issn 1616-6345

Vol. 5 • Issue 3/2009

roots

international magazine of endodontology

3 2009

_clinical report
The MAP System

_instrumentation
Endodontic file design

_industry report
The new GT Series X rotary shaping system

dti] Dental Tribune International

PEOPLE HAVE PRIORITY

Think Endo cordless!

No cord. Full power. Entran sets new standards in the area of cordless endodontics and combines the highest level of ergonomics with consistent W&H quality. For root canal preparation, there are a number of features at your disposal e.g. torque control, automatic direction change and 5 preset torque levels for NiTi files. Simple to operate, so you can concentrate on the treatment. With Entran you can enjoy complete freedom of movement inside the entire mouth - even in the most inaccessible posterior molar area.

wh.com

entran

Endodontics. Cordless!

Dear Reader,

Dr Gerald N. Glickman
Guest Editor

_It is a great pleasure for me to be addressing you in this publication, and as a speaker at the 14th Biennial Congress of the European Society of Endodontology. As a lifelong learner, career academician and practitioner, and current President of the American Association of Endodontists, I am committed to sharing the best of endodontics with colleagues around the world, and welcome the opportunity for dialogue with you.

There are a great many issues that deserve attention and apply to endodontic professionals in every practice setting and geographic location: access to care for patients in underserved populations, maintaining an interdisciplinary approach to treatment planning, staying abreast of the latest developments in research and technology, evaluating continuing education opportunities for reliable, timely information, and upholding the highest standards of patient care are only a few.

The American Association of Endodontists (AAE) strives to be a truly global resource of endodontic knowledge and education for the profession, our members and the public. We prioritise participation in international endodontic gatherings by our leaders, and promote those events in our publications and online. We recognise that there is thought leadership worldwide, and for this reason invite international speakers to AAE events.

A plethora of international endodontic research is submitted and reviewed for publication in our *Journal of Endodontics (JOE)*. Easier online access to quality reference material by our colleagues overseas is also being pursued, as the AAE begins to provide online-only subscriptions to the *JOE* to international endodontic organisations this year, and continues to post publications such as its *Glossary of Endodontic Terms* and *Clinical Guide to Endodontics* for free download to members on its Web site (www.aae.org). The list of similar efforts is bound to grow in the future.

I invite you to use our resources, and to share your own strengths with us. The AAE recently offered an international membership category for specialists residing outside the US. Please consider joining us in whatever capacity meets your needs. I would love to welcome you in person at our 2010 Annual Session in San Diego, California, next April!

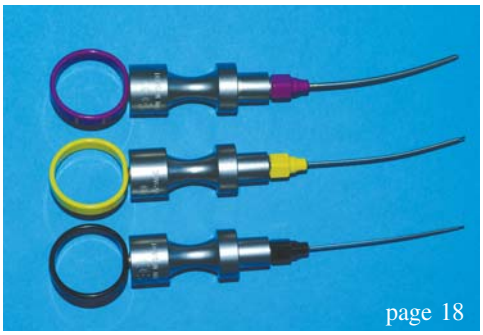
With warm regards,

Gerald N. Glickman

Dr Gerald N. Glickman
AAE President


page 10


page 14


page 18

editorial

clinical report

instrumentation

trends

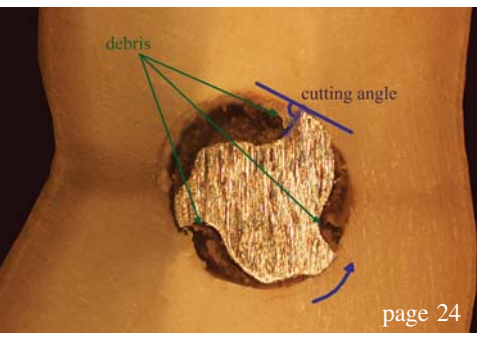
industry report

lifestyle

meetings

about the publisher

Cover image courtesy of Produits Dentaires SA (www.pdsa.ch).



page 24


page 34


page 40

Ultrastreaming in the root canal

for an effective cleaning

VDW.ULTRA®

New ultrasonic device with endo-focus. Safe operation thanks to clear user guidance following endodontic indications:

- Passive, ultrasonic irrigation reaches all areas inaccessible to instrumentation
- Cavity preparation
- Retreatments
- Removal of metal posts and separated instruments

VDW®

Want more information?
VDW GmbH · P.O.Box 830954 · 81709 München · Germany
info@vdw-dental.com · www.vdw-dental.com

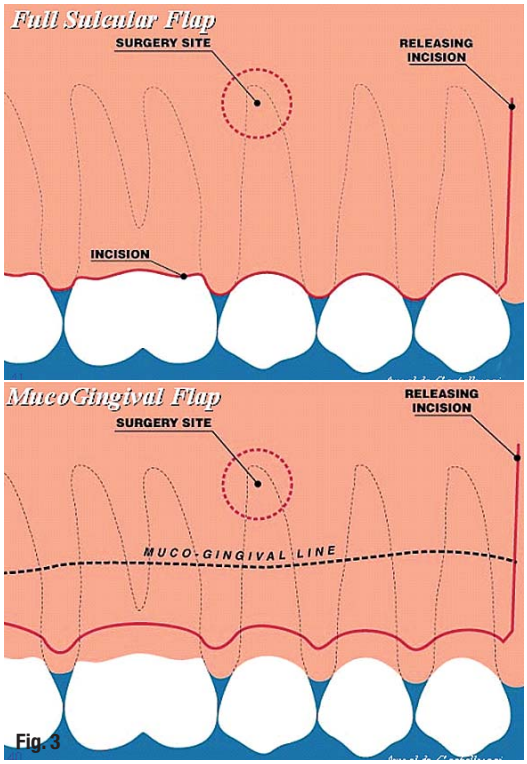
Endo Easy Efficient®

Apical microsurgery—Part II: Incision and atraumatic flap elevation

Author_ Dr John J. Stropko, USA

_The incision is made using a disposable CK2 microsurgical blade (SybronEndo). With the smaller size of this blade, accurate incisions can be made that have a cleaner cut than those of the much larger BP #15 or BP #15S blades. As the incision is being made, the operator needs to visualise the suturing process. Sometimes just a small variation in the design of the incision can make a significant difference to easier and less traumatic closure of the surgical flap. In general, the operator is working with relatively healthy tissue and no attempt should be made to remove or alter the periodontium. This is especially applicable when making a full sulcular flap.

All flaps are full thickness and the incision must be complete, so that there is no inadvertent tearing upon retraction of the flap. The split thickness flap is to be avoided as it is the most traumatic and healing is compromised. The periosteum does not survive the flap reflection procedure. It has been postulated that depolymerised periosteal collagen plays a role in rapid reattachment of the flapped tissues to cortical bone.[1]



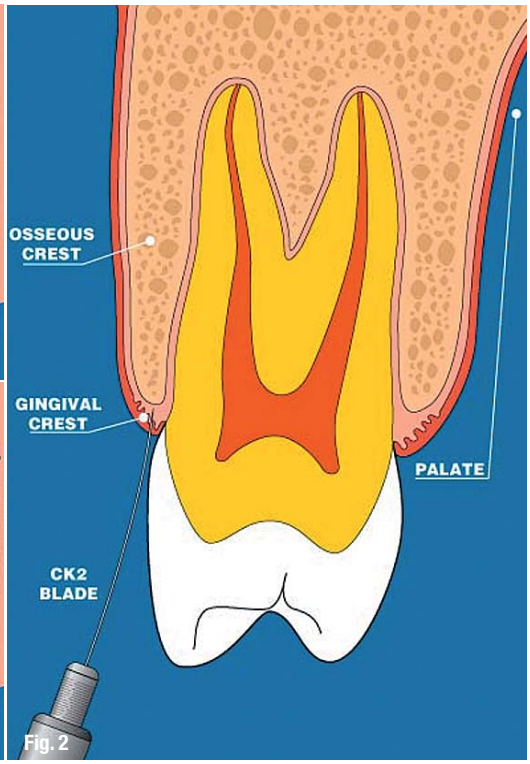


Fig. 1_Diagram showing the most often used full sulcular incision. *(Image courtesy of Dr Arnaldo Castellucci)*

Fig. 2_Ideally, the incision should be made to the osseous crest to preserve the healthy periodontal attachment.

Fig. 3_The Leubke-Ochsenbein Flap, or muco-gingival flap, is used when aesthetics are a concern and there is an adequate zone of attached gingiva. *(Image courtesy of Dr Arnaldo Castellucci)*

In general, all flaps should be extended, at a minimum, to the mesial of the second tooth anterior to the apex of the root being surgerised. The flap design differs depending on the integrity of the bone over the roots, the amount and nature of the attached gingival tissue, the anatomy of the jaw, and the absence or presence of fixed dental appliances. There are two flap designs: triangular (one releasing incision) and rectangular (two releasing incisions). They are normally either a full sulcular flap or a muco-gingival flap, depending on the location and situation presenting itself to the operator. In general, the longer the length of the flap, the easier it is to control and has no effect on the healing process.

_The full sulcular flap

This design is routinely used in all posterior quadrants. The full sulcular flap should be used in the anterior if there is thin zone of attached gingival tissue, or there is a concern about the possibility of a dehiscence over the root of the tooth being operated on. The incision is made through the gingival crest, following the curvature around the cervical of the teeth involved in the surgical area (Fig. 1). The operator should attempt to incise the tissue through the gingival crest to the osseous crest of bone, leaving the healthy gingival attachment intact (Fig. 2). The advantage of the full sulcular flap is the ability of the operator to visualise the emergence form of the involved teeth easily.

_The Leubke-Ochsenbein or muco-gingival flap

This flap is used only when there is an adequate amount of attached gingival tissue present and the periodontal probing is within normal limits. The incision design should be scalloping in nature and generally follow the architecture of the teeth, which allows for easy repositioning upon completion of the apical microsurgical procedures (Fig. 3).

All releasing incisions are made parallel to the long axis of the teeth. This is important because the blood supply to the area is also parallel to the long axis. If a wide-base flap is made, the blood supply to the tissue adjacent to the flap will be compromised and healing may not be as predictable or uneventful.

The reflection of the flap is accomplished using the Molt, Ruddle R, or Ruddle L (SybronEndo) periosteal elevators. The working end of the instrument is gently inserted into the releasing incision, line into the free gingival tissue apical to the muco-gingival attachment and as far apically as the incision and bony contours will gently permit (Fig. 4). The instrument is manipulated in a gentle up-and-down (apical-to-coronal) movement within the unattached gingival portion of the flap. Maintaining the same motion, the instrument is moved slowly towards the same apical position at the more distal extent of the flap. The working end of the elevator should be sharp so that the reflection will be a dissecting process, thus crushing or tearing of the tissue is avoided.

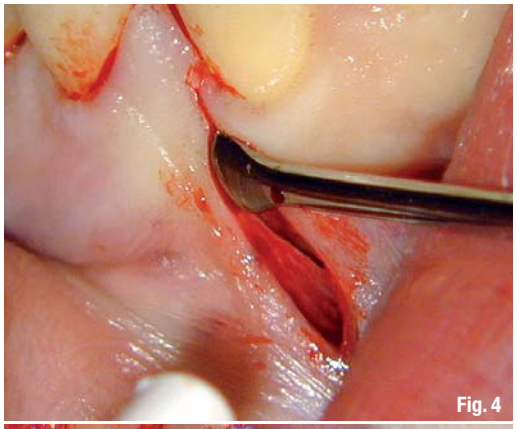


Fig. 4

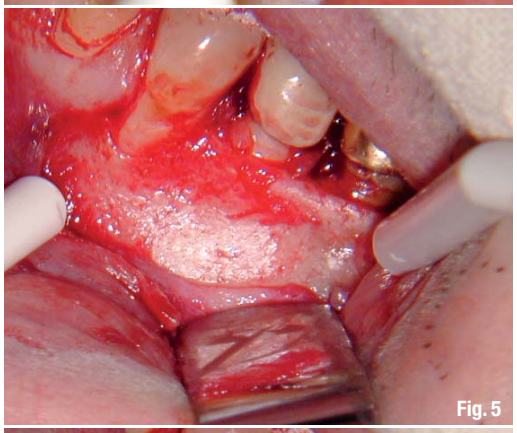


Fig. 5


Fig. 6

Fig. 4_The Molt, or Ruddle elevator, is inserted into the unattached gingival portion of vertical releasing incision.
Fig. 5_Tissue impingement by the retractor is the leading cause of post-operative discomfort.
Fig. 6_The retractor is placed into a prepared groove on the cortical plate stability to prevent tissue impingement.

Occasionally, especially in the posterior quadrants of the mandible, the muco-gingival line will actually be firmly attached to a microscopic bony ridge. The attached tissue must be gently dissected from it. Once the mesial few millimetres are loosened, the rest will generally peel away without much effort at all and will gently release from the osseous surface. The time spent initially to gently free the attached gingiva will be rewarded by a healing process that is more likely to uneventful.

This atraumatic elevation and reflection of the flap is a major contributor to the rapid healing response routinely observed only 24 hours post-operatively. It is important that the approximating surfaces of the flap are not touched after the incision is completed, so that there are no crushing injuries to inhibit or retard the healing process. An instrument such as the old wax spatula-shaped periosteal elevator has no place in the armamentarium of the endodontic microsurgeon.

Once the flap is gently and cleanly reflected, any tissue tags should be left intact as they will aid in the healing process. It is not necessary to clean the flap and exposed bone, as these efforts are time-consuming, can be traumatic to both the hard and soft tissue, and ultimately compromise the healing process.

The retraction of the flap must also be accomplished in a gentle and atraumatic manner. The most common cause of post-operative pain and swelling arises from impingement of the tissue during the retraction process (Fig. 5). The operator has to monitor the end of the retractor constantly to ensure there is no inadvertent impingement on the flap. This is when the 'scope' assistant is most helpful because they are observing the surgical site with a different set of eyes!

An effective way to achieve atraumatic retraction is to prepare a groove in the cortical plate of the bone, well apical to the anticipated access to the root end. A surgical length #8 round bur, on a high speed Innovator handpiece (SybronEndo), is used to make the groove. A high-speed handpiece that has air escaping from the working end should never be used because of the danger of air embolism.

The groove creates a definite place for the retractor instrument to seat into, which can then be easily maintained in position, by either the doctor or the assistant, thereby eliminating the problem of inadvertently slipping during the surgery. Impingement of the tissue is also more predictably avoided by using a groove to hold the retractor.

Retraction can be accomplished using either the Carr or Rubinstein Retractors. However, there are many different styles of retractors from which to choose. The specific retractor chosen is the one that will best maintain clear visibility to the surgical area and be comfortable for the operator to hold during the surgical procedure (Fig. 6).

After the flap is retracted and if there is any tension on the flap, the vertical releasing incision can be extended, or an additional releasing incision at the opposite side of the flap can be considered. The releasing incision is usually minimal, only 3 to 4 mm long, and often does not require suturing. In any case, it is imperative that the operator keeps in mind there should be no tension or stretching of the tissues. One should not hesitate to extend or modify the incision, to eliminate tension on the tissues during retraction. When there is tension, there is usually an opportunity for crushing or ischaemia of the tissue and a resultant delay in the healing process. Generally speaking, the larger the flap, the easier it is to maintain atraumatically during the surgical procedure._

_Reference

1. Harrison JW, Jurosky KA. Wound healing in the tissue of the periodontium following periradicular surgery. II. The dissectional wound. J Endod 1991; 17 (11): 544–552.

_author info

roots

Dr John J. Stropko received his DDS from Indiana University in 1964 and for 24 years practised restorative dentistry. In 1989, he received a certificate for endodontics from Boston University. He recently retired from the private practice of endodontics in Scottsdale in Arizona. Dr Stropko is an internationally recognised authority on micro-endodontics. He has been a visiting clinical instructor at the Pacific Endodontic Research Foundation (PERF), an Adjunct Assistant Professor at Boston University and an Assistant Professor of graduate Clinical Endodontics at Loma Linda University. His research on in vivo root canal morphology has been published in the *Journal of Endodontics*. He is the inventor of the Stropko Irrigator, has published in several journals and textbooks, and is an internationally known speaker. Dr Stropko has performed numerous live micro-endodontic and microsurgical demonstrations. He is the co-founder of *Clinical Endodontic Seminars* and is currently an instructor of Microsurgery in the Endodontic Faculty at the Scottsdale Center for Dentistry. He can be contacted at topendo@aol.com.

Diagnostic
Information
Treatment
Care
Healing

Design meets precision

There is hardly another dental equipment manufacturer who demonstrates such a passion for perfection as the Japanese family-owned company Morita. Our work reflects the highest standards in terms of quality, reliability, precision and customer satisfaction.

One example: the high-performance Apex Locator Root ZX mini. Root ZX mini uses the ratio technique of the Root ZX, the winner of many awards, to provide the highest measurement accuracy. Its function and precision are not affected by temperature fluctuations or moisture in the canal. Hardly larger than a smartphone, the Root ZX mini is compact and light, ideally suited for the hand or patient's chest if you like. There is space for this elegant high quality device wherever your treatment requires it. The coloured display is easy to read, the automatic calibration and the automatic zero balance make its use both comfortable and safe.

Talk to your dental equipment specialist retailer about the Root ZX mini, or call us directly: +49 (60 74) 8 36-0!

www.jmoritaeurope.com

MORITA

Thinking ahead. Focused on life.

The problems with canals

Author_ Dr Jonathan Murgraff, UK

_As with all problems we confront, a clear methodical approach is necessary to resolve them and to put matters into a clear perspective. The 'where, why and how' approach helps to break the problem down and will help you arrive at a reason for the blockage and feasibility of treatment success and outcome. But where is the blockage?

A mandatory preoperative peri-apical radiograph is best practice, showing several millimetres beyond the apex and above the crown reveals the whole root canal system. Does the whole root canal in question appear patent or sclerosed? Or does only the coronal middle or apical third appear sclerosed?

If the whole canal is sclerosed, are the adjacent root canals patent? If all the teeth appear sclerosed, the radiograph generally is too light and underexposed or underdeveloped. If only this canal is sclerosed, it may well be calcified, but very often overlap of anatomical structures such as the zygomatic buttress will obscure the patent canal (Figs. 1 & 2). In addition, incorrect placement of the radiograph without an appropriate holder for a paralleling technique may result in parts of the image being out of focus, or obscured.

Does the resistance to the canal correspond to the position of the radiopacity? If this is the case, what is the cause and nature of the calcification, what is its position and how far does it extend? Calcifications are primary, secondary or tertiary, irregular and rapid as a result of caries, trauma or cracks in the tooth. Calcifications often develop in the root canal via a process inflammation, bleeding in the pulp and a resultant nidus of calcification.

The calcification may be complete or incomplete. Very often, the calcification may be incomplete although the radiograph may not reveal any canal patency and a .06 file may be gently passed through a fine central canal in this area and then widened. Suffice it to say, high magnification with an operating microscope or loupe is necessary, with copious lubricant and irrigation.

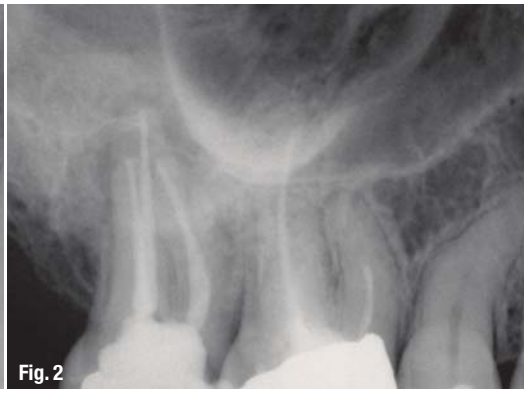


Fig. 1_Upper-right second molar appearing sclerosed.
Fig. 2_Canals now obvious after obturation.


Fig. 3


Fig. 4


Fig. 5


Fig. 6

Fig. 3_Calcified mesial canals apically where practitioner was unable to prepare canals calcified to the apex.
Fig. 4_Calcified canals now prepared to length.
Fig. 5_Mesial canal on an upper-left first molar, which appears not to have a patent canal.
Fig. 6_Mesial canal on post-operative radiograph now showing the acute bend in the mesial canal.

_Risk of damage

Complete calcification is more difficult to negotiate and is more likely to damage the tooth substance, especially as the root canal space is 3-D and the calcification may be at a curved portion of the canal. Various anatomical guidelines, aids and instruments are necessary for this task.

The straighter and more coronal section of the root canal is obviously easier to negotiate than an apical curved section (Figs. 3 & 4).

Again, an excellent light source and magnification are essential for an appropriate field of vision. In addition, transillumination placed on the buccal cervical surface of the tooth can reveal the orifice of the canal. Dye preparations that can stain organic components of the root canal and act as a visual aid are also available. The central sclerosed canal very often has a much darker brownish appearance and the outer root a whiter hue. There are various instruments that remove the sclerosed dentine and amongst these are the rotary instruments, for example goose-neck burs and ultrasonic smooth and diamond tips.

_Perform with caution

Great care should be taken to stay effectively in the centre of the root and not to excavate or burrow too quickly without reassessing the field by removing the dentine dust and, if necessary, taking a radiograph to ensure you are on course. Any detection of bleeding should be tested using an apex locator to determine whether this is pulpal tissue or perforation of the root. Immediate ringing of the apex locator is not a good sign and with radiographic conformation, the prognosis is reduced if perforation has occurred. MTA repair or surgical intervention can be considered but extraction may be an option at this stage and the patient has a right to know this situation. If the tooth is going to support a bridge, an implant may be a preferable option. Certainly, the issues must be discussed with the patient before the procedure, as the patient must be informed of the risks and outcomes.

As soon as canal resistance occurs beyond a curve, an operating microscope can't be used to see around a curve and tactile filing with pre-bent tips of files becomes the only intra-canal option (Figs. 5 & 6).

Great care must be taken with non-cutting tips to avoid perforation. However, apical perforations have better outcomes than coronal perforations, especially pupal floor perforations, as there is less risk of oral fluids acting as a nutrient source to any root canal infection.

If the canal appears patent, there are various reasons that the file may not go to length. The classic case in point is simple dentinal mud. Copious

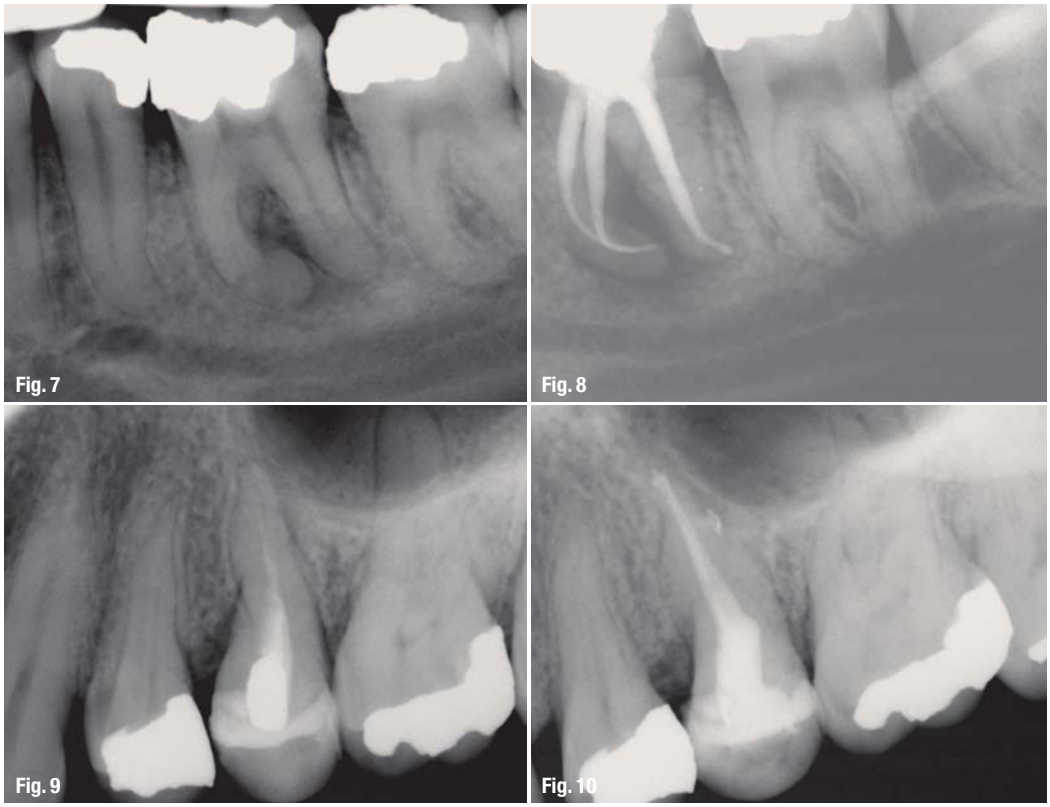


Fig. 7_Preoperative radiograph of lower-left first molar with a calcified mesial root apically.
Fig. 8_Post-operative radiograph showing the extreme nature of the 90-degree acute bend in the mesial canal.
Fig. 9_Upper-left second premolar with incomplete root filling and an acute coronal bend in the canal.
Fig. 10_Post-operative radiograph showing the root preparation and filling to length.

irrigation and patency filing help keep the guide path clear and patent. Creating a false canal, ledging or zipping the canal will result in the damage of tooth substance and cause the file not to follow the natural canal path but rather a falsely created pathway.

The best way of avoiding false pathways is to flare the canals coronally, which reduces the curvature and flexing of the file and will allow free movement apically of the file. Avoiding cutting-tip files will result in less gouging and ledging of the canal and then subsequent larger files being caught on the ledge, making the canal subsequently less negotiable.

Although rotary NiTi files have made endodontics faster in the hands of the practitioner, the metal file has an inherent elastic memory and as a result it is constantly trying to straighten. Ledging can result in curved canals with acute angles (apical and coronal) and from using larger files before a guide path has been created, and subsequent files may not be able to pass (Figs. 7–10).

Finally and rarely, a relatively mild curvature seen on the radiograph may seem difficult to negotiate, for example the mesio-buccal canal in an upper six tooth. On examining the file, much unwinding and work hardening can be seen to have occurred. This may well be the result of the canal not only bending in a mesio-distal plane but acutely at the same point in a bucco-palatal direction, i.e. in three dimensions placing great strain on the file. Again, coronal flaring, straight-line access and copious irrigation and lubricant are essential.

If there is any doubt in any situation, referral to an experienced colleague with recognised postgraduate training is always in everyone's best interest._

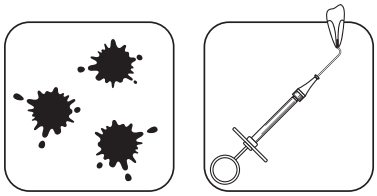
_author info roots

Dr Jonathan Murgraff graduated from King's College London and completed a two-year Master's degree in Endodontics at the GKT Institute. He has run an endodontic practice for ten years and also lectured and demonstrated at postgraduate endodontic courses. Dr Murgraff has a practice specialising in endodontics in both the West End of London and Hendon (north-west London). He can be contacted on +44 20 7486 3090 or +44 7974 344842.

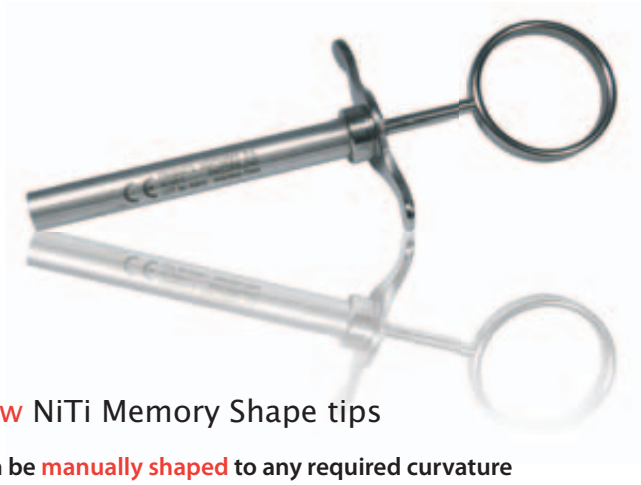
MAP SYSTEM

MICRO - APICAL PLACEMENT

by PD



problem solved



2009 New NiTi Memory Shape tips

Can be manually shaped to any required curvature
The needle takes back its initial straight shape after autoclave sterilization

endo & retro

The MAP (Micro-Apical Placement) System, «endo» and «retro» kits provide a unique and efficient method for placing root-canal repair materials (ProRoot MTA, amalgam, etc.) by orthograde or retrograde obturation.

Different kits available

Distributors:

Switzerland	heico Dent	071 891 71 55	www.heicodent.ch
Germany	i-Dent	0700 69 69 90 90	www.i-dent.org
France	VET	0450 738 582	www.v-e-t.fr
UK	QED	01733 404999	www.qedendo.co.uk
Benelux	Eurodontie	498 264904	www.eurodontie.be
Norway	Technomedics	69887920	www.technomedics.no
US	Roydent	1-800-992-7767	www.roydent.com
Others	PD, Switzerland	+41 (0)21 925 37 54	www.pdsa.ch

PD SWISS QUALITY

for dental specialists, worldwide

Produits Dentaires SA, Rue des Bosquets 18, CH-1800 Vevey, Switzerland
www.pdsa.ch

Minimally invasive and biomimetic endodontics: The final evolution?

Author_Dr David J. Clark, USA

Fig. 1_An immature maxillary molar is sectioned and viewed from the apical aspect.
Fig. 2_This lower bicuspid was treated with a generous crown-down endodontic shape and suffered a retrograde root fracture within three years of the endodontic treatment.
Fig. 3_This radiograph demonstrates a 31-year success with delicate shaping and crude obturation with silver points (#14), and a four-year failure with a large crown-down shape and heated gutta-percha (note the lesion on #13).

_Traditional endodontics is based on feel, not sight. Tactile proprioreception was the only guide as burs and files were blindly inserted into pulp chambers and root canal systems. With radiographs and electronic apex locators, this blind approach has produced the surprising result that, in the words of Dr Eric Herbransen, "the endodontics succeeds often in spite of us."

There is, however, a significant failure rate, especially long-term failure, that is driving mainstream dentistry to extract natural teeth aggressively in favour of implants. The sting of clinical failure is a powerful motivator for change. In this article, I describe the rationale and techniques involved in minimally traumatic endodontic access and shaping. Also, I discuss obturation techniques for smaller and non-round endodontic shapes in a follow-up article in this publication.

_Ribbons, sheets and banners

One of the most distressing hangovers of the era of blind endodontics and endo-restorative are the beliefs that canal systems are straight, exit at the radiographic apex and are round in cross section. In reality, most canal systems curve and exit short of the radiographic terminus. A very large number, at least 50 per cent, are ovoid or super-ovoid in cross section. Figure 1 demonstrates that of the three roots and canal systems shown, only one is round. As these canal systems mature, they narrow into a variety of unpredictable ovoid shapes, often with smaller anastomosing canal systems (Figs. 4–6).

_The evolution of endodontic shaping

The original endodontic shape was established based on mostly hand filing and filled with either silver points or cold lateral condensation of gutta-percha. Dr Angelo Sargenti later introduced a more rapid approach that involved machine-driven instruments (rotary files) creating larger shapes with significantly more dentine removal.

As of late, a crown-down approach has become popular. The roots are rapidly and blindly machined. This can result in better obturation of the apical half because of improved penetration of

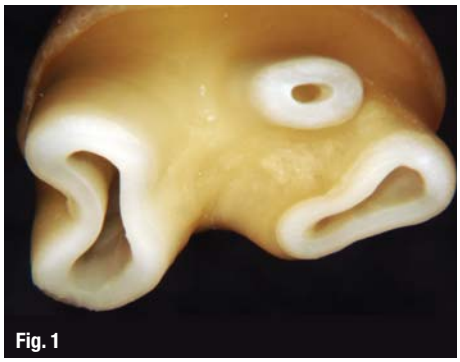


Fig. 1

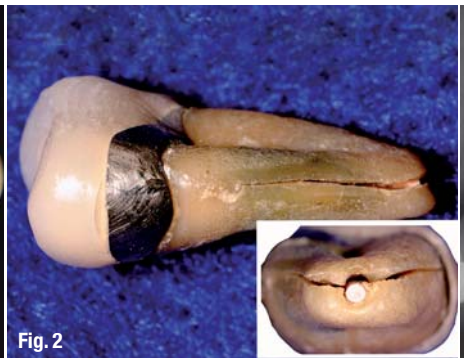


Fig. 2

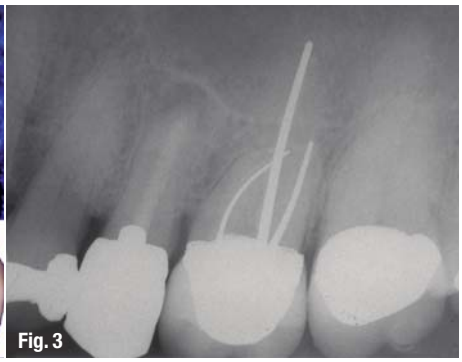


Fig. 3


Fig. 4

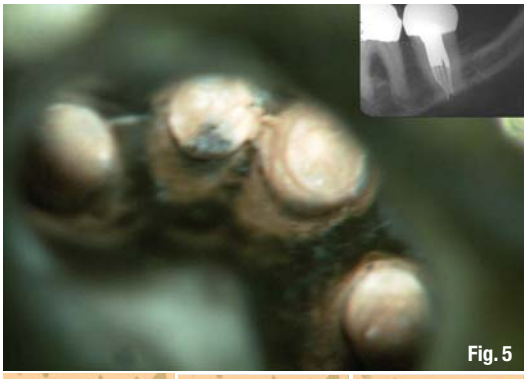


Fig. 5

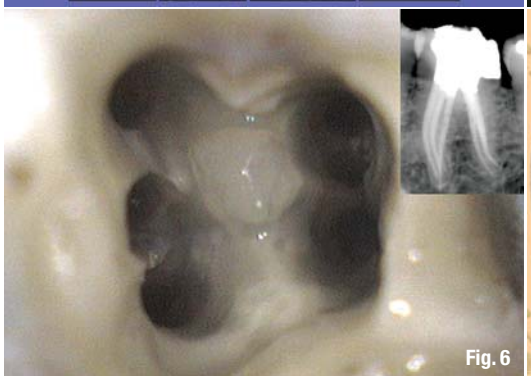


Fig. 6

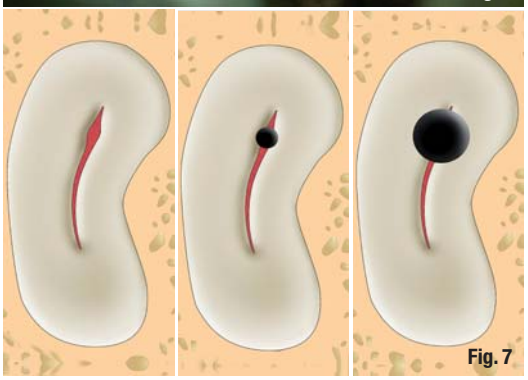


Fig. 7

Fig. 4_This mandibular incisor appears so frail with a lingual view or radiographic image. It appears husky with a mesial view. It is at least twice as broad bucco-lingually.
Fig. 5_One variation of potential anatomy in an ovoid root: system branches in apical third of a C-shaped second molar.
Fig. 6_Another variation of ovoid roots: non-round systems branch into five systems in the coronal third. (Image courtesy Dr John Khademi)
Several renderings contrast current endodontic shapes versus new biomimetic microscope-enhanced shapes.
Fig. 7_Preoperative pulpal space of the root, sectioned at the orifice (left). Lateral condensation shape that does not weaken the root but also does not address the potential complex anatomy (centre). New aggressive crown-down shape that weakens non-round roots (right).

irrigation during instrumentation and improved hydraulics during obturation. But at what cost (Fig. 2)?

_Is crown-down endodontics actually better than lateral condensation?

The outcome studies are inconclusive, but what we do know is that the success rate today is no better than it was 40 years ago (Fig. 3). The advantages of crown down are often offset by the weakening caused by Gates-Glidden burs and orifice shapers. The short-term thrill of the radiographic 'puff of sealer' at the apex is lost when the tooth implodes a few years down the line. Residual dentine is directly related to long-term strength and has indisputably been shown as the key to long-term tooth retention.

In contrast, the supposed strengthening of the root from a monoblock of bonded resin obturation, bonded core and fibre post is proving to be inconsistent.[1] Another startling revelation is that the dentine in an endodontically treated tooth is not more brittle than in a vital tooth.[2-4] In short, preservation of peri-cervical dentine and ferrule girth trump all other factors.

_Ovoid canal systems and roots are non-round for a reason

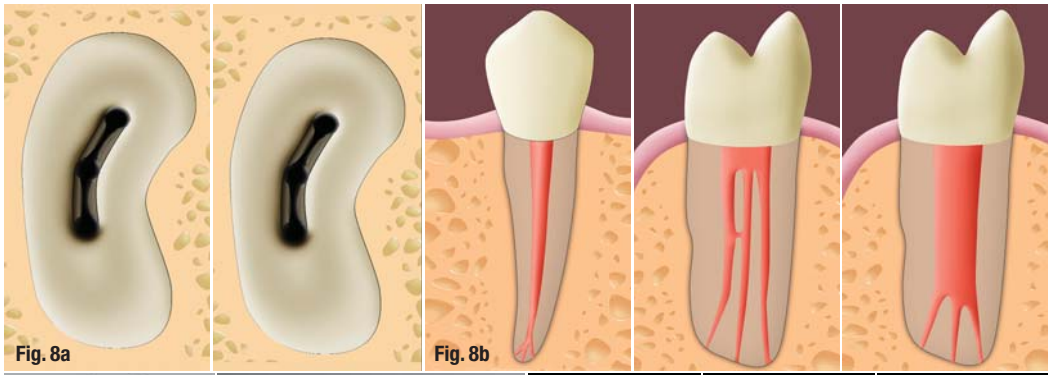
Rotary instruments and obturating points of gutta-percha are round because of the limitations of their mechanical nature. They create anatomically appropriate shapes in round roots but fail in ovoid roots. Over the ages, the dynamics of occlusion and arch form have guided the development of human tooth roots such that at least half have ovoid roots.

_Smaller and/or ovoid shaping: Why and how?

Why: Biomimetics is a treatment approach that aims to retain as much of the natural tissue as practical, and to mimic the physics and structures of the human body. There is nothing biomimetic about a stiff, round rod (prefabricated post) running through the centre of an ovoid root.

The natural ovoid root is essentially a semi-rigid pipe deriving its strength from without, not within. The endodontic and endo-restorative goal should be to mimic the pulp space that was present when the tooth was young. From that point, it can be argued that any secondary dentine that is deposited adds little additional strength because of the amorphous and irregular deposition pattern. This point is supported by the robust strength of young teeth with large pulp chambers and large radicular pulp spaces.

If a small round access that does not disturb primary dentine can allow instruments to engage potentially significant complex anatomy



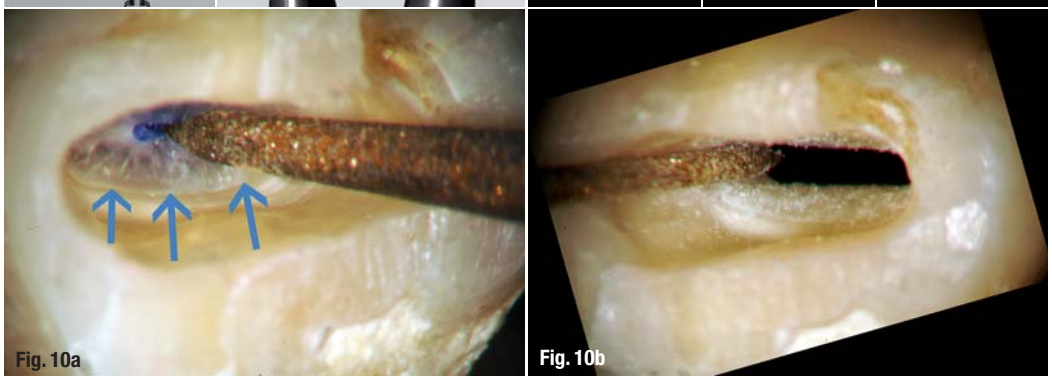


Fig. 8a_Two potential shapes that are anatomic and address the complex anatomy yet do not weaken the tooth.
Fig. 8b_The obturated anatomic shapes in the second axis.
Fig. 9a_A CK endodontic access bur (right) is shown and contrasted with the corresponding surgical-length round bur (left). The tip size of the CK bur is less than half as wide as the corresponding round bur. Designed by Drs Clark and Khademi, the CK endodontic access burs will be available from SS White Burs Inc.
Fig. 9b_A new model for lower incisor access is depicted, with the new CK endodontic access bur. Note that the access has been moved away from the cingulum and towards the incisal edge. The delicate tip size of the bur and its conical shape are helpful for both visual (dentists using microscopes) and tactile (little or no magnification) endodontics.
Fig. 10a_Extracted bicuspid is shaped to follow the pattern of secondary dentine that has been described by Carr as resembling glacial ice in appearance under the microscope. One border of secondary dentine and primary dentine is outlined with arrows. Glacial ice is one of the many terms used to describe the many colour and translucency features of secondary and tertiary dentine. CPR-2D (Obtura-Spartan) ultrasonic tip is pictured at 16x.
Fig. 10b_Depicts the much finer CPR-5D as the ovoid system is explored further apically with constant microscopic visualisation. Note the ideal visual environment that is the hallmark of the microscope–ultrasonic combination. It allows for identification of dentine maps for the ultimate in dentine preservation.

(e.g. a second or third major system and corresponding portals of exit), then the round access is acceptable. The reality of ovoid roots would seem to disagree with this approach.

Creating a large round access that results in removal of primary dentine of the delicate, narrow portion of the root is the common approach today. While this can allow access to the complex branching of systems that occurs further apically, it does not satisfy the more appropriate goals of anatomic biomimetic dentistry. Additionally, the single large round endodontic shaping pattern often encroaches upon a fluting in the centre of the root.

How: By visually shaping ovoid systems; the three components of ovoid shaping are:

1) the operating microscope with powerful coaxial shadowless lighting;
2) ultrasonic instruments; and
3) an understanding of the anatomy of ovoid roots.

Anatomic biomimetic shaping cannot occur safely by feel (Figs. 7–8a & b).

_Summary

Although no two roots are the same, general anatomic patterns allow the microscope-equipped clinician to search for major pulpal regions that will yield a high probability of cleaning and shaping the clinically available pulpal zones.

The shapes that were introduced during the Schilder era have served as a transitional technique to allow the first real 3-D compaction of gutta-percha. Endodontics is, in reality, a restoratively driven procedure; thus, minimally invasive and biomimetic principles will require different skills and materials to shape, pack and restore these non-round canal systems._

Table 1_
New microscope-enhanced protocol

- *Initial acces with round-ended carbide or diamond burs. For incisors and canines, the new CK endodontic acces burs provide optimum safety and dentine preservation (Figs. 9a & b).*
- *Gross de-roofing with tapered diamond burs, retaining a small 'soffit.'*
- *Provide straight-line access sweeping away from high-risk anatomy using the CPR-2D.*

Table 2_
For ovoid systems

- *Sweep the coronal ¼ of the ovoid system with the CPR-2D.*
- *Sweep the next ¼ or ½ with the CPR-4D or 5D (Fig. 10b).*
- *Irrigate, dry with the Stropko syringe and then evalutate at 16 to 24x for multiple systems that branch in the apical half.*
- *Begin filing.*

Editorial note: A complete list of references is available from the publisher.

_author info roots

Dr David Clark founded the Academy of Microscope Enhanced Dentistry and is a course director at the Newport Coast Oral Facial Institute. He has lectured for Clinical Research Associates in the Update Series. In addition, Dr Clark has authored the first comprehensive guide to enamel and dentinal cracks based on 16x magnification and numerous articles relating to minimally invasive dentistry, biomimetic endodontic shaping, diastema closure and advanced magnification. He helped pioneer the concept of biomimetic microendodontics and serves as an opinion leader for restorative dentistry and endodontics. He introduced the Clark Class II for posterior composites and developed the Bioclear Matrix System. Dr Clark can be contacted at drclark@bioclearmatrix.com.

The MAP System: A perfect carrier for MTA in clinical and surgical endodontics

Authors_Dr Arnaldo Castellucci & Dr Matteo Papaleoni, Italy

Fig. 1_White ProRoot MTA (Dentsply Tulsa Dental).
Fig. 2_Dovgan Carriers (Quality Aspirators).
Fig. 3_The carrier described by Dr Edward Lee.
Fig. 4_The pre-measured aliquot of MTA is easily delivered into the root-end preparation using the Lee Carrier. (Image courtesy of Dr John Stropko)
Fig. 5_The Micro Apical Placement System.
Fig. 6_The bayonet catch for connecting the exchangeable needles.
Fig. 7_The straight needles for non-surgical endodontics.

_Many materials are used to seal the root canal system from the oral cavity and the periradicular tissues. These include amalgam, zinc-oxide-eugenol-based cements, such as SuperEBA (H.J. Bosworth), IRM (Caulk) and Cavit. The main disadvantage of these materials is their sensitivity to the presence of moisture.[1]

However, it is well known and accepted that isolation of the operative field for moisture control represents a significant problem in clinical dentistry, in general, and in restorative dentistry and endodontics, in particular. The root canal system to be obturated must be dry in order to obtain a good seal, and contamination with blood must be avoided. During a direct pulp capping procedure, haemorrhage must be controlled. When attempting to seal a root perforation, a dry field is essential. Furthermore, the retro-preparation must be absolutely dry during apical surgery.

Recently, Torabinejad et al.[2] developed a new cement—Mineral Trioxide Aggregate (ProRoot MTA, Dentsply Tulsa Dental; Fig. 1). This cement appears to have all of the characteristics of an ideal cement that can create a seal between the root canal system and the oral cavity (mechanical and carious pulp exposures), as well as between the root canal system and the periodontium (iatrogenic perforations, open apices, resorbed apices, root-end preparations).

This cement is different to other materials currently in use because of its bio-compatibility,

Fig. 1

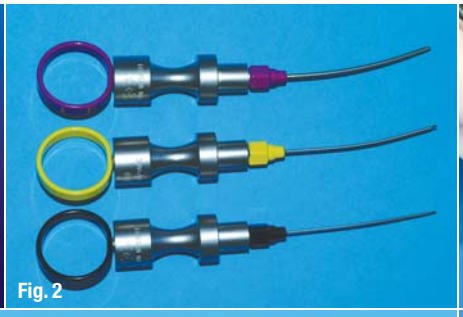


Fig. 2

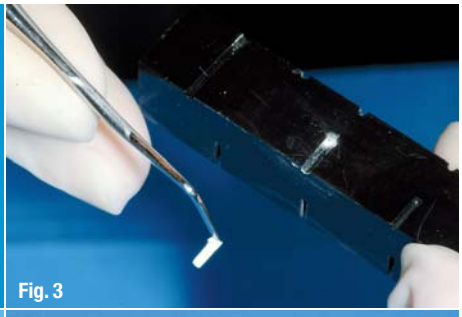


Fig. 3

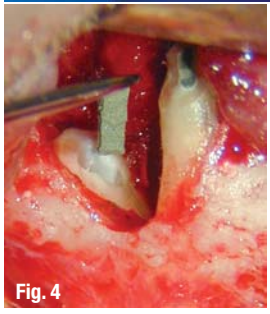


Fig. 4

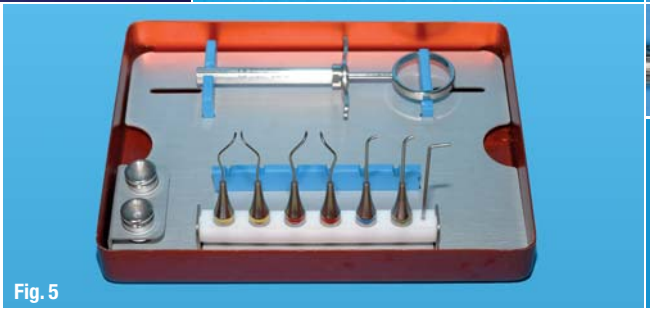


Fig. 5


Fig. 6

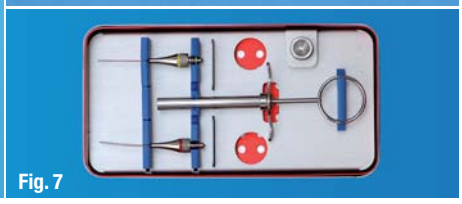


Fig. 7


Fig. 8


Fig. 9


Fig. 10

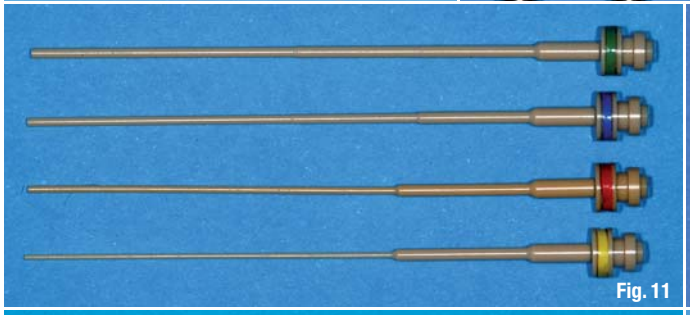


Fig. 11

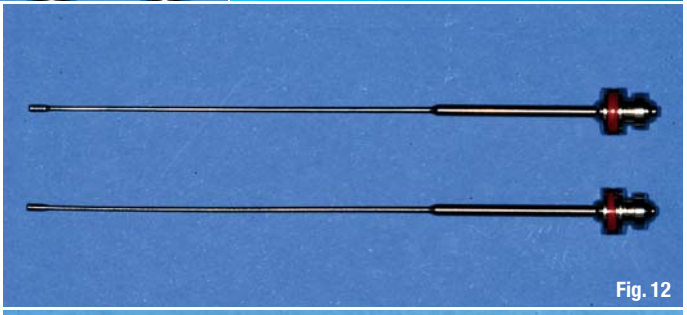


Fig. 12

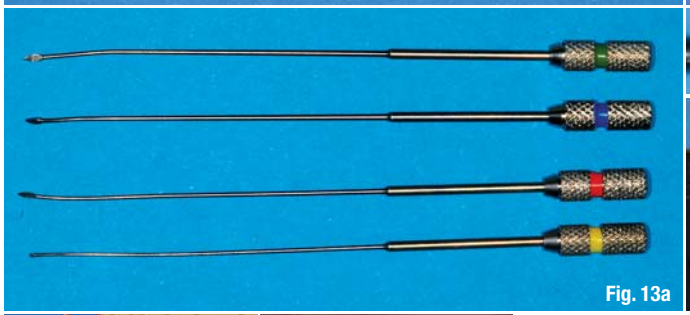


Fig. 13a


Fig. 13b

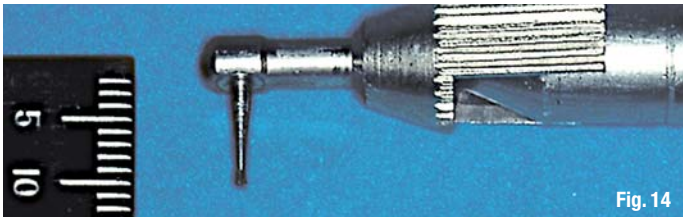


Fig. 14


Fig. 16


Fig. 17

antibacterial and sealing properties, and marginal adaptation, but primarily because of its hydrophilic nature.[2]

Materials used to repair perforations, seal the retro-preparation in surgical endodontics, close open apices, or protect the pulp in direct pulp capping are inevitably in contact with blood and other tissue fluids. Moisture may be an important factor, owing to its potential effect on the physical properties and sealing ability of the restorative materials.[3] As shown by Torabinejad et al.,[3] MTA is the only material that is unaffected by moisture or blood contamination.

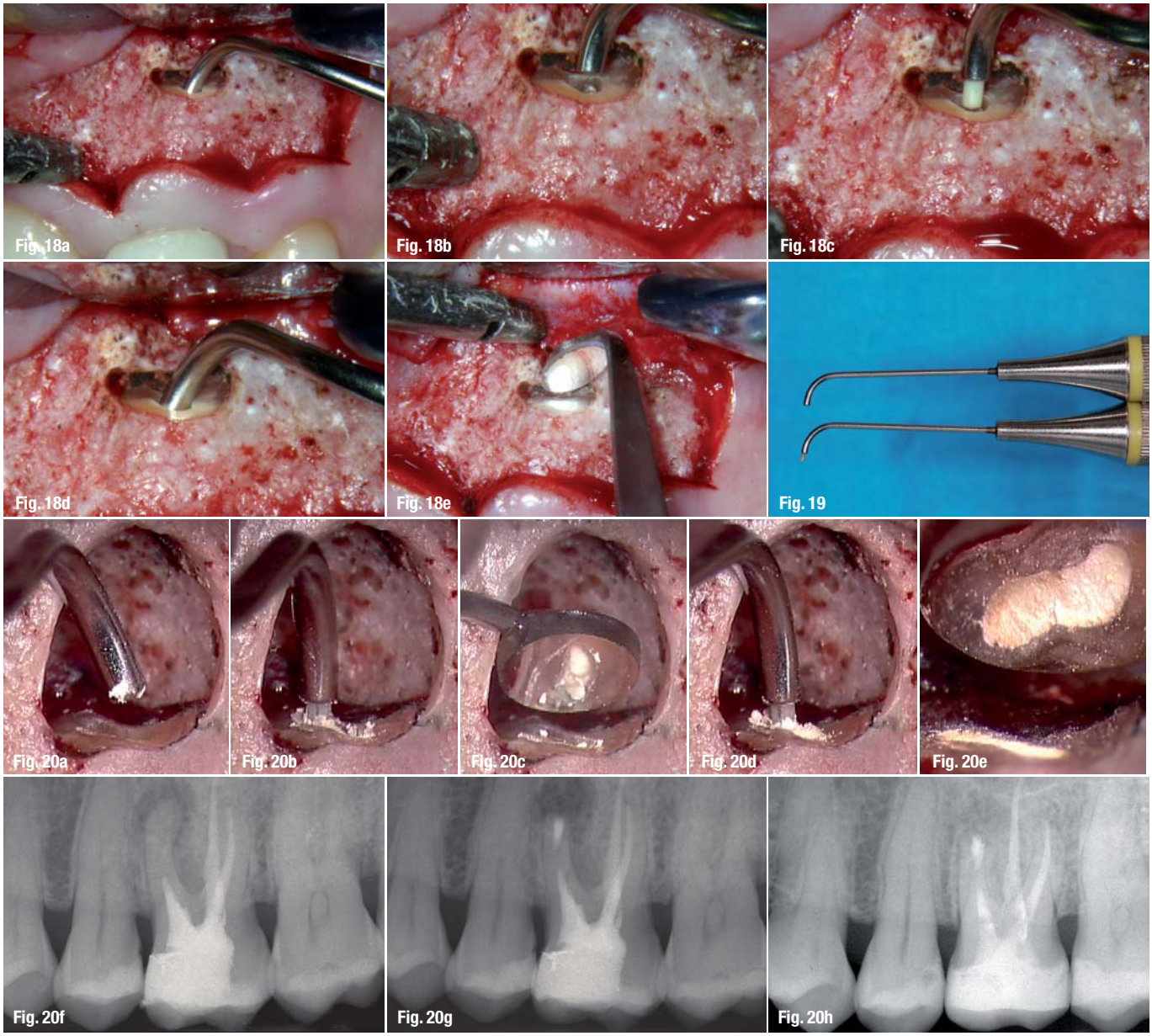
The presence or absence of blood appears not to affect the sealing ability of the MTA. In fact, MTA sets only in the presence of water.[2] MTA is considered today to be the material of choice for direct pulp capping,[4] closing open apices,[5] repairing perforations,[6] and sealing the retro-preparations in surgical endodontics.

Fig. 15

A disadvantage of the material is that it is not easy to handle and when it was first introduced to the market, there was no appropriate carrier to position it during different applications.

The first carrier that became available was the Dovgan Carrier (Quality Aspirators; Fig. 2). But even though the needles were bendable, the carrier was

Fig. 8_The triple-angle needle for surgical endodontics in posterior teeth.
Fig. 9_The single-angle needle for surgical endodontics in anterior teeth.
Fig. 10_Dispenser for filling material.
Fig. 11_The intra-cannular plunger of the angled needles is made of PEEK.
Fig. 12_The intra-cannular plunger of the straight needles is made of NiTi.
Figs. 13a & b_Cleaning curettes of different sizes (a). The tip at higher magnification (b).
Fig. 14_A 'miniature' contra-angle—still 11mm long!
Fig. 15_ProUltra Surgical Tips (Dentsply Maillefer).
Fig. 16_The root apex is cut at a 90° angle.
Fig. 17_The ultrasonic tip is ready to work along the axis of the root canal.



Figs. 18a–e_The pre-fitted needle is carrying the filling material. **Fig. 19**_The intra-cannular plunger inside the needle is intentionally longer than the needle itself. **Figs. 20a–h**_The carrier also functions as a plugger, beginning to compact the filling material in the deepest portions of the prepared cavity (a–e). Preoperative radiograph (f). Post-operative radiograph (g). Two-year recall (h).

not comfortable to use during surgery. In 2000, another carrier was proposed by Dr Edward Lee,[7] but its use was limited to surgery (Figs. 3 & 4). The Micro Apical Placement (MAP) System, a new universal carrier with special needles that can be used both in clinical and in surgical endodontics, was recently introduced by Produits Dentaires SA (Fig. 5).[8]

_The instrument

The system consists of a stainless-steel applicator with a bayonet catch (Fig. 6) for several exchangeable applicator cannulas (needles). The straight and curved needles (Fig. 7) are designed for non-surgical endodontics, while the triple-angle needles (Fig. 8), developed in cooperation with Dr Bernd Ilgenstein, and single-angle needles (Fig. 9) are best indicated for surgical endodontics.

The surgical needles are available in two variants, right-angled and left-angled, each with two external diameters, 0.9 mm (yellow) and 1.1 mm (red). The internal diameter of the cannulas is 0.6 mm (yellow) and 0.8 mm (red), which allows for sufficient portions of the retro-filling material to be applied successively.

The filling material can be taken from a dispenser/well (Fig. 10). The intra-cannular plungers of the angled needles are made of PEEK (Polyether Ether-Ketone), a polymer used for medical purposes (Fig. 11), and the plungers of the straight and curved needles are made of NiTi (Fig. 12). Residue of material inside the


Fig. 21a

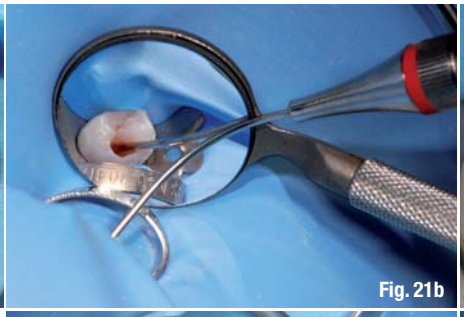


Fig. 21b


Fig. 21c


Fig. 22a


Fig. 22b

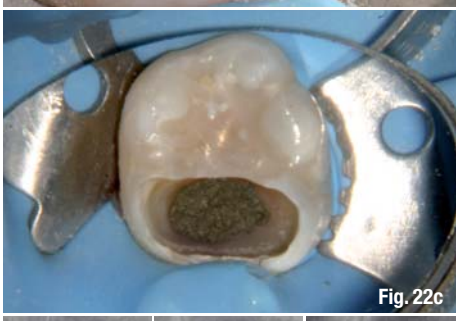


Fig. 22c


Fig. 22d


Fig. 23a


Fig. 23b


Fig. 23c


Fig. 23d


Fig. 23e


Fig. 23f

cannulas can easily be removed with a cleaning curette (Fig. 13).

_Surgical applications

For many years, the root end was surgically prepared by drilling a Class 1 preparation into the dentine, using a straight slow-speed handpiece or a 'miniature' contra-angle handpiece with small round or inverted-cone carbide burs (Fig. 14). This approach had many disadvantages, mainly the inability to create a preparation in the longitudinal axis of the root canal and to clean the buccal surface of the root end. In attempting to give sufficient retention to the cavity, there was always the risk of a palatal or lingual perforation, and the procedure became increasingly difficult, as the root canal became increasingly difficult to reach. The smallest burs were always too large compared to the diameter of the root canals, and the large cavities were therefore more difficult to seal. For the same reason, retro-preparations often failed to include isthmus areas.

The introduction of ultrasonic root-end preparation made it possible to obtain what is defined as the ideal retro-preparation: a Class 1 preparation at least 3 mm into the root dentine, with walls parallel to a coincident with the anatomic outline of the pulpal space.[9,10] In order to do this, special ultrasonic tips were developed to enable the clinician to reach every root in all clinical situations (Fig. 15). The use of the specifically designed retro-tips allows the operator to clean the root canal from an apical approach, leaving clean dentinal walls not only on the lingual or palatal side, but also on the buccal side, which was impossible to clean with the previous techniques. The cavity can now be made 3 mm deep without the necessity of making undercuts, as there is no need for further retention.

The retro-tips are of the same size as, or even smaller than, the original size of the root canal; thus, that the retro-preparation can be easily and predictably sealed with respect to the original anatomy. The isthmus area can now be included in the preparation, without damaging or weakening the root, while being extremely conservative in the mesio-distal dimension.

The root surface is no longer cut with a bevel at 45° but rather at an almost 90° angle (Figs. 16 & 17). This involves the need for a specific carrier in order to deliver the retro-filling material at a 90° angle (Figs. 18a–e). The MAP System is the perfect

Figs. 21a–c_The straight needle is carrying the MTA over a pulp exposure of an upper second premolar to perform a direct pulp capping.
Figs. 22a–d_Direct pulp capping with MTA and the MAP System. The pulp exposure (a). The straight needle is carrying the MTA over the pulp exposure (b). The MTA has been positioned and compacted (c). Two-year recall (d).
Figs. 23a–f_Use of the MAP System for the Apical Barrier Technique in the case of an open apex. Preoperative radiograph. The central incisor had previously been treated with cold lateral condensation (a). The straight needle is carrying the MTA to build the apical barrier (b). Intra-operative radiograph with the carrier in the root canal. The material in the peri-apical tissue is gutta-percha, which has been extruded during the re-treatment (c). The MTA has been positioned at the apex (d). Post-operative radiograph. The obturation has been performed using thermoplastic gutta-percha (e). 15-month recall (f).


Fig. 24a


Fig. 24b

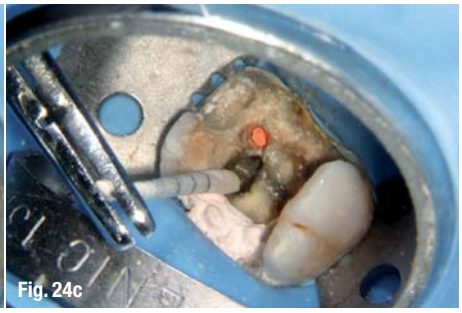


Fig. 24c


Fig. 24d

Figs. 24a–d_The straight needle is carrying the MTA to seal a perforation on the floor of the upper first molar.

carrier for this purpose, having several needles in different sizes and with different angulations. The single-angle needles are best indicated for anterior teeth, while the triple-angle needles are best indicated for posterior teeth. They are available in two variants, right-angled and left-angled, for an easier treatment of hard-to-reach regions (palatal canals of upper premolars and molars, lingual canals of lower molars).

The intra-cannular plunger inside the needle is intentionally longer than the needle itself (Fig. 19), so that it will not only deliver the MTA in the retro-preparation, but will also act as a plugger and thus begin to compact the material in the deepest portion of the prepared cavity (Figs. 20a–h). The risk of air bubbles can therefore be avoided. As a result, the retro-root canal filling will always be well compacted.

An advantage of using the MAP System during surgery is the perfect control of the obturating material, which will be laid in the retro-cavity without any dispersion in the surrounding bone and soft tissue.

Once the retro-cavity has been prepared using the ultrasonic retro-tips and the bleeding of the bony crypt is under control, the operator asks the dental assistant to mix the MTA to the correct consistency and then to handle the pre-fitted applicator syringe. The consistency of MTA must be neither too wet nor too dry. If the mixture is too wet, it will be difficult to compact the material in the cavity properly. If it is too dry, it will be difficult to extrude the material from the needle and the syringe may remain blocked. Should the latter be the case, it is essential to avoid pushing too hard. The PEEK plunger is insufficiently rigid and will remain bent next to the bayonet catch, and thus need to be replaced. For this reason, is always advisable to have two needles ready for use.

As previously stated, the following clinical applications for the straight needles with the NiTi plunger are indicated to carry MTA in non-surgical endodontics: during direct pulp capping (Figs. 21a–c & 22a–d), for the treatment of open apices (Figs. 23a–f), and during the repair of perforations (Figs. 24a–d).

_Conclusions

The MAP System is recommended as a universal MTA carrier for use in both surgical and clinical endodontics. The triple-angle needles, specifically designed to carry the filling material in the retro-cavity during surgery, allow for easy reach of all anatomically tricky regions. The retro-filling material can be laid from the fundus of the cavity, avoiding inclusion of air bubbles. The size of the needles can perfectly fit the size of the retro-cavity, avoiding any dispersion of materials in the surrounding tissues._

_author info roots

Dr Arnaldo Castellucci graduated in medicine from the University of Florence in 1973 and specialised in dentistry at the same university in 1977. He is past president of the Italian Endodontic Society, past president of the International Federation of Endodontic Associations, an active member of the European Society of Endodontology. He is editor of The Italian Journal of Endodontics and of The Endodontic Informer. An international lecturer, he is the author of the text Endodonzia (Endodontics), now available in English. Dr Castellucci can be reached at castellucci@dada.it.

2009
Greater New York Dental Meeting

The Largest Dental Convention/ Exhibition/Congress in the United States

85th Annual Session

NO Pre-Registration Fee!

MEETING DATES:
NOVEMBER 27th - DECEMBER 2nd

EXHIBIT DATES:
NOVEMBER 29th - DECEMBER 2nd

For More Information:
Greater New York Dental Meeting™
570 Seventh Avenue - Suite 800
New York, NY 10018 USA
Tel: +1 (212) 398-6922
Fax: +1 (212) 398-6934
E-mail: info@gnydm.com
Website: www.gnydm.com

Please send me more information about...

- ☐ Attending the Greater New York Dental Meeting
- ☐ Participating as a guest host and receiving free CE
- ☐ I speak _____ (enter language) and am willing to assist international guests

Name

Address

City, State, Zip/Country Code

Telephone E-mail

Fax or mail this to:
Greater New York Dental Meeting or
visit our website: www.gnydm.com for more information.

Endodontic file design is crucial

Author_Dr John T. McSpadden, USA

Fig. 1_A size 25 file with a 0.02 taper.

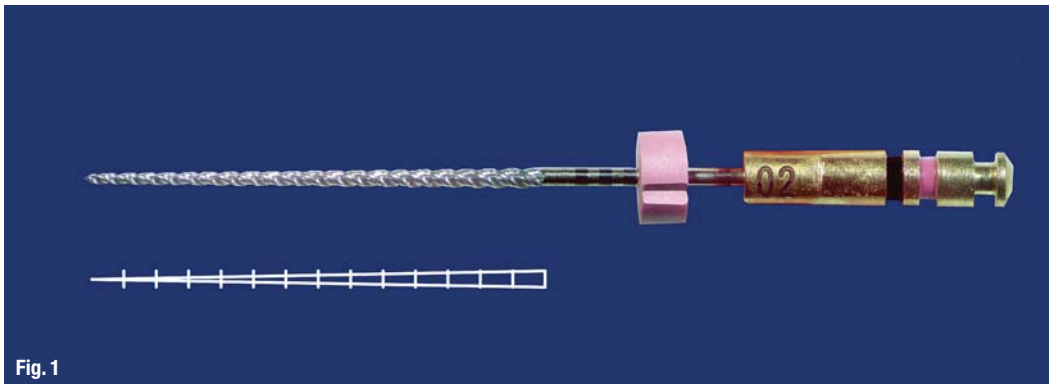


Fig. 1

_Why do we need to know anything about instrument design? The capabilities of files made of the same material are entirely dependent on design. Successes of file design and, to a considerable extent, clinical success are determined by how effectively the design addresses various canal anatomies. Clinical expertise and ergonomics depend greatly on understanding file design and how the design functions.

Although radiographs portraying desired canal shapes are often used to illustrate the capabilities of a particular type of file, the desired canal shape can be attained with virtually any set of files, provided they are used properly. How efficiently the shape can be attained is another matter.

No single aspect of file design is indicative of the file's overall usefulness. Optimising one design feature can compromise another. For instance, greater file flexibility is usually accompanied by greater susceptibility to torsion failure. Considerations for design effectiveness include the following: cutting ability, operational fatigue, stress concentration points, operational torque, torque at breakage, flexibility, screwing-in forces, ability to maintain the central axis of the canal, and tip mechanics.

_What are the basics of file design?

The taper

Standardised dimensions played an important role at the time they were instituted by providing the needed consistency for hand instruments, but were soon seen as limitations for rotary instrumentation. One of the first standards for file design to be eliminated was file taper. The taper is usually expressed as the amount by which the file diameter increases per millimetre along its working surface from the tip towards the file handle. For example, a size 25 file with a 0.02 taper would have a 0.27 mm diameter 1 mm from the tip, a 0.29 mm diameter 2 mm from the tip, and a 0.31 mm diameter 3 mm from the tip (Fig. 1). Some manufacturers express the taper in terms of percentage, in which case the 0.02 taper becomes a 2 per cent taper. Historically, as an ISO standard, a file was fluted and tapered at 2 per cent for 16 mm, but now files incorporate a wide variety of lengths and tapers of working surface.

Changing from one taper to another during instrumentation can be one of the most important methods of limiting file engagement and thereby limiting file stress. If a smaller tapered

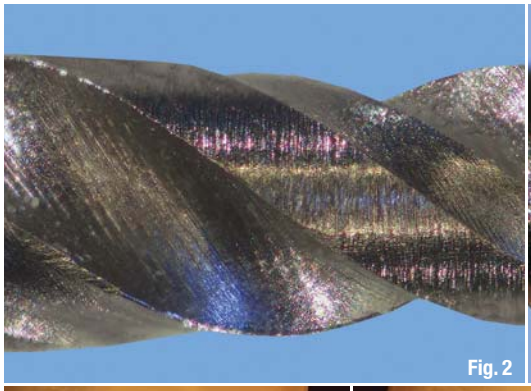


Fig. 2

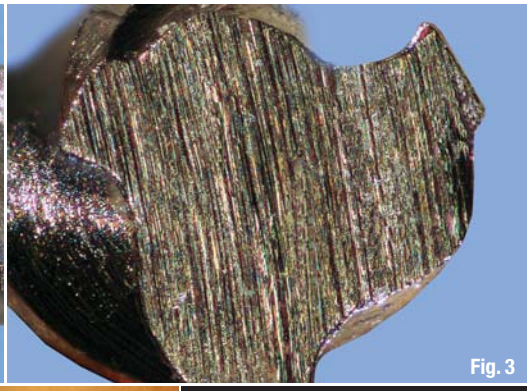


Fig. 3

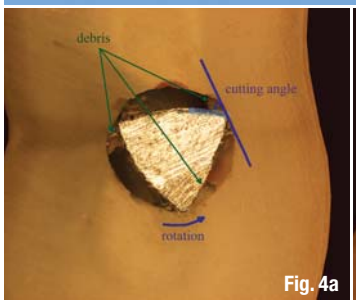


Fig. 4a

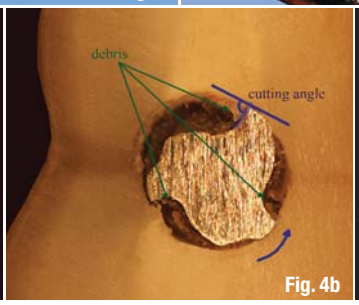


Fig. 4b

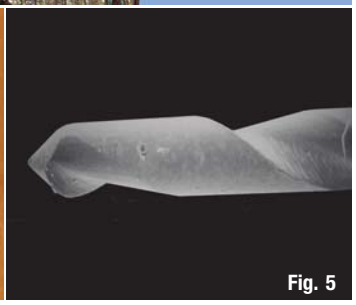


Fig. 5

Fig. 2_Quantec file.

Fig. 3_The central core circumference shown in the cross-section of the K-3 file is determined by the boundaries of the depths of the flutes, or is described as the largest diameter of the cross-section that has not been ground. The core taper may be less than the file taper in order to increase proportionately the file's flexibility towards the handle. A 0.04-tapered file with a 0.02-tapered core would have proportionally less cross-sectional mass and greater flexibility towards the handle than if the core and file taper were the same.

Fig. 4a_ The Pro-Taper file utilises a negative angle of incidence to enlarge the canal. The surface of the file blade meets the canal wall with an acute angle, resulting in a scraping action. More pressure is required when enlarging the canal in this manner.

Fig. 4b_The K-3 file utilises a slightly positive angle of incidence to enlarge the canal. The file blade meets the canal wall with an obtuse angle resulting in a cutting action. Less pressure is usually required when enlarging the canal in this manner. Excessive pressure can cause excessive torsion by forming chips too large to be dislodged.

Fig. 5_The GPX instrument (Brasseler) is used for removing gutta-percha from the canal. The friction of the wide land rotating against the gutta-percha causes it to plasticise, while the spirals auger it from the canal. The instrument is effective for removing gutta-percha but is ineffective as a larger size file because the land occupies most of the working surface and prevents the leading edge from engaging the canal surface.

file is inserted into the preparation of a larger tapered canal, only the apical portion of the file initially becomes engaged. Conversely, if a larger tapered file is inserted into a smaller tapered canal, only the coronal portion of the file initially becomes engaged.

The flute

The flute of the file is the groove in the working surface used to collect soft tissue and dentine chips removed from the wall of the canal (Fig. 2). The effectiveness of the flute depends on its depth, width, configuration and surface finish. The surface with the greatest diameter that follows the groove (defined as where the flute and land intersect) as it rotates forms the leading (cutting) edge, or the blade of the file that forms and deflects chips from the wall of the canal and severs or snags soft tissue. Its effectiveness depends on its angle of incidence and sharpness. If there is a surface that projects axially from the central axis as far as the cutting edge between flutes, this surface is called the land (and sometimes the marginal width).

The land reduces the screwing-in tendency of the file and transportation of the canal, decreases the propagation of micro-cracks on its circumference, supports the cutting edge and limits the depth of cut. Its position relative to the opposing cutting edge and its width determine its effectiveness. In order to alleviate frictional resistance or abrasion resulting from a land, some of the surface area of the land that rotates against the canal wall may be reduced to form the relief. The angle that the cutting edge makes with the long axis of the file is called the helix angle and serves to auger debris collected in the flute from the canal.

The core

The core (Fig. 3) is the cylindrical centre part of the file that has its circumference outlined and bordered by the depth of the flutes. Flexibility and resistance to torsion is partially determined by the core diameter.

The core taper and total external taper can be different, and the relative diameter of the core, compared to the file's total diameter, may vary along its working portion in order to change the flexibility and resistance to torsion. The importance of the ratio of core diameter to total diameter is often overlooked in predicting a file's susceptibility to failure and can be different for each file size of the same series.

Rake angle and cutting angle

If the file is sectioned perpendicular to its long axis, the rake angle (Figs. 4a & b) is the angle formed by the leading edge and the radius of the file. If the angle formed by the leading edge and the surface to be cut (its tangent) is obtuse, the rake angle is said to be positive or cutting. If the angle formed by the leading edge and the surface to be cut is acute, the rake angle is said to be negative or scraping.

However, the rake angle may not be the same as the cutting angle. The cutting angle, effective rake angle, is a better indication of the cutting ability of a file and is obtained by measuring the angle formed by the cutting (leading) edge and the radius when the file is sectioned perpendicular to the cutting edge.

In some instances, as with some Quantec files, a file may have a blade with a negative rake angle and a positive cutting angle. If the flutes of the file are symmetrical, the rake angle and cutting angle will be essentially the same. Only when the flutes are asymmetrical are the cutting angle and rake angle different. Both angles may change as the file diameters change and may be different for different file sizes.

The pitch

The pitch of the file is the distance between a point on the leading edge and the corresponding point on the adjacent leading edge along the working surface, or it may be the distance between points within which the pattern is not repeated. The smaller the pitch or the shorter the distance between corresponding points, the more spirals the file will have and the greater the helix angle will be and, generally, the greater propensity for the file to screw into the canal will be.

Most files have a variable pitch, one that changes along the working surface, because the diameter increases from the file tip towards the handle and the flute becomes proportionately deeper, resulting in a core taper that is different from the external taper.

Some instruments, such as the Quantec and K-3 files, have asymmetrical cross-sectional designs, in which case the pitch may be considered to be the distance between points within which the pattern is not repeated. The cutting angles, helix angles, and external and core taper may vary along the working surface of the file, and the ratios of these quantities can vary between instruments of the same series. Any change of any of these features can influence the file's effectiveness or its propensity for breakage as it progresses into the canal space, and can account for the uncharacteristic behaviour of some files in comparison to files that have different dimensions in the same series.

_Functions of lands

Lands are the surfaces of files that extend as far axially from the centre as the cutting edges that define the file's circumference. Lands are used to reduce screwing-in forces, support the cutting edge, reduce transportation, and limit the depth of cut in much the same manner that a safety razor functions. The surface of a land reduces the tendency of faults caused by stress or manufacturing imperfections in the metal to propagate along its cutting edge or circumference. Lands need not be very wide to function efficiently.

The force of abrasion is a direct result of the surface area of a land rotating against the wall of the canal. Wide lands can result in excessive abrasion forces that increase the torque requirements for rotation.

In addition, faster rotations of a file cause the lands to limit further the depth of cut, and wide lands on larger files can prevent the blades from engaging an adequate depth into the canal.

Wide lands can be very useful in small diameter files, as they add rigidity and enable the file to negotiate curvatures when canal enlargement is minimal. When lands are too wide for effective canal enlargement, the files can be used effectively for removing gutta-percha from the canal and circulating irrigation in the canal.

_File efficiency

Efficiency is defined as the ratio of the work done to the work equivalent of the energy supplied to the file. An efficient file, one with a superior cutting ability, requires less time, torque, and/or pressure to accomplish canal preparation.

The less pressure, torque and time required, the more likely that file failure can be prevented. The concept is often confused, however, by describing a more efficient file as a more aggressive file, a term that seems to be used with a negative connotation.

Aggressive forces of the operator on an efficient file are unnecessary and can be counter-productive. For example, if one pushes with excessive pressure on an efficient file, the chips that are formed on the wall of the canal can be larger than can be removed without requiring significantly more torque than would have been required for forming and removing smaller chips with less pressure.

Clinicians who change file systems and begin working with files that are more efficient have a tendency to apply the same force or apply force for the same length of time as was required with files that are less efficient. The excessive (aggressive) force on the more efficient file should be avoided.

Rather, the clinician will enhance the quality of preparation and reduce the threat of failure by learning to match the file's efficiency with the level of force required.

Without the benefit of efficiency data, clinicians often choose less efficient files because of the tactile sensations perceived. A file that enlarges a canal with inefficient scraping actions, for instance, can 'feel' smoother than a file that uses cutting actions. How an instrument 'feels' during use is not a reliable indication of its efficiency.

A major aspect of a file's efficiency is its ability to transport the canal. It should be remembered that time and force are functions of efficiency, and less time will be required to transport and enlarge a canal with an efficient file. In contrast, a less efficient file requires more time, which results in more rotations and greater fatigue, and/or more force, which results in greater torsion. The additional fatigue and torsion, of course, increase the possibilities of breakage.

One should remember that a file requires only one rotation in one position for the canal to be enlarged to the file's diameter at that position and if the file remains 360° engaged as it advances into the canal, no canal transportation is able to occur. Only if the file is allowed to rotate multiple times in one position and deviate from its 360° engagement, can the file begin to transport the canal. This phenomenon is important in differentiating between intentional and unintentional transportation. Even minor differences in file design dimensions can affect the cutting efficiency of files and their propensity for transporting canals.

_Design considerations

What are the most important relationships of the components of file designs and canal anatomies that enable us to improve our technique? Careful examination of technique and design considerations identifies the limitations and usefulness of existing instruments, and facilitates the development of a new generation of rotary instruments and techniques—one unencumbered by traditional concepts.

A few all-important consequential relationships of different file designs and tooth anatomies are useful in understanding how files function. Although research on endodontic instruments cannot determine with absolute certainty how files will react under all circumstances, research can result in inferences with significant predictability that can be used in considering instrument and technique design.

The following are some of the considerations and ramifications of designs that are most important in formulating techniques for difficult cases:

1. A file with a more efficient cutting design requires less torque, pressure or time to accomplish root canal enlargement.
2. In a straight canal, the ability of a file to withstand torsion is related to the square of its diameter.
3. In a curved canal, the ability of a file to resist fatigue has an inverse relationship with the square of its diameter.
4. The torque required to rotate a file is directly correlated to the surface area of the file's engagement in the canal.
5. The fatigue of a file increases with the number of rotations of the file in a curvature.
6. The fatigue of a file increases with the degree of curvature of the canal.
7. The smaller the surface area of the file engaged in the canal, the greater the rotation speed should be to improve efficiency.
8. The more spirals a flute has per unit length around the shaft of a ground file, the less the resistance to torsion deformation, but the more flexible the file is.
9. The fewer spirals a flute has per unit length around the shaft of a ground file, the more the resistance to torsion deformation, but the more rigid the file is.
10. The sharper the cutting blade of a file, the fewer the spirals per unit length of the file.
11. The greater the number of flutes with similar helix angles, the greater the file's tendency to screw into the canal and become bound.
12. Maximum engagement of a file occurs when it progresses into the canal at a rate that is equal to its feed rate—the rate the file progresses into the canal without the application of positive or negative pressure.
13. Less canal transportation occurs with a file with greater flexibility, an asymmetrical cross-section design, and/or a land._

_author info

roots

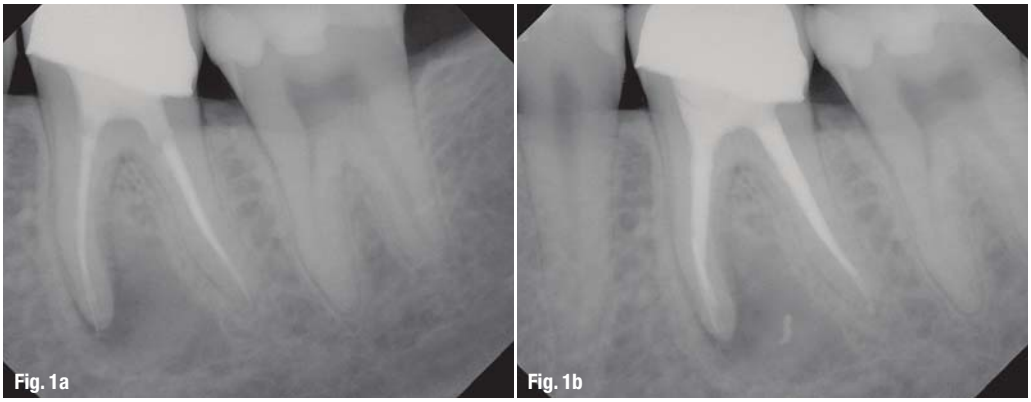
Dr John T. McSpadden is an international author, researcher and lecturer. He is the inventor of numerous endodontic instruments, an honorary member of the Société Française d'Endodontie, a member of the American Association of Endodontists and the recipient of its Louis I. Grossman Award. He is author of *Mastering Endodontic Instrumentation*, published by Cloudland Institute. Dr McSpadden can be contacted at jtmc@me.com.

Advanced strategies for the removal of warm carrier based devices: The specialist approach

Author_Dr Richard Mounce, USA

_Warm gutta-percha (GP) carrier-based devices (WGPCBD) have become popular primarily in North America and Western Europe amongst general practitioners over the past 15 to 20 years. When WGPCBD root canal treatments fail, carrier removal can be either simple or quite complex, depending on a host of factors. While there are radiographic clues as to the degree of clinical difficulty, it is not always possible to predict with certainty the ease of carrier removal in any given case. Re-treatment of WGPCBD is generally a specialist procedure. This article describes a number of removal techniques for WGPCBD, introduces the RealSeal 1 Bonded Obturator (RS1BO), and compares and contrasts its removal when required with a WGPCBD.

Removal of WGPCBD encompasses a wide range of possible techniques and equipment. It also requires flexibility on the part of the clinician to move instantly between techniques, should one method of removal be ineffective and another indicated. While a list of possible equipment required for removal is extensive, the clinician ideally should have the following, depending on the type of WGPCBD encountered:



Figs. 1–2a & b_Clinical cases re-treating warm gutta-percha carrier-based devices with the Twisted File in the manner described.

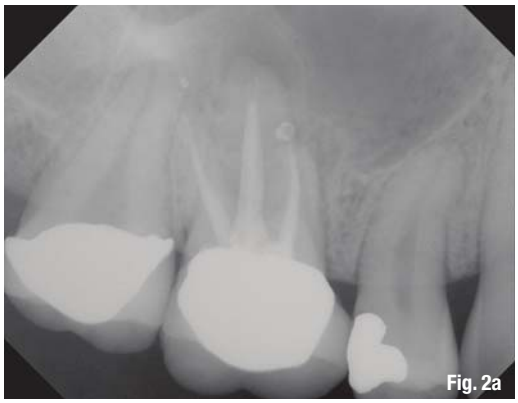


Fig. 2a

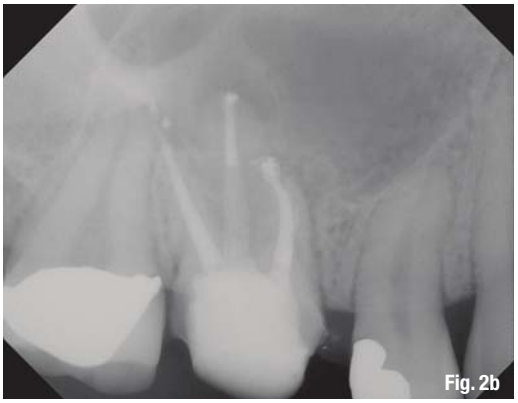


Fig. 2b

1. a surgical operating microscope (SOM);
2. a heat source such as the Elements Obturation Unit (EOU);
3. chloroform;
4. Hedstrom files in smaller sizes (20 and 25 are the most applicable);
5. large quantities of small hand K-files such as #6 to 10's;
6. rotary nickel-titanium (RNT) files for removal of the plastic carriers of WGPCBD—Twisted Files (TF) are recommended in this paper; and
7. the M4 Safety Handpiece. Once patency has been attained and the carrier is bypassed as described, using the M4 to reciprocate a hand K-file can efficiently create space next to the carrier to ease its delivery (described below).

_The challenge

Ideal canal preparation and carrier fit make both placement and subsequent removal of WGPCBD much more predictable. The converse is also true. Warm gutta-percha carrier-based devices that have been placed with significant frictional retention into long, narrow and curved canals are more difficult to remove than correctly placed carriers. Canals that have been prepared to a taper and master apical diameter that are smaller than adequate are more at risk of such frictional retention and challenging removal. Using a carrier that is slightly too large for the prepared canal space can yield the same result.

Some WGPCBD have traditionally had metal carriers and others plastic. The plastic used in the different sizes of various brands is not uniform. Some plastic carriers will dissolve in chloroform (polysulphone) and others won't. All things being equal, in the author's hands, metal carriers are easier to remove than their plastic counterparts, owing to their rigidity, and once loosened in the canal they are usually delivered intact. The same cannot be said of all plastic carriers.

_Metal carrier removal

1. As a first step, it is essential that the clinician create straight-line access. Any compromise of this requirement exponentially diminishes the possibility of removing the carrier.

2. If the carrier is protruding from the orifice, the carrier should be kept intact above the orifice to the greatest extent possible. In other words, the 'tail' of the carrier, i.e. the portion beyond the orifice, should be left in place.

In cases in which amalgam has been used as a build-up (and the metal tail is surrounded by amalgam), using an ultrasonic tip to remove the amalgam without touching the metal carrier can preserve the length of the metal carrier tail. Touching the hand K-file with the ultrasonic tip increases the likelihood that the tail will be broken at the orifice (particularly if the metal carrier is relatively small), vastly complicating its retrieval.

3. Once the tail of the metal carrier is fully exposed, one drop of chloroform at a time should be placed at the orifice. Small hand K-files should be worked down the canal alongside the metal carrier into the GP chloroform slurry. Paper points can be used to wick up the excess GP slurry. The metal carrier should become loosened once as much GP as possible is removed from the canal. It may be possible to gain apical patency alongside the metal carrier. If apical patency can be achieved, the M4 Safety Handpiece should be used. The M4 can reciprocate the hand K-file 90° clockwise and 90° anticlockwise to create more space alongside the carrier and allow solvents access to the apical third, to further loosen the metal carrier.

4. Once access is adequate, enough GP has been removed, and the metal carrier is sufficiently loose, a pair of Stieglitz forceps should be able to fully grasp the metal carrier and with a

Fig. 3_The Twisted file.

Fig. 3

clockwise turn of the wrist exert an upward force, removing the metal carrier. Most often, crowns will require removal to provide this access to the tail of the WGPCBD.

5. It is possible to use retentive grasping systems, such as tube and glue techniques, as well as mechanical screw-down locking systems that grasp the metal carrier and deliver an upward force. Such devices, in the author's hands, are rarely required after using the techniques described and are not included here.

_Methods for plastic carrier removal

1. For plastic carriers, often a RNT file spinning anticlockwise at high rpm (900–1,600 rpm) can pick up the carrier and propel it out of the canal. If this fails, heat should be used as described in option 2 below.

2. Heat, from a source such as the EOU, could also be used to melt the plastic carriers to create access into the canal and/or alongside a plastic carrier. The fine (.06) EOU heat tip can usually melt the carrier to at least mid-root in even the most curved and under-prepared canal preparation. Once the canal is cleared to this level, placing chloroform into the orifice one drop at a time will allow hand K-files to deliver chloroform apically. The combination of hand K-files and chloroform will dissolve GP, create space alongside the carrier and ideally allow the clinician to achieve patency. Once patency is gained, the M4 Safety Handpiece can be used as described above. Patency gained in this fashion will help release the remaining carrier and shift it towards the orifice with Hedstrom files. Some plastic WGPCBD are dissolvable in chloroform and others are not. Those made of polysulphone are dissolvable in chloroform if left in contact with polysulphone for a sufficient period and the chloroform is refreshed frequently. If this is unsuccessful, the clinician may consider using TF as described in option 3 below, to shred out the plastic carrier.

3. Instead of attempting to pick up a plastic carrier and spin it in a coronal direction as per option 1 above or melting the plastic carrier out as per option 2 above, shredding a plastic carrier

from the canal is an effective option. Before the advent of the TF, no RNT had been able to shred plastic carriers in a clockwise rotation predictably. Twisted Files, if used correctly, is the first RNT file that can do so.

The cutting flutes of TF are not manufactured by grinding. The micro-cracks and areas of metal roll-over present on ground RNT files are not present on TF. The micro-cracks act as the focus of RNT file fracture due to torsion and cyclic fatigue. The file is twisted during manufacture to create its cutting flutes while in a crystalline phase structure known as R-phase, an intermediate phase between austenite and martensite (the resting phase of nickel titanium and the phase present during function, respectively). The manufacture of Twisted Files is finalised with a deoxidation process that removes metal surface imperfections, yet maintains the hardness and sharpness of the cutting edges. These properties give TF unique capabilities relative to other RNT instruments that are ground from nickel-titanium wire. One of these functional capabilities is the ability of TF to grind through plastic carriers predictably at higher rpms, even in small and curved canal spaces. Clinically, depending on the size of the canal to be re-treated, a .06, .08 or .10 #25-size tip TF instrument is usually used. Twisted Files are rotated at 900 to 1600 rpm, to grind out the plastic of WGPCBD.

In plastic carrier removal, a TF is advanced passively into the canal as far as the carrier will allow it. If a TF will not advance into the canal holding the plastic carrier (be it a complete carrier or a fragment), the next smaller TF is used. The clinician should consider increasing the rpm used if beginning on the lower end of the recommended spectrum of 900 to 1600 rpm. No GP solvent (chloroform) is used for this first step; this initial insertion is done dry, optimally through the SOM. If the same TF taper will allow passive apical advancement, it can be reinserted in several steps until the entire carrier is shredded. At no time should a TF be forced, the plastic should shred without undue apical pressure. As the clinician approaches the apex, the clinician should place a hand file to establish whether apical patency can be achieved, particularly if the TF cannot make further apical progress for whatever reason. The clinician cannot assume that the apex has not been blocked with debris and/or ledged and hence that the TF is not further worsening an existing iatrogenic event.

It is essential that the clinician be cognisant of four matters in using TF to shred plastic carriers:

1. Care should be taken to prevent strip perforation by taking all necessary precautions to avoid the furcation and furcal side of the given root.
2. The clinician should err on the side of caution and first prepare canals with TF tapers that are smaller, as the canals can always be subsequently enlarged.
3. Use of too large a TF for carrier shredding can lead to unnecessary dentine removal and predispose the tooth to subsequent vertical fracture even if a perforation did not occur.
4. The length of the canal must be kept in mind to prevent TF passing beyond the MC, should the plastic carrier be easily removed.

Done properly, it will take approximately one and no more than two TF instruments to machine a plastic carrier out of the canal. Once the carrier has been shredded and the clinician has reached the apex, small fragments will remain along the root wall. Using Hedstrom files and one drop of chloroform at a time can predictably tug the remaining fragments out of the canal and render the entire canal free of plastic carrier.

Optimally following carrier removal, the clinician should gauge the MC (use a hand K-file to determine the initial diameter of the MC) and then finalise the preparation to the master apical diameter. While empirical, it is a common technique to gauge the apex and finalise the canal preparation to three sizes larger than the first file that bound at the MC (i.e. the initial diameter of the MC). Inherent in this recommendation is a caution that the MC should not be enlarged or transported and that the canal is to be shaped up to the MC and not beyond. In essence, the MC is not moved, enlarged or altered in any way.

Adequate master apical diameter preparation is critical because once the carrier is removed, blockage of the canal is more of a risk unless the clinician is careful to take specific steps to prevent such an iatrogenic event. Once the carrier is removed, great care should be taken, along with copious irrigation, to achieve and maintain patency until the ideal master apical diameter and taper are prepared.

As an aside, additional functionality of TF relative to ground RNT files is their ability to often shape an entire canal to a #25-size tip preparation with one file and to create larger tapers to the apex, as well as fewer required insertions and enhanced cutting ability and flexibility. Twisted Files are available in sizes of

.04/25/40/50, .06/25/30/35, .08/25, .10/25 and .12/25.

_RealSeal 1 Bonded Obturator

The RS1BO is a viable clinical alternative to WGPCBD. RealSeal 1 Bonded Obturator features RealSeal (RS) surrounding a polysulphone carrier. RealSeal is "a thermoplastic synthetic resin material based on the polymers of polyester and contains a difunctional methacrylate resin, bioactive glass and radiopaque fillers. RealSeal Sealer contains UDMA, PEGDMA, EBPADMA and BisGMA resins, silane-treated barium borosilicate glasses, barium sulphate, silica, calcium hydroxide, bismuth oxychloride with amines, peroxide, photo initiator, stabilisers and pigment. RealSeal Primer is an acidic monomer solution in water. RealSeal is non-toxic, FDA approved and non-mutagenic. With its radiopaque fillers, RealSeal is a highly radiopaque material. The sealer is resorbable. Aside from its capacity to be thermoplasticised, RealSeal can be dissolved with chloroform and re-treated."[1]

RealSeal has been extensively researched. Both in vitro[2–6] and in vivo[7–8] research has demonstrated its superior sealing ability relative to GP with statistical significance. Several clinical outcomes studies demonstrate that RS, in very limited follow-up periods, is equal to or better than GP in clinical success.[9–10] RealSeal 1 Bonded Obturators are:

1. 4 tapered polysulphone obturators surrounded by RS;
2. marketed in #20 to 90 tip sizes;
3. thermo-softened in an oven designed for RS1BO use—WGPCBD ovens should not be used with RS1BO;
4. sized with a verifier (the verifier that fits passively to the true working length is the correct RS1BO size);
5. dissolvable in chloroform, owing to their polysulphone carrier;
6. capable of bonding obturation with the benefits demonstrated above;
7. a means for clinicians to provide both a bonded and warm obturation in an efficient and predictable delivery medium; and
8. manufactured by injection moulding. Such a process keeps the obturator centred in the RS and as a result optimises the obturation hydraulics. RealSeal is physically absorbed into the RS1BO polysulphone obturator.

In the first study published on RS1BO, Testarelli et al.[11] state that "Statistical analysis showed a significant difference about the RS1 group, the Thermafil and One/Step group, while no significant differences were noted between these last two groups. Results show that the number of teeth that had no (= 0) leakage was higher in the RS1 group (8 specimens) than in the remaining ones (1 and 1 specimen, respectively)." They conclude that "under the conditions of the present experimental test, the new RS1 material (carrier-based Resilon) provided excellent preliminary results showing sealing ability at 24 hours significantly better that traditional carrier-based gutta-percha systems."

RealSeal is bio-compatible.[12–14] In re-treatment, RS1BO are easily removed from the canal with TF at the enhanced rotational speeds advised above, 900 to 1,500 rpm. Thus far, the author having re-treated extensive numbers of RS1BO in extracted teeth and several in live patients, TF has been all that was required to remove the obturator in re-treatment. The other techniques described above have not been necessary.

A clinically relevant discussion has been provided of carrier removal in re-treatment using a new and innovative technology in the form of the TF, as well as other common methods. A discussion of the RS1BO along with its re-treatment strategies has been presented for comparison with warm GP carrier-based devices.

I welcome your feedback._

Editorial note: A complete list of references is available from the publisher.

_author info roots

Dr Richard E. Mounce lectures globally and is widely published. He has a private practice specialising in endodontics in Vancouver in Washington. Dr Mounce offers intensive customised endodontic single-day training programmes in his office for one or two doctors.

For information, contact

Dennis at +1 360 891 9111 or
E-mail RichardMounce@MounceEndo.com.

DENTAL TRIBUNE
DT STUDY CLUB
COURSES | DISCUSSIONS | TECHNOLOGY | ON-DEMAND

"Online learning is not the next big thing,
it is the now big thing."

Donna J Abernathy
Training and Development Editor

DTSC - COURSES, COMMUNITY, TECHNOLOGY, ON-DEMAND

The DT Study Club makes all of this possible from the comfort of your own computer and without travel expenses. In other words, welcome to the community!

The purpose of this study club is to provide practitioners like yourself an opportunity to learn and network with like-minded colleagues in a friendly, non-threatening environment. We encourage you to take advantage of Dental Tribune's global outreach to access a variety of fresh perspectives and cultures, enhancing your educational mix.

24/7 LIVE AND INTERACTIVE ONLINE COURSES

Fulfill your yearly CE requirements with our growing list of archived ADA CERP approved courses.

DISCUSSION FORUMS

focused on helping today's practitioners to stay up to date. Networking possibilities that go beyond borders to create a truly Global Dental Village

VIDEO REVIEWS OF PRODUCTS

Our opinion leaders unveil new products, services, and give you their first impressions of the industry's hottest topics.

PEER REVIEWED CASE STUDIES

Upload, comment, participate. We encourage you to share your cases for review with like-minded practitioners.

REGISTER FOR FREE ON WWW.DTSTUDYCLUB.COM

CONTESTS WITH CHANCES TO WIN FREE TUITION FOR ADA/CERP C.E. ACCREDITED WEBINARS

SPONSORSHIP AND SPEAKING INQUIRIES:
JULIA WEHKAMP, J.WEHKAMP@DTSTUDYCLUB.COM, (416) 907-9836.

ADA C·E·R·P® | Continuing Education Recognition Program

Pm PRACTICE MANAGEMENT
Gd GENERAL DENTISTRY
Co COSMETICS
En ENDODONTICS
Im IMPLANTOLOGY
Pe PERIODONTICS
Or ORTHODONTICS
Dh DENTAL HYGIENE

WWW.DTSTUDYCLUB.COM

The new GT Series X rotary shaping system

Author_Dr L. Stephen Buchanan, USA

_What do dentists want from their rotary shaping instruments?

_Back in 1996, when rotary nickel-titanium shaping files were introduced to the marketplace, the primary question that dentists grappled with was: Should we dare put a handpiece-driven file into a root canal? Today, dentists ask themselves which set of instruments, out of the multitude available, is right for them. With every new company entering the market with a NiTi rotary file claiming that theirs is the next generation of design, while it may just be the latest to arrive in this intensely competitive field, it has become increasingly difficult to separate the marketing from the reality of using the file in patient's teeth.

So, how do we figure this out? I would say the answer lies in considering what we most want from our shaping instruments and comparing the offerings to those standards. A marketing research firm polled dentists to find out what they want from their files. The answers were, in this order:

1) resistance to breakage;
2) fidelity to the original canal path; and
3) efficiency.

I was gratified to note that the first two are both related to safety, which is essential. However, as simple as the concept of safety seems, the multivariate, and often oppositional, functional characteristics of file geometry make for a serious analytical challenge.

Examples of these countervailing features are abundant. While larger core diameters enhance a file's resistance to torsional stresses in straight canals, they radically increase its susceptibility to cyclic fatigue in curved canals. While sharper cutting flutes decrease friction and the resultant torsional stresses accumulated in a file during cutting, they significantly increase the amount of transportation from the original canal path in curved canals.

Beyond the difficulties of understanding factors affecting safety objectives, it is no less obscure to determine how these geometric variants affect efficiency. Do we look only at the cutting efficiency of a file blade during the use of a single file in a single cutting cycle? Or do we consider the number of instruments and steps necessary to complete the root canal preparation? Do we compare files relative to the time that they can cut in an apical direction before their flute spaces are jammed with debris?

_The importance of shaping objectives

Often lost in this cacophony of information about rotary shaping instruments is the issue of shaping objectives. It is difficult to choose an instrumentation system without considering the preparation result desired, as it would be difficult to choose a mode of transportation without knowing where you wanted to go. Most clinicians have only asked themselves whether they want to use hand files or handpiece-driven files, with the intention of creating the same outmoded root canal preparations they were taught in dental school some time ago. I feel that it is a bigger step forward to stay with hand files but to cut more predictable shapes than it is to use rotary files to cut shapes with a greater chance of poor short- or long-term outcomes. In this light, the consideration of shaping objectives can be divided into coronal, middle, and apical categories.

Traditionally, root canal preparations have been relatively large coronally and apically with varying, often anaemic, amounts of shape between those regions. Large coronal shapes became the rage when Dr Herbert Schilder and others[1,2] noted, correctly at the time, that greater amounts of coronal enlargement allowed for better results in apical regions. But that was only true for the relatively stiff stainless-steel files and relatively large irrigating needles we had at that time. The other reason that clinicians to this day cut big shapes in these regions is to facilitate the filling of root canals with lateral condensation of cold gutta-percha.

Fig. 1


Fig. 2


Fig. 3

The problem is that over-enlargement of this part of the canal unnecessarily weakens root structure and, in the case of molar canals, increases the chance of strip perforation. When I talk to prosthodontists, their fears of using endodontically treated teeth as critical abutments revolve primarily around structural integrity issues (assuming that the apical region has been thoroughly treated).

When I asked Dr Carl Reider, a retired but renowned prosthodontist from Newport Beach California, what he most wanted from his endodontist, he said he would prefer it if the endodontist could just suck the dying pulp out of the tooth without removing any dentine. He made that paradigm-shifting statement to me back in 1990. Fast forward to 2006, when a young prosthodontist stated to a room of endodontic graduate students that he would rather do full mouth reconstructions supported only by implant fixtures, rather than endodontically treated teeth (they were emotionally distraught) and I hear that same fear about losing important abutments owing to structural failure. It is therefore clear to me that controlling the amount of coronal enlargement is vital to long-term endodontic success, as well as to the long-term success of endodontics as a credible treatment in dentistry (Fig. 1).

What about the shaping objectives in the middle third of the canal? The problems associated with a paucity of shape in this region are seldom appreciated. Under-shaping the middle third of root canals is largely responsible for irrigation and cone-fit problems, and when carrier-based obturation is used, it will readily strip off gutta-percha from the carrier and allow it to arrive at the end of the preparation without gutta-percha around it—all of these being set-ups for failure. Fortunately, the advent of variably tapered shaping files ended the commonly under-shaped outcomes we saw when push-pull filing with .02 tapered K-files, so virtually all rotary shaping instruments of .06 or greater taper will solve this problem.

Apically, the traditional shaping objective has been the stop prep, an intentional ledge form short of the apical foramen. While the stop prep will work well when done perfectly, it is prone to failure, as it is unforgiving of length determination errors. When length is erroneously determined short, the stop prep, created by cutting increasingly larger files to working length, is a ledge that will confound efforts to bypass it when attempting to fill to an acceptable length in the canal. When length is erroneously determined long, or when a curved canal is shortened by straightening during shaping, the large and relatively stiff instruments that are taken beyond the root canal terminus will inevitably rip the end of a canal—a set-up for overfilling.[3]

In fact, the volume of literature correlating overfills with a higher incidence of failure[4–6] has largely misunderstood coincidence for aetiology, as most of the endodontic failures examined were overfills that happened in canals prepared with the stop preparation. As an apical stop is really an intentional ledge, any overfill occurring with this shaping objective is by definition indicative of a shaping failure, not a filling failure. When the apical foramina of canals are ripped open, it is virtually impossible to seal them adequately using cone-fit techniques. This is the only possible explanation for those failures when the bio-compatibility of our filling materials is considered.[6,7]

If we cut a tapered shape (with files that have safe tip geometry) that is short of ideal length, it is easy simply to cut the preparation further into the canal when the error is detected before filling. If we cut a tapered shape (with files that have landed flutes) too long, the tapered resistance form still exists and only requires that the fitted point be cut back to correct length before obturation—a recovery that takes less than 20 seconds.

Fig. 1_Endodontically treated maxillary molar with vertical root fracture in mesio-buccal root. While the endodontic therapy was quite good in the apical regions (note the apical accuracy of filling in all canals and the significant lateral canal in the MB root), the unnecessary over-enlargement of the coronal regions of the canals resulted in a loss of structural integrity and the splitting of the MB root within five years of treatment.
Fig. 2_Micro-CT view of the mid-root region of a curved mesial root of a mandibular molar shaped with size 30-.06 landed and non-landed rotary files. The canal shape on the left, significantly more conservative in size, was shaped with a landed-blade GT file. The canal shape on the right was shaped with a non-landed file of the same size tip and taper.
Fig. 3_Micro-CT reconstruction of curved canals shaped in a mesial root of a mandibular molar, comparing outcomes in the apical third with rotary files of radiused vs. aggressive tip geometry. Note the canal on the left showing severe transportation (aggressive tip) and the canal on the right following the original canal path as the canal terminates (radiused tip).

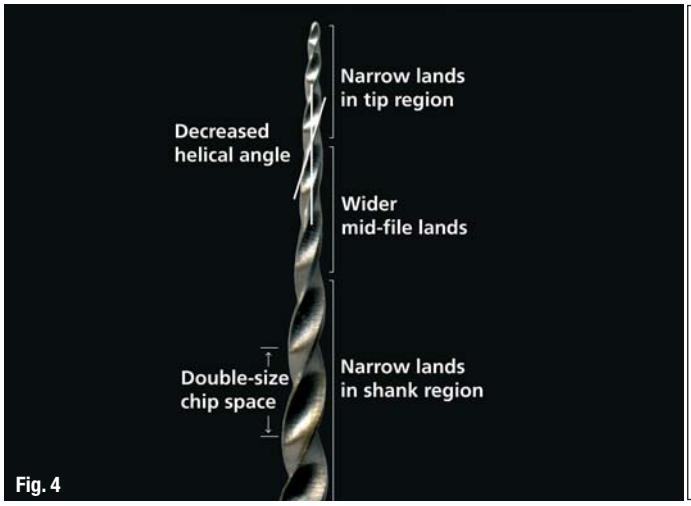


Fig. 4

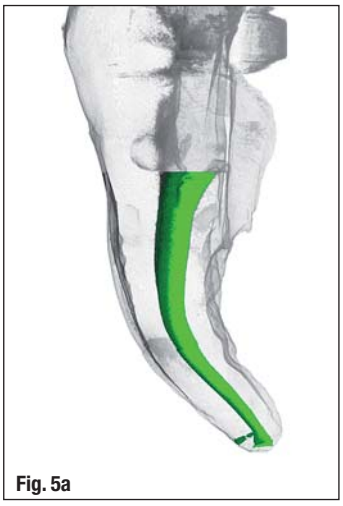


Fig. 5a


Fig. 5b

Fig. 4_GT Series X file: note the maximum shank diameter at 1mm, the radiused tip, the consistent, wider blade angle, and the variable width lands. At the tip and shank ends, the land widths are half the size of the lands in the middle region of the flutes, allowing rapid cutting without transportation.

Figs. 5a & b_Micro-CT reconstructions comparing Standard GT and GTX file function relative to transportation of curved canals. In this severely curved mesial root of a mandibular molar, the shapes in the adjacent canals shaped with the different file sets, are virtually identical and show exceptional fidelity to the original canal paths.

For my money, I want the apical preparation that is most forgiving, one that is tapered. In addition, when clinicians choose this apical shaping objective they get a twofer. Not only is it more predictable, with variably tapered shaping files, it also requires fewer instruments to achieve the result.

So what characteristics should we seek to meet our shaping objectives and ultimately answer the three primary needs cited by dentists in the aforementioned market survey? With the shaping objectives listed above it becomes clear that we need a file set that provides limited coronal enlargement and a tapered apical shape, preferably without serial step-back techniques required. While there are many files on the market that provide .06 tapers, which are adequate for small-root canals, larger tapers are typically desired for medium-root and large-root canals. The concept of maximum flute diameter (MFD) limitations is unique to the GT file family of instruments and not only controls coronal enlargement, but also allows preparation tapers greater than .06 to be created without unwanted cutting in those regions. While there are instruments that have somewhat limited flute diameters, no other file set limits the MFD to 1mm throughout the series as seen in the GT designs.

When a dentist tells me that he or she uses GT files but still likes to use Gates-Glidden burs at the start or end of the preparation, I know that they are still filling canals with lateral condensation because GT files cut shapes that are just slightly larger than GT gutta-percha points and there is not much room at the orifice level to place a spreader between the canal wall and the point. In the 21st century, with thermoplastic obturation techniques available that take less time than well-done cold lateral condensation, I would say that dentists need to pick a different filling technique if the one they are using requires dangerous over-instrumentation. While the 1mm coronal enlargement created by GT files may be smaller than many dentists are used to working through, continuous wave obturation, carrier-based obturation, warm lateral condensation, and even single cone fills (although I don't recommend this) are better than needlessly weakening root structure.

To the endodontists reading this article, be aware that over-cut coronal shapes are part of the reason prosthodontists are increasingly choosing implant-supported prostheses over endodontically treated abutments. All non-landed cutting flutes cut shapes significantly larger that the external geometry of the file itself, as seen in Figure 2. Anti-curvature shaping routines do nothing to minimise the shaping size; they just reduce the chances for strip-perforating narrow curved roots. The best method to retain maximal root strength and eliminate the possibility of exiting the root is to control coronal enlargement definitively, one of the most distinguishing features of both the GT and the new GT Series X file lines.

Moving to the other end of file geometry, file tip designs must be safe-ended. Every five years, a dental company introduces a new file with aggressive or semi-aggressive tip geometry. While the initial sensation of effortless apical progress is seductive, m-CT research and clinical experiences do not bear out manufacturers' claims of safety (Fig. 3). The real story is told when the manufacturer's directions for use are read and the technique recommended mentions that the files should never be taken beyond the apical foramen and that the file tips should never be used for more than one second at full length. Underappreciated in this regard is the dangerous combination of aggressive tip geometries and non-landed cutting flutes in curved canals. When a non-landed instrument is used in curved canals, mid-root curvatures are inevitably straightened, thereby shortening canal lengths, resulting in inadvertent placement of aggressive file tips beyond the apical foramen, an invitation to apical ripping. Of course all

aggressive tip, non-landed shaping files can be used with excellent outcomes if the user is experienced and adept; however, the workarounds necessary to avoid apical damage often require additional files and procedural steps to circumvent the inherent dangers.

Next on the list of file features are blade-edge and core geometries. While the file tip and shank features are obvious in their effect during shaping procedures, the functional characteristics of cross-sectional file geometry are less obvious. If we look at the four leading files on the market in cross-sectional view, there are three primary things to observe: cutting-blade edge, core size, and the size of the chip space between the flutes.

Each of these features has countervailing advantages and disadvantages—the trick is to optimise them. Cutting-blade edges cannot be too sharp, or significant transportation of curved canal paths surely result. Yet if they are inefficient and take too long to cut, cyclic fatigue will rapidly accumulate when these instruments are held around canal curves. Larger core diameters add strength to the instrument when it is used in a straight canal (improved torsional strength) but become quite dangerous in curved canals (decreased resistance to cyclic fatigue). Larger core diameters combined with non-landed cutting blades are the most dangerous, as the stiffness activates the cutting blades to transport and they are more prone to cyclic fatigue failure.

Furthermore, if the core diameter is smaller, the chip space becomes more capable of gathering cut dentine debris before the file stalls. Small chip space means that the file needs to be removed and cleaned more often before it can cut further in an apical direction. Also, as the core diameter becomes smaller, the inherent flexibility of the instrument increases—a very good thing in curved canals.

Thus, a small core diameter and the resultant large chip space are needed, as well as a blade edge that is effective without being too aggressive—a difficult set of parameters.

_GT Series X file features: M-Wire, variable-width lands, greater chip space and flexibility

The GTX file set was designed with all of these requirements in mind, playing to the previous strengths of the GT file, and improving those that could be optimised. Beyond geometry changes, this file is made of a new NiTi wire called M-Wire developed by Dr Ben Johnson, the inventor of carrier-based obturation. Through a series of heat-treatment and annealing cycles applied during the drawing of the wire, the resistance to cyclic fatigue has been greatly enhanced. This should not be understood to mean that files made of this advanced metal can be used repeatedly; rather the chance of breakage is intended to be significantly reduced when the instruments are used as before. Any file, regardless of design or metallurgy, will break when overused. But it's safe to say that this new wire is a great advancement in answering dentists' first priority: better resistance to fracture.

GT Series X files have the same radiused tip geometry, the same limited MFD, and they are still landed instruments but with a significant improvement—the land widths vary along the length of the file (Fig. 4). Experience gained through the twelve years of GT file manufacture and use has revealed that the width of radial lands is critical. Too large and they don't cut fast enough (a set-up for failure due to cyclic fatigue). Too small and they begin to transport curved canals like non-landed files. The key finding during design and prototype development was that we need different


Fig. 6


Fig. 7

Fig. 6_GT Series X file family: this reduced file set, with tip sizes of 0.2 mm, 0.3 mm, and 0.4 mm, will shape all canals except those with huge apical diameter. Standard GT .12 accessory files can be used if tip diameters are needed in 0.5 mm, 0.7 mm, and 0.9 mm sizes.
Fig. 7_Clinical case shaped with GTX files. The MB canals were shaped with a 20-.06 and a 30-.06 GTX file, the disto-buccal canal required a 20-.04 and a 20-.06, and the palatal canal was shaped with a 20-.06 and a 40-.08. Shaping time for this case was 11 minutes.

degrees of sharpness at different regions of a landed file. Because transportation is a function of blade sharpness and the rigidity of the instrument at a given position along the file, testing showed that the tip flutes, in the most flexible part of the file, could be safely narrowed to gain cutting efficiency without transportation in the highly curved apical regions of canals (Figs. 5a & b).

Furthermore, at the shank end of the file the lands could also be thinned without danger, in spite of the stiffness of that part of the file, because the shank end cuts through the straightest region of roots. With these efficiencies at hand, it became apparent the degree of stiffness in the middle section of the file, coupled with the significant amount of curvature encountered in the middle third of root canals, dictated maintenance of the original land width to prevent straightening of mid-root canal curves. The outcome of this optimisation was an at least doubled increase in cutting speed, as well as less taper lock during apical progress.

The final blade change is that the blade angles have been opened to a consistent 30 degrees along the length of GTX files, thereby nearly doubling the chip space between flutes. This increases the flexibility of these files and significantly extends the length of each cutting cycle. Where standard GT files cut for about four to six seconds before clogging up, GTX files will cut continuously for ten to twelve seconds before they need to be removed and cleaned.

A serendipitous result of these blade improvements is that rather than using a 20-.10, then a 20-.08, then a 20-.06 GTX file to cut initial shape in small curved canals, a single 20-.06 GTX file used in two cutting cycles will often create the initial shape in these canals. Obviously, this should be considered a gift when it happens, rather than an expectation—or breakage could result from pushing this file beyond its limits in tortuous canal morphology—but the 20-.06 GTX file will accomplish this amazing feat more often than not. When it baulks at cutting to length, a 20-.04 GTX file is cut to length, after which the 20-.06 will usually make it.

The final two changes from the standard GT line are a latch-grip handle shortened from 13 to 11mm and a file set reduced from 15 to 8 instruments in the set (Fig. 6). The shorter handle is obviously explained, but the reduced file set needs explanation.

A brief explanation for the reduced file set is two-fold: 1) a common cause of rotary file breakage is the selection of a taper size that is inappropriate for the canal curvature being shaped; and 2) the consistently ideal preparations created by landed rotary instruments require resistance form that is less tapered, to achieve apical accuracy of obturation. The longer, more complete explanation will be included in my next article on GTX shaping techniques.

Virtually any canal, short of those with open apices, can be ideally shaped with this eight-instrument file set. For bigger apical sizes and greater coronal enlargement, clinicians can use a standard GT file, for instance the 40-.10 or the .12 accessory files with tip diameters of .5, .7, and .9 mm.

_Will these efficiency improvements usher in the new age of endodontic expediency?

Nothing could be further from the truth. While I have never seen a patient in my 27 years of practice who has asked for a long, slow root canal, I have also never had a patient tell me that it's okay to shortcut the procedural necessities either. Providing nearly 100 per cent success in endodontic procedures requires endless patience during certain parts of the procedure, for example when looking for calcified canals or when negotiating difficult molar canals to their terminal points. Certainly, that is the case when doing conventional re-treatment of botched cases. So it is imperative that we improve the efficiency of any part of the procedure so that we can, for instance, spend the time needed to irrigate root canals adequately after they have been shaped. When I have struggled all the way through the negotiation phase of a tortuous set of root canals, I am grateful that I can then shape the canals in just a couple of minutes afterwards (Fig. 7)._

Editorial note: A complete list of references is available from the publisher.

_author info roots

Dr L. Stephen Buchanan is a Diplomate of the American Board of Endodontics and a Fellow of both the International College of Dentists and American College of Dentists. Clinicians interested in his DVD series, *The Art of Endodontics*, and his hands-on laboratory workshops in Santa Barbara, USA, can call +1 800 528 1590. For more information related to this article and for GTX updates and answers to frequently asked questions, please visit www.endo-buchanan.com. Free CE online courses are also available on the GTX System and other topics. Questions concerning challenging cases can be directed to +1 800 528 1590.

FDI Annual World Dental Congress

2-5 September 2010

Salvador da Bahia, Brazil

congress@fdiworldental.org
www.fdiworldental.org

fdi

BRAZIL SALVADOR DA BAHIA 2010

A dream of ice and snow

Author_ Claudia Salwiczek, Germany
Photographs_ Peter Grant, ICEHOTEL

_**Imagine a hotel,** where the inside temperature is below freezing and everything, from the rooms to the furniture, is made out of snow and ice. A hotel that is rebuilt from scratch every winter and that melts as soon as spring temperatures warm up the air. You don't think this is possible? An urban myth perhaps?

Then let's travel north, 200 kilometres inside the Arctic Circle, to the small village of Jukkasjärvi, in northern Lapland, Sweden. Here, the free flowing Torne River carries water that is among the purest in Europe. Artic temperatures and gentle movement create crystal clear ice – the building material for the truly unique and magical ICEHOTEL. In November, after the first ice has formed and the first layer of snow has fallen, construction for this year's ICEHOTEL will begin.

_A unique idea

For many years, the tourist operator Jukkas, present day ICEHOTEL, focused on the summer season and the many outdoor activities the region has to offer. In the 1980s the company decided to find a way to also take advantage of the dark and cold winter days. The abundance of ice and snow inspired the idea to invite ice artists to the area. In spring of 1990 an exhibition was set up in a specially built igloo, named Arctic Hall, to showcase the ephemeral art, which attracted many curious visitors to the area.

The idea of ICEHOTEL was born, after a group of guests, equipped with reindeer hides and sleeping bags, decided to use the igloo as accommodation. Nineteen years later, ICEHOTEL consists of about 80 unique hotel rooms, the famous ABSOLUT ICEbar, a cinema with an ice screen, an ice art exhibition hall, an ICEchurch and is world famous for its unique concept, its fantastic works of art and its extraordinary experiences.

_Building the ICEHOTEL

The building process is complex and long and, naturally, dependant on Mother Nature. Construction usually begins in mid-November when large clouds of snow start to drift along the Torne River. Under the direction of the ICEHOTEL Art & Design Group an international team of snow builders, architects, designers and artists then starts to create a version of ICEHOTEL that is different each year.

At first, snow is sprayed on large steel forms and allowed to freeze for a couple of days. After the forms have been removed, the maze of free-standing snow corridors is divided with walls in order to create the different size rooms. Under the right conditions, ice can be worked just like any other material. Bulldozers stack the blocks of ice, that are either sawed directly from the Torne River or created by compressing snow into wooden forms, on top of one another – just like one would when building a brick wall. One block is supported by another and the weight of the ice blocks is enough to ensure optimal adhesion. The ice is then shaped with special tools, like chain saws, cutters and drills for the rough work, and special instruments from Japan for the details. At last, fire is used to smooth the ice. The ICEHOTEL covers about 6,000 square metres and is built of approximately 10,000 tons of crystal clear ice and 30,000 tons of snow. The entire structure is naturally cooled by the arctic temperatures and melts back into the river with the onset of spring.

_Rooms for rent

The indoor temperature at ICEHOTEL is usually somewhere between -4 to -9°C, depending on the number of guests and the outdoor temperature, which can

be as cold as -40°C. The beds are made of snow and ice, covered with wooden boards, a mattress, reindeer pelts and specially-designed thermal sleeping bags. Just as in any regular hotel, a range of room types, from a basic double room to a deluxe suite, is available. The rooms are decorated with desks, chairs, lamps, sculptures, windows, doors and pillars, created by the ice artists.

Since the temperatures are of course well below freezing, guests of the ICEHOTEL are given a collection of gear including a thermal sleeping bag and a full jumpsuits made of beaver nylon. Most guests usually only spend one night in the actual ICEHOTEL. For longer stays, ordinary heated hotel rooms are available in the nearby Aurora House, which is made from conventional building material.

_A bar on the rocks

The ABSOLUT ICEbar, just as the rest of the hotel, is different from year to year. Everything, including the glasses, is specially designed and made of ice. Together, ICEHOTEL and ABSOLUT created the world's first ABSOLUT ICEbar in Jukkasjärvi in 1994. ABSOLUT ICEbars can also be found in Stockholm, London, Tokyo and Copenhagen, each bar build with the original ice from the Torne River. For a culinary experience you can visit the two restaurants in Jukkasjärvi. The ICEHOTEL Restaurant serves Laplandic gourmet food with raw materials on plates made of ice and The Old Homestead Restaurant offers an experience of Tornedalen and Sami Culture.

Swedish officials view the ICEHOTEL as a sort of national treasure because it fits into the government's project of educating people around the world about how clean water is essential for a healthy environment. Replicas of the ICEHOTEL can be found in cold regions around the world, like Finland, Norway, Alaska, Canada and Greenland.

This year, as the hotel will open its doors for the 20th season, many curious visitors from all over the world are expected to visit this magnificent piece of art. And despite the fact that the experience does not come cheap, the waiting list is several years long. So if staying at the ICEHOTEL sounds like an adventure you are ready to take on, we suggest you plan early, pack right and expect to be enchanted!_

For more details about ICEHOTEL please call +46 980 668 00 or visit the hotel's official website www.icehotel.com.

AAE energised endodontists in Orlando

Author & Photographer_Fred Michmershuizen, USA

_Nearly 4,000 dental professionals gathered at the Gaylord Palms in Orlando (Florida, USA) for the 2009 Annual Session of the American Association of Endodontists (AAE). The meeting, held from 29 April to 2 May, offered specialists and general practitioners an opportunity to learn about the newest products and techniques. From the opening session, when a military drill instructor motivated attendees to get on their feet and reach for new heights, to the closing celebration, featuring a rousing performance by the Beach Boys, attendees seized the occasion to get revitalised!

Dr Louis E. Rossman, President of the AAE, officially opened the meeting on Thursday morning with a vigorous and heartfelt speech that was fitting for this year's theme—*Engage, Energize, Educate*. Dr Rossman's message to endodontists was clear: it's all about confidence. "Not everyone in dentistry recognises the advances in our specialty, and many teeth that could be saved are simply being yanked," Dr Rossman said. "It is our duty to get out and deliver a message of confidence."

Furthermore, he said it is the responsibility of endodontists to emphasise the benefits of saving natural teeth and to trumpet the advances in the specialty that continue to make root canal therapy ever more beneficial to the patient. At the same time, he said, endodontists should immerse themselves in knowledge of implants, so that when a decision has to be made between root canal therapy and an implant, the endodontist can offer an opinion based on credible knowledge. Ultimately, he said, it is all about what is best for the patient.

After the opening session, attendees crowded into the exhibit hall featuring products from scores of exhibitors. Many companies launched new products.

Discus Dental Smart Endodontics introduced its LightSpeedCRX and LightSpeedMRX instruments, which are designed to clean and shape the coronal third and middle third of the canal. These new files complement the LightSpeedLSX files, which are used for the apical third. Discus also unveiled its new HotTip cordless warm vertical compaction device, which is used with the HotShot for obturation of the canal.

Many attendees visited the SybronEndo booth to investigate the company's Twisted Files, which are now available in new sizes. There was also a great deal of interest in the RealSeal 1 bonded obturation system available from Sybron.

Fig. 1_AAE President Dr Louis E. Rossman addresses his fellow endodontists on Thursday morning at the opening breakfast of the 2009 AAE Annual Session.
Fig. 2_Discus Dental Smart Endodontics introduced the HotTip cordless warm vertical compaction device, which is used with the HotShot for obturation of the canal.
Fig. 3_Seiler Precision Microscopes offered demonstrations of the prototype for a brand new model of scope with many new features and benefits.
Fig. 4_Jordco's eRuler was one of the many innovative products available on the exhibit floor at the AAE meeting.

Of course, before the canal can be cleaned, shaped and filled, the practitioner needs to see what he or she is up against. Companies offering magnification equipment showcased the latest in microscopes and loupes. Seiler Precision Microscopes offered demonstrations of a prototype for a brand new scope model with many new features and benefits.

A new anaesthetic delivery device—the Anesto—was unveiled by Innovadontics, a distributor of W&H products. Designed to be quick and easy, the Anesto delivers anaesthetic first to the soft tissue and then to the hard tissue. The developer of Anesto Dr Hamid Abedi was on hand to offer demonstrations.

There were also many educational offerings at this year's AAE meeting. For the first time, the AAE presented a Master Clinician Series, featuring live non-surgical endodontic techniques in a theatre-in-the-round setting. Series presenters included Dr James K. Bahcall, Dr L. Stephen Buchanan, Dr Giuseppe Cantatore, Dr Richard E. Mounce, Dr Ali A. Nasseh, Dr Clifford J. Ruddle and Dr G. John Schoeffel. In all, more than 100 educational sessions and more than 197 hours of continuing education credits were offered. An all-day pre-session symposium *Integration of advanced surgical procedures in your endodontic practice* was held on Wednesday.

At a luncheon on Saturday, Dr Rossman passed the reins of leadership over to incoming AAE President Dr Gerald N. 'Jerry' Glickman. Before officially taking office, Dr Glickman told *Dental Tribune* that he is looking forward to working with the AAE board and its members over the coming year for the future of the specialty. "It is our goal as endodontists to work with general dentists, other specialists, our dental schools and the public to continually address the need to preserve the natural dentition as long as possible," Dr Glickman said. "Ultimately it is about saving the natural tooth."

The *Celebrate Orlando!* event on Saturday evening concluded the meeting with a performance by the Beach Boys at the Hard Rock Live at Universal Studios.

The 2010 AAE Annual Session will be held in San Diego from 14 to 17 April._

_contact roots

American Association of Endodontists
211 E. Chicago Ave., Suite 1100
Chicago, IL 60611-2691, USA
Tel.: +1 312 266 7255
E-mail: info@aae.org

Dental Tribune International GmbH | Contact: Nadine Parczyk
Holbeinstraße 29 | 04229 Leipzig | Germany
Tel.: +49 341 484 74 302 | Fax: +49 341 484 74 173
n.parczyk@dental-tribune.com | www.dental-tribune.com

dti Dental Tribune International

www.dental-tribune.com

❑ I hereby order 4 issues of **COSMETIC DENTISTRY** for 35 € (1 year)*

❑ I hereby order 20 issues of **DENTAL TRIBUNE GERMAN EDITION** for 70 € (1 year)*

❑ I hereby order 10 issues of **DENTAL TRIBUNE AUSTRIAN EDITION** for 55 € (1 year)*

❑ I hereby order 4 issues of **ROOTS** for 35 € (1 year)*

❑ I hereby order 10 issues of **DENTAL TRIBUNE ASIA PACIFIC EDITION** for 55 € (1 year)*

PAYMENT OPTIONS

❑ **PayPal**
subscriptions@dental-tribune.com

❑ **Bank Transfer**
Commerzbank Leipzig
Account No.: 11 40 201
Bank Code: 860 400 00
BIC: COBADEFF
IBAN: DE57860400000114020100

*plus shipping and handling. Your personal data will be recorded and retained by Dental Tribune International GmbH, which has its registered office in Holbeinstr. 29, 04229 Leipzig, Germany. Your personal data is used for internal purposes only. After the payment has been made, the shipping process for the subscribed publication(s) will start. The subscription will be renewed automatically every year until it is cancelled six weeks in advance to the renewal date.

PERSONAL DETAILS/SHIPPING ADDRESS

Name

Position

Department

Organisation

Address

Country

Telephone

Facsimile

E-mail

Date/Signature

Fax form to: +49 341 484 74 173 or subscribe online at www.dental-tribune.com

Endo events

2009

FDI Annual World Dental Congress
Where: Singapore, Singapore
Date: 2–5 September 2009
Tel.: +33 450 4050 50
Web site: www.fdiworldental.org

14th Biennial ESE Congress
Where: Edinburgh, Scotland
Date: 24–26 September 2009
Tel./Fax: +44 1494 581542
Web site: www.eseedinburgh.com

58th Annual Meeting of the American Academy of Implant Dentistry
Where: New Orleans, LA, USA
Date: 11–15 November 2009
Tel.: +1 312 335 1550
Fax: +1 312 335 9090
Web site: www.aaid2009.com

1st Joint Scientific Congress of the German Endodontic Associations
Where: Wiesbaden, Germany
Date: 12–14 November 2009
Tel.: +49 341 484 74 202
Web site: www.dg-endo.de

Greater New York Dental Meeting
Where: New York, NY, USA
Date: 27 November–2 December 2009
Tel.: +1 212 398 6922
E-mail: info@gnydm.org
Web site: www.gnydm.org

2010

145th Midwinter Meeting Chicago Dental Society
Where: Chicago, IL, USA
Date: 25–27 February 2010
Tel.: +1 312 836 7300
Web site: www.cds.org.mwm

AAE Annual Session
Where: San Diego, CA, USA
Date: 14–17 April 2010
Tel.: +1 800 872 3636
E-mail: info@aae.org
Web site: www.aae.org

IADR 88th General Session & Exhibition
Where: Barcelona, Spain
Date: 14–17 July 2010
Tel.: +1 703 299 8095
Web site: www.iadr.org

FDI Annual World Dental Congress
Where: Salvador, Brazil
Date: 2–5 September 2010
Tel.: +33 450 4050 50
Web site: www.fdiworldental.org

Trans-Tasman Endodontic Conference
Where: Christchurch, New Zealand
Date: 4–6 November 2010
Tel.: +61 2 9518 7722
Web site: www.tteconference.com

submissions:

formatting requirements

_Please note that all the textual elements of your submission:

_the complete article,
_all the figure captions,
_the complete literature list, and
_the contact info (bio, mailing address, E-mail address, etc.)

must be combined into one Word document. Please do not submit multiple files for each of these items.

In addition, images (tables, charts, photographs, etc.) must not be embedded into the Word document. All images must be submitted separately, and details about how to do this appear below.

Text length

Article lengths can vary greatly—from a mere 1,500 to 5,500 words—depending on the subject matter. Our approach is that if you need more or less words to do the topic justice then please make the article as long or as short as necessary.

We can run an extra long article in multiple parts, but this is usually discussing a subject matter where each part can stand alone because it contains so much information. In addition, we do run multi-part series on various topics.

In short, we do not want to limit you in terms of article length, so please use the word count above as a general guideline and if you have specific questions, please do not hesitate to contact us.

Text formatting

Please use single spacing and un-indented paragraphs for your text. Just place an extra blank line between paragraphs.

We also ask that you forego any special formatting beyond the use of italics and boldface, and make sure that all text is left justified.

If you would like to emphasize certain words within the text, please only use italics (do not use underlining or a larger font size). Boldface is reserved for article headers.

Please do not 'center' text on the page, add special tab stops, or use underling as all of this must be removed before layout. If you require a special layout, please let the word processing programme you are using help you to do this formatting rather than doing it by hand on your own.

If you need to make a list, or add footnotes or endnotes, please let the Word processing programme do it for you automatically. There are menus in every programme that will help you to do this. The fact is that no matter how careful one might be, errors have a way of creeping in when you try to hand number footnotes and literature lists.

Image requirements

Please number images consecutively throughout the article by using a new number for each image. If it is imperative that certain images are grouped together, then use lowercase letters to designate the images in a group (ie, 2a, 2b, 2c).

Please put figure references in your article wherever they are appropriate, whether that is in the middle or end of a sentence. If you are not directly mentioning the figure in the body of your article, when it appears at the end of the sentence the figure reference should be enclosed within parenthesis and be inside the sentence, meaning before the period.

In addition, please note:

_We require images in TIF or JPEG format.
_These images must be no smaller than 6 x 6 cm in size at 300 DPI.
_Images cannot be any smaller than 80 KB in size (or they will print the size of a postage stamp!).

Larger images are always better, and something on the order of 1 MB is best. Thus, if you have an image in a large size, do not bother sizing it down to meet our requirements but send us the largest file sizes available. (The larger the starting image is in terms of bytes, the more leeway the designer has in terms of resizing the image to fill up more space should there be room available).

Also, please remember that you should not embed the images into the body of the text document you submit. Images must be submitted separately from the textual submission.

You may submit images through a zipped file via E-mail, unzipped individual files via E-mail, or post a CD containing your images directly to us (please contact us for the mailing address as this will depend upon where in the world you will be mailing them from).

Please do not forget to send us a head shot photo of yourself that also fits the parameters above so that it can be printed along with your article.

Abstracts

An abstract of your article is not required. However, if you choose to provide us with one, we will print it in a separate box.

Contact info

At the end of every article is a Contact Info box with contact information along with a head shot of the author. Please note at the end of your article the exact information you would like to appear in this box and format it according to the previously mentioned standards. A short bio may precede the contact info if you provide us with the necessary information (60 words or less).

Questions?

Please contact us for our Author Kit, or if you have other questions:

Managing Editor
Claudia Salwiczek
c.salwiczek@dental-tribune.com

roots
the international magazine of endodontics

dti] Dental Tribune International

www.idem-singapore.com

THE BUSINESS OF DENTISTRY

IDEM SINGAPORE

Visit us at fdi Annual World Dental Congress, Booth J27

INTERNATIONAL DENTAL EXHIBITION AND MEETING
Scientific Conference: 15 - 18 April, 2010
Trade Exhibition: 16 - 18 April, 2010

The Sourcing & Education Platform in the Asia Pacific

Join a turnout of over 6,000 manufacturers and distributors, potential partners, visitors and delegates from across the globe. IDEM Singapore 2010 is enriched with opportunities from trading and showcasing of high-quality dental equipment to learning and development in the field of dental practice. This event is a "must-attend" for every dental and associated professionals.

Uniquely Singapore: Where Great Things Happen

Now ranked among the world's top cities for meetings, Singapore is also a country with one of the most sophisticated dental markets. Come discover a world of unique contrasts in Singapore and sample an exciting weekend in this beautiful multi-cultural garden city.

Endorsed By:

aif
Approved International Fair

Supported By:

MINISTRY OF HEALTH

SINGAPORE EXHIBITION & CONVENTION BUREAU

Held In:

UNIQUELY Singapore
www.visitsingapore.com

International
Sharon Ng
Tel: +65 6500 6722
Fax: +65 6296 2771
s.ng@koelnmesse.com.sg

Europe
Ms Daniela Basten
Tel: +49 221 821 3267
Fax: +49 221 821 3671
d.basten@koelnmesse.de

In Cooperation With:

fdi
FDI World Dental Federation

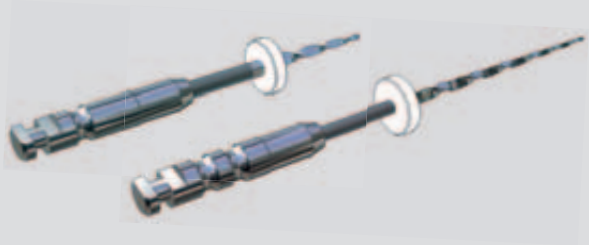
Organizers:

Singapore Dental Association

koelnmesse
we energize your business

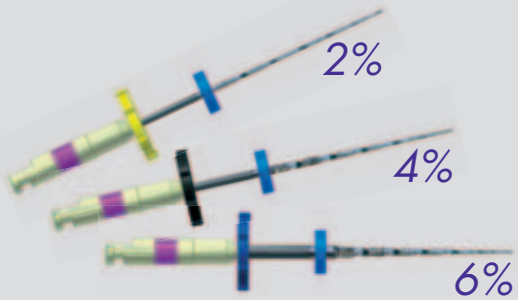
D-RaCe

Desobturation made easy



FKG RaCe ISO 10

Mechanical Glide Path

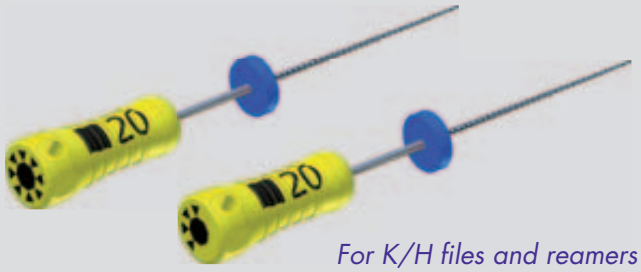


Spreader 4%

NiTi & Electro-chemical polishing

SMG handle

Indicator of uses



For K/H files and reamers

www.fkg.ch

FKG DENTAIRE
Swiss Dental Products

Crêt-du-Locle 4 • CH-2304 La Chaux-de-Fonds - Switzerland • Tél.: +41 (0)32 924 22 44 • Fax: +41 (0)32 924 22 55 • info@fkg.ch • www.fkg.ch