme temperature and bite sensitivity localized to the first upper left molar. Testing confirmed that tooth 2.6 was extremely sensitive to percussion and cold testing. A radiograph taken (Figure 14) revealed a large composite that appeared to be very close to the pulp chamber. No significant radiolucencies could be noted. A diagnosis of acute pulpitis with acute apical periodontitis was made. Options were discussed and the patient opted to proceed with endodontic therapy as recommended.

Access opening was made and four separate canals were located with the use of the operating dental microscope (Global Microscopes, St. Louis, MO). The pre operative radiograph was used to determine an approximate length of the canals (Figure 15). A # 08 hand file was introduced in all the canals. This file was taken to two thirds of the predetermined length with a watch winding motion. Care was taken to make sure that this length could be reproduced. A # 10 hand file followed and was carefully taken to the same length as the previous file in all the canals. At this point a # 10 file with the aid of the M4 handpiece was introduced into all the canals. This file was followed by the #15 and the #20 file to as close as possible to the predetermined length. None of these files were forced apically into the canals. Copious irrigation with 5% Sodium Hypochlorite was done in between files. A reciprocating Ni Ti instrument (Wave One Primary file, Tulsa Dental) was introduced into the canals trying to get as close to the predetermined length as possible. No apical pressure was used. This file was used in a brushing motion. The canals were irrigated and dried with paper points. Working lengths for all four canals were determined with the use of an apex locator (Bingo) and a #10 25mm hand file. A # 10 hand file with the M4 handpiece (Axis/SybronEndo, Coppel, TX) was taken to length, the presence of a reproducible glide path to this point was confirmed. This file was followed by an X-Plorer rotary NiTi file (Clinical Research Dental, London ON) # 15 01 taper to length. A # 20 01 and a 20 02 taper files followed. An electric motor with torque control was used for these files. Copious irrigation and patency files were used in between instruments. Once the reproducible mechanical glide path was created and confirmed a # 25 08 taper Wave one file was taken to length. Deep shape was achieved by using larger hand files with the M4 hand piece. Gutta percha cones were selected and the canals were obturated with a warm single wave technique. Postoperative radiographs confirm proper three dimensional obturation of all four canals (Figures 16a and 16b).

CONCLUSION

Scientific literature and clinical experience clearly show that successful outcomes are more likely and iatrogenic mishaps will be minimal when rotary and reciprocating instruments follow a designated route, a reproducible glide path. The incorporation of modern mechanized files into the instrumentation protocol will help achieve this important step in the endodontic procedure. OH

Dr. Yosef Nahmias was born and raised in Mexico City. After he had graduated from the Universidad Tecnologica de Mexico, School of Dentistry, in 1980 with a degree in dentistry, he decided to advance his education and chose endodontics as his specialty. Under the guidance of Dr. Harold Gerstein of Marquette University in Milwaukee, Wisconsin, he completed his thesis on Apex Locators and earned his Master of Science degree in 1983.

Dr. Nahmias has authored and published many articles. He continues to lecture in Canada, Mexico and across South America. The University of Toronto, Faculty of Dentistry has involved Dr. Nahmias in teaching their postgraduate level students in endodontics. Dr. Nahmias resides in Toronto, Ontario with his wife and five children, and has maintained a private practice specializing in endodontics in the town of Oakville, Ontario since 1983.

Imran Cassim qualified with a BDS degree from University of Witwatersrand In 1999. He attained distinctions in Physiology, Pharmacology and Anaesthetics during his undergraduate study. He received the African Oxygen Horace Wells Bronze Medal for the most distinguished student of the year in Anaesthetics in 1998. In 2009 He completed his Post Graduate Diploma in Endodontics at University of Pretoria, with distinctions In Oral Biology and Endodontics. Imran is currently studying part time, towards an MSc In Endodontics at University of Pretoria, and in private practice focusing mainly on endodontics and restorative dentistry in Durban.

Dr. Gary Glassman graduated from the University of Toronto, Faculty of Dentistry in 1984 and was awarded the James B. Willmott Scholarship, the Mosby Scholarship and the George Hare Endodontic Scholarship for proficiency in Endodontics. A graduate of the Endodontology Program at Temple University in 1987, he received the Louis I. Grossman Study Club Award for academic and clinical proficiency in Endodontics. The author of numerous publications, Dr. Glassman lectures globally on endodontics, is on staff at the University of Toronto, Faculty of Dentistry in the graduate department of endodontics, and is Adjunct Professor of Dentistry and Director of Endodontic Programming for the University of Technology, Jamaica. Gary is a fellow of the Royal College of Dentists of Canada, and the endodontic editor for Oral Health dental journal. He maintains a private practice, Endodontic Specialists in Toronto, Ontario, Canada. He can be reached through his website www.rootcanals.ca.

Oral Health welcomes this original article.

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