opinion
3-D endodontic instrumentation: Revision of a historical protocol

industry report
Strategies for the treatment of extremely curved root canals

case report
Management of referred pain
YOUR PATIENTS ARE NOT STATUES,
AND THAT’S OK.

Patient movement is the number one contributor to compromised image quality. Our new Planmeca CALM™ corrective algorithm will allow you to eliminate movement artefacts from CBCT images and succeed every time.

Find more info and your local dealer!
www.planmeca.com

Planmeca Oy, Asentajankatu 6, 00880 Helsinki, Finland. Tel. +358 20 7795 500, fax +358 20 7795 555, sales@planmeca.com
E=mc^3: Endodontics is equal to the third power of many changes

Revolutionary protocols and materials science demonstrate the evolving sophistication of modern era root canal therapy. The technological advances of the past three decades have enabled greater debridement and disinfection of the labyrinthine root canal space. Iterations of apex locators, enhanced magnification and illumination, new file designs and metallurgy provide for bio-minimalism and diminished fracture potential. The development of bio-active adherent sealers has enhanced the biologic potential of root filling. However, the sum of these innovations has not as yet produced a substantive increase in treatment outcome percentages. For years, clinicians have accepted on faith the purported marketing claims of company-supported in vitro testing. Fortunately, scientific determination of the metrics of success of product-neutral studies has replaced the possibility of experimental bias.

The most profound change in endodontics is the recognition that root canal therapy is a restoratively driven discipline. Bio-smart materials used in the root and crown do not require egregious removal of tooth structure as dictated by classical protocols. Clinicians blinded by the optics of the “artistry” of radiographic results are recognizing that this does not represent the totality of the biologic requirements of success.

The “look” academically disenfranchised the clinician from the understanding of the biomechanical dynamics of dentine and its impact on the potential for fracture. The excessive removal of tooth structure to enable treatment needs was counterintuitive to long term success and is fortunately a protocol of the past. As well, the overlooked impact of both light and heavy parafunctional loading on endodontically treated teeth is now recognized as the most important tipping point in the configuration of the restoration required.

The rigid restorative mandate of posts and cores had the propensity to cause catastrophic failure. Fortunately, reduced taper, new irrigation products have reduced the retention of greater volumes of tooth structure and the costs of new equipment. Overprepared tooth structure is not necessary in the adhesion era.

The dogma of the protocol of cleaning shaping, irrigation and “monobloc obturation” is axiomatic folly. The pendulum swings of new equipment and treatments are not necessarily best practices. The primary disease vector of pulpal and peri-radicular is biofilms and to date, the mechanism for their removal remains elusive. The work of Kishen and Shrestha on biofilm disruption by nanoparticles shows the greatest hope for elimination of recrudescent disease as a consequence of biofilm resistance intractability.

The ebbs and flows of endodontic growth, even if measured in dollops, has always have been part of the tenets of interdisciplinary dental therapeutics. The recognition that endodontics is an equal member at the table of disciplines is now assured as it has chosen to extend its involvement beyond the orifice. Endodontics is a foundational component of the state of oral health. Its outreach is now extended to a point commensurate with its potential.

Dr Kenneth S. Serota
Guest Editor
editorial

E=mc³: Endodontics is equal to the third power of many changes
Dr Kenneth S. Serota (Guest Editor)

opinion

3-D endodontic instrumentation: Revision of a historical protocol
Dr Kenneth S. Serota

industry report

Hand files are heroes in complex anatomies—A mandibular molar with seven root canals
Dr Hugo Sousa Dias

Strategies for the treatment of extremely curved root canals
Dr Bernard Bengs

Endodontic reboot: Adaptive core debridement and disinfective finishing
Drs Gilberto Debelian, Martin Trope & Kenneth S. Serota

case report

Diode laser-assisted vital pulp therapy in pulp polyp treatment
Drs Maziar Mir, Masoud Mojahedi, Jan Tunér & Masoud Shabani

Novel applications of a bioactive resin in perforations, root resorption and endodontic-periodontic lesions
Dr Marta Maciak

Management of referred pain
Drs Chady Torbay, Sara Salloum, Claudia Dib, Edgard Jabbour & Philippe Sleiman

practice management

Successful communication in your daily practice
Part V: Bad online reviews
Dr Anna Maria Yiannikos

interview

“We gain a better outcome for endodontic treatment”

manufacturer news

meetings

International Events

about the publisher

submission guidelines

international imprint
Gutta Percha Remover

- Breakthrough in Endodontic Retreatment -

Fast and effective gutta-percha removal.
Stress-free without torque control, reversal setting & requiring no solvents!

Simple steps, easily done.

Contact MANI for more information:
www.mani.co.jp/en
dental.exp@ms.mani.co.jp
3-D endodontic instrumentation: Revision of a historical protocol

Dr Kenneth S. Serota, USA

The past

The goal of the instrumentation phase of root canal therapy is to debride, disinfect and shape the root canal space prior to root filling while retaining an optimal amount of tooth structure. This is of paramount importance in the regions of peri-cervical dentine and isthmus/furcal anatomy. Historically, the significant flaws of stainless-steel files and reamers were their cutting geometry and rigidity. The technical protocol for these instruments, even Dr Schilder’s innovative envelope of motion,2 failed to correct debridement inadequacies. The root canal does not natively present in the round; Dr Schilder’s approach, while an improvement, failed to address the instrument design and technique changes required to optimise shaping and cleaning of the canal space (Figs. 1 & 2). The root shape

Fig. 1: The envelope of motion, as described by Dr Schilder, is generated by pre-curving a reamer and rotating and withdrawing the instrument during the working cycle. All the work is done on the outstroke, obviating the potential for ledge creation. Fig. 2: An axial view (cross section) of the mesial root of a mandibular molar demonstrates that the geometry of the canal space is irregular, elliptic/ovoid, but not round. (Unknown source) Fig. 3: The root shape mimics the canal shape. As such, making a round shape using the largest diameter file is clinically impractical. Using a preset taper greater than 0.04 jeopardises the integrity of the root structure.

Fig. 4: CBCT provides a z-axial image that demonstrates the number of canals present. As evident in the clinical case, the thinness of the dental isthmus housing the second mesiobuccal canal could readily have been compromised with a round file of the predetermined taper, a serious concern if only the flat film was relied upon. (Courtesy of Dr Martin Trope) Fig. 5: Micro-CT shows green (untreated canal) and red (treated portion of the canal after the use of a round file of minimum diameter). Less than 50% of the interfacial dentine was touched and debrided. (Courtesy of Dr Frank Paqué)
mimics the canal shape. Therefore, it is impossible to adequately sculpt the interfascial dentine of the canal unless the file chosen corresponds to the largest diameter of the non-round canal (Fig. 3), which can lead to weakening or perforation of the root structure. Studies assessing the planes of geometry of the root canal repeatedly demonstrate that the buccolingual diameter is greater than the mesiodistal diameter—canals are predominantly ovoid throughout the dentition, not round.

Until recently, our reliance upon flat film radiography to assess the spatial dimensions of root filling furthered the lack of appreciation for file taper sizes and flexibility fundamentals. The z-axis was hidden from view in flat film periapical radiographs; only the narrower mesial–distal dimensions of the root canal space were evidenced (Fig. 4). Faux 3-D imagery could be produced in theory by combining of angled mesial, distal and central ray radiographic projections. In 2-D, cleaning to the narrowest diameter appears adequate in post-treatment radiographs. The introduction of microcomputed tomography (µCT) and cone beam computed tomography (CBCT) has changed our understanding of the planes of geometry produced by our current treatment protocols. Mapping of the root canal space by µCT after instrumentation demonstrates that barely 50% of the canal is cleaned (Fig. 5). The idiom, “you can’t put a square peg into a round hole” suggests an endodontic idiom: you can’t put a round file into an ovoid canal and achieve the desired result.

The most under-appreciated sequela of round files is the creation of significant amounts of dentinal debris. Traditionally, the focus has been on the debris pushed through the apex during instrumentation to avoid post-treatment pain caused by periapical inflammation. The assumption that residual debris moves coronally and is flushed from the canal by irrigants is questionable. In fact, debris is pushed into the non-round parts of the canal, blocking these areas from further cleaning and disinfection by irrigation solutions and adjunctive technologies.

Additionally, when irregularities are compacted with detritus, increased pressure is exerted within the canal space with the attendant possibility of microfractures (Fig. 6). This is of critical concern with the new generation of nickel-titanium (NiTi) files, but not a factor with use of the XP-3D Shaper (Brasseler USA). The trend towards fewer files and larger tapers exacerbates this potential fracture problem.

Cognitive dissonance

The introduction of NiTi files fostered a transition to instruments that would potentially obviate the flaws inherent in the use of carbon and stainless-steel files. NiTi files are super-elastic and self-centring, and avoid ellipticisation of the apical terminus. With appropriate taper selection,
NiTi instruments should prevent thinning of the coronal and middle thirds of the root minimising thus preventing wall weakening or strip perforation. However, each generation of NiTi files, whether ground, twisted or heat-treated, shaped and cleaned far less debris than expected from the root canal space. Unfortunately, while a few systems included 0.04 tapers, the vast majority of single- or multi-tapered files have 0.06, 0.07 and 0.08 tapers. Some of the latest systems use asymmetrical rotary motion, conforming S-shaping and reciprocal motion. Unfortunately, separation of an NiTi instrument due to taper lock, cyclic fatigue and torsional resistance remains an omnipresent concern. The advantages of super-elasticity and self-centring were incalculable; however, the improvements were compromised by the persistence of round-core manufacturing (Figs. 7 & 8). The flaw in every iteration of NiTi files remains the same: the cutting geometry produces a round shape.

Inevitability of bio-minimal adaptive shaping

A new generation of adaptive/virtual core files, the XP-3D system, has dramatically changed the landscape of endodontic instrumentation. The XP-3D Shaper was designed to adapt to the anatomical shape of the canal while respecting the native framework of the root canal space without packing debris into untouched areas. The XP-3D Finisher (Brasseler USA) has a reach of at least 3mm, thereby touching even the widest canal diameters while not changing the original shape of the canal.\textsuperscript{10}

Booster Tip

The Booster Tip (BT) lead section fits into the pre-established glide path, ensuring precise guidance and centring of the instrument. A traditional glide path instrument produces a 15.02 or 10.04 size/taper.

XP-3D Shaper

To better explain the unique properties of the file, the physical characteristics of the MaxWire technology must be understood. At room temperature, the XP-3D Shaper is in the martensitic phase, enabling it to be bent and more readily placed in the canal. No more than three to five easy up-and-down strokes (swaths) of the serpentine XP-3D Shaper with the BT should result in an apical terminus shaped to a size 30 file and a canal taper of 0.02 (Figs. 10 & 11). The choice of a 0.3 mm diameter enables a 31-gauge irrigating needle to approximate the working length, preventing vapour lock. Maximum irrigation efficiency is ensured. Additionally, a shelf for seating the gutta-percha point prior to root filling is created. With an increasing number of strokes, the file has the capacity to expand from tapers...
of 0.01 to 0.02/0.04/0.06/0.08 while maintaining the flexibility of the original 0.01 taper. At body temperatures, the file attains its austenitic characteristics and attempts to achieve its potential of an 0.08 taper, a maximum that is needed in only the most unique cases.

As much healthy tissue as possible must be maintained; therefore, it is recommended that when the working length has been achieved in the first three to five strokes, an additional ten long strokes will achieve a 0.04 taper, which is sufficient to adequately disinfect the root canal space in very tight canals. In larger canals, the file will easily create larger tapers, as lesser dentinal resistance is met. As a function of its serpentine shape, light brushing and up to 30 long strokes will result in over 90% of the walls being touched in these larger non-complex canals (Figs. 12 & 13).

To summarise: the file is adaptive to the original shape of the canal; thus, the tooth shapes the canal space, in contrast to round NiTi files, where the file shapes the tooth. As shown in Figure 10, the file has a sinusoidal/serpentine shape. The space available for this shape in motion enables a light brushing technique to adapt and debride 90% or more of the walls in larger non-complex canals, which contrasts dramatically with the debris removal with round NiTi files. As previously discussed, round files will pack debris into the canal irregularities, a major drawback in sufficiently cleaning a canal. The serpentine shape, virtual core and 0.01 taper of the XP-3D Shaper enable it to adapt to the canals and ensure that debris remains in turbulent solution, ensuring its optimal removal from the canal (Fig. 14). This enables the irrigants to work maximally as the canal is shaped. Tests using photoelastic models have shown that apical pressure is not built up using the XP-3D Shaper, obviating concerns regarding microcracks. Round-core files should significant generation of apical pressure (Fig. 15).

Recently, new and costly irrigation devices have been introduced in the endodontic armamentarium as adjuncts to the traditional side-vented needle and passive ultrasonic irrigation. The EndoActivator (Dentsply Sirona), the EndoSafe Plus (Vista Dental), the Endovac Pure (apical negative pressure irrigation; Kerr) and the GentleWave (Sonendo) are all relatively new. The GentleWave sys-
tem claims to be capable of removing residual tissue, the smear layer, biofilm and bacteria from the tubules. Further scientific assessment of this device remains to be done.

XP-3D Finisher

The XP-3D Finisher is used adjunctively to the XP-3D Shaper. The Finisher’s design allows it to access and scrape untouched components of the canal walls without altering the canal shape created by the XP-3D Shaper. The file has a tip diameter of 0.25 mm with an 0.00 taper. It is extremely flexible and thus has tremendous resistance to cyclic fatigue. The spoon-shaped design of this file is created in a mould in the austenitic phase. At room temperature, the martensitic phase can be manipulated to any shape. Upon insertion into the canal, the file is heated to body temperature (35 °C), and the material seeks to revert to the austenitic phase (Fig. 17). In the austenitic phase, it forms a uniquely shaped cleaning instrument. At body temperature, the martensitic phase can be manipulated to any shape. Upon insertion into the canal, the file is heated to body temperature (35 °C), and the material seeks to revert to the austenitic phase. Without squeezing the bulb, rotation of the file produces a tip size of 3 mm. However, if the bulb is squeezed, the tip will expand to a maximum of 6 mm. The instrument cannot cut; thus, its only impact is scraping, which removes microbes up to 40 µ up the tubules (commensurate with root planing in periodontal therapy). As it is moved up and down in the canal, a vigorous agitation of the irrigants (sodium hypochlorite and EDTA) occurs, which adds to an enhanced inhibition or eradication of microflora presence from the root canal space (Figs. 18 & 19).

Retreatment

The XP-3D Finisher file has been modified for retreatment. The core is 0.03 mm in diameter with an 0.00 taper. This provides a more robust adaptation to the interfacial dentine, enhancing the removal of residual gutta-percha and debris from the irregularities (Fig. 20).

Conclusion

Preliminary studies of XP-3D files have shown remarkable removal of soft tissue, fewer residual dentinal chips in an isthmus, and bio-minimalistic shapes of the root canal space (optimal taper of 0.04), resulting in lower dentinal stress (fewer microcracks). An efficient debridement and disinfection of the apical third area is achieved by the BT and the serpentine design of the Shaper. Have we achieved the ideal fusion of technology and biology for long-term positive patient-centred treatment outcomes? Perhaps. What has been achieved is a redress of a design flaw that has persisted for much too long. This design change will bring endodontics closer to the desired objective of bio-minimal shaping that is tooth-directed. This will protect the native anatomy of the root, minimising functional stress and fracture potential.

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

about

Dr Kenneth Serota graduated with a DDS from the University of Toronto Faculty of Dentistry in Canada in 1973 and received his Certificate in Endodontics and Master of Medical Sciences from the Harvard–Forsyth Dental Center in Boston in Massachusetts in the US. Active in online education since 1998, he is the founder of the ROOTS endodontic forum and the NEXUS interdisciplinary forum. Dr Serota is an adjunct clinical instructor in the University of Toronto postdoctoral endodontics department.
My choice? All-in-one!

Endo it your way!

Find the VDW endo motor that matches your style

VDW.GOLD® RECIPROC®
Comprehensive endo motor with integrated apex locator

RECIPROC® blue
one file endo

vdw-dental.com/motor
Hand files are heroes in complex anatomies—A mandibular molar with seven root canals

Dr Hugo Sousa Dias, Portugal

Many of the difficulties in root canal therapy are due to variations in root canal morphology. A thorough knowledge of the basic root canal anatomy and its variations is necessary for successful completion of endodontic treatment.1, 2 These differences in root canal morphology influence the success of endodontic treatment and the long-term prognosis of the tooth.

In general, mandibular first molars have two roots, a mesial and distal, and usually three root canals.3 The aim of this clinical case report is to present and describe the unusual presence of seven root canals in a mandibular first molar, detected during routine endodontic therapy, and demonstrate the importance of obtaining patency.

Blocked, calcified, curved and transported canals challenge clinicians on a daily basis, and the use of hand files is crucial. It is important for the clinician to find a stiff and safe hand file that allows him or her to deal with such challenging situations.

Case report

A 35-year-old Caucasian female, with a non-contributory medical history, was referred for endodontic treatment of the mandibular right first molar with the chief complaint of severe pain for three days. The tooth was very sensitive to percussion, non-responsive to thermal
and electrical pulp tests, and showed no mobility, and periodontal probing around it was within physiological limits.

The initial radiograph showed a pulp stone in the pulp chamber and no signs of periapical pathology were observed (Fig. 1). Based on the results of clinical and radiographic examination, a diagnosis of necrotic pulp with symptomatic periapical periodontitis was made and root canal therapy recommended.

Local anaesthesia was performed, the tooth was isolated by rubber dam, the access cavity prepared and ultrasonic tip used to remove the pulp stone. Inspection of the pulp chamber revealed two mesial and two distal canal orifices. After using a DG16 endodontic explorer and surgical microscope, calcified tissue was observed between two mesial root canals and two distal root canals. With an ultrasonic tip, the overlying dentine was removed and two more canal orifices were detected in the mesial root and one more in the distal root (Fig. 2).

Initial negotiation and scouting of the root canals were carried out with size 8 and 10 K-type-file (MANI). The working length was verified using the Apex ID apex locator (Kerr Endodontics) and confirmed radiographically (Fig. 3). All of the canals were instrumented with a size 8, 10, 12 and 15 D Finder (MANI) to obtain a manual glide path using the NSK ER10 reciprocating handpiece (Fig. 4).

Cleaning and shaping were performed with rotary files up to size 25.04 in all of the root canals. Irrigation was performed throughout with 5.25 % sodium hypochlorite. A final irrigation protocol was done with 17 % EDTA and 5.25 % sodium hypochlorite, and irrigant was activated with a manual dynamic activation technique. The canals
were thoroughly dried and obturation performed using 4% gutta-percha cones (Fig. 5) and AH Plus (Dentsply Maillefer), employing the continuous wave of condensation technique with the Elements Obturation Unit (Kerr Endodontics; Figs. 6 & 7).

The pulp chamber was sealed with Ionoseal (VOCO) and a temporary restoration was performed. The patient was referred to her dentist for the permanent coronal restoration. At a follow-up visit after six months, she was asymptomatic (Fig. 8) and a post-treatment CBCT scan was performed using Veraviewepocs 3D R100 (Morita) that showed four portals of exit in the mesial root and two portals of exit in the distal root (Figs. 9–12).

**Technical points**

In order to deal with these kinds of anatomical variations and avoid procedural errors, the practitioner should observe the following points:

- An accurate inspection of the pulp floor yields important information, and the practitioner needs to be attentive when removing the pulp stone (the use of ultrasonic tips is safer).
- The use of magnification and powerful illumination is considered to be of key importance in this stage because it allows the practitioner to see all colour changes in the pulp floor.
- The initial root canal exploration should be performed with pre-curved small files (size 8 and 10) without any apical pressure.
- Before using any rotary file, it is important to create a manual glide path with hand instruments.
- During glide path creation, it is important to use intermediate size files (size 12) in order to reduce the percentual increase of tip size between 10 and 15 hand files.
- The practitioner must never push, peck or force any file inward and must provide constant irrigation between each file.

The reciprocating handpiece allows the practitioner to achieve an effective manual glide path with D Finder files. First of all, the hand files are always used until patency is achieved, and only after that are they connected to the reciprocating handpiece and used in an up-and-down motion (1 mm) until the file feels loose in the root canal. To preserve the root canal anatomy, avoid root canal transportation, strip perforation or another error, we decided to finish our preparation with a 4% taper.

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

about

**Dr Hugo Sousa Dias** graduated with a DDS from University Fernando Pessoa in Porto in Portugal in 2008 and completed the postgraduate programme in endodontics at the University of Lisbon in Portugal in 2015. Besides running a practice limited to endodontics in Porto, he is Director of the Master in Endodontics clinical residency programme at Foramen Dental Education in Porto. Dr Dias is the founder of the Portuguese Group for Endodontic Study (study club) and a member of the European Society of Endodontology and the Sociedade Portuguesa de Endodontologia [Portuguese endodontic society]. He has given more than 20 lectures around the world and is co-author of a chapter in the book *The Root Canal Anatomy in Permanent Dentition* (Springer, 2018).
THE NEW NITI FILE GENERATION

**HyFlex™ CM & EDM**
Stays on track

- Safer use
- Preparation following the anatomy
- Regeneration for reuse

**THE NEW NiTi FILE GENERATION**

**GuttaFlow® bioseal**
Double safety level

- Cost efficient root filling
- Excellent flow properties even at room temperature
- Fast working, fast curing, safe sealing (about 12-16 minutes)

**Step 1 (direct protection)**
Protection already at filling, e.g. with bioactivity due to possible residual moisture in the root canal

**Step 2 (sleeping protection)**
Regenerative protection against possible moisture ingress, e.g. by cracks

info.de@coltene.com | www.coltene.com
One of the major challenges in endodontics is the enormous complexity of root canals. Among other things, a large number of difficulties must be overcome in terms of the number, position, possible branches and curvatures of the canals. Case studies are used to demonstrate how predictable treatment results can be achieved in adverse anatomies too.

The aim of root canal preparation is the complete removal of all vital and necrotic tissue, infected canal wall dentine, foreign matter and root filling material. Adequate chemical disinfection should be made possible and shaping should allow wall-to-wall obturation of the canal system. As early as 1974, Herbert Schilder published guidelines on this topic, which have virtually remained unchanged, including the creation of a continuously conical canal shape from the access cavity to the apex, respecting the course of the root canal and maintaining the position of the apical foramen at a size as small as practicable.1

In the presence of very pronounced curvatures, especially abrupt or even S-shaped (i.e. double) curvatures, it can prove extremely difficult to implement these

---

**Fig. 1:** Pre-op radiograph of tooth #25. **Fig. 2:** Trepanation. **Fig. 3:** The untwisted PathFile after use in the canal.

**Fig. 4:** Radiographic measurement. **Fig. 5:** The HyFlex CM file sequence.
guidelines. The angle of curvature is not the only factor here; the length of the distance after the curvature is also decisive for the demands on the instruments. As the degree of difficulty increases, the risk of step formation, splinting and instrument fracture quite naturally increases.

Treatment planning

Initial information is provided by the preoperative radiographic image. In complex anatomies, such as those that often occur in the posterior region, a CBCT scan provides valuable information on 3-D curvatures and the confluence of canals. This information is extremely important for treatment planning, as it allows the clinician to determine a strategy regarding the instruments to be used and canal preparation in advance. For example, very narrow, strongly curved roots should, if applicable, be prepared with a smaller ISO size or a slimmer taper, since even very flexible nickel-titanium (NiTi) file systems become significantly stiffer with increasing dimensions, which entails unwanted transportation or even strip perforations as risks. Each case should be considered individually to allow sufficient removal of infected tissue without risking unwanted excessive removal of dentine.

In vital cases, the size of the preparation may be more moderate than in cases of pulp necroses or revisions, as less removal of dentine will be required here. Ultimately, of course, the treatment size should be determined by apical gauging (apical measurement). As this is only practicable to a limited extent in the case of very extreme, even opposing curvatures, even more attention should be paid to tactile feedback during instrumental canal preparation. Sufficient preparation is always required for root canal irrigation and subsequent obturation so that a shape of at least size 30.04, or better of size 30.06 or 35.06 (rarely larger in the case of strong curvatures), which is usually required in extreme cases, must be prepared manually using the step-back technique. Otherwise, it will not be possible to achieve sufficient disinfection and filling of the root canal.

Notes on preparation

The preparation of an optimal primary and secondary access cavity is extremely important, particularly in the case of strong curvatures. Therefore, a most straight-line access to the canal system is very important, as otherwise steps or blockages are created right at the beginning of treatment that can only be corrected with great difficulty.

First, the course of the canal should be probed with an ISO size 6, 8 or 10 scouting file, if necessary, after coronal pre-flaring with an orifice shaper or Gates–Glidden drill. Irrespective of the file system used, the preparation of a glide path is essential for safe canal preparation. Particularly in the case of strongly curved, narrow canals, the use of rotary NiTi glide path files is not only less prone to complications than with manual instruments, but also

![Fig. 6: The master point image.](image)

![Fig. 7 & 8: Root canal filling and check of tooth #25.](image)
more comfortable. The gliding space created allows a significantly lower-risk use of the following rotary NiTi files for canal preparation.\(^3\)

The point of confluence of canals represents a special case of curvature, as this often occurs particularly abruptly. It, therefore, makes sense, for example in the case of two canals in the mesial root of a mandibular first molar, to initially prepare only one canal fully to its working length. This will often be the mesiolingual canal. To determine the confluence, a gutta-percha point is then positioned in the prepared canal and a Kerr file is inserted into the other canal. The marking of the instrument tip in the gutta-percha point determines the length up to which the second canal must now be prepared. This avoids risky stressing of the instruments, as well as the unnecessary removal of dentine. Furthermore, the chemical preparation of the canal system is an indispensable part of the preparation, since only part of the canal wall surface is addressed during mechanical preparation.

Case 1: Pulp necrosis in an S-shaped canal

In November 2013, a 46-year-old emergency patient with acute symptoms of tooth #25 presented. The tooth had been restored with a ceramic inlay, the sensitivity test for cold was negative, and the tooth was sensitive to percussion and pressure. The preoperative radiograph revealed periapical periodontitis (Fig. 1). The diagnosis was pulp necrosis after a previous preparation close to the pulp. The inlay was removed and an adhesive pre-endodontic build-up was fabricated from composite. During trepanation, pus drained from the canal entrances. Working length was then determined, followed by initial preparation with Kerr files up to only ISO size 8, for time reasons, together with intermittent irrigation with heated 6% sodium hypochlorite (NaOCl). Subsequently, a drug deposit was inserted by rotating in Ledermix. Owing to the small preparation size, the use of calcium hydroxide would only have been possible to a limited extent.

Root canal therapy was continued approximately six weeks later: after anaesthesia and placement of a rub-
ber dam, tooth #25 was trepanned under the microscope (Fig. 2). The glide path was first prepared manually with C+ Files of ISO sizes 6 and 8 (Dentsply Maillefer), then mechanically with PathFiles of size 13, 16 and 19 (Dentsply Maillefer). The more flexible HyFlex Glidepath files (COLTENE) were not yet available at the time of treatment. A detailed image of the brand-new PathFile illustrated how extremely the S-shaped canal configuration had stressed the rotary NiTi instruments after a single use (Fig. 3). It depicted the plastic deformation of the instrument, a clear indication that this instrument could only withstand the requirements with good fortune. A fractured instrument would certainly have been within the realms of possibility.

After radiographic confirmation of the working length, the canals were prepared with the HyFlex CM (controlled memory) NiTi files (COLTENE; Figs. 4 & 5). The following sequence was used: 15.04, 20.04, 20.06, 25.04, 25.06, 30.04 and 30.06. Intermittent irrigation was again performed with heated 6% NaOCl.

After apical gauging, the final preparation was performed in steps of 0.5 mm from ISO size 35 to ISO size 60 using manual NiTi Kerr files in the step-back technique for safety reasons. Thus, a cone of ten was created in the apical region. Although possible in principle, the use of a 35.06 HyFlex CM was deliberately abstained from, as while these instruments offer high flexibility in general, the stiffness might still have been too great for the S-shaped course of the canals. Finally, irrigation was performed with a 17% EDTA solution and 6% NaOCl, activating the irrigation liquids by ultrasound.

After the master point try-in with configured gutta-percha points, warm vertical root canal filling was performed using the modified Schilder technique (Figs. 6–8). The tooth was sealed adhesively with composite and a glass-fibre pin (Fig. 9). Postoperative radiographs after one year and 4.5 years, respectively, showed the complete healing of the extensive osteolysis (Figs. 10 & 11).

Case 2: Pulpitis aperta of tooth #37
A 46-year-old patient presented with pulpitis complaints regarding tooth #37 in October 2013. The tooth had been restored with a partial gold crown, and the marginal seal was incomplete (Fig. 12). After local anaesthesia, the restoration and the cement build-up were removed. Underneath was the opening of the pulp chamber (Fig. 13). The diagnosis was pulpitis aperta. First, an adhesive, pre-endodontic composite abutment was created under rubber dam isolation. At the same time, the coronal pulp was removed during trepanation of the pulp chamber (Fig. 14). As pain treatment, Ledermix was applied as a drug owing to the time limitation, and the tooth was closed adhesively with composite.

Further treatment was performed in one visit in December 2013. After local anaesthesia, the drug was removed and the course of the canal was probed with C+ Files of ISO sizes 6, 8 and 10 under control of an endodontic motor. The radiographic confirmation of the working length showed a pronounced, abrupt curvature of
the canals in the apical third of the mesial root (Fig. 15).
The glide path was prepared with PathFiles of sizes 13, 16 and 19, then expanded with ProTaper hand files S1 and S2 (Dentsply Maillefer), which were prebent with the Endo-Bender (Kerr). Rotary preparation was performed with the HyFlex CM.

In this case, the following sequence was used with ascending sizes and tapers: 15.04, 20.04, 20.06, 25.06, 30.04, 30.06 and 35.06. The path of the canal was manually expanded intermittently with prebent ProTaper hand instruments F1 to F3 and then perfectly shaped with the corresponding rotary HyFlex files, as the instruments were stopped in the mesial root by the speed limiter of the endodontic motor owing to the extreme curvature. The entire preparation was performed under intensive irrigation with heated 6% NaOCl. In addition, an ultrasound-activated final irrigation with 17% EDTA and NaOCl was performed three times for 20 seconds. After the master point try-in, the root canal was obturated vertically with warm gutta-percha using the modified Schilder technique (Figs. 16–18). Tooth #37 was sealed adhesively with a glass-fibre pin and composite (Fig. 19). Postoperative radiographic control after one year and approximately 4.5 years showed continued uneventful apical conditions (Figs. 20 & 21).

Discussion

These cases demonstrate that the safe preparation of even extreme curvatures is predictable owing to the use of highly flexible instruments such as the HyFlex CM.
Meanwhile, additional instruments have become available in sizes 15.01, 15.02 and 20.02, as has HyFlex EDM size 10.05, which are superior to the files used at the time in terms of material properties and thus offer greater safety in difficult cases (Figs. 22 & 23). Furthermore, it can be seen that hybridisation with manual instruments can be helpful or even necessary to minimise the risk of fracture and to control abrupt curvatures. The file sequences used are of course material-intensive, especially since the files were discarded after use in each patient case. This procedure is costly, but offers the best possible safety to avoid cross-contamination and instrument fracture.

Conclusion

The postoperative radiographic checks after several years proved that even very complex anatomies can nowadays be treated safely, predictably and sustainably with suitable instruments. For the patient, this implies the long-term preservation of the natural dentition, even in challenging cases.

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

contact

Dr Bernard Bengs is a specialist in endodontics certified by the German Society of Endodontology and Traumatology.

Vosstraße 1, 10785 Berlin, Germany

Dr.bengs@gmx.de

Fig. 22

Fig. 23

Figs. 22 & 23: HyFlex Glidepath files and HyFlex EDM 10.05 Glidepath file.
Fifty years ago, Dr Herbert B. Schilder introduced two legacy concepts to the science of endodontics: the constricted envelope of motion for instrumentation and the use of hydraulics to enhance the rheology of the obturation material used to seal the root canal space and optimize its gravitometrics. These were radical innovations for their time and despite technological and biological shortcomings of the armamentarium available, these innovations should have been technology-iterated and shortcomings in material and manufacturing evolution obviated; however, until recently that has not proved to be the case in toto. In order to truly understand the inherent flaws, the clinician must recognize the totality of what is necessary to engender predictable clinical success in endodontics.

Endodontic reboot: Adaptive core debridement and disinfective finishing

Drs Gilberto Debelian, Norway; Martin Trope & Kenneth Serota, USA

Fig. 1a: This axial view of a mandibular molar demonstrates the ovoid eccentricity of the canals and existence of an isthmus connection between the mesiobuccal and mesiolingual canals consistent with findings of numerous studies.¹⁻⁴ Fig. 1b: The root canal space is an arborizational, anastomotic, labyrinthine complexity, morphologically comparable to the pathways of a maze. While primary canals exist, the tributaries, accessory branches and lumina of the dentinal tubules harbor extensive tissue and microflora. The existence of these vast, capacious passages has been demonstrated throughout the past century, beginning with the work of Hess and continues to this day with the use of microcomputed tomography.¹² Figs. 2a & b: The axial view of the obturation (microstructural replication) demonstrates the flaw in flat field film interpretation. Significant areas of the buccolingual dimensions of the root canal space remained uncleared despite the illusory appearance in the radiograph.

Fig. 3: Dr Herbert B. Schilder’s principles included a continuously tapering shape, maintenance of the original anatomy, an apex as small as practical, and conservation of tooth structure. A continuously tapering space was acquired using precurved hand instruments, which imposed discontinuous contact with the canal walls and created an envelope of motion. Transactionally, Schilder created a virtual core. Fig. 4: The ideal file would produce an apical size that three-dimensionally cleaned the minor apical foramen. The SAF is a hollow file designed as an elastically compressible, thin-walled pointed cylinder that is composed of a NiTi lattice. Its hollow shape allows for the continuous flow of irrigant through its lumen. It was a beginning in the paradigm shift toward minimally invasive 3-D debridement and disinfection.
The evolution of nickel-titanium (NiTi) instrumentation manufacture has persisted with a round core blank, regardless of whether it was ground, twisted, nanocoated, heated or metallurgically reformulated. NiTi files are superelastic and able to self-center, avoid apical ellipticisation and, with appropriate taper selection, prevent thinning of the coronal and middle thirds of the root, resulting in weakening or strip perforation. They are, however, unable to cleanse most of the intracanal space effectively (Fig. 3). Moreover, regardless of design configurations with a variable tip or variable taper or multiple tapers on a single file, they were unable to adequately cleanse the isthmus confluence of many canals. A revolutionary design in file configuration, the Self-Adjusting File (SAF) System (ReDent NOVA) was introduced to correct this deficiency by including a virtual core (Fig. 4). It showed significant promise in terms of the degree of debris removal in complicated intracanal anatomy such as the isthmus when compared with the widely accepted ProTaper system (Dentsply Maillefer, Switzerland); however, it failed to take hold as a true replacement for traditional “round” rotary instrumentation systems.

The manipulation of the metallurgical properties of NiTi by thermomechanical processing treatments has led to significant improvement on the clinical performance of the endodontic rotary files. The transition from the martensitic phase (soft phase) to the austenitic phase (stiff phase) is dependent on temperature and metal stress. The reversible transition between these two phases increase the safety and performance of these files during rotation. Unfortunately, fracture still occurs due to cyclic fatigue and torsional failure when the elastic limit is exceeded (Fig. 5a).

The new generation of NiTi alloys have transformation temperatures much higher than those of conventional austenitic materials used in previous generations of rotary instruments and will transform at close to body temperature. A recent study of ProTaper Universal, HyFlex CM, TRUShape and Vortex Blue showed that a temperature increase to 37 °C, simulating body tempera-

Fig. 5a: The revolution in endodontic instrumentation imparted by the first generation of NiTi instruments related to their shape memory and superelasticity. Despite the advantages, these files were susceptible to fracture due to fatigue and torsional failure. Fig. 5b: Heat treatment (thermal processing) is one of the most fundamental approaches to adjusting the transition temperatures of NiTi alloys and affecting the fatigue resistance of NiTi endodontic files. Newer alloys (e.g., MaxWire) transforming close to body temperature have demonstrated superior resistance to cyclic fatigue and torsional failure. Fig. 6: An overview of the unique features of the XP-endo Shaper are demonstrated. The discontinuous adaptive debridement motion kinesis mimics Schilder’s envelope of motion exactly.

Fig. 7a: A traditional NiTi file from a round blank is represented in red and XP-endo Shaper in blue. The sinusoidal motion of the XP-endo Shaper in contrast to the round file, which augers, demonstrates the benefit of adaptive debridement. In conjunction with the XP-endo Finisher, unprecedented levels of debris removal and disinfection are possible. Fig. 7b: Minimally invasive endodontics, preservation of coronal dentinal girth and optimal apical size. (Courtesy of Dr. G. Debelian)
ture, substantially decreased the fracture resistance of all instruments tested. MaxWire (Martensite-Austenite electropolish-fleX), while not included in this study, is analogous to Vortex Blue. The temperature effect on the latest generation of NiTi files is shown in Figure 5b.

A new generation of adaptive/virtual core files, the XP-endo system (FKG Dentaire, Switzerland) has dramatically changed the view of endodontic instrumentation. In the absence of a solid core, this system allows the tooth to dictate the canal configuration achievable and allows cleaning of the canal with a degree of thoroughness that is unprecedented. Figure 7 details various features of the XP-endo Shaper. The Booster Tip lead section fits into the pre-established glide path, ensuring precise guidance and centering of the instrument. A traditional glide path instrument is used consistent with a #15/0.02 (size/taper) instrument. There are no cutting flutes on the lead section of the Booster Tip, and the XP-endo Shaper instrument slips into the prepared apical component of the glide path to a depth of 0.25 mm. The next 0.25 mm section of the Booster Tip is configured with six cutting flutes. Rotation of these flutes sizes the next 0.25 mm of the canal space anywhere from a #25/0.02 to #60/0.02 (size/taper) instrument; however, the apical size chosen for the XP-endo Shaper is #30. The taper of the XP-endo Shaper is 0.01; however, the MaxWire alloy of the Shaper enables the martensitic shape at room temperature to realise the memorised shape as illustrated at body temperature (Fig. 6). By repeated swaths (a motion analogous to whittling in contrast to pecking) of the file, the taper created ranges anywhere from 0.02 to 0.08. The ideal intracanal taper throughout is 0.04, which preserves

---

**Fig. 8a:** Photoelasticity is an experimental technique for stress and strain analysis useful for conditions of complicated geometry or loading. As evidenced by the accompanying images, the XP-endo Shaper demonstrates the least stress in the apical third. **Fig. 8b:** ProTaper NEXT was the first example of an attempt to migrate away from the augering peck and pull motion of most NiTi files. Its swaggering motion was an improvement with regard to emulating the constricted envelope of motion; however, its foundation remained a round blank with all the attendant issues related to cyclic fatigue and torsional failure.

---

**Fig. 9a:** The apical 10 mm of the file transforms into a bulb more coronally and a tip in the last few millimetres. When rotating at canal temperature, the XP-endo Finisher exhibits a total expansion of 3 mm. **Fig. 9b:** The XP-endo Finisher is placed in the canal in the martensitic phase. When in the canal, body temperature transforms it to the austenitic phase. Moved up and down in 7–8 mm increments, the natural shape of the canal expands or constricts the tip or the bulb and disrupts debris, tissue or biofilm, which is removed by the turbulence of the irrigant.
dentinal girth in the coronal third and sustains maximal
dentinal retention in any root curvature. Figure 7a demon-
strates the difference between the ability of a standard
round NiTi file to clear a less than ideal volume of intra-
canal debris in contrast to the more significant maximal
debridement achieved by the XP-endo Shaper’s adap-
tive discontinuous contact of the canal walls. The desired
minimally invasive shape achieved with this unique instru-
ment is shown in Figure 7b.

The distinctions of greatest importance between the
XP-endo Shaper and conventional NiTi instruments are
as follows: The Shaper does not compact debris on the
flutes, resulting in increased frictional resistance, as it pro-
vides substantial space in the lumen of the virtual core;
nor does it force the debris apically as evidenced in instru-
ments used with reciprocating motion.11 As the points of
contact on the dentinal walls are discontinuous, less stress
is applied and thus less cyclic fatigue created than with
conventional instruments,12 which can be readily demon-
strated in photoelastic testing models (Fig. 8a). Figure 8b
demonstrates that efforts have been made with other file
systems to emulate the uniqueness of the adaptive core
design of the XP-endo Shaper; however, regardless of the
design alterations, a solid round core remains.

Inhibition or eradication of microflora presence from
the root canal spaces is a multifactorial conundrum. The
bulk of the microbes reside in the primary canal in a plank-
tonic/loose form; however, there is a vast network of lab-
ynthine irregularities acting as a microbial reservoir that
communicate with the primary canal. While irrigation with
disinfectants may be very effective against planktonic mi-
crobes, it is not sufficiently effective when the microbes
are in biofilm form or in canal irregularities. The ability of
organisms within the residual biofilms to create an adap-
tive mechanism to the environmental changes resulting
from the treatment protocol can result in recrudescence
of the pathosis.13 The biofilm must be eliminated before
the disinfectants will work. This is analogous to scaling
and root planning in periodontal therapy.

As already mentioned, most files produce a final round
shape on any given canal cross section and as such the
practitioner is limited in the capacity to scrape the walls
of the nonround root canal space; at best, a round file
can brush the walls to facilitate an enhanced disinfection.
Alternative methods must be applied to remove toxins
unreachable by traditional files.

The XP-endo Finisher was designed to be adjunctive
to the XP-endo Shaper. The Finisher has many proper-
ties that allow it to gain access and scrape untouched
components of the canal walls, and the turbulence it
produces in the canal irrigant enhances its antimicrobial
properties. The file has a .025 tip diameter with a .001
taper. It is extremely flexible and thus has tremendous
resistance to cyclic fatigue. Its primary action within the
root canal is to scrape the walls that it contacts rather
than debride and sculpt a shape into the wall of the canal.

When the file is cooled below 35 °C, it is in the mar-
tensitic phase. It can be bent to any other shape when in
this phase. When the file is heated to body temperature
(37 °C), it will change to the austenitic phase. When the
file is rotated in the austenitic phase, it creates a uniquely
resistant to cyclic fatigue.
shaped cleaning instrument: The apical 10 mm of the file transforms into a bulb shape coronally while retaining a tip in the last few millimetres. Since the depth of the spoon is 1.5 mm, the total diameter of the bulb and tip is 3.0 mm. However, if the bulb is squeezed, the tip will expand to a maximum of 6 mm; if the tip is squeezed, the bulb will likewise expand to a #300 file (Fig. 9a); however, since the instrument cannot cut, the only impact on the dentine is optimised scraping. Therefore, if moved up and down in the canal, the bulb and tip will expand or contract in concert with the natural 3-D diameter of the canal. Maximum loss of length when transforming from straight to full austenitic phase is 1 mm.

The small core diameter of the file maintains its flexibility and cyclic fatigue resistance, causing it to scrape, not shape, the dentinal walls. This, plus the turbulence that is created in the irrigant, results in a large surface area of the canal being touched by the file and removal of biofilm that would never be removed by round files.

Figure 9b shows the action of the XP-endo Finisher. In the martensitic phase, the Finisher is placed in the canal before it changes to full austenitic phase. The middle illustration demonstrates full austenitic phase at canal temperature; the file will expand to the extent that is determined by the canal anatomy. By moving the Finisher up and down in a 7–8 mm swath, it expands and contracts according to the anatomy of the canal. A recent study demonstrated the efficacy of the Finisher in comparison with traditional modes regarding hard-tissue debris removal; the results are reflected in Figure 10. A more recent study showed that the Finisher had the greatest bacterial reduction compared with standard needle irrigation, sonic agitation with the EndoActivator and PIPS (photon induced photoacoustic streaming).

Figure 11 is an example of the unique action of the Finisher. The irregularity in the canal is in the mesiodistal dimension owing to internal resorption. The Finisher enabled removal of debris and tissue in the irregularity while retaining the original shape of the canal and preventing further weakening of the root.

There is a third file in the XP-endo system, the XP-endo Finisher R designed for retreatments. This file is a #30/0.00 making it slightly stiffer and more efficient in removing root filling material adhering to the canal walls, especially in the curvature or oval areas. The residual amount of filling material when a tooth is retreated is difficult to calculate; however, studies using histological evaluation of teeth with post-treatment periapical periodontitis show evidence that bacterial colonisation is associated with the canal remnants. A new supplementary strategy using a finishing instrument was evaluated for its ability to improve filling material removal in a recent study, and the results showed substantial reduction in residual contents when the Mtwo system and RECIPROC system were used for retreatment. The results using the XP-endo Finisher R instrument were encouraging because the remaining filling volume showed a 69% reduction in volume contents. In canals with residual filling material, an adjunctive approach with the XP-endo Finisher R instrument significantly enhanced removal (Fig. 12).16

Conclusion

Preliminary studies on XP-endo files have shown remarkable removal of soft tissue, fewer dentinal chips residual in the isthmus and canal walls after instrumentation, and low dentinal stress (fewer microcracks). The minimally invasive conservative instrumentation engenders a low amount of dentine removal coronally and efficient debridement and disinfection of the apical third area. Have we achieved the ideal fusion of technology and biology for long-term positive treatment outcomes? Perhaps. What has been achieved is a redress of a design flaw that has persisted for much too long.

Editorial note: This article first appeared in May 2017 in the Dentaltown magazine.

A list of references is available from the publisher.

about

Dr Gilberto Debelian is an adjunct visiting professor in the postgraduate programme in endodontics at the University of Pennsylvania, US. In addition, he maintains a private specialist endodontic practice in Bekkestua, Norway.
– education everywhere and anytime
– live and interactive webinars
– more than 1,000 archived courses
– a focused discussion forum
– free membership
– no travel costs
– no time away from the practice
– interaction with colleagues and experts across the globe
– a growing database of scientific articles and case reports
– ADA CERP-recognized credit administration

Join the largest educational network in dentistry!
Diode laser-assisted vital pulp therapy in pulp polyp treatment

Drs Maziar Mir, Germany; Masoud Mojahedi, Germany; Jan Tunér, Sweden & Masoud Shabani, Iran

A pulp polyp or hyperplastic pulpitis is inflammation of the exposed dental pulp owing to an open cavitated carious lesion, tooth fracture after trauma or long-standing fractured restoration. Type I hypersensitivity reactions may also have a role in pathogenesis of pulp polyps because of the higher concentration of histamine, immunoglobulin E and interleukin in primary or permanent teeth. Removal of the polyp, pulpectomy and root canal therapy are considered for treatment of this disease.

Internal root resorption and a periapical lesion (apical periodontitis) can often be seen in a tooth affected by a pulp polyp. The former indicates chronic inflammation with odontoclastic activity, and the latter expresses severely inflamed pulps, for example irreversible pulpitis or an infected root canal system. A pulp polyp is referred to as asymptomatic irreversible pulpitis.

Recently, vital pulp therapy (VPT) has proven to be a successful treatment for molars with irreversible pulpitis associated with apical periodontitis. Based on many effective diode laser properties, diode laser-assisted VPT has shown to be a powerful method for VPT.

This article aims to present successful results obtained by diode laser-assisted VPT in a case of pulp polyp disease, applied in permanent mandibular molars using calcium-enriched mixture (CEM) cement. One tooth also showed internal root resorption and periapical periodontitis and the other was not.

Case presentation

A 17-year-old male patient with complaints of deep caries and an exophytic mass at a right mandibular permanent molar was referred to us for treatment (Figs. 1a & b).

Medical history

The patient’s medical history showed no systemic medical problems, no allergic reaction, no use of medications or recreational drugs and no history of past surgical procedures. Thus, the patient did not need to be referred for medical consultation.

Dental history

Oral and maxillofacial examination of the patient revealed no temporomandibular joint disorder or myofascial disturbances, no functional or parafunctional habits, a Class I occlusion and poor oral hygiene.

Clinical findings

In the oral examination process, the exophytic mass was found to interfere with eating and occlusion, causing intermittent pain and simultaneous bleeding.

Diagnosis

The radiographic examination showed internal root resorption at the middle third and a periapical lesion at the end of the mesial root of the first molar, as well as large dental carious lesions in the first and second right molars of the mandible (Fig. 2). The patient was thus diagnosed with a pulp polyp.

Laser-assisted VPT in the treatment of a pulp polyp

After the patient had completed the consent form, the operation area was anaesthetised through blocking of the inferior mandibular alveolar nerve with 2% lidocaine (1:80,000 adrenaline; 1.8 ml; Darou Pakhsh Pharmaceutical).

In the next step, the controlled area was defined and laser warning signs were properly placed in order to secure the operating room. The eye protection of the patient, the patient’s guardian and the assistant were checked.

After reviewing the patient’s information (examination sheet and radiograph, consent form, etc.), mouth rinsing was done with a 0.2% chlorhexidine oral rinse (Shahre Daru Laboratories) for about one minute.

The pulp polyp was removed with a high-power diode laser (Gigaa Laser) and the canal orifices were cleaned with a cotton pellet soaked in normal saline for five minutes, followed by low-level diode laser irradiation.

The laser parameters applied for the pulp polyp removal were as follows: wavelength of 980 nm, power of 1.2 W, fibre of 400 µ, initiated fibre, continuous wave and
contact mode. After completing this procedure, Low Level Laser Therapy (LLLT) was performed (Figs. 3a & b). The laser parameters for bio-modulation intentions were the following: wavelength of 980 nm, output power of 300 mW, irradiation time of 10 s and energy of 3 J. The size of the laser aperture was 7 mm² and irradiation was performed in a rotational mode at a distance of 5 mm. The area of the canal orifice was 13 mm².

After this procedure, the CEM cement dressing was placed (Fig. 4a). The CEM cement dressing was done on a base of 2 mm of CEM cement paste (Biunique Dent) prepared according to the manufacturer’s instructions using a sterile plastic instrument. A dry sterile cotton pellet was used to achieve better adaptation of the CEM cement to the cavity wall at the exposure site.

Interim restorative treatment with a glass ionomer cement (Fuji IX, GC Europe) was applied according to the manufacturer’s instructions without finger pressure after CEM cement placement (Fig. 4b). We decided to place the permanent filling after one month.

Post-procedural education
The patient was advised to respect oral hygiene according to the Caries Management by Risk Assessment requirements, and the next visit was scheduled for two days after the VPT procedure.

Final result
Excellent pulp polyp removal was achieved and the VPT was carried out with no bleeding, carbonisation or char. The patient did not experience any discom-
Fort and was satisfied with the result. Radiographic examination was performed in order to monitor the result of the laser-assisted pulpotomy based on radiographic changes (Fig. 5).

**Follow-up**

The first visit after treatment was scheduled for two days after the procedure. No pain was experienced and the second LLLT was performed with the same setting, but in contact mode at the coronal part, the mid-root part and the apical part of each root of the two affected molars in order to promote the healing process. The next visit was again scheduled for two days later in order to perform the third LLLT.

Finally, at the follow-up appointment at seven months, a successful treatment outcome was observed clinically and the patient experienced no pain. The good results were also evident in the radiographic examination (Fig. 6). A successful treatment outcome could be observed, the periradicular radiolucency had disappeared and the internal root resorption of the mesial root of the first molar had stopped.

**Discussion**

Diode lasers are used extensively in many dental practices.\(^\text{15}\) Laser–tissue interaction with a high-power diode laser is based on photothermal effects and in LLLT is not photothermal, but works based on a photochemical mechanism.\(^\text{11, 12}\) Since LLLT is dose-dependent,\(^\text{33}\) the laser parameters have to be respected carefully.\(^\text{14, 15}\) The precise molecular mechanisms for LLLT are not entirely clear, but its clinical effects on pain control, inflammation reduction and wound healing are well investigated.\(^\text{15–18}\) Gupta et al. reported that laser pulpotomy with high-power diode lasers showed better clinical and radiographic results in human primary molars than did electrosurgery and ferric sulphate pulpotomy in order to achieve good coagulation.\(^\text{19}\) Uloopi et al. have applied low-level diode lasers in pulpotomy and they noted that Low Level Laser Therapy can be considered for pulpotomy in primary teeth, its success being comparable to mineral trioxide aggregate pulpotomy technique.\(^\text{20}\)

**Conclusion**

It is clear that the aim of diode laser application in pulpotomy can be very different. In this case, a high-power diode laser was applied for pulp polyp removal and good coagulation, and LLLT was used to promote the healing process. Based on the laser protocol applied in this study, diode lasers can be successfully used for VPT of pulp polyps.

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

**contact**

Dr Masoud Shabani  
Department of Community Dentistry  
School of Dentistry  
Ardabil University of Medical Sciences  
Ardabil, Iran  
m.shabani@arums.ac.ir
Sign up to the finest e-read in dentistry
Novel applications of a bioactive resin in perforations, root resorption and endodontic-periodontic lesions

Dr Marta Maciak, Poland

Introduction

During the last decade, a considerable amount of attention has been directed towards the development of so-called bioactive materials. To understand this phenomenon better and to avoid misinterpretation, a condensed review of the literature and an assessment of various definitions need to be considered.

Bioactivity has been defined and can be interpreted in various ways. A broad definition that has several meanings is the following: a material that is able to have a biological effect or a material that is biologically active and forms a bond between the tissue and the material. In the field of tissue engineering, the term “bioactivity” is related to the cellular effects induced by the release of biologically active substances and ions from the biomaterial, for example from bioactive glasses both in soft- and hard-tissue engineering applications. In addition, its activity

There are already several commercially available dental materials that can be defined as bioactive. For instance, any fluoride-releasing material, calcium silicate- and calcium aluminate-based cements, and calcium-based or calcium-containing materials. Biomaterial scientists in the field of implantology have adopted the word “bioactive” to mean materials that are bound to each other through a biomineralised interface. There appears to be confusion within the dental profession, including among scientists, clinicians and industry persons, to what extent biomineralisation can be achieved with dental materials and which materials can be appropriately termed “bioactive” or “biomineralising”.

Bioactivity has been defined and can be interpreted in various ways. A broad definition that has several meanings is the following: a material that is able to have a biological effect or a material that is biologically active and forms a bond between the tissue and the material. In the field of tissue engineering, the term “bioactivity” is related to the cellular effects induced by the release of biologically active substances and ions from the biomaterial, for example from bioactive glasses both in soft- and hard-tissue engineering applications. In addition, its activity...
has been demonstrated in pulp capping experiments in non-human primates.\(^5\)

Thus, in medicine, bioactivity covers all interaction of materials with living cells and tissue, including the effects of pharmaceuticals. In biomaterial science, with bioceramics and bioactive glasses, bioactivity of a material usually denotes that the material is capable of forming hydroxyapatite minerals on its surface \textit{in vitro} and \textit{in vivo}.\(^6\)

The following theoretical question should be asked: can a material that releases ions for biomineralisation be considered bioactive or is the substrate on which the biomineralisation occurs bioactive? Thus, bioactivity of dental materials relates to their potential to induce specific and intentional mineral attachment to the dentine substrate.\(^7\)

Another definition has been presented in an article by Lööf et al.: “Bioactivity of a ceramic material is a surface property that provides a bond between the material and living tissues without fibrous encapsulation.”\(^8\) In yet another definition, bioactivity is described as follows: “A bioactive material is one that forms a surface layer of an apatite-like material in the presence of an inorganic phosphate solution.”\(^9\)

ACTIVA BioACTIVE-RESTORATIVE and ACTIVA BioACTIVE-BASE/LINER (Pulpdent) have been shown to exhibit bioactive properties based on this last definition. ACTIVA BioACTIVE products are the first dental resins with a bioactive ionic resin matrix. They have a shock-absorbing rubberised resin component and reactive ionomer glass fillers that mimic the physical and chemical properties of natural teeth. These bioactive materials actively participate in the cycles of ion exchange that regulate the natural chemistry of the teeth and saliva and contribute to the maintenance of tooth structure and oral health. ACTIVA has the strength, aesthetics and physical properties of resin composites and is more bioactive than glass ionomer cements.\(^10\) ACTIVA seals teeth against mi-
croleakage\textsuperscript{11, 12} and its continuous release and recharge of significant amounts of calcium, phosphate and fluoride ions provide patients with long-term benefits.

In the US, the bioactivity claim for ACTIVA, being the first bioactive resin material, has been accepted. Based on its strength and durability due to a patented rubberised resin molecule that absorbs stress and resists fracture, the author has used ACTIVA BioACTIVE-RESTORATIVE and ACTIVA BioACTIVE-BASE/LINER in lieu of mineral trioxide aggregate (MTA) and Biodentine (Septodont) for selected endodontic and other procedures.

The cases presented here are off-label treatments using ACTIVA BioACTIVE-BASE/LINER in cases with a poor prognosis and in which extraction (and an implant) may have seemed a more obvious choice of therapy. These procedures are not listed in the company’s indications for use and were carried out by the author after explaining the possible potential benefits, as well as the risks to the patient. All of the patients agreed to the treatment and signed an informed consent form for endodontic treatment.

**Case 1**

A 28-year-old female patient was referred and presented with pain of tooth #46. The referral letter stated that endodontic retreatment was needed and the perforation had been closed with MTA. The patient was in considerable pain when eating and when closing her mouth. Her medical history did not present any contraindications to dental treatment.

The clinical examination showed a temporary filling in tooth #46. A radiograph taken on 20 October 2015 showed extrusion of MTA into the furcation, as well as a bony defect (Fig. 1). Perforation of the floor of the pulp chamber was diagnosed.

Upon removal of the temporary filling, a large amount of purulent exudate filled the pulp chamber and was evacuated. After the MTA had been removed, the furcation was flushed with metronidazole (liquid; Polpharma) and 2% chlorhexidine (Cerkamed). The borders of the perforation were refreshed with a carbide bur, and then the pulp chamber was etched with 37% orthophosphoric acid for 10 seconds, followed by a thorough rinse. Through the perforation, a collagen sponge (ANTEMA, Molteni Dental) was applied to support the ACTIVA BioACTIVE-BASE/LINER and to protect the underlying bone defect. The sponge was not visible on the radiograph. The canal orifices were protected with cotton pellets and the entire pulp chamber was treated with a dentine bonding agent (DenTASTIC UNO, Pulpdent), which was light-cured, and then covered with ACTIVA BioACTIVE-BASE/LINER, covering the floor of the pulp chamber (Fig. 2).

The tooth was closed with GIZ glass ionomer (Ihde Dental) as a temporary filling. The patient was pain-free within two days. A follow-up radiograph taken on 3 November 2015 (14 days postoperatively) showed the beginning of the healing of the bone in the furcation area (Fig. 3).

**Case 2**

A 16-year-old patient was referred with root resorption of tooth #21. A CBCT scan and radiograph (Figs. 4 & 5) taken on 30 March 2017 clearly demonstrated the root resorption. Note the temporary filling in the pulp chamber. The patient’s medical history was non-contributory. The diagnosis was mixed internal and external root resorption.

After removal of the temporary filling, inflamed granulation tissue was seen inside the canal. In spite of the fact that the apical portion of the canal was calcified, it was located. The canal was shaped and cleaned with the Self-Adjusting File (SAF) System (ReDent NOVA) and
XP-endo Finisher (FKG Dentaire), and flushed with 5.25 % sodium hypochlorite (NaClO), 17 % EDTA (Cerkamed) and metronidazole (Polpharma). As a first temporary canal filling, Dexadent (Chema-Elektromet) was applied for one week to treat the inflammatory tissue in the canal. During subsequent visits, the canal was rinsed with 40% citric acid (Cerkamed) and 2 % chlorhexidine (Cerkamed) using the SAF System and XP-endo Finisher. A temporary filling of Multi-Cal (Pulpdent) mixed with 2 % chlorhexidine (liquid) was inserted into the canal. Initially, the temporary dressing was replaced every two weeks to accomplish removal of granulation tissue and to stimulate bone regeneration. Over the course of about seven months, a reduction of the bone lesion was observed, as evidenced by radiographs (Fig. 6) and CBCT and under high magnification.

The final treatment after approximately 11 months (Fig. 7) consisted of cleaning the canal with the XP-endo Finisher and EDTA and 2% chlorhexidine irrigation. The resorption area was plugged with a collagen sponge (Antema) to provide support for ACTIVA BioACTIVE CEMENT and to prevent it from flowing beyond the root structure. A dentine bonding agent (All-Bond Universal, Bisco) was applied to the canal space, but not polymerised, just slightly air-dried, and the root was filled from the apex to the pulp chamber with ACTIVA BioACTIVE-RESTORATIVE. A fibre post (Cytec blanco, Hahnenkratt) was immediately placed, following which the pulp chamber was filled with ACTIVA. After 20 seconds, the restoration was light-cured from three different directions for 20 seconds each.

The final result can be seen on a radiograph from 13 February 2018. Complete bone healing adjacent to the resorption area was observed (Fig. 8). While the radiograph shows the fibre post, the collagen sponge and ACTIVA BioACTIVE CEMENT do not possess sufficient radiopacity to be seen on a radiograph.

Case 3
A 63-year-old female patient presented for dental treatment. A panoramic radiograph (Fig. 9) revealed a heavily restored dentition with single crowns, a three-unit bridge and multiple missing teeth in both arches. She complained of pain in the mandibular right premolar area. Her medical history did not present any contra-indications to dental treatment.

When the patient was informed that tooth #45 would have to be extracted, she objected and asked if anything could be done to save it, even if only on a temporary basis, as she was reluctant to commit to wearing a removable partial denture. She thus consented to a treatment that offered no guarantee of success.

Clinical examination showed third-stage luxation and pus in the gingival pocket. A radiograph showed a three-wall infrabony pocket (Fig. 10A) reaching the apex of the root. The diagnosis was periapical periodontitis with purulent exudate and root caries on the mesial aspect. The treatment consisted of endodontic and periodontal treatment after a panoramic radiograph and realtime polymerase chain reaction (PET test, PET Plus, MIP Pharma) were performed.

Endodontic treatment was performed on 2 July 2014 with a HyFlex file of size 25.04 (COLTENE) and the SAF System. The pus was evacuated from the root canal and the canal was flushed with 5.25% NaClO and metronidazole, and Dexadent ointment was applied and left for one week. To avoid extra expenses, no bone grafting material was used; only a deep curettage was performed.

An occlusal cavity was prepared and filled with ACTIVA BioACTIVE-RESTORATIVE, and the tooth was splinted to the adjacent premolar with fibreglass and ACTIVA (Fig. 10B). The purpose of the splint was to lend...
support to the tooth, which presented with a Class III mobility, thus promoting healing. After a few days, the patient reported being free of pain, and no exudate in the canal was observed.

On 10 July 2014, the canal dressing was changed to Multi-Cal mixed with 2% chlorhexidine and left for a period of two weeks. Two weeks later, the Multi-Cal was removed with the SAF System using 40% citric acid and distilled water. Then the canal was rinsed with 2% chlorhexidine and dried with suction. GuttaFlow (COLTENE) was used as a sealer, and a master cone was softened in chloroform and placed in the canal. Vertical hot condensation was carried out in the apical part. The remainder of the root canal was filled with a continuous wave of gutta-percha. The period until the next appointment determined whether the treatment would be successful or not. Healing of the infrabony lesion continued during this period (Fig. 11).

Three months later, the gutta-percha was partially removed from the canal, which was etched and rinsed, followed by application of the dentine bonding agent (All-Bond Universal). The canal was filled with ACTIVA CEMENT and a fibre post was placed, and after 20 seconds, it was light-cured (Fig. 12). After three years, a radiograph showed complete bone healing and periodontal attachment (Fig. 13).

Conclusion

Based on the available published research and after early favourable results had established the effectiveness of ACTIVA BioACTIVE materials, and based on the pH, release of calcium and phosphate ions and apatite formation in the presence of saliva, the decision was made to expand the number of suitable cases. Although a favourable outcome could not be guaranteed, clinical cases followed over a period of three and more years presented with positive results and provided evidence that the bioactive properties of ACTIVA BioACTIVE materials through their ability to stimulate apatite formation and osteoblasts provided a viable treatment option. The evidence has been presented here with radiographs and CBCT scans showing new bone formation. Although histopathological evidence has not been provided, a periodontal evaluation demonstrated periodontal attachment in the cases presented here.

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

contact

Dr Marta Maciak, PhD, graduated with a DDS from the Medical University of Białystok in Poland in 1999. In 2007, she graduated with a specialty in conservative dentistry and endodontics from the university’s Department of Restorative Dentistry. From 2004 to 2009, she was an assistant in the same department. In 2009, she received a PhD in medical sciences in dermatology. She is a member of the Polish Dental Association and Polish Endodontic Association. She has authored many publications, and since 2005, she has lectured in Poland and numerous other countries, in addition to presenting practical training in the fields of endodontics and aesthetic dentistry. Her main interests are aesthetic dentistry, endodontics and prosthetics. She can be contacted at martamaciak2012@gmail.com.
The Dental Tribune
International Subscriptions

I would like to subscribe to

☐ CAD/CAM
☐ ceramic implants*
☐ Clinical Masters**
☐ implants
☐ laser
☐ ortho*
☐ prevention*
☐ roots
☐ Journal of Oral Science & Rehabilitation***

EUR 44 per year (4 issues per year; incl. shipping and VAT for customers in Germany) and EUR 46 per year (4 issues per year; incl. shipping for customers outside Germany).

* EUR 22 per year (2 issue per year; incl. shipping and VAT for customers in Germany) and EUR 23 per year (2 issue per year; incl. shipping for customers outside Germany).

** EUR 12 per year (1 issue per year; incl. shipping and VAT for customers in Germany) and EUR 14 per year (1 issue per year; incl. shipping for customers outside Germany).

*** EUR 200 per year (4 issues per year; incl. shipping and VAT).

Your subscription entails access to the digital version of the publication and will be renewed automatically every year until a written cancellation is sent to Dental Tribune International GmbH, Holbeinstr. 29, 04229 Leipzig, Germany, six weeks prior to the renewal date.

Shipping Address

Name
Address
Zip Code, City
Country
E-mail
Date, Signature

☐ PayPal ☐ Credit Card

Credit Card Number
Expiration Date
Security Code

SUBSCRIBE NOW!  T +49 341 48474 302  subscriptions@dental-tribune.com
F +49 341 48474 173  www.dental-tribune.com/contact
Management of referred pain

Drs Chady Torbay, Sara Salloum, Claudia Dib, Edgard Jabbour & Philippe Sleiman, Lebanon

Introduction

Referred orofacial pain, which is pain sensed at a site apart from the site of origin, is very frequent in dental clinics. As endodontists, the diagnosis of pain and successful pain management are our primary tasks. Pain referral undeniably has a neural basis. Specific passages and neural couplings in the brain and in the body are believed to lead to the probability of pain referral. As an illustration, some of the most enervating pain conditions that manifest initially as dental pain arise from the structures innervated by a common nerve network, the trigeminal system.

Referred pain can make diagnosis difficult and can result in off-target or wholly unnecessary root canal therapies, tooth extractions or surgeries. The incidence of dental-related pain during an acute myocardial infarction is a serious example of referred pain.

Therefore, listening to the patient, obtaining a detailed dental history and collecting comprehensive diagnostic data are factors that improve the diagnosis of the problem before treatment initiation. The most favourable therapy for referred pain is treatment of the cause of the symptom; this involves identification of the site of the primary disease, which may not be simple in all circumstances. If the origin site cannot be identified, therapy is only symptomatic, with generally administered analgesic drugs. Certainly, adequate pain management is a compelling and universal requirement in healthcare. For this reason, collaboration between the departments of dentistry, pharmacology and physiology might be needed.

In this report, we describe two cases of misdiagnosis and a delay of appropriate treatment, resulting in the excessive and ineffective use of drugs. In these, several oral healthcare professionals failed to diagnose the cause of persistent facial pain because of the inability to conduct a comprehensive dental examination. Furthermore, they failed to use new technology to aid diagnosis.

Case 1

A patient suffering from what looked like facial myalgia was referred for consultation. He was a manager at a well-known medical hospital and had for several weeks suffered from extreme pain. His doctors thought that it...
was inflammation of the trigeminal nerve, and since analgesics and anti-inflammatory had had almost no effect, the patient was put on Tegretol. A friend advised him to seek a dental consultation just in case. A CBCT scan was taken to obtain adequate visualisation for diagnosis and a clinical examination was performed. Nothing specific was found, but the image around the third molar (Fig. 1) was suspicious. The surgeon thus suggested that it be extracted, but once the anaesthetic had worn off, the pain was still the same. I asked for a copy of the CBCT scan and was looking over each tooth in the evening when something caught my eye under the second molar. From the axial views (Figs. 2 & 3) and the multiplanar reformatte d (MPR) view (Fig. 4), it looked like a migrating infection from the molar going around the mandibular nerve and that may have been the cause of the pain, as the inflammation can exert pressure on the nerve, causing pain. I immediately called the patient and asked to see him as soon as possible in the morning. On his arrival, the first thing I did was to check the vitality of the tooth in question, as well as the rest of the dentition, both maxillary and mandibular. The mandibular second molar did not show any sign of vitality in response to heat, cold or electronic stimulus and was almost negative on percussion, which was curious. I explained the situation to the patient, and he agreed that we do the drilling test, and it did not react at all. I opened the access cavity, and as soon as I began testing the permeability on the distal canal, the patient began experiencing severe throbbing pain that radiated to the left of his face. A few seconds later, inflammatory liquid started draining from the distal canal, and I used the MacroCannula of the EndoVac (Kerr) to help it drain faster. The drainage lasted almost 15 minutes. Once it had stopped, the patient felt some relief, but he asked for a pause in treatment, as the pain was intense. We agreed not to finish the treatment in the same day and that I would see him the following day, and he promised to keep me posted during the day. After taking a long-deserved nap, he called me and told me that he felt like a normal person again. All medications were stopped—he was feeling peculiar from the Tegretol—and the next day I finished the root canal therapy (Fig. 5) using TF Adaptive (Kerr) and the Sleiman sequence of irrigation with the EndoVac, followed by warm 3-D obturation of the root canal system, and later a crown was placed.

Case 2

The patient was referred to the clinic suffering from pressure on a mandibular molar. She also described a burning sensation on her lower lip. A radiograph was
taken (Fig. 6), and it showed an incomplete root canal therapy with a radiolucency in the apical area. I informed the patient that a CBCT scan would be essential in order to determine exactly what was going on. From the axial view (Fig. 7), we could see clearly the amount of bone destruction under the mesial roots in particular. Additionally, I noted that the bone covering the mandibular nerve had resorbed in certain areas, which could put the nerve in contact with the inflammatory liquid, causing what the patient described as a burning sensation. On the sagittal slices (Fig. 8), we could see the volume of the lesion and the intimate relation with the mandibular nerve. The 3-D reconstruction using Anatomage software revealed the volume of the lesion (Fig. 9). The lesion did not look cystic, as it was confined to the spongy bone, with no damage to the cortical bone lingually or buccally, and no defined borders. I advised the patient that we would need to put her on antibiotics 24 hours prior to the treatment as a precaution in order to try to minimise any flare-up, as such an occurrence would place more pressure on the nerve. The following day, the root canal therapy was performed using TF Adaptive and the Sleiman sequence of irrigation with the EndoVac, followed by warm 3-D obturation of the root canal system. During the use of negative pressure, a great deal of drainage continued for almost 10 minutes from the mesial canals. Root canal therapy was performed in a single session (Fig. 10). Antibiotics were continued for seven days. Figure 11 shows a comparison between five weeks and immediately postoperatively. Figure 12 shows a comparison between five months and demonstrating that the healing process was proceeding well. Taken at the one-year follow-up, Figure 13 shows the beautiful healing and complete closure of the bone surrounding the mandibular canal. Figure 14 provides a comparison between the initial situation and the progress after one year.

Discussion

Orofacial pain has been associated with many neurological diseases, as well as some cardiac problems. In this paper, we discovered a low prevalence of referred dental pain, from the origin site of pain origin, evaluated through a tomographic scanner, to the other sites. The extended illness in the patient (case 1) was caused by a slip-up on the part of the treating dentist. Medical misinterpretations can have tragic effects on the lives of patients. Therefore, a standard and logical protocol should be followed in the hope that a correct diagnosis of pain can be made and the appropriate therapy directed to the source of pain and not the site of pain.
Actively listening to patients is vital for both diagnosis and pain management. It is only through effective communication between both parties that dentists and patients can produce the best treatment plan. Equally important are a good knowledge of the facial anatomy, a carefully recorded medical history and a clinical examination including pulp tests and advanced radiographic techniques. Likewise, shedding light on some factors that could play role in the occurrence of the referred pain might be beneficial.

Recurrent dental pain occurs the most in women, and this is in accordance with some reports indicating that women have a higher rate of some painful facial conditions. Recent medical evidence suggests that the trigeminal and vagus nerves are frequently viewed as pain mediations to the facial region. Moreover, the differences in pain perception and the presence of proprioceptors in the periodontal tissue increases the probability of referred pain accompanying periapical lesions over the probability of such pain with periodontal lesions.

Additionally, when suspecting referred pain of any unknown origin, it is the dentist’s responsibility to refer the patient to the appropriate physician, providing a detailed report of the tests performed. As the diversity of referred pain becomes more complicated across a wide range of situations, and the necessity to coordinate interaction among multiple disciplines becomes ever more important, combining well-functioning teams is a critical target throughout the healthcare system, especially when odontogenic causes of pain have been ruled out and non-odontogenic causes need to be considered. An interdisciplinary team is one in which the team members include all kinds of medical specialists, not just dental ones. Researchers have suggested that working together decreases the potentiality of medical errors. Effective teams disintegrate hierarchy and concentrate the power of healthcare systems.

However, under the mantra “the doctor knows best”, a physician may be hypnotised into thinking that asking for a consultation or for more accurate diagnostic details, whether concerning equipment or experience, might be embarrassing and self-devaluing. Moreover, professional custom often runs against obtaining second opinions, standing in the way of the best therapy. Nevertheless, physicians should always prioritise the patient’s welfare and ask for help if needed.

Editorial note: A list of references is available from the publisher.
Hi! I am Dr Anna Maria Yiannikos and I am in the happy position to present you the 5th part of this new loved series filled with communication protocols. This series includes the most popular and challenging scenarios that might occur in your dental practice. I will show you how to deal with them so that your patients always leave your practice feeling: “My dentist is THE BEST!”

Each individual article of this series will teach you a new specialised protocol that you can easily use, customise and adapt from the same day to your own dental clinic’s requirements and needs.

Let’s start with today’s challenging topic which is... how to deal with a bad online review from a stranger. Imagine receiving a negative review at your Facebook page from someone who is not even a patient—maybe, because he just wants to be mean, or maybe he just wants to hurt you.

5 fantastic tips

Let’s not focus on that though! Our goal is to change the negative incidence into a positive one. Isn’t that correct? You might ask: “Dr Anna, how can I do that? This guy, who gave me the bad review, is not even a patient.” Let’s discover 5 fantastic tips that I have for you today. You will just love them!

1. Do not take it personally

Take a deep breath. The first rule of dealing with negative reviews is to not take them personally! That’s because as your business grows, you will have to face more and more of them. Do not get into the bad reviewer’s trap responding to what he says.

For example, you should not get defensive and list all of the reasons why the potential patient is wrong. He is, quite frankly, a jerk that loves making a personal
attack. Avoid joining the conversation—it is absolutely wrong!

2. Don’t try to remove it
Even if you try to remove the negative review from that online site, you might not be able to! Most important, remember that most people who frequent review sites and look for your business on social media, know that not all of your reviews are perfect. Don’t sweat if you have received one bad review.

3. Ask for positive reviews
What would be wise to do is to focus on getting more positive reviews from friends and loyal patients!

After all, every positive review takes the sting out of a negative one. Ten positive reviews and one negative might give pause for thought; but 100 positive reviews and one negative review isn’t for sure a big deal.

Send the request immediately to your friends to rate your clinic asap! What will be the result? You will receive so many positive reviews that the bad review will be at the bottom of the list, and now who will see it? Most probably no one!

4. Move on
Enjoy all the great things that your friends say about your practice! The reality is that you have to deal with bad reviews, you can’t ignore them!

5. Don’t allow posts on your Facebook page
If you cannot handle the bad feeling of someone being mean to you, turn off the feature that allows anybody to post on your page. Remember that you’re only turning off original posts—not comments. If they’re negative, you can respond in the comment section or let other visitors comment on your posts.

Make the best of it!
I know that you feel bad about this unfair situation but you can transform it easily and quickly in to a positive one. I have done that myself! Things like that can happen. Grab the opportunity to make it positive by using the above troubleshooting guide that I offer you!

In the next issue of roots magazine, I will present to you the sixth part of this unique new series of communication concepts that will teach you… how to deal with economic crisis! I will help you to discover 5 effective ideas that will increase your income immediately!

Until then, remember that you are not only the dentist of your clinic, but also the manager and the leader. You can always send me your questions and request for more information and guidance at dba@yiannikosdental.com or via our website www.dbamastership.com. Looking forward to our next trip of business growth and educational development!
We gain a better outcome for endodontic treatment

By DTI

A main cause of endodontic failure is the recolonisation of the poorly treated root canal system with microorganisms. The primary goal of endodontic treatment has always been to effectively irrigate the canal and prevent reinfection of the periapical tissue. As a means to achieve greater success, longevity and reliability in modern endodontics, proper irrigation has been enhanced through the activation of the irrigant. In contrast to ultrasonic activation, the flexible EDDY tip, launched by VDW in 2015, uses sonic activation of the fluid. We spoke to Dr Grzegorz Witkowski, a leading Polish endodontist, about his daily experience with sonic activation and his irrigation protocol.

How long have you been using EDDY?
I started using EDDY more than two years ago. Before EDDY, I was an ultrasonic system user—and I still continue to use ultrasonic tips for some uses. Therefore, I was sceptical about the tip at the beginning. As soon as I saw how it worked, it changed a lot in my practice.

The activation of the fluid is so effective that I quickly adopted it.

How does it work?
EDDY is not an ultrasonic device, but a sonic one. Because of the frequency it uses, which is between 5,000 and 6,000 Hz, it is tremendously effective. It works like an ultrasonic device in many ways, but seems to activate the irrigant more effectively, especially in curved canals, which in turn enhances the procedure. The activation is 3-D, which means that EDDY moves the fluid in a 3-D direction into all lateral canals, isthmuses and other anatomical complexities.

If the clinician already uses ultrasonic activation, why should he or she switch to EDDY?
As I said, I was sceptical about changing from ultrasonic to sonic. I continue to use ultrasonic tips in my practice, for example to remove some remnants of the

Dr Grzegorz Witkowski is a member of the European Society of Endodontics, Polish Association of Endodontics and Polish Academy of Aesthetic Dentistry. Since 2004 he runs a private practice in Olsztyn (Poland) focused on endodontics, CAD/CAM and aesthetic dentistry.

Fig. 1: EDDY polyamide tip in oscillating motion.
material in retreatment. For most endodontic cases, however, it is easier to use sonic activation. It works just like ultrasonic activation, as it activates the fluid and spreads it with the proper amount of power into every part of the canal.

For regular treatment and even retreatment, I would say EDDY is a faster and safer means of activation. In particular, general dentists will appreciate the flexible and elastic tip. One does not have to worry about the preparation of the wall, which is really important, as this instrument will not damage the canal walls. There is no transportation of the canal, which many dentists know is a common procedural accident. For EDDY, one just irrigates and activates. What an effective method! Without canal transportation, with the proper preparation and a proper irrigation protocol, we gain a better outcome for endodontic treatment.

What is your irrigation protocol?

My own protocol is quite complex. As an endodontist, I mostly deal with difficult cases. In my workshops, however, I always recommend the same protocol. I start with the main fluid, sodium hypochlorite, usually 5.25 per cent. I use 20 to 40 ml per canal, which is quite a lot. I also use citric acid to remove the smear layer. After that, I continue to use sodium hypochlorite. To neutralise the pH, I use distilled water. At the end, I use chlorhexidine for a prolonged antibacterial effect and stabilising effect of the collagen matrix. I do not dry the canal with alcohol.

I learnt that EDDY is more effective when one places a syringe with additional sodium hypochlorite into the canal and administers it continuously. EDDY will rinse everything thoroughly.

When do you know that you have cleaned the canal properly?

First of all, it is important to understand that one never knows. If you ask 100 endodontists what irrigation protocol they would recommend, they would not be able to reach a consensus. Every endodontist may agree in general, but regarding specifics, everybody will say something different. My focus is on understanding the fluid interactions and easy ways to activate it. The sodium hypochlorite does not work at all levels, so one needs to use different fluids.

It is commonly understood in endodontics that the process of chemical irrigation should take longer than mechanical preparation. A molar with four canals takes me 60 minutes to treat and I spend approximately 40 minutes of that on irrigation. Preparation nowadays is easy, but we do preparation for proper irrigation. With the advances in root canal preparation, we now have to focus on proper irrigation. In particular, we have to rinse at every level; during preparation, we should already establish a clean system. All files push some debris to the apex. Proper irrigation is the main means of preventing that.

How important is it to have a flexible tip?

The flexibility of the EDDY tip is a big advantage, especially for S-shaped canals and other complicated anatomies. EDDY can easily be applied into the canal. With an ultrasonic tip, one touches the walls, which may lead to transportation of the canal. This is something to be avoided. With the flexible EDDY tip, one can easily follow the preparation path. General practitioners who do not activate the fluid and then use EDDY will notice a difference, especially on the postoperative radiograph.

Thank you very much for the interview.
All Planmeca’s CBCT units support three different types of 3-D imaging, as well as extra-oral bitewing, cephalometric and digital panoramic imaging. This flexibility to switch between 2-D and 3-D allows clinicians to optimise their imaging and select the techniques that work best with each case. With proprietary features for imaging with ultra-low radiation doses and patient movement correction also available, Planmeca provides a completely unique dental imaging experience.

The Planmeca Ultra Low Dose protocol is the best method for acquiring CBCT images at low radiation doses, according to the company. It can be used with all voxel sizes and in all imaging modes and allows clinicians to gather more information than from standard 2-D panoramic images at an equivalent or even lower dose. All this is possible without a statistical reduction in image quality.¹

Whereas Planmeca Ultra Low Dose protects patients from unnecessarily high doses, the new Planmeca CALM imaging protocol helps avoid retakes by compensating for movement. According to studies,² patient movement may occur in up to 40% of cases, meaning that image quality is not optimal in a significant portion of CBCT scans. Planmeca CALM corrects artefacts caused by movement, resulting in sharper final images. The algorithm can be applied before the image is captured, as well as after the scan has been completed.

When purchasing a new CBCT unit, clinicians should ensure they request all the necessary information on the product. This would include accurate information on patient radiation doses and comparison of the differences in image quality between standard and low-dose images, as well as images with and without artefact correction. Making the right choice will lead to improved diagnostics, saved time, reduced costs and lower radiation exposure for patients.

References
1. Ludlow JB, Kolvisto J. Dosimetry of orthodontic diagnostic FOVs using low dose CBCT protocol. Poster session presented at: 93rd General Session & Exhibition of the International Association for Dental Research; 2015 Mar 11–14; Boston, MA.
Strengthened composition and rounded cross section

GL153 Safe10 series: Stay true to form

An unavoidable truth of endodontics is that the root canal is a complex space to work in. Shaping root canals helps to make navigation easier, but the files used in this process can be prone to fracture as a result of cyclic or torsional fatigue. META BIOMED's new GL153 Safe10 series is a set of instruments with exceptional resistance to fatigue, allowing you to navigate and clean long, tapered and complex canals more easily than ever before.

The GL153 files undergo a proprietary thermomechanical treatment that gives them a much greater resistance to fatigue. The controlled memory wire used in their manufacture has been verified by an independent scientific study to significantly increase the number of cycles before failure compared with other files on the market.

The strengthened composition and rounded cross section of the GL153 work to create a smooth, efficient path, shaping the root canal and preserving the surrounding tooth structure without risk of file separation.

META BIOMED's standing as one of the dental industry's primary innovators ensures that the GL153 is optimally designed for the practitioner's and patient's safety and comfort. The flute design of the files reduces the screw effect, greatly decreasing the likelihood of over-instrumentation. In addition, no elastic limits are exceeded, and there is no risk of taper lock when used in the recommended reciprocating motion with a constant downwards pressure.

Torsional fracture often occurs when a file tip becomes stuck in a canal and the shank continues to turn. With a flute length of just 10 mm, the GL153 Safe10 series promises that the apex of the tooth can be reached safely and that ideal root canal preparation is more achievable than ever.

"With its unlimited flexibility and excellent resistance to fracture, the GL153 Safe10 series represents our commitment to providing high-quality solutions for everyday dental procedures at a low cost," said Ian Yun, Managing Director at META BIOMED.

www.meta-biomed.com
International Events

**GNYDM**
25–28 November 2018
New York, USA
[www.gnydm.com](http://www.gnydm.com)

**ADF**
27 November – 1 December 2018
Paris, France
[www.adfcongres.com](http://www.adfcongres.com)

**CIOSP**
30 January – 2 February 2019
São Paulo, Brazil
[www.ciosp.com.br](http://www.ciosp.com.br)

**AEEDC**
5–7 February 2019
Dubai, UAE
[www.aeedc.com](http://www.aeedc.com)

**CDS Midwinter Meeting**
21–23 February 2019
Chicago, USA
[www.cds.org](http://www.cds.org)

**IDS 2019**
12–16 March 2019
Cologne, Germany
[www.ids-cologne.de](http://www.ids-cologne.de)

**AAE Annual Meeting**
10–13 April 2019
Montreal, Canada
[www.aae.org](http://www.aae.org)

**KRAKDENT**
10–13 April 2019
Krakow, Poland
[www.krakdent.pl](http://www.krakdent.pl)

**Dental Salon**
22–25 April 2019
Moscow, Russia

**APDC & SIDEX**
8–12 May 2019
Seoul, Korea
[www.apdc2019.org](http://www.apdc2019.org)

Waiting for you in 2019!
The largest Annual Dental EVENT IN THE WORLD!
How to send us your work?

Please note that all the textual components of your submission must be combined into one MS Word document. Please do not submit multiple files for each of these items:

- the complete article;
- all the image (tables, charts, photographs, etc.) captions;
- the complete list of sources consulted and the author or contact information (biographical sketch, mailing address, e-mail address, etc.).

In addition, images must not be embedded into the MS Word document. All images must be submitted separately, and details about such submission follow below under image requirements.

Text length

Article lengths can vary greatly—from 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 unusually long article in multiple parts, but this usually entails a topic for which each part can stand alone because it contains so much information.

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

We also ask that you forego any special formatting beyond the use of italics and boldface. 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 use underlining.

Please use single spacing and make sure that the text is left justified. Please do not centre text on the page. Do not indent paragraphs, rather place a blank line between paragraphs. Please do not add tab stops.

Should you require a special layout, please let the word processing programme you are using help you do this formatting automatically. Similarly, should 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 enable you to do so. The fact is that no matter how carefully done, errors can creep in when you try to number footnotes yourself.

Any formatting contrary to stated above will require us to remove such formatting before layout, which is very time-consuming. Please consider this when formatting your document.

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 these in a group (for example, 2a, 2b, 2c).

Please place image references in your article wherever they are appropriate, whether in the middle or at the end of a sentence. If you do not directly refer to the image, place the reference at the end of the sentence to which it relates enclosed within brackets and 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.
- These image files must be no smaller than 80 KB in size (or they will print the size of a postage stamp!).

Larger image files are always better, and those approximately the size of 1 MB are best. Thus, do not size large image files down to meet our requirements but send us the largest files available. (The larger the starting image is in terms of bytes, the more leeway the designer has for resizing the image in order to fill up more space should there be room available.)

Also, please remember that images must not be embedded into the body of the article submitted. Images must be submitted separately to the textual submission.

You may submit images via e-mail, via our FTP server or post a CD containing your images directly to us (please contact us for the mailing address, as this will depend upon the country from which you will be mailing).

Please also send us a head shot of yourself that is in accordance with the requirements stated above so that it can be printed with your article.

Abstracts

An abstract of your article is not required.

Author or contact information

The author’s contact information and a head shot of the author are included at the end of every article. Please note the exact information you would like to appear in this section and format it according to the requirements stated above. A short biographical sketch may precede the contact information if you provide us with the necessary information (60 words or less).

Questions?

Magda Wojtkiewicz
(Managing Editor)
m.wojtkiewicz@dental-tribune.com
Copyright Regulations

roots, the international magazine of endodontics, is published by Dental Tribune International (DTI) and appears in 2018 with four issues. The magazine and all articles and illustrations therein are protected by copyright. Any utilisation without the prior consent of editor and publisher is inadmissible and liable to prosecution. This applies in particular to duplicate copies, translations, microfilms, and storage and processing in electronic systems. Reproductions, including extracts, may only be made with the permission of the publisher. Given no statement to the contrary, any submissions to the editorial department are understood to be in agreement with a full or partial publishing of said submission. The editorial department reserves the right to check all submitted articles for formal errors and factual authority, and to make amendments if necessary. No responsibility shall be taken for unsolicited books and manuscripts. Articles bearing symbols other than that of the editorial department, or which are distinguished by the name of the author, represent the opinion of the aforementioned, and do not have to comply with the views of DTI. Responsibility for such articles shall be borne by the author. Responsibility for advertisements and other specially labeled items shall not be borne by the editorial department. Likewise, no responsibility shall be assumed for information published about associations, companies and commercial markets. All cases of consequential liability arising from inaccurate or faulty representation are excluded. General terms and conditions apply. Legal venue is Leipzig, Germany.
Adapted to Nature

Single-file system
Shape memory alloy
Adaptive Core
Preserves dentine, easy and safe

ENDO DONE!

www.fkg.ch

The new EQ-V system by Meta Biomed for the most reliable, convenient and precise root canal obturation.