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case report
Management of pulp canal obliteration

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Multiple studies of root canal histology have confirmed its complexity, and its intricate anatomy is being revealed more and more to us, via in vitro and laboratory studies. As new articles are published and new equipment brought to the market, there is one question to be answered: how can we use all this information to develop a comprehensive clinical treatment that is clear to endodontists and to general dentists in order to serve our patient better?

Root canal therapy is a series of steps, where each procedure depends on the previous one:

- Clinical judgement and CBCT are used to evaluate the level of 3-D complexity of the root canal system for proper diagnosis and treatment planning.
- Shaping is performed for cleaning of the main canal, or the space of lesser resistance, where the smear layer produced has to be eliminated via the proper sequence and appropriate technique of chemical preparation in order to open access to all spaces and prevent lateral pushing of the debris, thereby blocking the system (often, we, the practitioners, are responsible for blocking the system and “simplifying” the initially complex anatomy). Ongoing studies have shown that we can accomplish almost a zero bacteria load level via a proper irrigation sequence, using the appropriate timing, volume and chemicals, and this can be accomplished by affordable means and does not require sophisticated and expensive equipment. Chemical preparation is not only used for cleaning the canal system. The latest studies using cryotherapy have shown that it helps reduce postoperative pain at the inexpensive use of cold water at the end of the procedure.
- 3-D obturation sealing of the canal in order to fill what has been cleaned builds on the success of the two previous steps, completes the treatment of the whole complexity of the endodontic system and makes the following restorative steps possible.

A clear understanding of the demands and restrictions of the anatomy, as well as the role of each step in order to treat the root canal system, is essential. Though the temptation may be strong to try what seems an easier route—one file/one chemical/one cone—it is the natural complexity that should be guiding us in how we address it and how we treat it.

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Management of pulp canal obliteration: A clinical case report and tips and tricks

Dr Hugo Sousa Dias, Portugal

Introduction

Clinical management of calcified teeth provides an endodontic treatment challenge and makes up a significant portion of current endodontic practice. People are living longer and want to maintain their natural dentition. There are several factors that might influence the development of varying degrees of moderate and severe calcification of the pulp chamber, as well as the root canal system, such as multiple restorations, trauma, vital pulp therapy and chronic irritation arising from deep restorations or cracks.

Pulp stones in the pulp chamber, sclerotic dentine usually in the pulp chamber, dystrophic calcification in the root canals, and pulp canal obliteration in the pulp chamber and the root canal are some of the clinical situations commonly encountered by endodontists. Pulp canal obliteration, also called calcific metamorphosis, is a sequelae of tooth trauma. It has been reported to develop...
more often in teeth with concussion and subluxation injuries.2–4

Calcific metamorphosis is defined by the American Association of Endodontists as “a pulpal response to trauma characterised by rapid deposition of hard tissue within the canal space”.19 It is generally asymptomatic and patients present clinically with yellow discolouration of the affected tooth crown and apparent loss of the pulp space radiographically. This discolouration is due to a greater thickness of dentine deposition. The incidence of pulp canal obliteration after dental trauma has been reported to be approximately 4–24%. It is generally accepted that the frequency of pulp canal obliteration is dependent on the extent of the luxation injury and the stage of root formation, and generally, obliteration of the pulp canal spaces advances in a coronoapical direction.4–6 The exact mechanism of canal obliteration is unknown, but is believed to be related to damage to the neurovascular supply of the pulp at the time of injury.5

The critical management decision is whether to treat these teeth endodontically immediately, upon detection of the pulpal obliteration,7–9 or to wait until signs and symptoms of pulp or periapical disease occur.10–15 Only 1–16% of teeth with pulp canal obliteration will develop pulpal necrosis and only 7–27% of them will develop radiographic signs of periapical disease.5

There is a progressive decrease in the response to thermal and electrical pulp testing as pulp canal obliteration becomes more pronounced. Furthermore, a significant difference in electric pulp testing between partially obliterated and totally obliterated teeth has been reported. It is generally accepted that an absence of a positive response to the electric pulp test does not automatically imply pulpal necrosis.2 It is also generally accepted that sensibility tests are unreliable.5 Teeth undergoing pulpal obliteration are generally asymptomatic.2 Such teeth are often an incidental finding during clinical or radiographic investigation.

The literature suggests that pulpal necrosis and periapical disease are not common complications of pulp canal obliteration, and if root canal therapy is selected as a routine procedure, most treatments would be unnecessary, as the majority of teeth with pulp canal obliteration will never suffer pulpal necrosis or periapical disease. Smith recommends delaying treatment until there are symptoms or radiographic signs of periapical disease, a view accepted by many.10–15

It is possible to differentiate two types of radiographic pulp canal space obliteration: partial pulp canal obliteration: partial pulp canal oblitera-

Figs. 6a & b: Access cavity preparation. Fig. 7: The calcifying process soon becomes circumferential, forming a calcified ring around the nerve.18

Fig. 8: Root canal entrance. Fig. 9: Glide path with D Finder files and M4 Safety Handpiece.
tion (limited to the coronal part of the tooth) and total pulp canal obliteration (extended to the coronal and radicular pulp canal spaces), with or without associated periapical pathosis. Complete radiographic obliteration of the pulp space does not necessarily mean the absence of the pulp canal space; in the majority of these cases, a pulp space with pulp tissue is present, but the sensitivity of conventional radiographs is too low to allow visualisation of this.\(^5\)

Taking into account the degree of difficulty of the clinical management of these kinds of cases, the practitioner should be aware of the possible complications that may occur. The complications include root perforation and irretrievable instrument fracture.\(^6\) This article presents a case report with some valuable tips regarding the clinical approach to such cases.

Case report

A 47-year-old male patient was referred to our clinic in order to evaluate a symptomatic tooth (tooth #11). The patient had spontaneous pain in the right maxilla, in the vestibule of the maxillary right central incisor. At the clinical examination, a fistula in the buccal area of the tooth was identified. The tooth was very sensitive to percussion and non-responsive to thermal and electric pulp tests, without mobility, and periodontal probing around it was within physiological limits.

The patient gave a history of trauma in childhood. On examination, tooth #11 was found to have a discoloured crown (Fig. 1) and undergone a previous root canal therapy attempt. Initial radiographs were taken (Fig. 2), and these revealed that the canal could not be traced from the coronal and middle thirds. Cone beam computed tomography (CBCT) scans were requested for the patient (Figs. 3 & 4). Based on the results of the clinical and radiographic examination, a diagnosis of necrotic pulp with chronic apical abscess was made and root canal therapy recommended.

Local anaesthesia was performed, and the tooth was isolated with a rubber dam (Fig. 5). The access cavity was prepared, with an incisal orientation (following the long axis of the tooth), under continuous inspection.
under the operating microscope. The action of the long shank bur is only in the darker dentine (tertiary dentine), avoiding removal of the lighter dentine (primary dentine; Figs. 6a & b). After finding a ring of calcification (Fig. 7), we use an ultrasonic tip to have a more controlled cutting action and better visual control; in this clinical case, we selected the RedStar RS-2 ultrasonic tip (Kerr Endodontics).

In such a clinical situation, it is important to follow a basic sequence of irrigate and scrub with sodium hypochlorite/EDTA, dry, observe and cut until one can find the root canal. Radiographic control during this procedure is fundamental in order to avoid any mishap.

When the root canal entrance was identified (Fig. 8), a short (21 mm in length) and more rigid hand file was selected to allow more tactile control and a more effective cutting action. The root canal was instrumented with size 8, 10, 12 and 15 D Finders (Mani Inc.) to obtain a manual glide path using the M4 Safety Handpiece (Kerr Endodontics; Fig. 9).

Working length radiographs were captured (Figs. 10a–c). Cleaning and shaping were performed using TF Adaptive (Kerr Endodontics) up to size 25.06 with the Elements Motor (Kerr Endodontics) in Adaptive Motion. Irrigation was performed during the entire treatment with 5.25% sodium hypochlorite. A final irrigation protocol was done with 17% EDTA and 5.25% sodium hypochlorite, and irrigant was activated with the manual dynamic activation technique. The canals were thoroughly dried and obturation performed using Autofit 4% gutta-percha cones (Kerr) and AH Plus (DENTSPLY Maillefer), employing the continuous wave of condensation technique with the Elements Obturation Unit (Kerr Endodontics). The pulp chamber was sealed with Ionoseal (VOCO) and a temporary restoration was performed (Fig. 11). The patient was referred to his dentist for the permanent coronal restoration. At a follow-up visit after three months, the tooth was asymptomatic (Fig. 12).

Tips for clinical management of pulp canal obliteration

1. It is essential to remember that the pulp chamber is always located in the center of the tooth at the level of the cementoenamel junction (CEJ; Fig. 13).\(^5\)
2. The calcified pulp chamber is darker than and appears a different colour to the axial wall root dentine.\(^5\)
3. A much better solution is to prepare the access cavity close to or through the incisal edge. This approach facilitates straight-line access and is a more predictable approach to locating the pulp chamber while avoiding unnecessary damage (Fig. 14).\(^5\)
4. The use of the dental operating microscope is recommended to identify colour changes (Fig. 15).\(^5\)
5. Using long shank burs in a slow handpiece or preferably ultrasonic tips to penetrate deeply into the canal system is recommended.\(^6\)
6. Sodium hypochlorite can also be used to aid in the identification of a calcified canal by visualising the occurrence of bubbling (called a bubble or champagne test).5
7. Take radiographs at multiple angles to maintain alignment and direction during the procedure.
8. A CBCT scan is quite useful in the planning and progression of treatment.1
9. Alternate between size 8 and 10 K-files with a gentle watch-winding motion with minimal vertical pressure with regular replacement of the instruments before fatigue occurs.5
10. Frequently irrigate and scrub with chelating agents/ sodium hypochlorite. After that, dry and observe.
11. A crown-down approach has been recommended to improve tactile sensation and better apical penetration.5
12. In single-rooted teeth, never forget the root canal centricity in the root, look for the colour changes (sometimes, it is useful to use the fisheye view: deliver irrigant to the pulp chamber) and search the root canal lingually in maxillary incisors. In multirooted teeth, look for white lines and white spots.
13. The calcification process as seen in pulpal obliteration occurs in a coronoapical direction, so once the initial canal has been located an instrument tends to progress more easily as it advances toward the canal terminus.5
14. In premolars and molars, taking into consideration the following anatomical landmarks may be useful.

**Important anatomical landmarks** (Figs. 16 & 17)

- D ≈ 7 mm (distance from midpoint of a line connecting the two cusp tips to the pulp chamber ceiling)
- C ≈ 11 mm (distance from midpoint of a line connecting the two cusp tips and closest point to the furcation)
- E ≈ 2.5 mm (height of the pulp chamber)
- C ≈ 11 mm (distance from the buccal cusp tip to the closest point to the furcation)
- E ≈ 6 mm (distance from the buccal cusp to the pulp chamber ceiling)
- F ≈ 2 mm (height of the pulp chamber)

The measurements were similar for both maxillary and mandibular molars.

15. The decision flowchart (Fig. 18) outlines the various treatment options that can be considered depending on the presenting signs and symptoms.

**Conclusion**

In this article, I have provided several tips for approaching the endodontic challenge of pulp canal obliteration. However, in an era devoted to conservative dentistry, other tools are emerging that may allow a more conservative, faster and more predictable approach in a large number of clinical situations where root anatomy is favourable: microguided endodontics.

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**About**

Dr Hugo Sousa Dias graduated with a DDS from University Fernando Pessoa, Porto, and completed the postgraduate programme in endodontics at the University of Lisbon. Besides running a practice limited to endodontics in Porto, he is Director of the Master in Endodontics clinical residency programme at Foramen Dental Education. Dr Dias is the founder of the Portuguese Group for Endodontic Study (study club). He is a member of the European Society of Endontology 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).
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How to give a second life to third molars: A case series with follow-up

Drs Pio Bertani & Paolo Generali, Italy

Introduction

Dental autotransplantation entails extracting and repositioning a tooth into a different site in the mouth of the same patient. A successfully transplanted tooth offers several advantages, given the preservation of the periodontal ligament: the proprioceptive function is maintained, the alveolar bone volume is preserved, orthodontics can be included in the treatment plan, and the dentofacial development and growth of the jaws are not impaired. Moreover, pulp regeneration and continued root development can be expected when a donor tooth with incomplete root formation is chosen and infection of the pulp tissue is prevented.1, 2

History

Tooth transplantation has been carried out for centuries. The earliest reports of tooth transplantation involve slaves in ancient Egypt who were forced to give their teeth to their pharaohs. In the late eighteenth and early nineteenth century, transplants of teeth between people were relatively common at specialist dental practices in London. Surprisingly, tooth allotransplants have been found to last six years on average. In Scandinavia, during the 1950s and 1960s, autotransplantation of teeth began to be carried out under increasingly controlled conditions.3, 4

Success and survival rates

The success of autogenous tooth transplantation depends on the vitality of the periodontal ligament. High success and survival rates have been reported for autotransplantation if proper case selection is done and a proper surgical technique is used. A prospective study by Mejare et al. reported a cumulative survival rate of 81.4% over a four-year follow-up,5 while other studies have reported survival rates ranging from 71.0% to 95.0% for up to ten years of follow-up.6, 7 The success and survival rates reported are similar or even better than those of implants.8

Indications

The first permanent molars are very prone to caries because of their ana-
tomical structure, with deep pits and fissures, and early eruption in the mouth. They sometimes need to be restored very early, and the standard of care is often suboptimal. Therefore, in adolescence, it may happen that they become chronically infected and non-restorable. Extraction is mandatory, but the patient is often too young for an implant or a three-unit fixed dental prosthesis. Waiting means mesial migration of the second and third molars, and perhaps extrusion of the maxillary molars. Even worse, space maintainers have a high failure rate. Consequently, hopeless first molars in young patients are among the most suitable and most frequent indications for third molar autotransplantation. Endodontically compromised or non-restorable second molars are another indication. Autotransplantation from premolars to lateral or frontal regions is a procedure that has been in use in the Scandinavian countries since the end of the 1950s. This technique can be used also in the case of ectopic maxillary canines.

**Preoperative factors**

Favourable prognostic factors include a young age (15–25 years old), a donor tooth with an open apex and root length ranging from two-third to complete development, possibility of atraumatic extraction and repositioning of the donor tooth (root morphology, position and size of the crown), suitable recipient site conditions (absence of inflammation, and good bone volume and quality), employment of a suitable protocol (atraumatic technique, minimal extraoral time, type of stabilisation, adequate follow-up, and timing of the eventual endodontic treatment). The key factor is the healing of the periodontal ligament. Periodontal ligament remnants on both sides of the wound are a favourable condition. Transplantation of a tooth into a newly created socket means that periodontal remnants are only on one side, the one without vascularisation, and so the likelihood of success is reduced. The ideal recipient site should be free of inflammation, but a hopeless tooth scheduled for extraction often presents with a periapical lesion.

The authors’ opinion is that a balance of preoperative factors should guide the practitioner in making the best clinical decision. When most prognostic criteria are met, such as young age, good general health, shape of the third molar roots, keratinised tissue and ease of extraction, the presence of inflammation at the recipient site can be tolerated. This approach is suggested by Shim et al., while Nimčenko et al. suggest extraction of the diseased tooth two weeks before transplantation. This approach, however, multiplies the costs and discomfort. If the balance of preoperative factors is positive, the authors of this paper prefer to carefully extract the hopeless tooth and transplant the donor tooth immediately after bleeding has stopped.

**Technique**

Dental autotransplantation is effectively a planned avulsion and replantation in the least traumatic way. Local anaesthesia is administered and prophylactic antibiotic administration is also recommended. Preparation of the recipient site includes extraction of any root remnants.
and debridement, and then the donor tooth is atraumatically extracted. A loose fit of the transplanted tooth in its new socket is generally recommended. In some cases, when the donor tooth fit is satisfactory, no further preparation of the new socket is required and the donor tooth is directly placed into the fresh extraction socket. If this is not the case, an atraumatic preparation of the new socket using surgical burs or implant drills is performed. The transplanted tooth is then tried in the recipient socket and relative adjustments are made if needed. In the meantime, the tooth is kept in the donor socket or in saline solution. The transplanted tooth should be placed slightly below the occlusal plane. Once proper fit and position have been achieved, the transplanted tooth is fixed with horizontal mattress sutures crossing over the occlusal plane. Postoperative care consists of oral hygiene and dietary instructions; a recall appointment is usually scheduled for after seven to 14 days for the removal of the sutures.

Follow-up

The transplanted tooth is positioned in infraocclusion, and eruption occurs during healing; subsequently, the tooth makes contact with the opposite arch. This is a sign of periodontal healing. In not entirely successful cases, a partial ankylosis develops, preventing the eruption. Some restorative work may be needed to take care of the occlusion and eventually of proximal contacts. A complication is root ankylosis with resorption, but also in these unsuccessful cases, most often the tooth is functional for many years, and eventually an optimal implant site develops.

In teeth with open apices, after the transplant, the root formation will continue and the revascularisation will lead to the obliteration of the pulp, which can be observed on radiographs as part of the healing process. The tooth remains vital, but not sensitive, except for the proprioception of the periodontal ligament. Clinically, a recall is needed at one week to check suture stability, at two weeks for suture removal, after two to three months for endodontic treatment, at six months, at one year for radiographic follow-up and at two years for radiographic follow-up.

Case series

Clinical Case 1
A 47-year-old male patient in a good medical condition and a non-smoker was referred to our dental practice for endodontic retreatment of the right maxillary second molar. The dental history revealed that the tooth had been endodontically treated three months before because of acute pulpitis. After the treatment, the patient complained of pain on chewing. Antibiotics and a non-steroidal
anti-inflammatory drug were prescribed, but the pain remained. After a month, a sinus tract appeared. The tooth was re-treated in another practice without success. The clinical inspection revealed the presence of a sinus tract near the apical region of tooth #17. The tooth had been prepared for a full crown, but was without even a temporary crown, and the access cavity had been closed with temporary filling material. Cracks were evident on the buccal and mesial surfaces. Periodontal probing showed a deep pocket (> 12 mm) on the distal aspect of the root trunk (Figs. 1 & 2). The periapical radiograph showed a radiolucency between the roots of the second and third molars. The radiographic appearance of the endodontic treatment was good, without clear evidence of periapical radiolucencies (Fig. 3). A perforation of the pulp chamber floor was suspected. A CBCT scan was performed (Figs. 4–7), and it confirmed the suspicion of perforation, along with the presence of a large periapical radiolucency and an unfavourable root shape.

The treatment plan was discussed between the authors of this paper. According to the prognostic classification of Gorni and Gagliani, it was a tooth with a modified anatomy due to previous endodontic treatment and with a 47% possibility of successful retreatment. The prognosis is dependent on the presence of bacterial infection of the perforation site, and successful treatment depends mainly on immediate sealing and prevention of infection; perforation of the furcal region of molars is especially troublesome because this causes considerable mechanical damage. In this case, bacterial infection had been present for almost one year. The prognostic factors did not recommend any retreatment attempt, and the surgical option was ruled out because of anatomical considerations. However, the root morphology, position and size of the crown, good bone volume and quality, and possibility of atraumatic extraction and repositioning of the donor tooth recommended avulsion and transplantation of the adjacent third molar. After a discussion with the patient, a detailed informed consent form was signed and the procedure was scheduled.

After local anaesthesia with 2% mepivacaine with 1:100,000 adrenaline, the right maxillary second molar was atraumatically extracted. Initially with a size 15c surgical blade, the periotomy was realised and then the tooth was extracted after separating the roots to avoid unnecessary trauma to the alveolar bone. Then the donor right maxillary third molar was extracted after periotomy as described and transplanted into the adjacent site. Because of the slight differences in the root anatomy, it was necessary to remove the intraradicular bone septum of the receiving site to al-

Case 3—Figs. 16a–d: (a) Pre-op periapical radiograph. (b) Radiograph at the one-year recall. (c) Radiograph at the 11-year recall. (d) Clinical image after 11 years of function.

Case 4—Figs. 17a–d: Clinical images. (a) Extraction site of fractured tooth #47. (b) Tooth #48 positioned in the extraction site. (c) Two weeks after surgery, before suture removal. (d) Eight-year recall.
Clinical Case 4

A 23-year-old female patient presented with a vertical root fracture of tooth #47. Tooth #48 was transplanted to site #47. The tooth was fully functional after eight years (Figs. 17a–d & 18a–d).

Clinical Case 5

A 16-year-old female patient required extraction of a maxillary molar. Tooth #18 was transplanted to site #16. Root development was still continuing after two years (Figs. 19a–d).

Pulp histology and necessity of endodontic treatment

Full development of the root can be expected when surgery is performed under ideal circumstances and Hertwig’s epithelial sheath is preserved; moreover, it depends on the root length at the moment of transplantation.14 Teeth in the early stages of root development show less post-transplantation root growth than those with more mature roots, but incompletely formed apices.15 Pulp regeneration and revascularisation are expected when the apical foramen displays at least a diameter of 1 mm radiographically.16 Obliteration of the root canal is to be expected, owing to ingrowth of connective tissue. When roots are completely developed, root canal therapy is indicated.17 In one of our cases, pulp histology was performed on the tissue extracted from root canals, and connective tissue with low vascularity was found (Figs. 20 & 21).

Conclusion

The advantage of autotransplantation over implants is that it is a biological replacement, in which a vital periodontal ligament remains. This makes it possible to move a transplanted tooth orthodontically after the operation and to effect bone regeneration if necessary. In contrast to implants, a transplanted tooth normally erupts in harmony with the neighbouring teeth during further growth and development. The surrounding gingivae and interdental papillae are thus retained.

Autotransplantation can be considered an established treatment option with very high success rates. In addition to moving developing teeth, the autotransplantation of fully formed teeth could be considered an alternative to implant placement when suitable donor teeth are available.

Editorial note: A list of references is available from the publisher.
Case 1

Low tooth positioning, and a odontoplasty of the donor tooth crown was performed to maintain it not in occlusion. An antibiotic (amoxicillin/clavulanic acid, 1 g, by mouth twice a day for five days) was prescribed, along with rinses with 0.2% chlorhexidine. The tooth was kept stable with sutures (Fig. 8). A periapical radiograph was taken (Fig. 9). At the suture removal at two weeks, the tooth showed good stability, and positive adaptation of the soft tissue was observed (Fig. 10). At four weeks, the tooth was stable and the soft tissue looked healthy (Fig. 11). The patient did not show any adverse effects and stated that the tooth was fully functional. Examination of the avulsed second molar showed the extent of the perforation (Figs. 12 & 13).

Clinical Case 2

The left mandibular second molar of a 35-year-old female patient had been compromised because of a vertical root fracture and a large periapical lesion was present. After explanation and informed consent, the treatment was scheduled. The right mandibular third molar was preferred as a donor to the left mandibular third molar because of a more compatible anatomy and for an easier stabilisation. After local anaesthesia of both the donor and the recipient sites with 2% mepivacaine with 1:100,000 adrenaline, the left mandibular second molar was extracted and the alveolus debrided. Then the donor tooth was atraumatically extracted, quickly repositioned in the recipient site and stabilised with sutures at about 1.5–2.0 mm of infraocclusion. An antibiotic (amoxicillin/clavulanic acid, 1 g, by mouth twice a day for five days) and a non-steroidal anti-inflammatory drug (ibuprofen, 600 mg, by mouth twice a day for five days) were prescribed, along with rinses with 0.2% chlorhexidine. The sutures were removed after two weeks and endodontic treatment was performed after three months. The periapical lesion healed and the tooth was fully functional after 12 years (Figs. 14a–d & 15a–d).

Clinical Case 3

A right mandibular first molar of a 16-year-old female patient with heavy structural damage was extracted after explanation, informed consent and a mandibular block with 3% mepivacaine. The receiving site was debrided, and the right mandibular third molar was atraumatically extracted, positioned in the alveolus and stabilised with sutures. An antibiotic (amoxicillin/clavulanic acid, 1 g, by mouth twice a day for five days) and a non-steroidal anti-inflammatory drug (ibuprofen, 600 mg, by mouth twice a day for five days) were prescribed, along with rinses with 0.2% chlorhexidine. The sutures were removed after two weeks and the endodontic treatment was performed after two months. The tooth was still in full function after 11 years (Figs. 16a–d).

Case 4—Figs. 18a–d: Radiographs. (a) Pre-op panoramic. (b) Immediately after transplantation. (c) One-month recall, after endodontic treatment. (d) Eight-year recall.

Case 5—Figs. 19a–d: Radiographs. (a) Pre-op periapical. (b) Immediately after transplantation. (c) One-year recall. (d) Two-year recall.
Direct pulp capping as a conservative procedure to maintain pulp vitality

Dr Jenner Argueta, Guatemala

From a completely optimistic point of view, the ultimate goal for every dentist performing a restorative and/or endodontic procedure should be to maintain the pulp vitality and functionality of the tooth without any discomfort for the patient. The pulp tissue is needed to provide nutrition, innervation and immunocompetence, with these acting as a defence mechanism and alerting to the presence of any external aggression.

The pulp tissue may be exposed to the oral environment as a result of dental caries or by mechanical means when performing restorative or prosthetic procedures. Two possible treatment options in these types of cases are root canal therapy and tooth extraction; the former procedure is a good choice, whereas the latter should be avoided at all costs in order to maintain the patient’s oral health and natural function.

A third alternative in the case of pulp exposure is to use conservative vital pulp therapy procedures, which include direct pulp capping, indirect pulp capping where
the pulp is not fully exposed, and partial or total pulpotomies; this way, it is possible to maintain the vitality of the tooth, the nociceptive function and the body's self-defence system. Thanks to the points mentioned previously, among others, it has been shown that teeth with no root canal therapy survive longer than those that have been treated endodontically.2, 5, 6

Next, we present two clinical cases in which the pulp tissue was exposed mechanically when carious tissue was removed. In both cases, it was managed to maintain the pulp vitality of the affected teeth by means of direct pulp capping. The vital pulp capping protocol suggested in this article is presented in the first case. The second case describes a treatment performed with long-term follow-up, where full formation of calcified tissue below the capping material could be observed by means of radiography. The treatment protocol was similar in both cases.

Clinical Case 1

The 24-year-old patient attended the dental clinic with transient provoked pain in tooth #19 (Fig. 1). The diagnosis was reversible pulpitis. The carious tissue was removed under complete isolation, producing two incidences of pulp exposure, with minimal bleeding (Fig. 2). Bleeding was stopped by applying pressure for 10 seconds using a cotton swab dampened with a sterile saline solution. The cavity was disinfected with 2.5% sodium hypochlorite (Fig. 3), and then white mineral trioxide aggregate (MTA, Produits Dentaires) was placed as a direct pulp capping material (Fig. 4). To ensure that the MTA was placed accurately, the MAP System micro-applicator for dental materials (Produits Dentaires) was used. This system allows the clinician to place the material exactly on the exposure site, and this avoids staining the dentinal walls, which could over time show pigmentation due to the material used (Figs. 5 & 6). Once the MTA was placed on the sites of pulp exposure and the deep parts of the pulp chamber roof, a light-curing calcium hydroxide paste was applied. This was used to protect the material (Fig. 7) and to be able to proceed to the bonding procedure, to put the final restoration of the tooth in place during the same session (Figs. 8 & 9). Seven days after the procedure, the patient was completely asymptomatic and the tooth responded normally to sensitivity tests. In clinical situations like this, it is expected that there will be radiographic evidence of mineralised tissue formation below the cap between six and nine months after the procedure.7

Clinical Case 2

The 35-year-old patient attended the dental clinic with transient provoked pain in tooth #4. The diagnosis was
reversible pulpitis. The same vital pulp therapy protocol described in the first case (Figs. 10–12) was followed, except that in this case, the permanent restoration was not put in place during the same session. In its place, a temporary non-radiopaque restorative material was placed. This made it possible to ascertain the suitable thickness of the pulp capping material and its precise positioning at perforation level, while keeping the dental margin clear for a good bonding protocol (Figs. 13–15). It has been reported that the success rate of vital pulp therapy procedures may drop when the final restoration is put in place two days after the initial procedure. The MAP System is very useful for precise and stable placement of the capping material in direct procedures, indirect procedures, and partial and total pulpotomies. Here, the final restoration was placed 15 days after the initial procedure and the patient was completely asymptomatic. Nine months later, full formation of calcified tissue could be seen at the level of the pulp capping, the tooth remained vital and the patient was completely asymptomatic (Fig. 16).

Obtaining the right diagnosis is key to the success of conservative pulp therapy. An ideal case is a diagnosis of reversible pulpitis with no previous history of spontaneous or prolonged dental pain. It is generally accepted that a history of spontaneous pain or pain at night is associated with the existence of an irreversible pulp inflammation process. In these cases, the success of direct pulp capping may be questionable, although there are studies indicating that vital pulp therapy can be successful even in these situations.

When it comes to the long-term success of conservative pulp procedures, it is extremely important to provide a final permanent restoration for the tooth that ensures a suitable marginal seal. The reason is that this last factor, in conjunction with the absence of bacterial contamination during the procedure, is among the most important factors to consider in order to avoid subsequent pulp inflammation. The success rate reported for vital pulp therapy procedures using MTA with a follow-up period of up to ten years is greater than 80%—a fairly high percentage for a dental procedure within that functional period.

It appears that conservative pulp management is becoming more popular as time goes on. Here, considerations include the importance of the pulp tissue, current advances related to protocols and appropriate materials for procedures to maintain pulp vitality, and economic factors that influence decision-making in many countries, causing many patients to tend towards the premature extraction of teeth owing to the cost of root canal therapy.

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

about

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Minimally invasive root canal shaping—A new protocol

Dr Bogdan Moldoveanu, Romania

Minimally invasive—the most well-known oxymoron in dentistry—is probably nowadays considered the new standard of care in almost every field of dental medicine, but more so in endodontics. Despite improved oral and dental health, the demand for endodontic treatment and restorations remains high among individuals with relatively complete dentition and dental awareness.1 The need for adequate endodontic treatment is most likely one of the driving forces behind all the improvements that have reached practitioners in recent years. The use of nickel-titanium (NiTi) rotary files in root canal preparation is one of those improvements and has provided a reduction in the frequency of procedural errors and the time required for chemomechanical preparation in relation to manual files.2

Shaping is considered a crucial phase in root canal therapy because it not only is aimed at removing remaining pulp tissue, microorganisms and debris, but should also create the preconditions for effective irrigation and obturation.1,4 These tasks should be accomplished without altering the diameter and position of the apical foramen or excessively weakening the root in any part. New instruments have been introduced every year, each claiming to be better than the previous one and having the ability to provide a better outcome. Regardless of any commercial interests, with regard to root canal shaping, from the aspect of the success of endodontic treatment, it is very important to maintain the original form of the canal as far as possible while the root canal is being gradually enlarged from the apical to the coronal region.3

The need for successful endodontics has probably set the stage for a new generation of rotary files, made with heat-treated NiTi. The various thermomechanical procedures and the improvement in composition of the alloy that is used in manufacturing NiTi files are aimed at improving the flexibility of NiTi files.5–7 Improved flexibility of NiTi files would minimise the intracanal irregularities, such as canal transportation, and would ensure an increase in the success of root canal therapy.

One of the most well-known instruments when it comes to heat-treated rotary files are the HyFlex CM files (COLTENE). The controlled memory (CM) wire made with a thermally treated NiTi alloy, owing to the austenite/martensite transformation, has a stable martensitic microstructure at body temperature.8 Therefore, the structure of HyFlex CM enables significant fatigue resistance, ease of bending and the ability to return to its original shape when heated above the transformation temperature.9

Recently, COLTENE has introduced a new type of file, the 20/05 EDM (the preparation file), which comes as a much-needed addition to the already existing EDM shaping system. HyFlex EDM instruments (COLTENE) are manufactured using the technique of electrical discharge machining and are the first endodontic files to be made with this method.10 Electrical discharge machining can be used in manufac-
turing all types of conductive materials (e.g. metals, alloys, graphite and ceramics) of any hardness at high precision levels. This manufacturing process uses spark erosion to harden the surface of the NiTi file, resulting in superior fracture resistance and improved cutting efficiency. HyFlex EDM NiTi files are manufactured using CM alloy technology just like the HyFlex CM NiTi files. HyFlex EDM 25 has a taper that changes throughout the file shaft and a 0.25 mm apical diameter. Throughout the file shaft, HyFlex EDM 25 has three different cross sections: quadratic in the apical third, trapezoidal in the middle third and almost triangular in the coronal third. The other HyFlex EDM files (10/05 and 20/05) have a single taper of 0.05 throughout the working part.

The purpose of this case report is to present a new protocol that uses only three files in order to reach an optimum result, sacrificing a minimal amount of dental structure. One of the most important things that a clinician can focus on is being open-minded to question the paradigms of our profession. In time, some paradigms can become a false “standard of care” to those who blindly follow statements that are not supported by valid information. Adherence to some ideas promoted in the virtual or actual professional environment may ruin the balance of accurate knowledge, leading both clinicians and researchers to understand things solely from their perspective, for it seems evident to them that there is no other way to be. This is what we have come to know as the settlement of the paradigm.

One of the most well-known paradigms in endodontics concerns the instrumentation of curved root canals, for which it is believed that the use of a #25 file in the apical portion fulfills all of the cleaning and shaping objectives of root canal therapy. The idea behind this theory is mostly centered around what can happen if one over-instruments the root canal. Failures such as deviations, perforations and zipping may have a higher rate of occurrence when one enlarges the apical diameter beyond a #25 file. However, when one is treating a tooth exhibiting signs and symptoms of periapical periodontitis, further enlargement by hand files might be required, since it appears that the minimum instrumentation size needed for penetration of irrigants to the apical third of the root canal is a #30 file.

Case report

The patient who is the focus of our discussion came to our office reporting intense pain in response to hot and cold stimuli in the left maxilla (Fig. 1). He described the pain as being spontaneous at times and that in order for it to subside administration of anti-inflammatory medication was required. Upon examination, an accurate diagnosis was established of symptomatic irreversible pulpitis affecting tooth #27. The patient had had the tooth prepared for a crown sometime in the last 60 days (Fig. 2), but unfortunately the treatment was not completed for unknown reasons. Caries seemed to be absent; therefore, a minimally invasive approach was planned. Most likely, the pathology was caused by either trauma or an iatrogenic event.

After isolation of the tooth (Fig. 3), an access cavity was created using high-speed diamond burs and ultrasonic tips (Figs. 4–8). Pre-flaring in the coronal and middle thirds was done with the HyFlex EDM 25 instrument (at a torque of 4 Ncm and a speed of 500 rpm). It is a proven fact that pre-flaring allows an increase in the instrument size that binds in the root canal, irrespective of the discrepancy between the size of the file and anatomical diameter. Afterwards, canal scouting was performed using an ISO size 10 stainless-steel K-file up to working length. Upon establishing the working length, with the help of an apex locator, the 10/05 EDM file (glide path file) was used up to working length (at a torque of 4 Ncm).
of 3 Ncm and a speed of 300 rpm. Subsequently before finishing the preparation with the 25 EDM file, the 20/05 EDM (preparation file) was used to full working length (at a torque of 3 Ncm and a speed of 400 rpm). At this point, the working length was confirmed again with an ISO size 20 NiTi K-file. Root canal shaping was completed with the 25 EDM file, which was inserted to full working length (at a torque of 3 Ncm and a speed of 400 rpm; Figs. 9–12).

This recommended shaping protocol also has the benefit of extruding less debris outside the root canal, thus improving the patient’s quality of life after the completion of the therapy. Dentinal and pulp tissue debris, microorganisms and irrigating solutions may extrude into periadicular tissue during the preparation of root canals, thus causing complications such as postoperative pain, inflammation/infection and flare-up, and possibly delaying the healing process.

The instruments in such an order are also very well suited for maintaining the anatomy of the root canals. The HyFlex EDM 25 file determines slightly less transportation at every level and in most cases stays a little more centred compared with other instruments available.

Using the HyFlex EDM instruments as opposed to the HyFlex CM ones is no random choice. HyFlex CM files are manufactured via a grinding procedure. Grinding procedures during the production of NiTi files cause the formation of irregular areas, such as pits, fissures and metal folds. Being subjected to huge flexural and torsional forces, the instruments need to be resistant and the surface of the file must not change throughout the therapy. According to a study by Uslu et al., the surface of used HyFlex EDM files was found to be statistically significantly rougher than that of used HyFlex CM files. The surface properties of HyFlex EDM files, when compared with those of HyFlex CM files, were better retained after use for severely curved root canal preparation.

The sequence proposed in the present article is easy to use, easy to learn and highly versatile. One may adapt it to different cases, be it a severely curved mesial root of a mandibular molar or a highly calcified canal in a mandibular central incisor. Following several easy steps, but respecting the order in which the files must be used, success is just around the corner.

After chemomechanical treatment, the root canals were filled using a single-cone filling technique (ROEKO Guttapercha Points and ROEKO Guttaflow bioseal, both COLTENE), and the access cavity was sealed using composite materials (Figs. 12–16).

Conclusion

Living in a world full of endodontic opportunities, it is important that the clinician use all the means available to provide the best quality of care for patients. Hopefully by applying this particular sequence in root canal therapy, the clinician can achieve the task more easily and in a much safer manner.

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

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Maxillary sinus and root canal therapy complications

Drs Valerie Batrouni, Pamela Kassabian, Edgard Jabbour & Philippe Sleiman, Lebanon

Introduction

The maxillary sinus is the largest paranasal sinus and overlies the maxillary alveolar process. The topographic anatomical relationship between the maxillary posterior teeth and the maxillary sinus necessitates great care in performing endodontic treatment.

It has been suggested that the incidence of sinusitis of dental aetiology is increasing. One reason for this apparent increase may be the availability of improved imaging, specifically in-office cone beam computed tomography (CBCT) scanning.

In fact, many accidents can occur during endodontic treatment that can affect the sinus, starting from the cleaning and shaping phase. A simple #10 K-file (Kerr Dental) can pass beyond the apex and perforate the sinus membrane, and the periodontal ligament will be damaged by losing its resistance to pressure, making it very easy for pressure irrigation to irritate the sinus cavity. The accidental extrusion of sodium hypochlorite into the maxillary sinus can cause a burning sensation, accompanied by nasal bleeding, swallowing of blood and interrupted breathing. The use of the EndoVac system (negative pressure; Kerr Dental) safely delivers irrigants to the apical terminus of root canals.

During the obturation phase, endodontic sealers that contain zinc oxide are considered to be a growth factor for Aspergillus (fungus). The authors suggest that the possibility of contaminated obturation material introducing spores into the sinus should be considered.
Clinical Case 1

A patient was referred to the office with problems related to separated files. He was a pilot and was complaining of pus draining from his nose when flying. From the preoperative radiograph (Fig. 1), it was clear that there were two separated file fragments in the mesial canals and one cone passing beyond the apex in the palatal root. I requested an iCAT scan, and from this, the left sinus was clearly almost full with inflammatory fluid (Fig. 2) and the cone in the palatal canal was clearly emerging into the sinus. We could also see the two separated files in the two mesial canals clearly in the MPR view (Figs. 3 & 4), as well as another file entering the sinus and not attached to the canal (Fig. 5). We could see the file using different filters (Figs. 6–9), as well as the inflammation inside the sinus and the separated file. We additionally gained a better idea of the location of the cone protruding from the palatal canal into the sinus.

The treatment plan was to try to solve it with a conventional approach and if necessary to perform microsurgery to save the tooth. With the help of H-files, I managed to retrieve the cone from the palatal root, but the files inside the mesial root were impossible to bypass or even to reach with ultrasonic tips. I decided not to overdo it in order to avoid creating an additional problem, like perforating the canal, and decided to seal the canals (Fig. 10). A surgical approach was immediately taken for the mesial canals, cutting 3 mm of the mesial root using the Impact Air handpiece (SybronEndo), and this gave me a direct view of the Schneiderian membrane, where the third file was barely hanging (Figs. 11 & 12). I managed to delicate grab it and to remove it (Fig. 13). Figure 14 shows the postoperative situation, after performing retrograde preparation of the mesial canals.

Clinical Case 2

The patient was referred for a dull pain affecting a maxillary molar. On the preoperative radiograph, we could see a diversity of obturation materials, including single cones, resin cement and silver cones, with some of them already fragmented and one piece protruding from the root. Looking closely at the sinus and the sinus membrane, we could see that the membrane had been perforated by the inflammatory/infection process, which had led to sinus infection (Fig. 15).

Under the operating microscope and using ultrasonic and K3XF rotary files (Kerr Dental), I managed to clear the root system of all the previous obturation materials, and placed a dry cotton pellet and temporary cement, as the patient had become tired during this long appointment (Fig. 16). Figure 17 shows some minor debris of silver cones that had passed beyond the mesial apex and using the MacroCannula of the EndoVac, I managed to retrieve one small piece of the silver cone and to complete the chemical cleaning of the root canal system.

Figure 18 shows the immediate postoperative situation, focusing on the obturation of the mesial canals, and a slight improvement of the membrane and the sinus is evident. Figure 19 shows the three-month follow-up with an almost complete closure of the membrane and the bone of the sinus floor.
The maxillary sinus is located at a lower level than the floor of the nasal cavity, and it is closely associated with maxillary tooth roots. Some studies have shown that the palatal root of maxillary first molar is most commonly found inside the maxillary sinus, while others have found that the mesiobuccal roots of the second molars have the greatest protrusion into the sinus.

Diagnosing maxillary sinusitis of dental origin requires a careful clinical and radiographic examination. It has been suggested that the incidence of sinusitis of dental origin is increasing, or at least we are becoming more aware of it. One reason for this finding may be the availability of improved imaging, such as in-office CBCT scanning. CBCT provides an accurate evaluation of maxillary bone quality and quantity around posterior root apices without the distortions and superimposition caused by teeth and the surrounding structures, and it can give us a clear idea about the position of the roots and apices vis-à-vis the sinus cavity and the membrane. If the Schneiderian membrane has a thickness of 0.5 mm and greater, with or without the presence of an apical radiolucency, the tooth is considered to have an endodontic infection. Sinus membrane perforations can have several sequelae, including reduced resistance to infection, and the most frequent complications are nose bleeding, sinus obstruction, and acute or chronic sinus infection.

In the presence of a periapical lesion, studies have shown that potent virulence factors are produced because of pulp necrosis, such as collagenase and lysosomal enzymes, which promote the destruction of periapical tissue and may reach the maxillary sinus. Bacteria and toxins in apical lesions may infiltrate the maxillary sinuses via direct diffusion through porous maxillary bone or through blood and lymph vessels, causing thickening of sinus mucosa.

During obturation, extrusion of the obturation materials is dependent on the root filling technique used and the skills of the operator; the root may have been over-instrumented and the apical seal not created, which can result in the extrusion of obturation material into the sinus. Also, bacteria may colonise the surface of the extruded material, sustaining apical inflammation/infection. Furthermore, the extrusion of endodontic sealers that contain zinc oxide is considered to be a growth factor for Aspergillus. The authors suggest the possibility of contaminated root canal obturation material introducing spores into the sinus.

The authors recommend the following to avoid iatrogenic errors:

1. respecting the working length during the initial shaping procedure and taking the working length at the first exploration of the roots;
2. keeping the working length stable on the rotary files by placing two rubber stops and retaking the working length after the coronal flaring;
3. using the negative pressure technique in order to avoid any extrusion of any chemical product beyond the apex in the irrigation phase;
4. a carefully adjusted tug-back of the cone and respecting the protocol of obturation in order to avoid any extrusion of the material beyond the apex (over-extrusion) and into the sinus in the obturation phase;
5. respecting proper mixture and dosage of the sealer so that a creamy mixture not a fluid one results—paste fillers are not to be used to push the sealer into the canal.

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

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Apical lesions:
To treat or not to treat?

Dr Christophe Verbanck, Belgium

Introduction

What do endodontic experts base their decisions on: intuition, experience or CBCT imaging? The following case report on a 10-year-old patient shows that an apical lesion does not necessarily mean the affected tooth has to go. Using flexible nickel-titanium (NiTi) files, even root canals with curves or special features can be cleaned safely and with long term success.

While much evidence exists in clinical dentistry, it is mainly of relatively poor quality. As a result, many clinicians rather rely on their own clinical experience. An apparently simple clinical scenario can be treated several ways and still have a favourable prognosis in each case, as various discussions in expert groups on the corresponding social media channels suggest. Endodontic treatment is no exception. Recent work at Ghent University in Belgium has shown that dentists are frequently biased when it comes to making treatment decisions. For example, for a tooth presenting with a persistent and chronic asymptomatic apical lesion, an endodontic specialist will more readily choose retreatment or apical surgery than extraction and rehabilitation with an implant and crown or no treatment at all—quite the opposite is true for prosthodontists and oral surgeons. In fact, the treatment should actually be driven by the patient, giving informed consent after he or she has been informed comprehensively about treatment options, and their inherent benefits and risks, and after he or she has been given estimations on the longevity of every option. This article will use a case report in order to discuss whether (and if so, at what stage) apical lesions should be treated.

Endodontic treatment choices

Recent data from Ghent University and other epidemiological studies show that an extraction was chosen in...
22% of cases where an apical lesion of up to 1 cm was present. If the lesion was larger than 1 cm, an extraction became even more attractive for the participants: 50% opted for this option. This conclusion might seem logical; however, the dentists that took part in the study had no idea about the histology of the present apical periodontitis (i.e. whether it was a true cyst, an apical pocket cyst or periapical granuloma) because their decision-making process was based on radiographs alone. Naïr claims that it is impossible to make a differential diagnosis between cystic and non-cystic lesions based on radiographic information alone, and if not followed up, it is also impossible to say whether the lesion is healing or worsening.2

Moreover, when the limitations of 2-D radiographs are considered, it is evident that these hold implications for evaluation and clinical planning.3 Wu et al. showed that there was a high incidence of teeth with a healthy or healing periapex confirmed on a conventional radiograph that showed apical periodontitis on cone beam computed tomography (CBCT) and by histology.3 Evidence thus suggests that even the main imaging modality of our times can be misleading and inaccurate when considered in isolation (Figs. 1 & 2a–c).

Although CBCT can more accurately and reliably detect and measure the size of an apical lesion, unfortunately there are no studies that justify the use of CBCT as a standard diagnostic tool for periapical lesions.4 Morris et al. concluded that, if root canal therapy is necessary and teeth are still restorable with a direct or indirect restoration and have a (long-term) positive or controllable periodontal situation, an endodontic treatment should always be the first option.5 The presence of apical periodontitis and its size should be of no concern—at this point—to making a treatment choice.

**Does size matter?**

In general, the literature suggests, as well that the larger the lesion, the more unfavourable the conditions for healing. The reason is quite simple: a larger lesion normally needs a long time to grow. The more established a biofilm becomes, the greater the diversity of bacteria and the more it compromises a predictable treatment outcome.6 As this approach is somewhat speculative, more research needs to be done,7 although in general it can be stated that for every millimetre increase in the radiographic periapical area, the likelihood of success decreases by 14% in comparison to cases with no lesion at all. Especially in endodontic microsurgery, there is a negative correlation between the size of the lesion and the possibility of healing,8 but this does not mean that a surgical approach necessarily follows the initial endodontic treatment.

In conventional root canal therapy, a lesion size equal to or greater than 2 mm (on a conventional radiograph) is considered a risk factor for potential reintervention after initial treatment—even though this is complicated by the fact that the dimensions of a radiographic lesion are, to a certain degree, based on clinical judgement and radiograph angle and quality.9

Larger radiolucencies are more likely to be cystic of nature, but as stated before, it is impossible to make a correct histological judgement based on a radiograph alone.2 Larger anomalies also tend to expand into nearby anatomical structures, which, in turn, tends to be unfavourable for endodontic (surgical) treatment because of the potential risk of those structures being affected during the procedure (e.g. sinus and nasal cavities, and mandibular nerve canal). This does not mean that therapy is impossible, but it becomes less predictable and more in need of the intervention of a specialist.

**Case report: Young patient with a chronic apical abscess**

A 10-year-old patient was referred for root canal therapy on a right mandibular molar. Tooth #46 showed the clinical presence of a sinus tract on the buccal aspect. The referral letter stated that the possibility of success could be low because of the large area affected by apical...
periodontitis and that an extraction would be necessary. Nonetheless, both the patient and the parents were keen to try to save the tooth.

After clinical and radiographic examination, pulp necrosis and a chronic apical abscess were diagnosed (Figs. 3 & 4). Probing of the buccal sinus tract led to the apex. Since it is impossible to know the histology of an apical radiolucency of this size, endodontic treatment was the first choice, although the furcation could be probed, which made the periodontal situation less predictable. The choice was also based on the expectation that root canal therapy would be far less complex than an extraction with the following orthodontic and prosthodontic treatment.

The endodontic treatment consisted of two appointments. During the first appointment, tooth #46 was isolated with a dental dam and all caries was removed. For cleaning the root canals, a modular NiTi file system (HyFlex EDM) by Swiss dental specialist COLTENE was used (Fig. 5). After coronal flaring, the canals were shaped and cleaned using HyFlex EDM files up to a file size of 40/04. The reason for using this system was the high flexibility of the files that compensates for the fact that the slightly curved mesial canals were difficult to reach with limited mouth opening. In addition, only a small number of files are necessary to accomplish proper apical enlargement. The files move perfectly through the centre of the canal, which allows a significant reduction in the number of files used without compromising the preservation of the natural root canal anatomy.

Chemical debridement and disinfection was carried out with sodium hypochlorite (5.25%) and ultrasonic activation in order to employ acoustic cavitation. After the placement of an intermediate dressing with non-setting calcium hydroxide, the tooth was restored with a composite restoration to avoid coronal leakage with a teflon barrier in between.

Flexible shaping to file size 60/02

At the second appointment, the sinus tract was still present, but probing at the site of the furcation was almost impossible. The swelling was almost completely gone (Fig. 6). Once again, the tooth was isolated with a dental dam and both mesial canals were shaped with HyFlex EDM Finishing files to a final size of 50/03. For the distal canal, we used a sequence of files up to size 60/02. Further cleaning was performed with sodium hypochlorite and a penultimate rinse of citric acid (40%). Since there was no draining of pus into the root canals upon drying the canals or coming from the sinus tract, both mesial canals were obturated with a bioceramic sealer. The distal canal was sealed with an apical plug of mineral trioxide aggregate at the apex. The distobuccal cusps were completely covered with composite. Further ameliorations of the restoration might be necessary once tooth #47 is in its final position (Fig. 7).

After three months, a recall appointment was planned to follow up on the healing of the sinus tract. The mucosa had healed and there was no longer any sign of the sinus tract. Buccal probing of the furcation was almost impossible and the radiograph showed almost complete healing (Figs. 8 & 9).

If I was not an endodontic specialist with a high affinity for root canal therapy in general and a great desire to try to save every tooth, I probably would have opted for extraction for several reasons:

- The referring dentist was in doubt as well.
- A large area affected by apical periodontitis was present on 2-D imaging.
- The sinus tract did not completely heal after the first treatment with an inter-appointment calcium hydroxide dressing.
- The periodontal situation was not certain at the start of the treatment because the furcation could be probed.
- The compliance of patients of this age is not always predictable and sometimes requires more steps.

Radiographic success at last?

Considering the studies mentioned in this article, the case presented shows that prejudices and subjective diagnosis should not withhold us from performing a root canal ther-
apy in the case of a large apical lesion. With informed consent and the correct motivation from the patient’s side, root canal therapy should always be the first choice. In the case described, it appeared to be the right decision ultimately.

Although conventional 2-D imaging that is used for (early) follow-up might hide the presence of lingering apical periodontitis (or a lesion growing in another direction) and CBCT imaging might be the only true indicator of our ability to reduce or prevent further apical infection, there is no way to make a distinction on a radiograph or CBCT scan between scar tissue and apical infection when no clinical symptoms are present whatsoever. This leads to the final question, whether it is necessary to seek absolute (radiographic) success or just clinical survival.

Conclusion

Combining several imaging tools helps endodontic specialists to make the right diagnosis and treatment choices in cloudy clinical situations. With modern pre-bendable NiTi files, even root canals with severe curves can be shaped efficiently, just as anatomies with apical lesions and sinus tracts can be. In the long run, even teeth might be preserved that were condemned to be extracted by the referring dentist or at least present challenging conditions to the endodontic expert.

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

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Soft-tissue management in endodontic microsurgery

Modern procedures/techniques lead to more favourable long-term therapeutic success

Dr Francesco Maggiore, Germany

Modern endodontic microsurgery is drastically different from traditional endodontic surgery in many ways. Accurate diagnosis provided by cone beam computed tomography (CBCT), knowledge of the soft-tissue physiological principles, proper magnification and illumination provided by an operating microscope, conservative osteotomy and root resection, microscopic management of the apical third, the use of ergonomic microsurgical instruments such as micromirrors and ultrasonic tips, and the application of biocompatible and bioceramic materials are just some of the key features of current microsurgical procedures and promote a favourable long-term outcome.

In particular, proper flap design and soft-tissue management are among the most important concepts in current endodontic microsurgery. The primary purposes of flap design and elevation are to provide adequate surgical access to the underlying bone and root structure and to promote scar-free soft-tissue healing. Flap design and elevation should prevent any damage to adjacent critical anatomical entities. The major flap designs used in endodontic microsurgery are the paramarginal and the intrasulcular flaps; the outline can be either triangular or rectangular. The flap outline mainly depends on the length of the roots, the proximity of anatomical structures and accessibility to the apical area of the treated teeth.

Owing to the position of the roots and root apices, surgery on anterior teeth relies on direct and straightforward access to the apical lesion. Furthermore, the aesthetics of the soft tissue is a priority. In the molar region, the aesthetic appearance of the soft tissue plays a secondary role, with the focus being on convenient and adequate surgical access to the root apices that allows for faster and complication-free endodontic surgery.

**Fig. 1:** Pre-op radiograph of tooth #14. The tooth was symptomatic and sensitive to percussion.

**Fig. 2:** Clinical pre-op photograph of the soft tissue. **Fig. 3:** A triangular paramarginal flap was raised to access and treat the apical third of tooth #14. **Fig. 4:** Intra-op photograph of the resected root.
Paramarginal flaps and incisions at the level of the papillae are preferably performed using a microblade, which has the advantage of minimal trauma, especially in the presence of thin or poorly keratinized tissue. The use of a microblade often results in scar-free healing, which is particularly important when surgery is conducted on anterior teeth or when aesthetics plays a primary role.

Once the apical microsurgery has been completed, great care has to be taken in repositioning and suturing the elevated soft tissue. The ultimate aesthetic result of the soft-tissue manipulation depends on several factors, such as the tissue biotype, the kind of incision performed, the choice of instruments used for incision, the elevation and retraction of the flap, as well as the careful reapproximation and proper suturing technique.

In endodontic microsurgery, the most commonly used suturing techniques are the single-knot suture and the continuous sling suture. Synthetic monofilament 5/0, 6/0 or 7/0 sutures are generally used to secure the flap.

Figures 1 to 10 demonstrate a clinical case of soft-tissue healing after endodontic microsurgery performed on tooth #14.

*Editorial note: This article was first published in Dental Tribune Germany, Issue 7/2017.*

“The ultimate aesthetic result of the soft-tissue manipulation depends on several factors, such as the tissue biotype, the kind of incision performed, the choice of instruments used for incision, the elevation and retraction of the flap, as well as the careful reapproximation and proper suturing technique.”

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**Fig. 5:** Synthetic monofilament 6/0 sutures were used to secure the flap in its original position. **Fig. 6:** Note the reapproximation of the soft tissue at the junction between the vertical and horizontal incisions (10× magnification). **Fig. 7:** On the day of suture removal (72 hours after surgery), the tissue showed good healing.

**Fig. 8:** Clinical photograph of the soft tissue immediately after suture removal. **Fig. 9:** Control of the soft tissue two months after the surgery. **Fig. 10:** Control of the soft tissue four months after the surgery. The vertical and horizontal incisions are barely visible.
Successful communication in your daily practice

Part IV: Promoting a new service

Dr Anna Maria Yiannikos, Germany & Cyprus

My dear readers, be cordially welcomed again to the series “Successful communication in your daily practice”. I am Dr Anna Maria Yiannikos, and I am in the happy position to present you the 4th part of this series filled with helpful communication protocols. This series includes the most popular and challenging scenarios that might occur at your dental practice, and how you can deal with them so that your patients always leave your practice feeling: “My dentist is THE BEST!”

The specialised communication protocol that will be presented to you today, and that will not only help you to solve your clinics communication problems but also to increase your revenues, is… how to promote a service or technology before you apply it. In the following, I will be describing 5 unique steps that will guarantee the increase of your patients’ interest!

Promoting a new service

Over the years, you will have the urge to buy new equipment, to launch new technologies or a new service at your clinic (like for example laser, CAD/CAM technology or implant treatment). Everyone knows that this is the correct approach if you want to keep ahead from competition and have a constant improve to the quality of your services.

Your concern of course is how you will inform your patients as soon as possible about this new development in order to have the desirable impact and results. You want to boost their interest in your new service so that they will accept it immediately when you propose it to them for the first time.

5 steps to promote a new service

Congratulations! You have decided on widening your portfolio to another great service or technology! After having implemented the new service, take a second to think of what you are expecting from it. Do you expect to gain an increase on sales, on profits, and an immediate ROI (Return On Investment)? Just picture yourself receiving the above results successfully by using only the following 5 essential steps.

Step 1: Clarify your patients’ interests

Before you are going to apply the unique new technology in your dental clinic (although you have already ordered it from your supplier), make a short patient survey in which you should ask the following questions:

“Tick the most desirable new technology that you find essential for your dental treatment.” (Technologies listed below) or
“In case that we have this new service, would you choose it?” or
“Would you share the information of this new technology or service that you have heard of we are offering at our clinic?”

Be sure that your patients already know about the benefits of the new technology you want to apply in your practice. Otherwise, rephrase the question. In case of buying a laser device, the question could be for example:

“Would you be interested to get a filling without pain, drill, and anaesthesia with our latest laser technology equipment?”
After having clarified your patients’ interests, proceed with step 2. But, you should be careful with the following step! Although, you probably might already know that you are going to implement a certain new service, you should be 100% sure of this before starting a promotional campaign to educate your patients. Otherwise, you might lose them. Once a desire is initially raised, they might try to find a similar service elsewhere, and switch to one of your colleagues/competitors instead.

Step 2: Educate your patients

Start educating your patients through your blog, articles on your Facebook page, and your website. Be sure to thoroughly explain to them the WIIFM (What’s In It For Me) concept—the actual benefits for them! Otherwise, I will guarantee you that they will not pay any attention to what you are saying or doing.

Step 3: Talk personally

Talk personally with your patients regarding the upcoming technology when you have them on spot. When talking to them, you should use phrases like:

“Because you are one of the most valuable patients we have, I would like you to be one of the first to know that we will soon have this unique service at our clinic…”

Step 4: Use opinion leaders

Another crucial step in order to promote your new service is to talk about it when you are in social gatherings. You should treat this “news” like it was gossip, as if you are informing your close friends about the latest trend they need to know all about. Grab the opportunity when you go out with friends and talk about the new thing at your clinic that you are so excited about. Remember: Always explain the benefits!

Furthermore, you can educate the public by making your own VIP seminars at your clinic. This is a very powerful promotion tool that I can highly encourage you to use.

Step 5: Be the expert

It does not matter whether other practices offer the technology or technique you have recently implemented to your practice as well. What is crucial is to demonstrate and emphasise those points that differentiate your service from others. Differentiation points could be your unique specialisation in this certain subject, or remarkable courses that you attended in order to gain expertise. Don’t be shy to inform the public of how well-educated you are in this special new service or technology. Your patients will already await your new service and will be excited about it. Imagine that they will wait in line for your latest service to be applied at them! I always implement the above 5 steps when I have a new service to introduce to my patients.

These strategy is definitely working, which I can tell you from my own experiences. When I bought my first laser device 15 years ago for example, investment costs were actually covered within six months. You think that this is too difficult? Not at all! You only have to focus, be prepared, and use the 5 steps strategically!

In the next issue of roots magazine, I will present to you the fifth part of this unique series of communication concepts. In this, I will teach you how to deal with a bad online review from a stranger. I will help you to discover the 5 fantastic tips that you will just love!

Until then, remember that you are not only the dentist of your clinic, but also the manager and 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!

contact

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Has the enigma of the single instrument been solved?

Dr Guillaume Jouanny, France

Introduction

Since the publication of an article in 2008 describing the use of a single nickel-titanium (NiTi) file for canal preparation, the manufacture of an instrument capable of preparing the entire endodontic system on its own has been an objective pursued by the vast majority of companies. The use of just one single-use instrument could offer several advantages: simplification of the protocol, reduction in the length of treatment, reduction in the number of instruments used and therefore potentially the cost for the practitioner, a reduced risk of cross contamination, etc. What are the different strategies proposed by manufacturers to solve the enigma of the single instrument?

A little bit of history

Pierre Fauchard is considered to be the father of modern dentistry. In 1728, he published a work on dental surgery titled Le chirurgen dentiste, ou traité des dents. For the first time in literature, the techniques of root canal preparation were described. At the time, this involved inserting an instrument into the canal to clear the canal of its contents and relieve the patient’s pain (Fig. 1).

Many years later, in 1965, a standardisation system for the size of instruments with a corresponding colour code still used today was adopted by the American Association of Endodontists under the impetus of Dr John Ingle.

Fig. 1: Extract from a chapter of the book by P. Fauchard published in 1746 (second edition) concerning endodontic treatment at the time. “(The dentist) should open and enlarge the canal, or the cavity inside the tooth, with a broach, or perforator the same size as this canal. He should then take a long, fine needle, such as an embroiderer would use, and, holding the end in his fingers, or with clockmaker’s tweezers, insert the tip of this needle as far as possible into the depth of the tooth cavity; this should be done two or three times in succession, after which this cavity should be opened up, and the internal membrane pierced. (...)”

opinion
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In 1974, Herbert Schilder described the step-back technique, which dominated endodontics until the arrival of NiTi instruments 20 years later. This technique consists of the alternating use of files and H-files. It enables the mechanical and biological objectives set by the author to be achieved. It requires many instruments and a certain level of dexterity.

In 1985, James Roane described the balanced forces technique. This involved turning a hand file while applying apical pressure (clockwise for a hand file) at a maximum angle of 180°, then turning the file in the other direction (anticlockwise) while maintaining apical pressure at an angle of 120° or more. Clockwise rotation enables the file to push into the canal, and the anticlockwise movement enables the dentine to be cut. It is this motion that inspired Dr Ghassan Yared and his reciprocating motion with NiTi instruments almost 25 years later.

In 1992, John McSpadden launched the first NiTi instrument used in a continuous rotary motion with a 2% taper. Then in 1994, Ben Johnson launched a series of instruments also made from NiTi that use continuous rotary motion with a 4% taper, which would later be known as ProFile instruments. Today, they are considered to be the fathers of continuous rotation using NiTi files.

The year 2010 saw a paradigm shift in the field of shaping instruments with the market launch of the Self-Adjusting File (SAF; ReDent NOVA). This marked the first time that an instrument had been designed and described for its ability to fulfil biological objectives by adapting to anatomical constraints. This instrument is unlike any other and has found it difficult to carve out a market share despite its obvious qualities.

After the article by Yared published in 2008, RECIPROC (VDW) and WaveOne (Dentsply Sirona) were launched in 2011. It is now possible to prepare canals with just one single-use instrument.

Finally, 2016 saw the launch of the XP-endo Shaper (FKG Dentaire). This instrument is also something of an outsider in the field of standard NiTi files. It enables the canal to be prepared with a single instrument by adopting a more conservative approach better adapted to the anatomy of the canal.

Many other sequences are constantly being marketed with different cross sections, different tapers, different alloys, different designs, different colours, etc. Each sequence claims to address the enigma of canal preparation. At the next trade fair, you will almost certainly see the latest instrument in a new colour that will enable root canals to be prepared faster, better and with less risk of fracture.

The concept of single-instrument preparation is often associated with specific motions, which it is important to understand. The following is an overview of the motions used to drive root canal preparation instruments and this terminology makes it possible to clearly define all the instruments available:

- Most NiTi instruments are used in a continuous rotary motion, that is the file rotates on its axis at a certain speed.
- Other motions used are called reciprocating motions (Fig. 2). These are composed of alternating opposite movements, along either the vertical plane (file axis) or the horizontal plane. For a vertical reciprocating motion, we talk about amplitude, and for a horizontal reciprocating motion, we talk about an angle of rotation in the cutting or non-cutting direction of the file. A symmetrical horizontal reciprocating motion has different angles of rotation in the cutting and non-cutting directions. An asymmetrical horizontal reciprocating motion has different angles of rotation in the cutting and non-cutting directions. After a certain number of cycles, the file therefore performs a complete rotation in the direction with the highest angle of rotation.
The concept of a single instrument for preparation is based on the principle of using just one shaping instrument. Manual or mechanised catheterisation with files with a small diameter (0.10 and 0.15 mm) and small taper is still essential. Several approaches have been proposed by manufacturers.

**Movement-focused approach**

The instrument itself is not particularly novel. WaveOne (Fig. 3) is a modification based on the design of the ProTaper files (Dentsply Sirona). The cross section has changed a little, but the preparation area is similar. WaveOne is available in three apical diameters: 0.21, 0.25 and 0.40 mm. WaveOne Gold has recently been released with a heat-treated alloy, making the instrument more resistant, and is available in four apical diameters: 0.20, 0.25, 0.35 and 0.45 mm.

RECIPROC (Fig. 4) is an adaptation based on the design of the Mtwo files (VDW). RECIPROC is available in three apical diameters: 0.25, 0.40 and 0.50 mm. RECIPROC blue was recently released with a heat-treated alloy, making the instrument more resistant, but the sizes of the instrument have not changed in relation to the standard RECIPROC.

In this approach, the innovation lies in the motion that drives the instrument. Both RECIPROC and WaveOne are driven by an asymmetrical horizontal reciprocating motion with a greater angle of rotation in the cutting direction (150°/90° for RECIPROC with a speed of 300 rpm, and 170°/50° for WaveOne with a speed of 350 rpm). For commercial reasons, the thread has been reversed so that the instrument cuts in an anticlockwise direction in contrast to all other continuous rotary systems, which cut in a clockwise direction.

The choice of the final diameter given to the root canal preparation is made at the time of catheterisation. If catheterisation is difficult, the smallest instrument is chosen; if catheterisation with an ISO size 10/15 file is possible, the medium-sized instrument is used; if the canal is wide and the catheterisation files reach the apex without constraint, the widest instrument is chosen.

Final canal preparation must be determined after catheterisation. This involves shaping and this depends on the instrument initially chosen. For a single-rooted tooth, there is no major difference in preparation area between a standard sequence of several instruments and the use of this single instrument. There is certainly an associated time-saving and reduced risk of fracture owing to the reciprocating motion, which protects the file from torsional stress, and because the instrument is single-use only (currently none of the sequences available on the market are sold as single-use sequences). However, several studies have highlighted a greater risk of the tooth being weakened (appearance of a microcrack) in comparison with sequential widening of the root canal.

**Instrument-focused approach**

In this approach, the instruments have a completely innovative design. They form part of the new wave of instruments that are intended to be more conservative.

The literature shows that, in certain complex cases, our traditional shaping instruments only enable 20–40% of the root canal surface to be prepared. These results are related to the root canal anatomy. Canals frequently have an oval cross section and all of the conventional instruments used in a continuous rotary or horizontal reciprocating motion have a preparation area with a round cross section. Our current preparations are therefore deficient and result in giving canals the shape of the last preparation file used (Fig. 5).

New canal preparation concepts entail using instruments that adapt to the shape of the canal. They enable a greater canal surface area to be prepared while saving more tissue and are therefore in line with the current trend towards less invasive dentistry. Two different instruments fall within this trend: SAF and XP-endo Shaper.

SAF

This is a hollow instrument that resembles a coronary stent. The external surface is rough and the instrument is used with a vertical reciprocating motion at an amplitude of 0.4 mm and at a rate of 3,000–5,000 vibrations per minute. The instrument is available in two diameters: 1.5 and 2.0 mm. Irrigation is performed at the same time as preparation by means of a pump connected to the instrument (Fig. 6).
The instrument will prepare each canal in four minutes once the working length has been reached. The revolutionary concept of this instrument has been well documented in the literature: a greater percentage of root canal wall surface prepared, no microcracks formed, optimal reduction in bacteria, no apical extrusion of debris, no or very few preparation errors, optimal centring of the instrument in the canal, etc.

Despite this, the instrument has been taken off the market in a considerable number of countries owing to a defect affecting the motor driving the instrument. There is also the question of whether this concept is too innovative for minds often a little too resistant to change. This extremely interesting concept will certainly give manufacturers ideas for new instruments in the near future.

XP-endo Shaper

This is an NiTi instrument with a 1% taper (therefore extremely flexible), an apical tip diameter of 0.3 mm and a zigzag shape (Fig. 7). The instrument is inserted into the canal after standard catheterisation and is then used in continuous rotation at a speed of 800 rpm using a vertical reciprocating motion. Once the working length has been reached, the instrument rotates continuously with a reciprocating motion at an amplitude of 5 mm. This action is repeated ten times. The final preparation is tested with a gutta-percha point with a diameter of 0.3 mm and 4% taper. If the point can be inserted to the working length, preparation is complete; otherwise, the sequence of ten movements is repeated a second time.

The preparation principle of this instrument depends on its shape, alloy and expandability. At ambient temperature, the instrument is in a martensitic phase, that is it is not rigid and can be deformed (Fig. 8). Inside the canal, at 35°C, the instrument enters the austenitic phase, that is it resumes its zigzag shape (shape memory) and becomes rigid again. Its shape enables it to be compressed into an unenlarged canal, enabling the canal to be prepared by adapting to its original shape thanks to reciprocating movements. Very promising studies yet to be published demonstrate more economical and more appropriate root canal preparations than conventional techniques.

Watch this space

Since the introduction of NiTi in endodontics, we have known how to prepare canals in a reproducible manner. The journey towards the single instrument was started in 2010 with the aim of simplifying and improving our shaping procedures. Two approaches have been put forward by manufacturers: the movement-focused approach, which is inspired by classic designs of instruments in continuous rotation driven with an asymmetrical horizontal reciprocating motion, and the instrument-focused approach, which has proposed original new designs and launched the concept of the single instrument suited to the original anatomy of the canal. These two approaches enable canals to be prepared with a single instrument (in addition to catheterisation instruments). However, is it possible to prepare the canal better? In modern dentistry, which aims to be conservative and minimally invasive, the second approach appears more promising.

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

about

Dr Guillaume Jouanny received his DDS from Paris Descartes University in France in 2008. He practised general dentistry and endodontics in private practice from 2008 to 2012. He was a clinical assistant in restorative dentistry and endodontics at the same university from 2010 to 2012. He moved to Philadelphia in the US to specialise in endodontics in 2012 at the University of Philadelphia and graduated in 2015. Since 2015, he has been practising endodontics in Paris in private practice and teaching endodontics at Paris Descartes University.
Overview

Confirmed Invited Speakers

Paul Abbott
Australia
Is there still a role for medicaments in endodontics?

Andreas K. Braun
The Netherlands
Root resorption after dental trauma - findings and treatment possibilities

Filippo Cardinali
Italy
Solutions to simplify shaping and cleaning improving the quality of the root canal treatment

Antonis Chaniotis
Greece
Management of severe curvatures and complex anatomy with controlled memory files: A new approach

Andreas K. Braun
The Netherlands

Gustavo De-Deus
Brazil
The relationship among reciprocation, glidepath and canal scouting

Franck Diemer
France
How asymmetric geometry and heat-treatment influence the behavior of rotary root canal instrument

Samuel O. Dorn
USA
Extraction-Replantation: An alternative surgical technique

Nick Grande
Italy
The paradox of minimal invasive endodontics

Mo K. Kang
USA
Pulp tissue regeneration: Challenges and new outlook

Gianluca Gambarini
Italy
3D endodontics: Shaping root canals in 3 dimensions

Anil Kishen
Canada
Nanomaterials in endodontics: A potential game changer

Sergio Kuttler
USA
“Past, present and future of endodontic files”: Where science meets technology

Seung Jong Lee
Korea
Are the viable cells the only predictor for delayed replantation?

Francesco Maggiore
Italy
Soft tissue management in endodontic microsurgery

Tara Mc Mahon
Belgium
Does heat treated NiTi facilitate endodontic therapy?

Syngcuk Kim
USA
Long term prognosis of endodontic Tx vs. Implant Tx

Yosef Nahmias
Canada
How to prevent instrument breakage by creating a mechanical reproducible glide path (don’t rotate, reciprocate)

Cliff Ruddle
USA
Endodontic Disinfection: 3D Irrigation

Frank Setzer
USA
Management of iatrogenic errors by non-surgical and surgical retreatment.

Michael Solomonov
Israel
Contemporary approaches to instrumentation of non-round root canals

Asgeir Sigurdsson
USA
Is it toothache? non-odontogenic pain presenting as dental pain

Yoshi Terauchi
Japan
Predictable and minimally invasive method to retrieve a separated file

Martin Trope
USA
The expanding role of vital pulp therapy

Martin Trope
USA
The paradox of minimal invasive endodontics

Gianluca Plotino
Italy
3D endodontics: Shaping root canals in 3 dimensions

Gianluca Gambarini
Italy
Solutions to simplify shaping and cleaning improving the quality of the root canal treatment

Ghassan Yared
Canada
Management of second mesio-buccal, narrow and curved canals with only one reciprocating instrument.

Lecture titles are tentative and subject to change.
All Planmeca’s CBCT units support three different types of 3-D imaging, as well as extraoral 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.

www.planmeca.com

References
1. Ludlow JB, Koivisto 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.
Treat root canals easily and efficiently. Through its “Peace of mind included—the Endo-System” campaign, VDW supports this claim by presenting its approach with its optimal interplay of products and services. With the VDW Endo-System, dentists and patients can benefit from safety in use and long-term treatment success—even in the most challenging medical situations.

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Long-term treatment success in endodontics—and thus satisfied patients over the long-term—depends on the optimal interaction of all components of the process. The VDW Endo-System offers a complete set of different products and services from a single source. This is how VDW makes the demanding discipline of endodontics as easy and efficient as possible for dentists. With the VDW Endo-System, dentists can perform even complex endodontic procedures successfully and economically—with peace of mind included.

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Review: ROOTS SUMMIT 2018 crew says thank you

By DTI

Over 450 people from 50 countries gathered at the European School of Management and Technology (ESMT) in the German capital to attend the 2018 ROOTS SUMMIT, held from 28 June to 1 July. At this year’s event, attendees benefitted from the expertise of ten international speakers, could practise their skills in 17 hands-on courses, and had the opportunity to exchange ideas and experiences with like-minded people. For over 20 years now, ROOTS has been the premier global discussion forum for the dental specialty of endodontics.

On 28 June, the first ROOTS SUMMIT day started with pre-congress hands-on courses. Dozens of dental professionals arrived at the ESMT Berlin that morning to take part in interactive learning workshops sponsored by some of the leading suppliers of oral care products and presented by internationally prominent practitioners in the field.

What followed were three days of scientifically and clinically relevant lectures, which dealt with such topics as invasive cervical resorption, pain and infection management, the role of bioceramics in endodontics and adhesive post-endodontic restoration.

In addition to the extensive scientific programme, 40 companies showcased the most recent trends in endodontics at the industry exhibition, which was distributed across all levels of the ESMT. During lunchtime and coffee breaks, participants tried out the newest dental products and technologies.

Besides the learning and networking opportunities, ROOTS SUMMIT featured an entertaining social pro-

Fig. 1: Stephen Jones, Dr Freddy Belliard and Dr David E. Jaramillo.
gramme. A welcome re-
cption on Friday evening
and a public viewing event
on Saturday provided a laid-
back and fun atmosphere
for organisers, speakers
and industry representa-
tives to enjoy drinks, snacks
and chats.

The 2018 ROOTS SUMMIT
was organised in collabo-
ration with Dental Tribune
International. At the clos-
ing ceremony on Sunday
afternoon, it was announced
that the next meeting will
be held in 2020 in Prague
in the Czech Republic.
The exact dates are yet
to be made known and more details will follow soon.

“ROOTS SUMMIT Berlin 2018 was a tremendous suc-
cess on many levels. Our scientific programme received
rave reviews from all who attended. There were too
many highlights to choose one above all but suffice it to
say that the key to why this meeting was so good was
the level of speakers chosen and the topics discussed.
The hands-on courses were at a higher and deeper
level than is normal at such an event,” said co-chairman
Stephen Jones.

“A favourite feature of most people attending a ROOTS
SUMMIT is the case presentations. The summit would not
be possible without the generous support of the spon-
soring companies. Their trust in the topics chosen by our
scientific chairman, Dr. David E. Jaramillo, was complete
and unconditional, which paid huge dividends in terms of
the quality of programme the attendees received.”

“As with all ROOTS SUMMITs, everyone enjoys the
same lectures, which leads to lively debate and dis-
cussions during the social events. The reception at the
ESMT could have gone for hours and our evening event
at Alte Turnhalle for the World Cup match of Uruguay
vs. Portugal was even more lively and lasted well into
the night,” added Jones. “We are a bit sad that the next
ROOTS SUMMIT will not be until May of 2020, but that
is more than offset by the excitement that it will be in the
beautiful city of Prague, in the Czech Republic. If you
missed ROOTS SUMMIT Berlin 2018, do not make the
same mistake with the 2020 edition. Details on regis-
tration will be available by the end of this year and the
programme will be available shortly after that.”

The event organisers also invite everyone who is inter-
ested in ROOTS SUMMIT to follow their Facebook page
for further information. More photos of this years’ edition
can also be viewed there.
International Events

**Dental-Expo**
24–27 September 2018
Moscow, Russia
www.dental-expo.com

**BDIA Dental Showcase**
4–6 October 2018
London, UK
www.dentalshowcase.com

**IFEA 11th World Endodontic Congress 2018**
4–7 October 2018
Seoul, Korea
www.ifea2018korea.com

**DenTech China – Exhibition & Symposium**
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Shanghai, China
http://www.dentech.com.cn

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**JADR Annual Meeting**
17–18 November 2018
Hokkaido, Japan
http://jadr66.umin.jp

**GNYDM**
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www.gnydm.com

**ADF**
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Paris, France
www.adfcongres.com

**CIOSP**
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www.ciosp.com.br

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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 emphasise 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.

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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).

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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.
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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.)

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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.

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An abstract of your article is not required.

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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?

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