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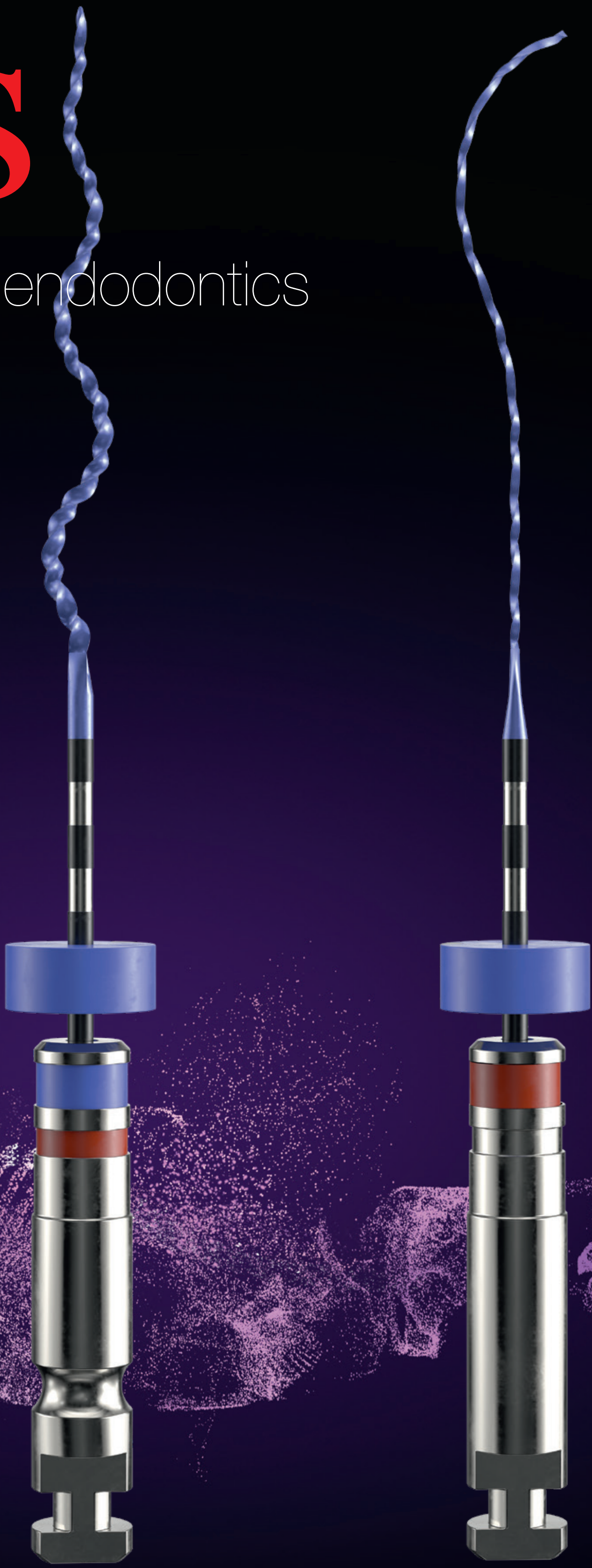


including ROOTS SUMMIT special

ROOTS SUMMIT special
Lecture programme, abstracts and speaker information

study
Impact of reciprocal and OTR motion on mechanical NiTi files' resistance

case report
Management of intracanal separated instruments

dti] Dental Tribune International

Steve Jones

Co-chairman
ROOTS SUMMIT

Dear readers,

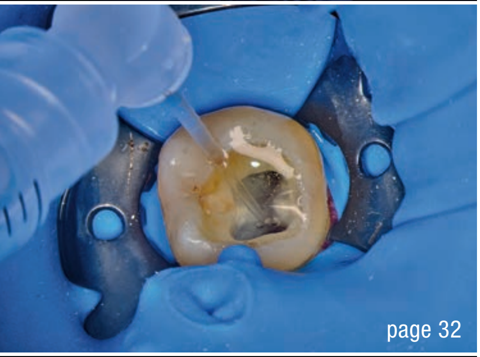
Welcome to this year's second issue of the roots **magazine**. There are many ways that the world has changed during this period as we wage a global battle against SARS-CoV-2. Our hope is that all of you are well and that you are staying safe during this difficult time. We also wish you a safe return to your practices.

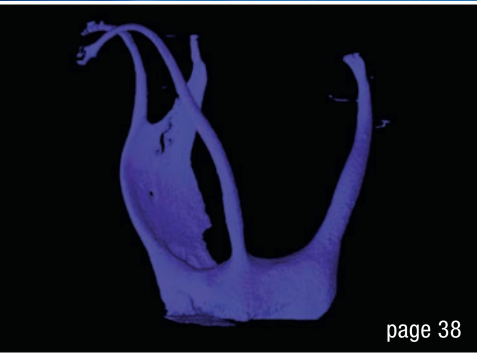
The current situation has forced us to reschedule ROOTS SUMMIT to one year later than planned. The location remains the same, Prague in the Czech Republic, and the dates will be 20–23 May 2021. As so many people registered for our terrific programme, we will be hosting an online event for registered participants this Friday, 22 May, and Saturday, 23 May. Please take a look at the programme pages and join us for this valuable programme. There will also be an offer to register for the live event in 2021, and early registration for 2021 will include this exclusive online content.

It gives us great pleasure to be able to showcase the work of the members of our Facebook group, ROOTS (www.facebook.com/groups/rootsendo). This month, Dr Sourav Banerjee's case report, "Management of iatrogenic pulpal floor perforation in a mandibular molar with MTA and PRF", provides a terrific example and comprehensive summary of the practical and useful information that is shared multiple times per day on ROOTS. If you have not already joined, please visit www.rootsendoforum.com and do so.

Thank you for picking up this issue, and we wish you continued good health and a safe return to normalcy.

Steve Jones
Co-chairman
ROOTS SUMMIT





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Lecture programme

ROOTS SUMMIT 2020 *online*

Day 1: Friday, 22 May 2020

10:00–11:00 Root to crown: Advanced adhesive endodontic/restorative concept
Dr Daniel Černý

13:00–14:00 When size matters: The management of apical inflammatory root resorption and how to adequately seal the altered anatomy in just one visit
Dr Bogdan Moldoveanu

14:00–15:00 Microsurgical management of the maxillary molar's palatal root
Dr Jaime Silberman

15:00–16:00 New motions and sequences for NiTi heat-treated rotary instruments
Prof. Gianluca Gambarini

Day 2: Saturday, 23 May 2020

09:00–10:00 Post-endodontic restorative treatment of severely damaged teeth
Dr Marian Fanica

10:00–11:00 Digital planning in intentional replantation and autotransplantation
Dr Francesc Abella

11:00–12:00 Prognostic factors in endodontic retreatment
Dr Gianluca Plotino

12:00–13:00 Separated instruments—my approach
Dr Hugo Sousa Dias

13:00–14:00 The new CanalPro Jeni motor: The instantaneous control for fully automated shaping and disassembling retreatment procedures
Dr Eugenio Pedullà

14:00–15:00 Endodontic access: What size best contributes to long-term endodontic success?
Dr Stephen Buchanan

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Speakers
ROOTS SUMMIT 2020 *online*

Dr Francesc Abella
(Spain)

Dr Francesc Abella graduated in 2005 in dentistry from the Universitat Internacional de Catalunya, Barcelona, Spain. From 2005 to 2014, he completed his master's degree and PhD in endodontics at the same university. He works in a private practice limited to endodontics and restorative dentistry in Barcelona, and in clinical endodontics, his areas of special interest include CBCT in endodontics, microcomputed tomography, dental anatomy, dental traumatology, periapical pathology, adhesive restoration and restoration of endodontically treated teeth. Besides his work in private practice, he is involved in endodontic research projects in the postgraduate endodontic programme of the Universitat Internacional de Catalunya.

Over the years, Abella has given several lectures and hands-on courses worldwide. He is the author of several papers in peer-reviewed journals and part of the expert committee convened by the European Society of Endodontology on the use of CBCT. Abella is also an active member of the Asociacion Española de Endodoncia [Spanish association of endodontics] and the secretary of the Sociedad Española de Odontología Conservadora y Estética [Spanish society of conservative and aesthetic dentistry].

Dr Stephen Buchanan
(USA)

Dr Buchanan received his dental degree in 1978 from the University of the Pacific Arthur A. Dugoni School of Dentistry in San Francisco. In 1980, he completed the endodontic graduate programme at Temple University in Philadelphia. He began pursuing 3D anatomy research early in his career. In 1989, he established Dental Education Laboratories, a state-of-the-art training facility devoted to hands-on instruction where he still teaches endodontic treatment, retreatment and segmented file retrieval. Early in his career, Buchanan identified the power of video and film media in training and produced the award-winning video series, The art of endodontics. Buchanan also holds a number of patents for dental instruments and techniques. Most notably, he was the first dentist to introduce variable-tapered instruments in endodontic therapy and pioneered a system-based approach to treating root canals. Buchanan is a diplomate of the American Board of Endodontics and a fellow of the International and American College of Dentists. He currently serves as a clinical guest professor at the Herman Ostrow School of Dentistry of the University of California and the University of California Los Angeles School of Dentistry and as a guest lecturer at Loma Linda University School of Dentistry. He maintains a full-time private practice limited to endodontics and implantology in Santa Barbara, California.

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Dr Daniel Černý
(Czech Republic)

Dr Daniel Černý received his dental degree from the Charles University's Faculty of Medicine in Hradec Králové, Czech Republic, in 1998. Between 1998 and 2007, he worked as an assistant professor at the same faculty. He is currently completing his doctoral degree with a focus on adhesive post-endodontic treatment at Palacký University Olomouc in the Czech Republic. Since 2001, he has maintained a private practice limited to adhesive dentistry and endodontics in Hradec Králové.

Černý has been the President of the Czech Endodontic Society since 2015. He was the co-founder and first President of the Česká akademie dentální estetiky [Czech academy of dental aesthetics] from 2007 to 2009. From 2009 to 2013, he served on the editorial board of LKS—Časopis České stomatologické komory [journal of the Czech Dental Chamber]. He is also the co-founder of the Dental Summit congress in Prague, Czech Republic. He has been the co-owner and director of the HDVI continuing education institute since 2010. Černý has contributed four chapters to dental books and lectures both nationally and internationally.

Dr Hugo Sousa Dias
(Portugal)

Dr Hugo Sousa Dias graduated with a DDS from University Fernando Pessoa, Porto, Portugal, and completed the postgraduate programme in endodontics at the University of Lisbon, Portugal. Besides running a practice limited to endodontics in Porto, he is Director of the Master in Endodontics clinical residency programme at Foramen Dental Education, Porto. Dias is the founder of the Portuguese Group for Endodontic Study (study club), and a member of the European Society of Endodontology and the Sociedade Portuguesa de Endodontologia [Portuguese endodontic society]. He has given more than 40 lectures around the world and is co-author of a chapter in the book *The Root Canal Anatomy in Permanent Dentition* (Springer, 2018).

Dr Marian Fanica
(Romania)

Dr Marian Fanica graduated from the University of Medicine and Pharmacy Carol Davila in Bucharest, Romania. He received a bachelor's degree in dentistry in 2005 and a master's degree in endodontics in 2015. His practice has been limited to endodontics since 2015 with a field of interest also in dental adhesives. Dr Fanica is an international lecturer and hands-on dental trainer in Europe and Asia. His professional memberships include the European Association of Osseointegration, the Society of Esthetic Dentistry in Romania and the Dentistry National Organization in Romania.

Prof. Gianluca Gambarini
(Italy)

Prof. Gianluca Gambarini is head of endodontics and restorative dentistry at the Sapienza University of Rome, Italy, and director of the dental school's master of endodontics programme. He maintains a private practice limited to endodontics in Rome, where his focus is on endodontic materials and clinical endodontics.

As an international lecturer and researcher, Gambarini has held more than 500 presentations at world's most renowned international congresses and universities. He has also received several awards and led research projects funded by national and international grants. In addition to that, Gambarini is an active consultant in the development of new technologies, surgical procedures and materials for root canal therapy. Furthermore, he holds patents concerning endodontic technologies he has developed. Currently, Gambarini serves as Chairman of the Clinical Practice Committee of the European Society of Endodontology.

Dr Bogdan Moldoveanu
(Romania)

Dr Bogdan Moldoveanu graduated from the Faculty of Dental Medicine at the Iuliu Hațieganu University of Medicine and Pharmacy in Cluj-Napoca, Romania, and then pursued postgraduate studies in endodontics at the dental school of the University of Turin, Italy. There, he graduated with a master's degree in clinical and surgical micro-endodontics. He also holds a certificate in dental implantology from the Carol Davila University of Medicine and Pharmacy in Bucharest, Romania. He is an assistant professor at the University of Turin, where he teaches in the master's programme in clinical and surgical micro-endodontics, and he is an assistant professor at the Iuliu Hațieganu University of Medicine and Pharmacy in the discipline of dentistry, endodontics, cariology and oral pathology. He is the CEO of the postgraduate educational platform Endodonție Cu Pasiune [endodontics with passion] and undertakes clinical work in Cluj-Napoca, focusing on surgical and nonsurgical micro-endodontics. Moldoveanu has been invited to speak at a large number of congresses around Europe. He is a member of the Italian Academy of Endodontics and the European Society of Endodontology, and an international specialist member of the American Association of Endodontists.

Dr Eugenio Pedullà
(Italy)

Dr Eugenio Pedullà graduated with honors in dentistry from the University of Catania, Italy, in 2003. He obtained his PhD at the same university in 2007 and a master's degree at the Sapienza University of Rome, Italy, in 2008. He is currently a researcher and a clinical instructor in operative dentistry and endodontics at the University of Catania. Pedullà is also in private practice in Catania, specialising in endodontics and operative dentistry. Pedullà is the author of a number of articles on NiTi instruments and endodontics published in international (including the *Journal of Endodontics* and *International Endodontic Journal*) and national journals (*Dental Cadmos* and *Giornale Italiano di Endodonzia*), and has spoken at national and international conferences. He is a member of several dental societies.

Dr Gianluca Plotino
(Italy)

Dr Gianluca Plotino graduated in dentistry from the Università Cattolica del Sacro Cuore, Rome, Italy, in 2002. He obtained his PhD there in 2009 and received certification as first and second level professor in 2018. Plotino works in his own private practice limited to endodontics and restorative dentistry in Rome. He has received several international prizes, published more than 90 articles in scientific peer-reviewed journals on various endodontic and restorative topics, and contributed numerous chapters to textbooks.

Plotino is an associate editor of the *European Endodontic Journal* and the *Giornale Italiano di Endodonzia* and serves on the editorial board of several other journals. He is a certified member of the European Society of Endodontology, an international member of the American Association of Endodontists, and an active member of the Italian Academy of Endodontics and the Italian Society of Conservative Dentistry.

Dr Jaime Silberman
(USA)

Dr Jaime Silberman is a graduate of the Universidad Peruana Cayetano Heredia, Lima, Peru, where he completed his dental education. He then received an MSc and a certificate in operative dentistry from the University of Iowa, Iowa City, US Silberman continued his postdoctoral education at Columbia University in the City of New York, US, where he received his specialty training certificate in endodontics and his DDS. Before settling in Palm Beach County, Florida, US, Silberman served as a full-time assistant professor in the Division of Endodontics at Columbia University for five years. Since 1997, he has been working in a private practice limited to endodontics in the New York/New Jersey area and later in Florida.

Currently, Silberman is a faculty member of the endodontic postgraduate programmes at Nova Southeastern University, Davie, Florida, US, and Columbia University. He has been invited to give lectures in New York, locally in the US and internationally in South America. In addition, Silberman is a board-certified endodontist and a member of the American Association of Endodontists, American Dental Association and Florida Dental Association.

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Abstracts
ROOTS SUMMIT 2020 *online*

Day 1: Friday, 22 May 2020

10:00–11:00

Root to crown: Advanced adhesive endodontic/restorative concept

Dr Daniel Černý

Long-term data show that survival of nonvital teeth has always been a challenge. Both endodontic and restorative dentistry contribute critically to the treatment outcome. The concept of care presented in this lecture has been developed by both endodontists and prosthodontists over 18 years of cooperation. It is based on four main ideas common to both fields: tissue preservation (unnecessary hard dental tissue loss should be prevented), replacement with similar materials (lost tissue should be replaced with material of similar physical properties), adhesion (all components of the restoration should adhere to each other) and safety (when failure occurs, it should not be catastrophic). Over the years, the protocol has been extended from nonvital teeth only to teeth with compromised integrity and challenged vitality. The endodontist delivers a ready-to-use abutment tooth free of pathology for the final restoration regardless of the tooth vitality. In this lecture, the decision-making process, material selection, complete workflow and long-term outcomes will be presented. After this lecture, participants should be able to identify clinically relevant factors for the restoration of nonvital teeth and teeth with challenged vitality, determine the need for different adhesive tools to construct the buildup of the abutment tooth with fiber posts and various resin composites, and describe critical details of the ideal final restoration of nonvital teeth.

13:00–14:00

When size matters: The management of apical inflammatory root resorption and how to adequately seal the altered anatomy in just one visit

Dr Bogdan Moldoveanu

In most cases in which we encounter a failure of the initial endodontic treatment, the root canal anatomy we are confronted with is altered. Neglecting this structural modification might lead to a series of procedural errors, which in the end will result in another unsuccessful treatment attempt. Periapical lesions cause the destruction of the surrounding hard tissue, leading to an irregular dimension and shape of the apical foramen. This problem might also occur owing to different iatrogenic events during previous treatment attempts. It is important to have the necessary theoretical knowledge and practical skills to properly seal these root canals even if the situation, at times, might seem hopeless. During this presentation, I will analyse the techniques, materials and tools required for the obturation of wide and irregular apexes, focusing on the mineral trioxide aggregate single-visit approach. This procedure will allow any dentist to solve complex and complicated situations in a single visit.

14:00–15:00

Microsurgical management of the maxillary molar's palatal root

Dr Jaime Silberman

One of the most challenging conditions during endodontic microsurgery is the surgical management of the palatal root of the maxillary molar. The proximity to the sinus, the depth to the palatal vault, the location of the greater palatine foramen, the proximity of major vessels and nerves to the apices of the palatal root, and the configuration of the zygomatic process of the maxilla are some of the anatomical features to consider in selecting the proper surgical approach. This clinical presentation will describe and discuss the surgical management, by an apicoectomy, of a compromised palatal root with regard to the preoperative and postoperative significance of CBCT for these complex cases, the traditional microsurgical approaches and the application of guided surgical techniques.

15:00–16:00

New motions and sequences for NiTi heat-treated rotary instruments

Prof. Gianluca Gambarini

The new heat-treated controlled memory (martensitic) rotary files have different properties from traditional superelastic NiTi instruments. As a consequence, their clinical use may vary. This presentation aims to describe differences in their properties and suggest innovative combinations of motions and simplified sequences to gain the most from the new instruments and to improve the simplicity, efficacy and safety of the procedures.

Day 2: Saturday, 23 May 2020

09:00–10:00

Post-endodontic restorative treatment of severely damaged teeth

Dr Marian Fanica

In this session, we will discuss isolation of teething in extreme clinical cases, the importance of using a dual cure adhesive

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inside the root canal, choosing the correct type of post for core-buildups, what are the best materials for core-buildups and why. Other issues discussed will include conserving the maximum amount of dentine possible through the use of caries detectors, the use of silane primers with glass fiber posts, minimising shrinkage through the use of delayed light activation, removal of old posts predictably, and crown lengthening with minimal ferrule effect. Participants will learn multiple tips and tricks which will greatly improve patient outcomes.

10:00–11:00

Digital planning in intentional replantation and autotransplantation

Dr Francesc Abella

In recent years, primary endodontic treatment, nonsurgical retreatment and microscopical surgery have achieved success rates of around 90 per cent. However, there are situations in which the tooth cannot be saved using these techniques. The first part of this lecture will discuss intentional replantation. This is an accepted endodontic treatment procedure in which a tooth is extracted and treated outside the oral cavity and then reinserted into its socket to correct an obvious radiographic or clinical endodontic failure. It should not be considered a last-resort treatment prescribed only for unsalvageable teeth as proposed by Grossman. Although intentional replantation is not a frequently performed procedure, it yields a tooth survival rate of 88 per cent, according to a recent meta-analysis. In addition, the new advances in computer-aided rapid prototyping (CARP) models (tooth replicas) and 3D-printed guiding templates allow us to apply this technique in a much more predictable way. In situations where the tooth cannot be saved, there is the option of performing an autotransplant (both open and closed apex). The complications observed in the past can be overcome thanks to advances in diagnostic and surgical techniques, particularly CARP models and 3D-printed guiding templates. The digital planning not only allows for the selection of the most suitable donor tooth according to tooth morphology, but also shows the ideal 3D position and the required dimensions of the alveolus during surgery. Moreover, the use of tooth replicas can reduce the additional socket time and possible donor tooth injury during the procedure. Through the results of two in vivo investigations, as well as clinical cases and videos, we will teach the digital step-by-step to plan all types of cases.

11:00–12:00

Prognostic factors in endodontic retreatment

Dr Gianluca Plotino

The long-term prognosis of the endodontically treated tooth is closely related both to the quality of the endodontic therapy itself and to the quality of the coronal restoration. The evolution of materials, techniques and technologies in endodontics has undoubtedly helped clinicians to improve the prognosis of endodontic therapies, especially in teeth previously considered unrestorable, contributing to a consequent increase in the confidence of patients and dental colleagues in the endodontist. After the lecture, participants should know what the endodontic prognosis in the retreatment of a compromised tooth is; understand what the endodontic prognosis in already treated compromised teeth destined for endodontic surgery is; describe what the endodontic treatment options in the severely compromised teeth are and select the correct materials, devices and therapeutic approaches for each different clinical situation.

12:00–13:00

Separated instruments—my approach

Dr Hugo Sousa Dias

The endodontic management of a fractured instrument within the root canal is a difficult process that requires training, experience and knowledge of the methods/techniques that can be used. It is a time-consuming and challenging procedure often associated with anxiety for both clinician and patient and has a variable success rate. In this webinar, I will demonstrate my clinical approach to these challenging situations.

13:00–14:00

The new CanalPro Jeni motor: The instantaneous control for fully automated shaping and disassembling retreatment procedures

Dr Eugenio Pedullà

Endodontic treatment has proven to be one of the most successful procedures in dentistry. Several instruments and some kinematics were proposed for safe and efficient endodontic preparation. However, each kinematic (like continuous rotation or reciprocation) has some advantages and disadvantages as well as sometimes after the first root canal treatment, endodontic retreatment with the removal of the old filling material (usually gutta-percha and sealer) by different manual or rotary instruments could be required to achieve the final success of the treatment. During this webinar, we will go through the pros and cons of the different kinematics related to endodontic procedures as well as the strength and weakness of different rotary files used to remove the filling material in the different anatomical conditions. Moreover, we will introduce the new fully automated, electric controlled, CanalPro Jeni motor and its "self-driving mode" and "shaping guided by irrigation" algorithm for shaping instruments and the new file Remover to accomplish gutta-percha removal.

14:00–15:00

Endodontic access: What size best contributes to long-term endodontic success

Dr Stephen Buchanan

The best access cavities are cut in a precise balance between conservation and convenience form. Cut huge access cavities and expect to see relatively huge numbers of root-fractured teeth within five years of treatment. I will show you why I cut as little tooth structure as possible while ensuring ideal pathways into each canal. Experience has shown that the quality of the access preparation more than any other single factor is critical to the remainder of the case. The discussion will explain the techniques and tools necessary to create perfect entry paths. This webinar will include a live demonstration of dynamic CT guidance for creating minimally invasive access cavities in calcified teeth.

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The new endodontic channel for comprehensive learning

An interview with Dr Gianluca Plotino. By Nathalie Schüller, DTI

Dr Gianluca Plotino

Dr Plotino, last year we spoke about your endodontic bucket list course (Interview with Dr Gianluca Plotino, *Clinical Masters* 2019). Your goal was to offer a different format, a wish list for participants of materials and devices you use in your clinic daily that are best suited for each case. Are you satisfied with the results?
The bucket list course was very successful and presented all over the world. It was really appreciated, as it was built based on the needs of the participants and this was very clear to everybody who attended this course. After this success, an idea came to me for a new project, which is to try to give everybody the possibility of following my courses and my projects with a different format. Therefore, at the end of 2019, I launched "endo channel".

Indeed, you announced in December the launch of "endo channel" by Gianluca Plotino, a new ambitious project. Can you tell me all about it?
This is my own endodontic channel, available on www.endo-channel.com, a place where I can talk about my work and what I think about endodontics, without filters or commercial influence, a place to share my pleasure of speaking about endodontics and what I have learned, my secrets.

It will be structured in two parts, a main programme with courses (in general 2-hour courses), webinars, etc. The second part will feature interviews with colleagues about hot topics of the moment, as well as advice and feeds with information I will provide on specific topics.

The reason I created "endo channel" on the web is because I do not much like to communicate through social media channels such as Facebook or Instagram for my professional endeavors. I prefer to keep those for my social activities in my private life and do not post professional information there. For anything related to my work, my passion about endodontics, I prefer to communicate in a more scientific manner, such as writing articles in scientific literature or publishing interviews in important magazines like *Clinical Masters* or writing books.

I just finished writing a book a few weeks ago and will in the coming months be finished with another one, which will be published soon thereafter.

I will run the channel starting with the basic concepts in endodontics. The goal is to create around eight courses on primary endodontic treatment. We will start with access cavity preparation, then go through all the steps of clinical primary endodontic treatments, such as orifice location, looking for calcified canals, glide path creation, negotiation and pre-flaring. We will then look at the instrumentation needed for the root canal and the ideal instruments for preparing the root canal system.

The second part of the year will be dedicated to the importance of the apical preparation and root canal irrigation for clinical success, especially focusing on the actual techniques and materials for improving root canal disinfection, and on root canal filling materials and clinical techniques to fill the root canal—in short, the importance of new technologies for improving the treatment outcome. That is more or less the programme this year.

In the webinar courses, I will talk about different topics and give tips and tricks on diagnosis, anatomy, and the different steps of endodontic treatment, among others.

The channel will be as interactive as possible. People will be able to ask questions about issues that they are not able to solve themselves or need advice on.

As you know, I am not only a specialist in endodontics but a specialist in all that is related to restorative dentistry. I work on restoration of endodontically treated teeth, conservative dentistry, prosthetic dentistry and interdisciplinary treatments. So, in the future, my goal for "endo channel" is to share my 360° experience in dentistry, to convey the relationship of endodontics to the other disciplines of dentistry. "endo channel" will not be focused on endodontics only but all the components of restoration of endodontically treated teeth and the strategies for restoring teeth in general, with an interdisciplinary focus for treatment, such as periodontics and orthodontics related to endodontics. This is my new, long-term project and I hope to be able to reach and help as many people as possible around the world and communicate my message about endodontics.

You offer courses at your center and are often invited to teach all over the world. Why did you feel the need to create such a channel?
I felt the need to communicate with people all around the world, people that follow me, in a different manner from the live courses I teach and so the idea of "endo channel" came to life. I want people who are interested to be able to follow my ideas and work in order to learn how to perform endodontic treatments in the best possible way and with the most updated techniques and technologies.

Will "endo channel" be available at a cost or free?
The platform was launched at the beginning of March 2020. I plan to publish monthly courses. The first course, consisting of four episodes, is already ready to be launched and will be available for all on the platform. I will update my endodontic social media pages, Facebook and Instagram, when something new is published on "endo channel".

People will be able to subscribe yearly to have access to the entire content of the channel and be able to follow everything that I publish, including articles and webinars. There is also the possibility of choosing to subscribe only to one specific event or course of interest during the year. A subscription for access to the entire content is not required if one is only interested in a specific course. Those who do not wish to pay any subscription fee will have free access to some basic endodontic information and free content.

How do you foresee the importance of social media in teaching?
I am increasingly focusing on web platforms and online education because with this type of education you can reach more people around the world. A lot of people have called me or written to me about their interest in my course, but they often cannot afford to take the time or pay the costs to come to Rome or other locations where I teach.

"The importance of the practical sessions and the interaction between the teacher and the participants is still of utmost importance and should be maintained."

Therefore, the technology that we have today has really made it easy to help and reach more people.

Among the advantages of a live course is the importance of learning by doing, performing in the practical part of a course immediately what one has been taught in the theoretical session, with the teacher available to address problems or questions one might have in putting the theory into practice. Do you see in the future education being offered only via the web or do you feel that live courses will still have to be available?
The importance of the personal, direct contact with people in a set location is still very important for persons who want to go even deeper into something that they are interested in learning. The theoretical aspect is important, and my theoretical courses offer a lot of practice possibilities, as I have made sure to include clinical videos that clearly show the clinical techniques. The practical sessions and the interaction between the teacher and the participants are still of utmost importance and should be maintained, even more so for people who feel they need practical training, and so I think that both online courses and live ones will still be needed.

Editorial note: This interview was first published in the Clinical Masters magazine*, volume 6, issue 2020.*

about

Dr Gianluca Plotino received his degree in dentistry in 2002 from the Università Cattolica del Sacro Cuore in Rome, Italy, and completed his PhD there in 2009. He maintains a private practice specialising in endodontics and restorative dentistry in Rome. Dr Plotino has been awarded several international prizes, published more than 100 articles in scientific, peer-reviewed journals, 2 textbooks and has contributed to numerous chapters in reputable textbooks. He gives lectures and presents courses across the world. He is a certified member of the European Society of Endodontology, an international member of the American Association of Endodontists, and an active member of the Italian Academy of Endodontics, the Italian Society of Endodontics and the Italian Society of Conservative Dentistry.

Impact of reciprocal and OTR motion on mechanical NiTi files' resistance to fracture in cyclic fatigue testing and during canal preparation in resin blocks

Dr Sławomir Gabryś, Poland

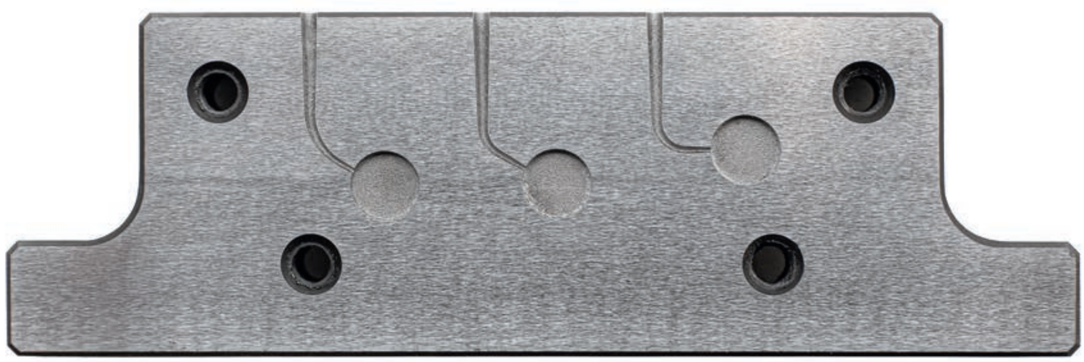

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Fig. 1: The custom-made device with artificial stainless-steel canals for cyclic fatigue tests.

Introduction

It has been over 30 years since endodontic hand files made of nickel-titanium (NiTi) alloy were first used in 1988.[1] This fact provided an opportunity to introduce to the market rotary NiTi files with tapers of larger than .2 in 1992.[2] Root canal preparation with engine-driven files revolutionised this very important stage of root canal therapy, which has become quicker and more effective.[3] At the same time, maintaining the original canal path has become easier than with files made of stainless steel.[4] However, apart from the obvious advantages of using rotary NiTi files, we can also find some disadvantages. One of these weaknesses is a possibility of fracturing a file inside a root canal. The fracture frequency of rotary files, as illustrated by the research conducted on many cases at the University of Pennsylvania's School of Dental Medicine in the US and at Nanjing Stomatological Hospital in China, equals approximately 2 per cent of cases.[5,6] For a clinician, that is an unwelcome event which may hinder or even make a disinfection of the entire root canal system totally impossible.[7] Thanks to the endodontic microscope and ultrasound, it is possible to remove fractured files from canals;[8] however, there is always the risk of widening the canal too much and, in consequence, weakening the root or causing a perforation.[9]

We may distinguish two mechanisms which may cause file fracture. The first one is cyclic fatigue failure, and the second is torsional fatigue failure.[10] A file rotating in a curved canal undergoes cyclic tension (concerning the surface of a file situated on the external wall of the curvature) and compression (concerning the surface of a file situated on the internal wall of the curvature). Cyclic tension and compression repeated with every rotation lead to material fatigue and, in consequence, to file fracture.[11]

A file which widens a canal also undergoes torsional stress resulting from dentine cutting. If the elastic limit of the alloy is exceeded, the file fractures owing to torsional fatigue failure.

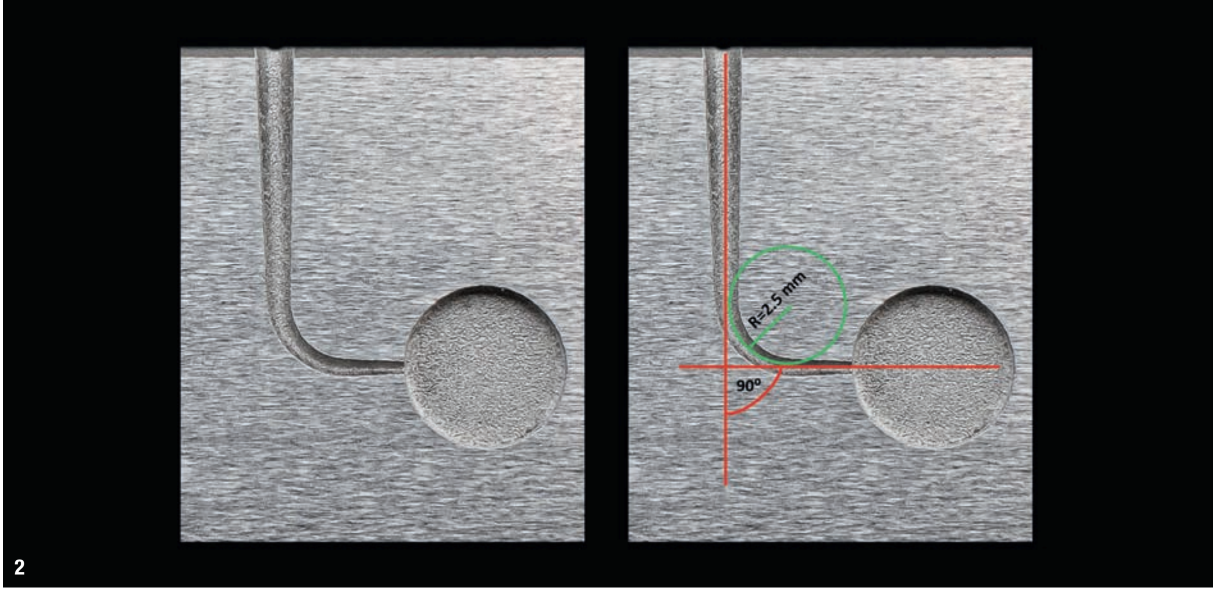

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Fig. 2: An artificial canal used in this study: 16 mm in length, 90° angle of curvature and 2.5 mm radius of curvature.

There are plenty of factors influencing file fracture: the operator's experience, instrumentation technique (access, sequence used, glide path), instrument design and heat treatment of its alloy, degree and radius of the canal's curvature, parameters set on the endodontic motor (speed, torque) and the type of file motion (continuous rotation, reciprocation, Optimum Torque Reverse).[12]

The aim of the present study was to investigate the impact of reciprocal motion and Optimum Torque Reverse motion on file fracture in cyclic fatigue testing and during the preparation of artificial canals in resin blocks, where a file apart from working in a curved canal has to widen this canal. The files used in the test were RECIPROC blue R25 (VDW) and Endostar E3 Azure 25/.06 (Poldent).

RECIPROC blue R25 files are thermally treated NiTi instruments and have a nominal size of 0.25 mm at the tip and a taper of 0.08 mm/mm in the last 3 mm from the tip. The instruments have an S-shaped cross section. These are left-cutting files designed to operate in reciprocal motion.

Endostar E3 Azure 25/.06 files are thermally treated NiTi instruments and have a nominal size of 0.25 mm at the tip and a constant taper of 0.06 mm/mm. They also have an S-shaped cross section. These are right-cutting files designed to operate in rotary, reciprocal and Optimum Torque Reverse motion.[13]

Both instruments (RECIPROC blue and Endostar E3 Azure) undergo post-manufacture complex heating–cooling proprietary treatments that result in a visible titanium oxide layer on the surface of the instrument which gives the characteristic blue colour. This treatment changes the transition temperatures between martensitic phase and austenitic phase, which is claimed by the manufacturers to result in superior mechanical properties of the NiTi instruments.

Reciprocal motion for canal preparation was proposed by Yared in 2008.[14] In such motion, the file performs alternately partial clockwise (CW) rotation and partial counterclockwise (CCW) rotation. This partial rotation is referred to in degrees, for example 180° CW and 90° CCW, which means that a file alternately moves half of the rotation CW and then a quarter of the rotation CCW. So, for the file to make a full rotation (360°), it needs four cycles CW and CCW. The use of reciprocating motion was shown to extend the lifespan of a NiTi instrument.[15] The recommended reciprocal motion for the RECIPROC blue R25 file is 150° CCW and then 30° CW rotation at a speed of 300 rpm.[16]

Optimum Torque Reverse (OTR) motion was patented by J. Morita in 2015. This new motion was introduced to exploit reciprocation's benefits and minimise its disadvantages, such as increased transportation of the debris towards the apex.[17] OTR motion combines rotary motion with reciprocation. When a file is inserted into the canal, it rotates 360° CW, and when the force acting on the file is too large, the file reverses its rotation in a CCW direction by 90° and then continues rotation in the CW (cutting) direction for 180°. During this half rotation in the cutting direction, sensors of the handpiece calculate the force acting on the file. If the force is too large, the file will automatically reverse rotation again (90° in the CCW direction) and then it will rotate in the CW direction for 180° and the motor will calculate the acting force again. So, if the force acting on the file is constantly too large, the file performs a reciprocal motion (180° CW and 90° CCW). If the force acting on the file is small, the file constantly rotates in the CW direction.[18] One can set five levels of torque to activate reciprocal motion in OTR motion: 0.2 Ncm, 0.4 Ncm, 0.6 Ncm, 0.8 Ncm and 1.0 Ncm. The smaller the torque that is set, the more often the file works in reciprocation (90° CCW and 180° CW). All right-cutting files, like Endostar E3 Azure, can operate in OTR motion.

Materials and methods

For the test, the following files were used: 40 new RECIPROC blue R25 files with a 0.25 mm tip size and a variable taper (.08 at the tip to 0.04 at the shaft) and 40 new Endostar E3 Azure 25/.06 files with a 0.25 mm tip size and a constant taper of .06. All instruments used were 25 mm long. The files were examined under a stereomicroscope (Leica M50, Leica Microsystems) at

Fig. 3: Micro-caliper for measuring fractured instruments.

20× magnification. No defects or deformations were detected; thus, all the files were subjected to this study.

The study consisted of two parts. The first was a cyclic fatigue resistance test, and the second was preparation of canals in resin blocks.

Cyclic fatigue resistance test

Twenty RECIPROC blue R25 and 20 Endostar E3 Azure 25/.06 files were used for this test. A total of 40 instruments were divided randomly into four groups (each group included ten instruments of the same brand; $n = 10$) depending on the motion being tested:

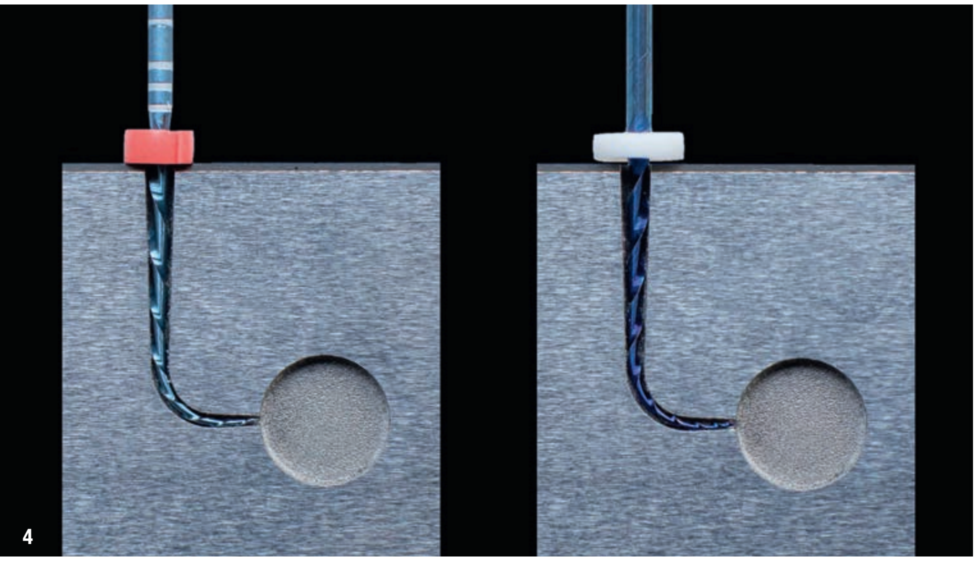
- Group 1: RECIPROC blue R25 in continuous rotation CCW at 300 rpm and a torque of 2 Ncm
- Group 2: RECIPROC blue R25 in reciprocation ("RECIPROC ALL" programme)
- Group 3: Endostar E3 Azure 25/.06 in continuous rotation CW at 300 rpm and a torque of 2 Ncm
- Group 4: Endostar E3 Azure 25/.06 in reciprocation of OTR motion with the activation torque set at the lowest level (0.2 Ncm) so that a file in an artificial canal constantly worked in reciprocal motion 180° CW to 90° CCW and at a speed of 300 rpm.

The files were tested on a custom-made device with an artificial stainless-steel canal (Fig. 1). The device was made according to the guidelines described by Plotino et al. in 2010.[19,20] The artificial canal was 16 mm long and had a 90° angle of curvature and a 2.5 mm radius of curvature (Fig. 2).

The instruments were driven by two electric motors depending on the motion used. The Endostar Provider endodontic motor (J. Morita) was used for Groups 1, 3 and 4, and VDW.SILVER RECIPROC (VDW) was used for Group 2. To decrease the friction between the instruments and artificial canal walls, WD-40 synthetic oil (WD-40 Co.) was sprayed into the artificial canal before use of each file. The instruments rotated/reciprocated freely inside the simulated canal until fracture occurred. The time to fracture was measured (in seconds) using a digital stopwatch (Junsd JS-307, Shenzhen JUNSD Industry Co.). Next, each fractured instrument was measured with a digital micro-caliper (Magnusson, Fig. 3) with an accuracy of 0.02 mm, to check that each file was positioned in the canal to the same depth (Fig. 4).

Preparation of canals in resin blocks

Twenty RECIPROC blue R25 and 20 Endostar E3 Azure 25/.06 files were used for this test. A total of 40 instruments were divided randomly into four groups (each group contained ten instruments of the same brand; $n = 10$) depending on the type of motion used in the resin block:



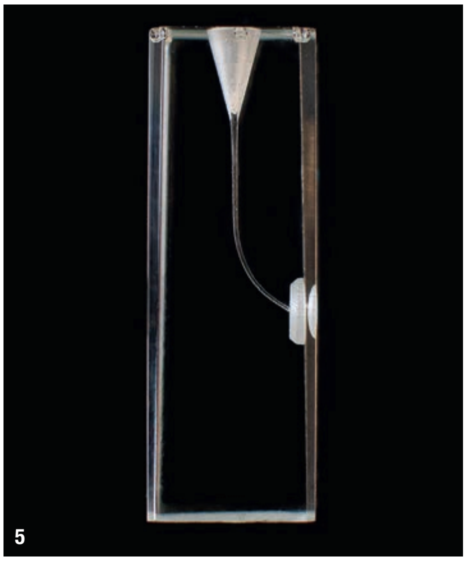


Fig. 4: Positioning of the files inside artificial canals: on the left RECIPROC blue R25 and on the right Endostar E3 Azure 25/.06. **Fig. 5:** Edodontic training blocks with an artificial canal 18.5 mm long with a 55° curvature in the apical area.

Table 1

Group	TtF Mean (SD)	FL Mean (SD)
Group 1	31.2 (2.90)	4.01 (0.34)
Group 2	40.1 (3.35)	3.95 (0.32)
Group 3	89.6 (6.33)	3.78 (0.29)
Group 4	217.3 (23.25)	3.79 (0.41)

Table 2

Group	NPB Median (SD)
Group 1	7 (1.20)
Group 2	9 (1.10)
Group 3	10 (1.10)
Group 4	14 (1.29)

Table 1: Means and standard deviations of the time to fracture (TtF) in seconds and the fractured fragment length (FL) in millimetres. **Table 2:** Medians and standard deviations of the number of prepared blocks (NPB) until file fracture occurred.

- Group 1: RECIPROC blue R25 in continuous rotation CCW at 300 rpm and a torque of 2 Ncm
- Group 2: RECIPROC blue R25 in reciprocation ("RECIPROC ALL" programme)
- Group 3: Endostar E3 Azure 25/.06 in continuous rotation CW at 300 rpm and a torque of 2 Ncm
- Group 4: Endostar E3 Azure 25/.06 in reciprocation of OTR motion with the activation torque set at the lowest level (0.2 Ncm) so that a file in the artificial canal constantly worked in reciprocal motion 180° CW to 90° CCW and at a speed of 300 rpm.

The tests were run on resin endodontic training blocks (VDW) containing an artificial canal 18.5 mm long with a 55° curvature in the apical area (Fig. 5). Each file was used to prepare canals in consecutive resin blocks until the file fractured. The number of blocks prepared until fracture occurred for each file was noted down, including the block in which fracture occurred.

All the canals were instrumented by just one operator (the author of the article). The blocks were installed in a bench vice to secure their stability during the canal preparation. The patency of the canal was first determined with a size 10 K-type file (Poldent). The file was inserted into the canal until the tip could be seen in the foramen. Next, the canal was widened to size 20/.02 with a size 20/.02 Endostar NT2 file (Poldent) to the working length (18 mm). The aim was to standardise the canals in the blocks so that the files worked in the canals with the same initial size. Thereafter, the proper canal preparation started. With the RECIPROC blue file or Endostar E3 Azure file, four cycles were made including three pecking movements in the apical direction. In the fourth cycle, the working length of 18 mm was reached. Between every cycle, the canal was irrigated with distilled water from a syringe with a side-vented needle. Next, the size 10 K-type file was inserted until the tip of the file was visible in the apex (patency), and again the canal was irrigated with distilled water. Between cycles, file edges were cleaned on a sponge. After achieving working length, the canal was considered prepared and the work with the same file was continued in the next blocks until fracture occurred.

Statistical analysis

Statistical analysis was performed with the IBM SPSS programme (Version 25.0, IBM Corp.). To check significant statistical differences among groups, the Kruskal–Wallis test was performed. When significant statistical differences occurred, the Games–Howell post-hoc test was used. It helped to identify among which groups exactly significant statistical differences occurred. The choice was made based on homogeneity variances in compared groups. The level of $p < 0.05$ was considered statistically significant.

Results

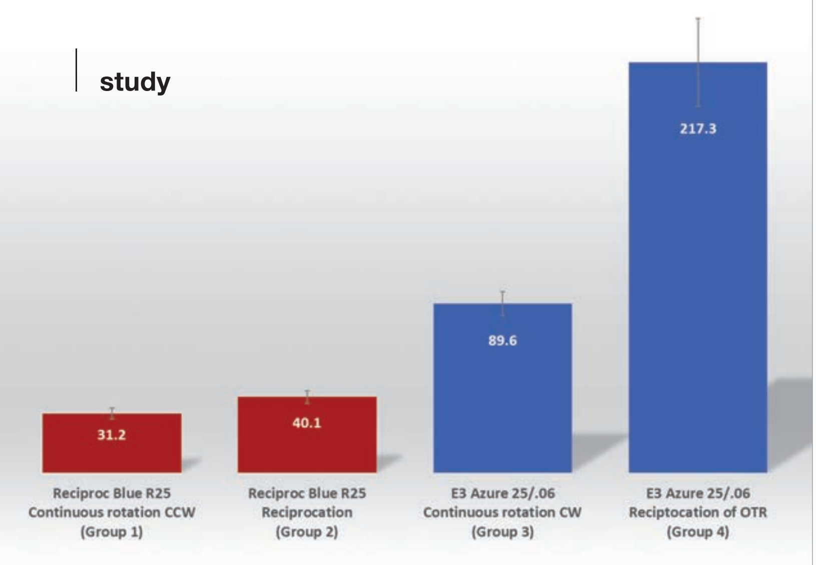
Cyclic fatigue resistance test

The means and standard deviations of the time-to-fracture values (in seconds) of the tested groups are shown in Table 1. The analysis showed statistically significant differences among all four tested groups ($p < 0.001$). Group 4 gained the highest results in comparison with the remaining three groups. Group 1 gained the lowest results. Comparing the influence of the type of motion (continuous rotation vs reciprocation) on time to fracture for the same type of files (Group 1 vs Group 2; Group 3 vs Group 4), statistically significant prolongation of time to fracture occurred in reciprocal motion dedicated to RECIPROC files and in OTR reciprocal motion ($p < 0.001$; Fig. 6).

The means and standard deviations of the length of the fractured fragments (mm) are also shown in Table 1. The analysis did not show statistically significant differences in the length of the fractured fragments ($p > 0.05$).

Preparation of canals in resin blocks

The medians and standard deviations of the number of prepared blocks until fracture for all tested groups are shown in Table 2. Statistically significant differences concern all groups compared with one another ($p < 0.001$),



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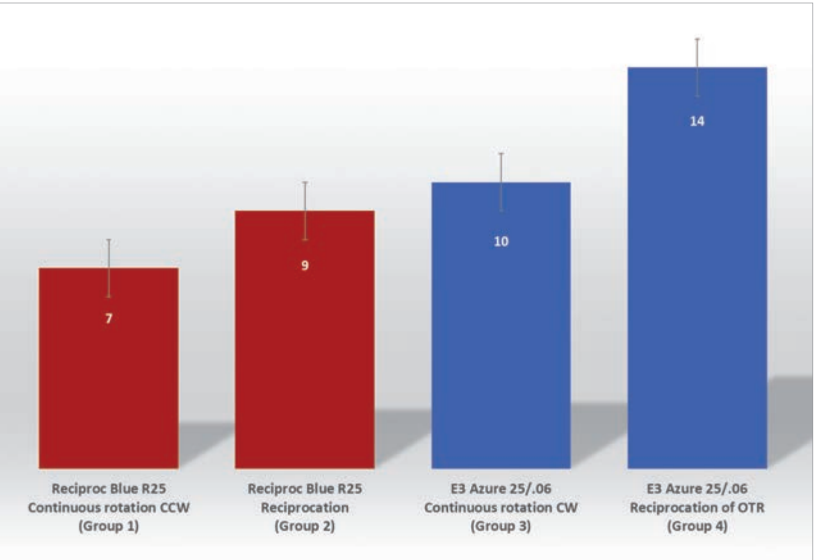

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Fig. 6: Mean time to fracture in seconds. Red bar: RECIPROC blue R25 (continuous rotation vs reciprocation). Blue bar: Endostar E3 Azure 25/.06 (continuous rotation vs OTR reciprocation). **Fig. 7:** Median number of prepared blocks. Red bar: RECIPROC blue R25 (continuous rotation vs reciprocation). Blue bar: Endostar E3 Azure 25/.06 (continuous rotation vs OTR reciprocation).

except for the comparison of Group 2 with Group 3. The median number for Group 4 turned out to be the highest in comparison with the remaining groups. The opposite was true for Group 1: it achieved the lowest median value of the analysed variable. Comparing the influence of the type of motion (continuous rotation vs reciprocation) on the number of prepared blocks until fracture (Group 1 vs Group 2; Group 3 vs Group 4), a statistically significant increase in the number of prepared blocks occurred for both reciprocal motions: dedicated to RECIPROC files and OTR motion ($p < 0.001$; Fig. 7).

Discussion

The research showed a longer lifespan of NiTi rotary files operating in two types of reciprocal motion. Both reciprocal motions (the one dedicated to RECIPROC blue files and OTR motion for Endostar E3 Azure files) extended the time to fracture in a cyclic fatigue test and increased the number of canals prepared in resin blocks before fracture.

Often, cyclic fatigue tests are performed to compare resistance to fatigue of particular files which differ in design, for example cross section, heat treatment (or the lack of it) and different manufacturing processes.[21–23] This research concentrated on the influence of the type of motion on resistance to fatigue. It was not the author's intention to compare RECIPROC blue R25 to Endostar E3 Azure 25/.06 in cyclic fatigue resistance tests because the comparison of these two files would be unreliable owing to their different width at the breaking point (about 4 mm from the apex). These files have a different taper in the last few millimetres from the tip. The RECIPROC blue R25 has a taper of .08 in the last 3 mm from the tip; therefore, its width in the third millimetre equals 0.49 mm, whereas Endostar E3 Azure 25/.06 has a stable taper of .06, and its width in the third millimetre from the tip equals 0.43 mm. The Endostar E3 Azure file is 0.49 mm wide in the fourth millimetre from the tip. The author of this study did not know the exact data indicated in the literature on the taper of the RECIPROC blue R25 above the third millimetre from the tip, but its width in the fourth millimetre from the tip is certainly larger than 0.49 mm because that is the width of this file in the third millimetre from the tip. The research of Haïkel et al.,[24] Gambarini[25] and Plotino et al.[26] revealed that the increase of the cross-sectional area by the increase of the taper or the size of the file leads to the decrease in resistance to cyclic fatigue. Therefore, the comparison of two files of a similar build and heat treatment but different taper was not the purpose of this research.

There was no significant difference in the mean lengths of the fractured fragments for all tested instruments. Each file fractured at around 4 mm from the tip, which means they were properly positioned in the artificial canal.

Resin blocks were used for the research in order to define the number of canals that could be prepared until the file fractured. Research on extracted teeth would have a higher clinical value. However, it would be difficult or even impossible to find canals which have the same repetitive anatomy. In resin blocks, the canals are identical, having the same length, width, taper, degree and radius of curvature. As a result, the files were used in the same conditions. Of course, the material of resin blocks does not have the same mechanical properties as those of root dentine. The Knoop hardness of resin blocks is lower than that of dentine surrounding the pulp chamber of a tooth (22 kg/mm^2 and 30 kg/mm^2, respectively).[27,28] Therefore, the results achieved in resin blocks cannot be directly transferred to clinical work. The number of canals prepared in resin blocks for each file in this research cannot be considered a safe number of canals that may be prepared with these files *in vivo*.

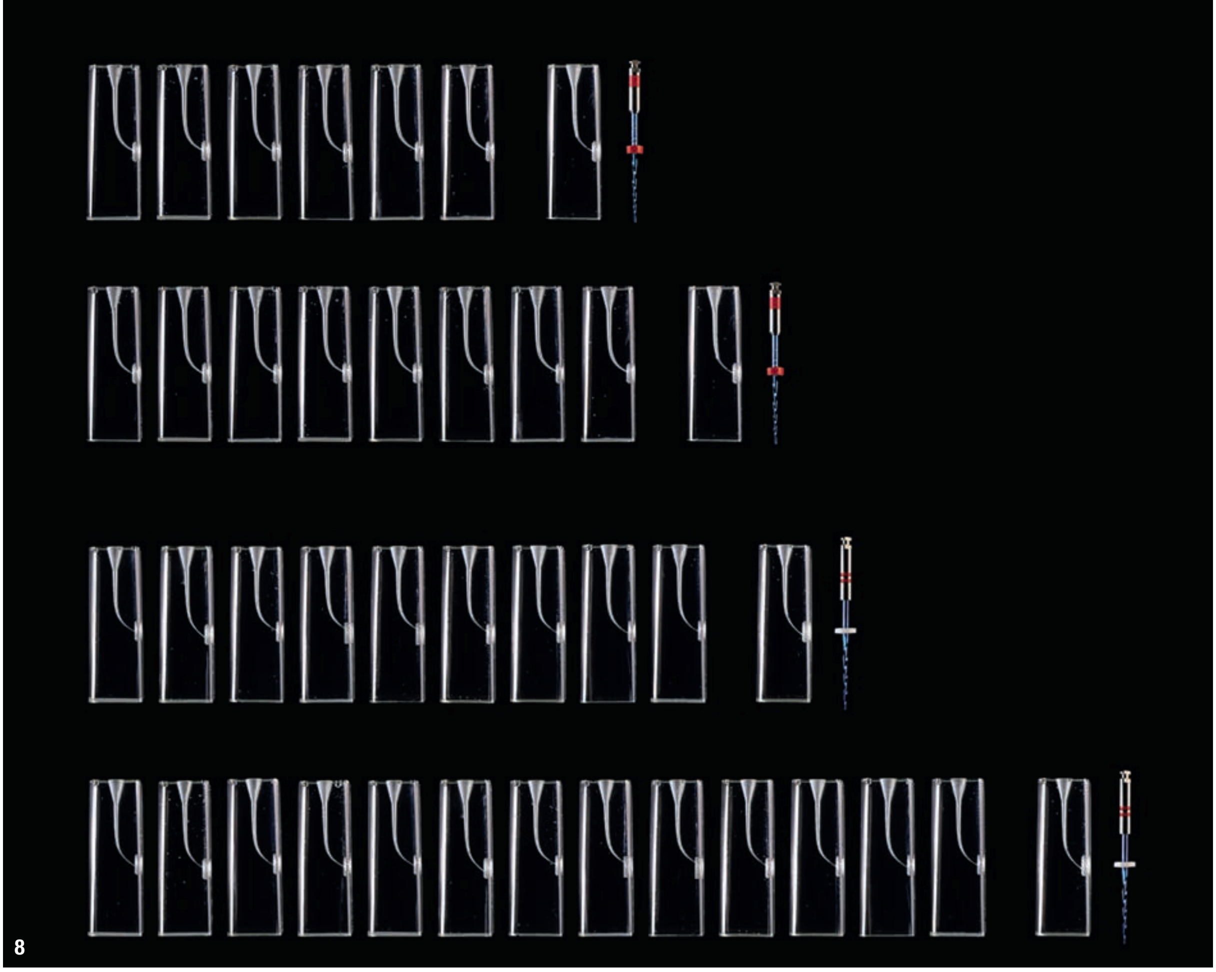

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Fig. 8: First line (RECIPROC blue R25, continuous rotation): six blocks prepared without fracture, and the file fractured inside the seventh block. Second line (RECIPROC blue R25, reciprocation): eight blocks prepared without fracture, and the file fractured inside the ninth block. Third line (Endostar E3 Azure 25/.06, continuous rotation): nine blocks prepared without fracture, and the file fractured inside the tenth block. Fourth line (Endostar E3 Azure 25/.06, OTR reciprocation): thirteen blocks prepared without fracture, and the file fractured inside the fourteenth block.

The research for this article consisted of two parts: cyclic fatigue resistance testing and resin block preparation. The aim was to check the influence of reciprocal motion on the lifespan of files both in the fatigue test and in the conditions in which the file works in curved canals and undergoes torsional strain resulting from canal widening (resin block test), which simulated the conditions in which a file works during an endodontic treatment. In a systematic review of *in vitro* studies by Ahn et al.,[15] it was found that, in most studies, reciprocal motion increases a file's resistance to fatigue in comparison with continuous rotation. There are very few studies which have investigated the influence of reciprocal motion on the lifespan of files which, at the same time, are affected by a fatigue mechanism and torsional stress. The results of this research show that using reciprocal motion during preparation of the canals decreases the risk of a file fracturing in a canal (Fig. 8).

In the present study, OTR motion was investigated because it is a new motion in endodontics and there is very little research on the influence of this motion on cyclic fatigue.[29,30] There has been no research on the influence of OTR motion on file fracture during canal preparation until now. Based on the present study, reciprocation of OTR motion prolongs the time to fracture and enables preparation of a larger number of canals before fracture.

Conclusion

Within the limitations of this study, both reciprocal motions (the one dedicated to RECIPROC files and OTR motion) significantly increased resistance to cyclic fatigue of the tested files compared with continuous rotation. Also, the number of canals in resin blocks prepared until file fracture significantly increased with the use of the two reciprocal motions.

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

about

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Root canal therapy with modern NiTi files: Case reports

Dr Ahmed Shawky, Egypt

When it comes to root canal therapy, endodontists all over the world face the same challenges: obtaining a precise visualisation of the situation, choosing the right instruments and clearing the whole root canal system of bacteria and debris. Sometimes, a severely curved root canal on the radiograph even gives the impression of a "dancing" molar. In the following two cases, I demonstrate, using modern nickel-titanium (NiTi) files, what it means for an endodontist to "walk like an Egyptian".

A meaningful image of the anatomical structures within the tooth usually leads the way to a successful endodontic treatment. Imaging techniques, such as CBCT, provide detailed visualisation of structural features and the outline of the main canals. However, in nature, anatomy may vary substantially, often even within one patient. While the answer to what root canals of the typical incisor look like is literally straightforward, most molars feature highly curved root canals. The following two cases illustrate how modern NiTi files like the HyFlex system (COLTENE) allow for an efficient and safe root canal therapy even in challenging anatomical conditions such as curved canals or lost anatomy. Owing to the sharp S shape on the radiograph, the molar in the second case even appeared to be dancing, which made for a quite difficult task to begin with.

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Fig. 1: Preoperative radiograph of the dilacerated root of tooth #14 (Case 1).

Case 1: Respect the curve

A 28-year-old female patient presented in our dental clinic with acute pain in her maxillary right first premolar. The radiographic examination revealed a dilacerated root. After mechanical interference of the tooth germ, a shift occurs

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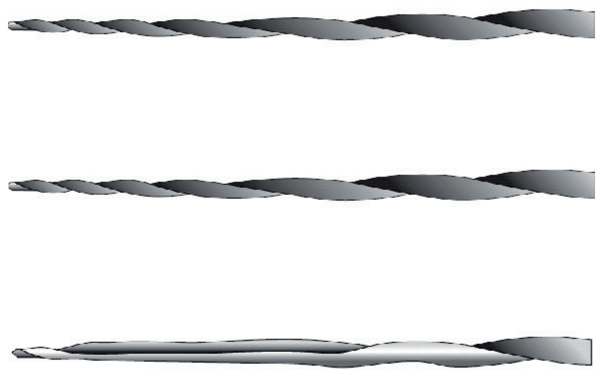
Fig. 2: Controlled memory effect in prebendable NiTi files.

between mineralised and non-mineralised parts of the tooth and can cause a sharp lateral bend in the canal. As the malformation commonly dates back to childhood, dilacerated roots are mostly detected on the radiograph (Fig. 1). After clinical and radiographic examination, acute pulpitis and symptomatic apical periodontitis were diagnosed. We advised the patient on a non-surgical root canal therapy.

At the beginning of the endodontic treatment, tooth #14 was isolated with a dental dam. The canals were then scouted using small hand files (ISO 06, 08 and 10). In order to regain patency, EDTA gel was dispensed into the pulp chamber before we used a combination of a watch-winding and envelope motion to work our way through the canal with the files.

Actual preparation of the canal was performed using the latest generation of NiTi files by COLTENE. In close cooperation with leading universities and global endodontic specialists, the renowned research department of the company developed an extremely versatile concept which meets various demands encountered in practice. The modular HyFlex system facilitates root canal preparation with rotary instruments for both experts and beginners. As the name already indicates, the HyFlex is a highly flexible NiTi file which proves to be incredibly fracture-resistant. There are two types of sets: the classic CM model and the EDM version.



3a–c

Figs. 3a–c: CM-treated NiTi file: new **(a)**; save for reuse **(b)**; and unwound **(c)**.

Modular NiTi file system for more flexibility

The abbreviation "CM" stands for "controlled memory" effect, which improves certain physical qualities of the alloy, mainly the flexibility, resistance to cyclic fatigue and lack of restoring forces in curved canals.

4a–c

Figs. 4a–c: HyFlex CM file sequence: 15/.04 **(a)**; 20/.04 **(b)**; and 25/.04 **(c)**.

Fig. 5: Postoperative radiograph (Case 1).

Similar to classic stainless-steel files, the instruments can be prebent, but they do not bounce back like conventional NiTi files (Fig. 2). After use, CM-treated NiTi files can quickly be regenerated by autoclaving and are then ready for their next application, until they reach the end of their life cycle by clearly displaying an unevenly bent shape. The refined NiTi files are very resistant to cyclic fatigue and can be reused safely, as long as they do not unwind (Figs. 3a–c). "EDM" is short for "electrical discharge machining", a specific manufacturing process of the files. Spark erosion improves the cutting performance of the instrument, as it produces a unique file surface. Owing to its material properties, the file is virtually unbreakable and is ideal for dentists who require fast and reliable results using a reduced file sequence.

In this case, I used the HyFlex EDM 25/.12 orifice opener for pre-flaring. Next, a glide path was created using the HyFlex EDM 10/.05. A handy technique to efficiently prepare a reliable and sufficient way through the canal is tactile controlled activation (TCA). The method is described by Dr Antonis Chaniotis, among others, in more detail. The rotating NiTi file is activated inside the canal in one stroke until the file reaches working length. Friction gives an indication of the precise anatomical structure of the canal. When resistance can be felt, the file will be withdrawn and checked for deformations. The canal is thoroughly rinsed before the next stroke brings the file closer to the apex. With prebent NiTi files, it is even possible to investigate the exact contour of a given canal behind a sharp curve. After the glide path file, the classic HyFlex CM files were then used for shaping in the following sequence: 15/.04, 20/.04 and 25/.04 (Figs. 4a–c). Every change of instrument was accompanied by the traditional rinsing protocol. Finally, the canal was obturated using the warm vertical compaction technique (Fig. 5).

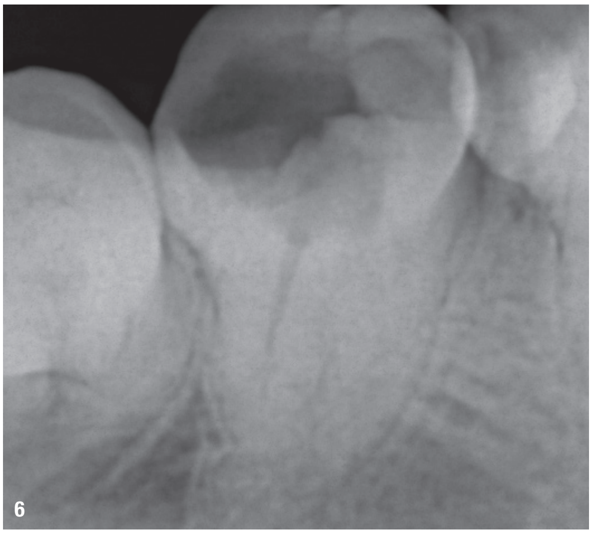
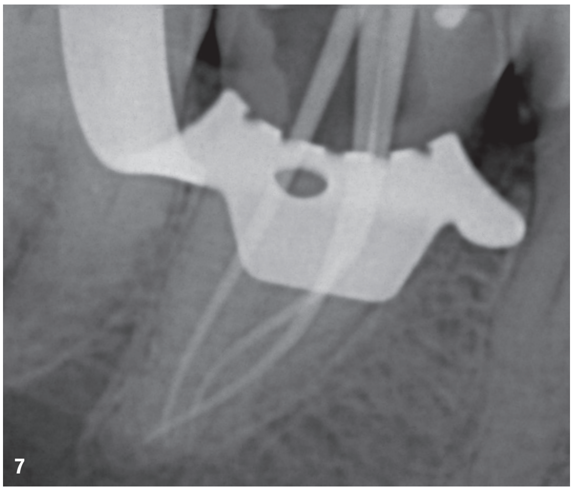


Fig. 6: Preoperative radiograph of the dancing molar (Case 2).

Case 2: The dancing molar

Our second case was also very "moving" to say the least. A 34-year-old male patient presented with his mandibular left second molar showing signs of acute pulpitis. Both the clinical and radiographic examination supported this, as well as the corresponding diagnosis of symptomatic apical periodontitis. The radiograph moreover unearthed a very unusual root canal anatomy: the intersecting periodontal membrane spaces revealed a complex radicular anatomy with a short-radius cervical curvature just beneath the orifice in the mesiolingual root as well as a double curvature in the mesiobuccal root (S shape). The distal canal was just simple, and the unusual molar really gave the impression of a dancing star. This good preoperative image once again was a decisive factor for a successful, natural shaping of the canal (Fig. 6).

Like in Case 1, scouting was performed with hand files up to size 10 in a mixed watch-winding and envelope motion. Pre-flaring was achieved using the HyFlex EDM 25/.12 orifice opener and then a glide path was formed with the HyFlex EDM 10/.05 glide path file using the TCA technique. Once again, the sharp curvature of the root canals was managed by inserting HyFlex files into the canal in a similar TCA manoeuvre up to the maximum working length of 24 mm. In the mesial canals, the following sequence was used for shaping: HyFlex CM 15/.04, 20/.04 and 25/.04. The shaping sequence in the distal canal was as follows: HyFlex CM 25/.04 and finally the universal file HyFlex EDM 25/~. Even at an almost 90° angle, the flexible files did not break and moved at all times in the centre of the canal. The cone fit also showed how closely the files followed the natural anatomy of all three root canals (Fig. 7). Obturation was done using the warm vertical com-



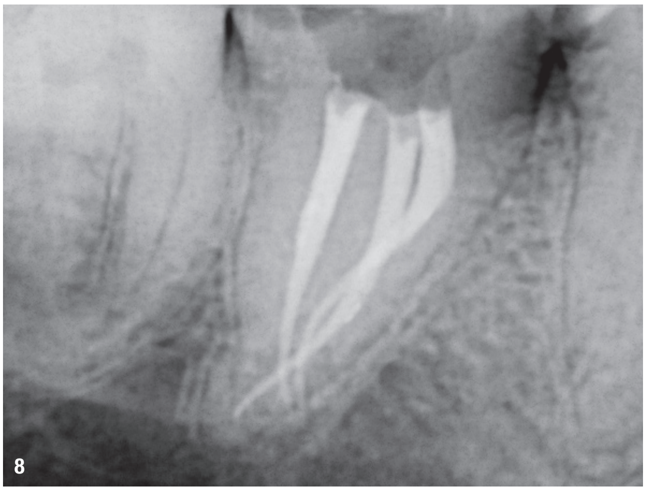


Fig. 7: Cone fit (Case 2). **Fig. 8:** Postoperative radiograph (Case 2).

paction technique. At the follow-up, the postoperative radiograph showed the beautifully twisted locations of the three reliably obturated canals (Fig. 8). The patient was very relieved and left the clinic with a positive prognosis.

Growing awareness of dental health

Discussing case reports with my international colleagues, I often find that the challenges of endodontics are very much the same around the globe. Treatment options do not differ much thanks to the worldwide standards that have risen substantially over the last 20 years. One part of this development is definitely the high-quality imaging techniques that provide the basis for a thorough analysis even before the actual operation takes place. Another shaping factor is the precision of modern NiTi instruments. Virtually unbreakable, the files allow endodontic experts to “walk like an Egyptian” elegantly around every curve and help them to follow the natural design of the 3D root canal system.

One trend I have witnessed in our dental clinic is the growing number of younger patients in need of endodontic treatment. In this group, long-lasting solutions are particularly important. This can easily be achieved by taking enough time for the mechanical and chemical preparation while choosing a durable obturation material like gutta-percha that will stay in the canal for a substantial amount of time. These new patients are well informed and have a clear idea of what they are willing to invest. It is crucial to walk them through the process and explain about the advantages of modern endodontic equipment. If the patient understands the opportunities a solid root canal therapy offers and knows about the alternatives, he or she will quickly agree to the clinical procedure.

Conclusion

A detailed radiographic examination usually allows endodontists to come up with the right treatment plan. The corresponding sequence of prebendable NiTi files like the HyFlex system helps the dentist to navigate severely curved and shaped root canals according to their natural design. Even in comparatively young patients, the long-term prognosis after endodontic treatment is good if modern technical auxiliaries are combined with the right manual skills.

This article is part of a three-part series that is titled So Many Roots to Travel *and was developed by COLTENE. In the series, endodontic specialists around the world discuss their most spectacular cases and show how they met the treatment challenge using modern NiTi instruments.*

about

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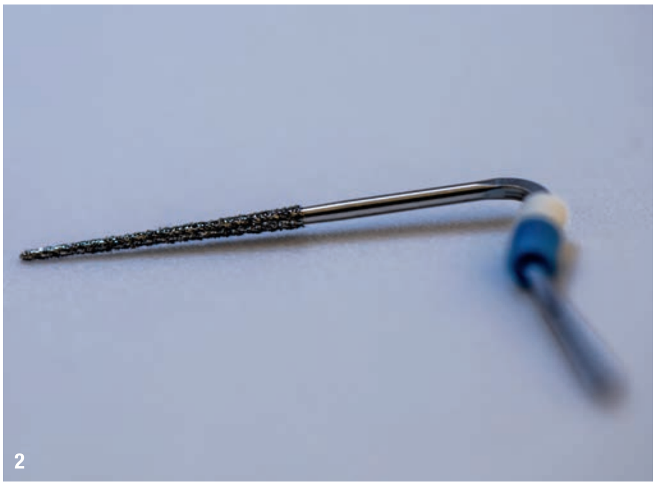
Management of intracanal separated instruments: A clinical case report

Dr Hugo Sousa Dias, Portugal



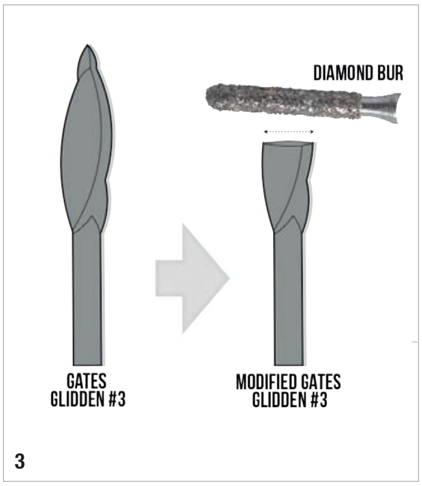


Fig. 1: Initial radiograph. **Fig. 2:** Micro File Type D for use with SONICflex 2003 L with OSADA adapter. **Fig. 3:** Modified size 3 Gates–Glidden bur (showing modification of a Gates–Glidden bur with a diamond bur).

Introduction

According to Lambrianidis, a great variety of foreign objects (fragments of the whole range of instruments used in root canal instrumentation, e.g. fragments of ultrasonic tips and fragments of irrigation needles) may be found in the root canal, compromising cleaning and shaping procedures and thus having a potential impact on the treatment outcome.[1] These foreign objects may be largely attributed to iatrogenic errors, and fracture is an undesirable and troublesome incident during root canal therapy or retreatment that frustrates both practitioners and patients.

Endodontic instruments are the foreign objects most frequently found in the root canal; a literature review revealed a prevalence of retained fractured instruments at between 0.7 and 7.4 per cent of teeth undergoing root canal therapy.[1,2] This mishap can happen even to experienced clinicians following the most appropriate preventive measures and may occur in both anterior and posterior teeth, but it is most frequently reported in molars, having similar rates for the maxilla and mandible.[1] The vast majority of instrument fracture occurs in the apical third of the root canal.[3] A study from the endodontics graduate programme at the University of Pennsylvania, Philadelphia, US, conducted between 2000 and 2004, found that the probability of file fracture in the apical area was estimated to be 33 and six times greater than in the coronal and middle thirds of the root canal, respectively.[4]

Several factors have been implicated in the failure of root canal instruments, and they have been grouped into four main categories, namely, operator-related, anatomy-related, instrument-related and technique-/use-related:[1]

- Operator-related: Skill, proficiency, judgement
- Anatomy-related: Access cavity, root canal anatomy
- Instrument-related: Material, design, manufacturing process and errors
- Technique-/use-related: Motor's operating parameters, instrumentation technique, reuse and sterilization, irrigants.

The endodontic management of a fractured instrument within the root canal is a difficult process that requires training, experience and knowledge of the methods and techniques that can be used. It is a time-consuming and challenging procedure often associated with anxiety for both clinician and patient and has variable success rates.[1] According to Lambrianidis, the best management of instrument fragments during root canal therapy is retrieval, in order to enable sufficient debridement and obturation of the root canal system.[1]

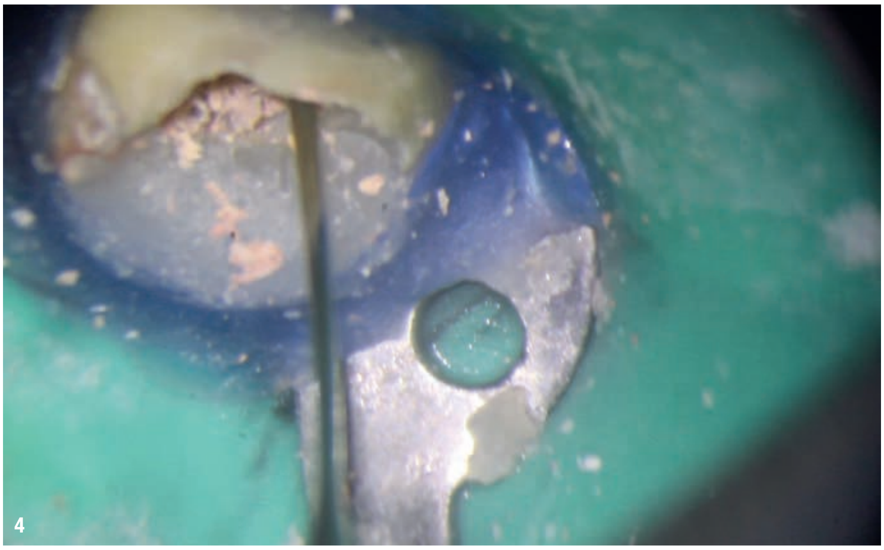


Fig. 4: Modified size 3 Gates–Glidden bur creating a staging platform. **Fig. 5:** Radiograph after removal of the coronal part of gutta-percha and creation of a staging platform.

At present, there is no standardised procedure for safe and consistently successful instrument fragment removal. In each case, the chances of success should be balanced against potential complications. There are four treatment options for managing fractured instruments:

– no intervention;
– non-surgical management;
– surgical management; and
– tooth extraction.[1]

When the clinician decides to manage a clinical case of a separated instrument, it is important to take into consideration that all procedures include the risk of additional errors that may eventually jeopardise the prognosis of the tooth, and the clinician should continuously re-evaluate the progress of management procedures, and consider alternative options when needed. There are certain steps to be followed prior to any decision and, particularly, initiation of efforts to retrieve the fragment. It is necessary to inform the patient about the incident, the procedures necessary to correct it, the alternative management modalities, and the impact of this iatrogenic error, as well as all alternative treatment options on prognosis.[1]

The clinician should take into consideration the fragment location, as it provides fundamental information for decision-making regarding the potential management and risks associated with the process. Another factor to evaluate is the type of instrument fractured and its size. These factors can dictate which technique or approach the clinician needs to adopt in order to deal with this challenging clinical situation.

Various techniques and instruments, which quite often have to be combined, have been advocated for fragment

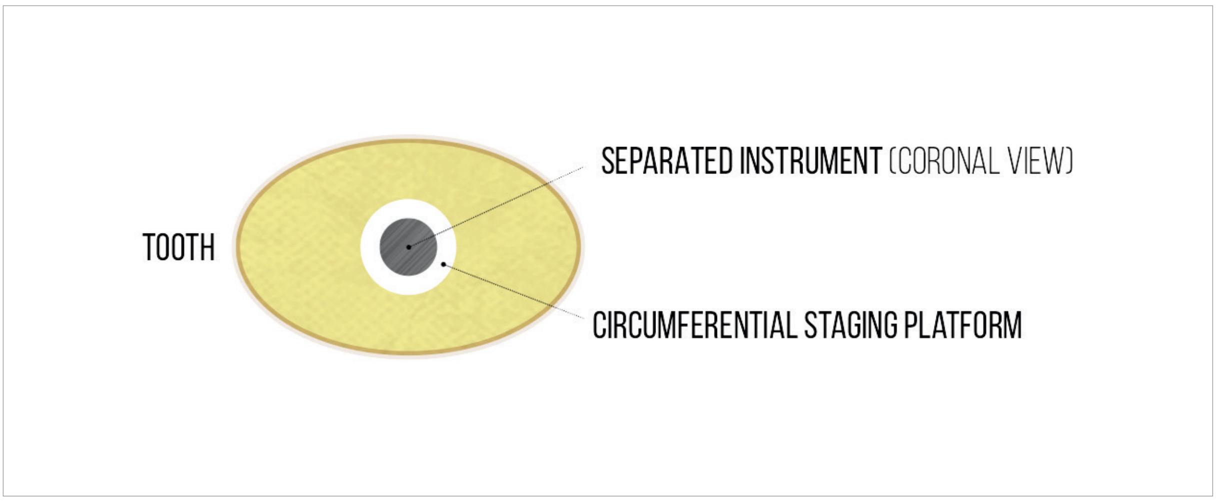
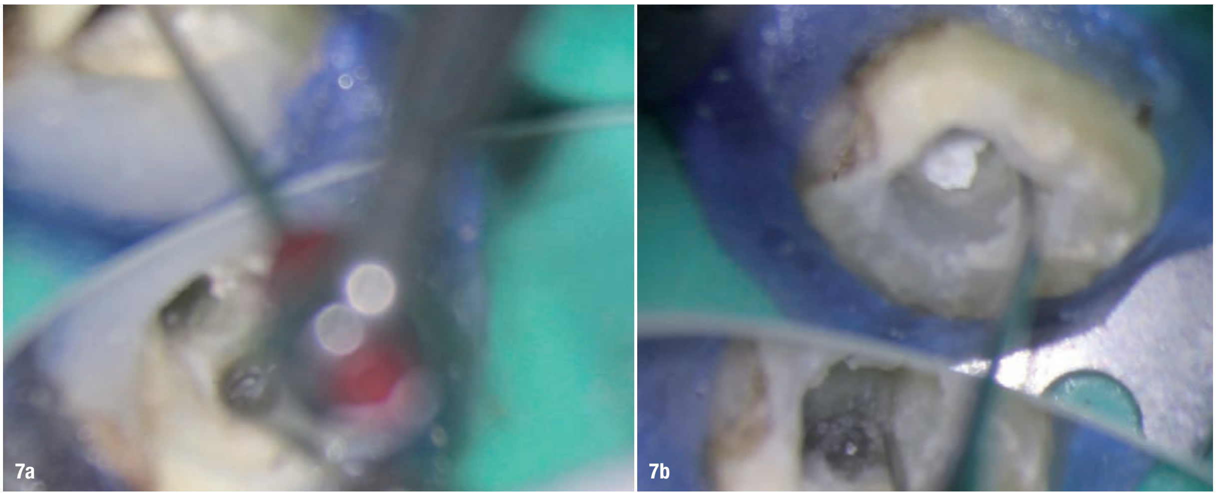


Fig. 6: Schematic representation of a staging platform.



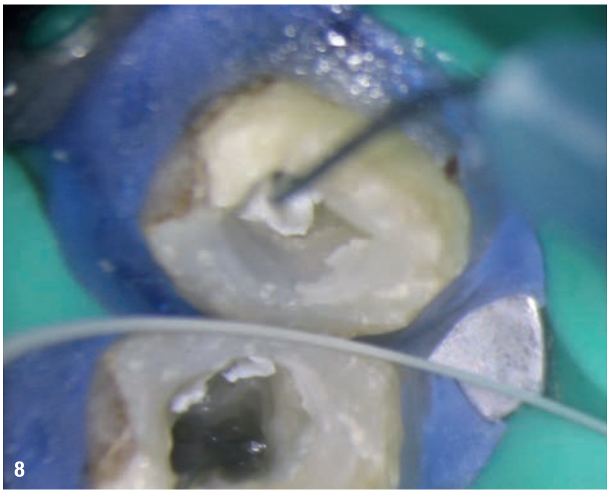
Figs. 7a & b: SONICflex quick 2008 L with a size 25 Endo clean tip, creating a space around the coronal part of the separated instrument.

retrieval. Technological advances in magnification, particularly the dental operating microscope, seem to be key factors in a successful outcome, as they can increase visibility through the use of magnification and light, enabling clinicians to visualise the coronal portion of most fractured instruments. The combination of microscopy, ultrasonics and advances in mechanical techniques used to retrieve foreign objects from the root canal ensure safety and increased efficacy.[1] This article presents a case report with some valuable tips regarding the clinical approach to cases of separated instruments.

Case report

A 44-year-old female with a noncontributory medical history was referred for endodontic retreatment of the mandibular left first molar with the chief complaint of pain for one week. The tooth was very sensitive to percussion and demonstrated no mobility, and periodontal probing around it was within physiological limits. An initial radiograph was taken (Fig. 1). Three separated instruments in mesial and distal root canals from previous root canal therapy and signs of periapical pathosis were observed. Based on the results of clinical and radiographic examination, a diagnosis of a previously treated tooth with symptomatic apical periodontitis was made, and retreatment was recommended.

Local anaesthesia was performed, the tooth was isolated by dental dam and the access cavity was prepared. The gutta-percha coronal to the fragment was removed with a sonic device (SONICflex 2003 L, KaVo) and Micro Files Type D (MANI), under direct microscopic visualisation (Fig. 2). Thereafter, a circumferential staging platform around the most coronal aspect of the fragment was prepared with a modified size 3 Gates–Glidden bur (MANI, Fig. 3), rotated at a reduced speed of 300 rpm and directed apically until it made light contact with the most coronal aspect of the fractured instrument, in each canal (Figs. 4 & 5). This platform needs to be slightly larger than the diameter of the fragment at its coronal aspect (Fig. 6). Using a sonic device (SONICflex quick 2008 L, KaVo) with



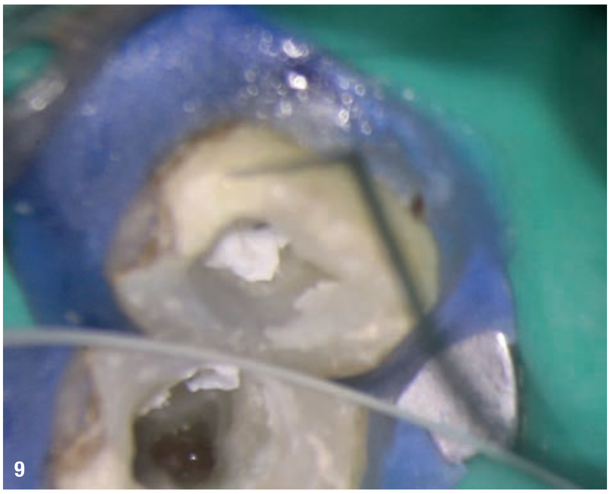
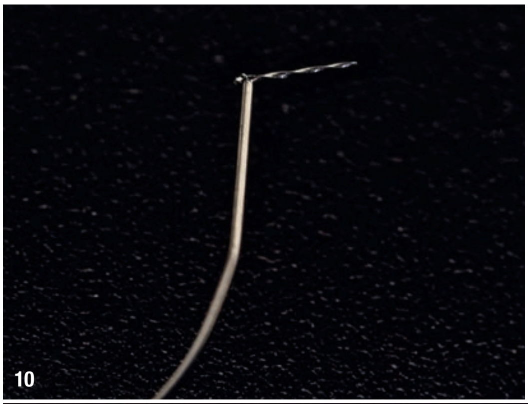
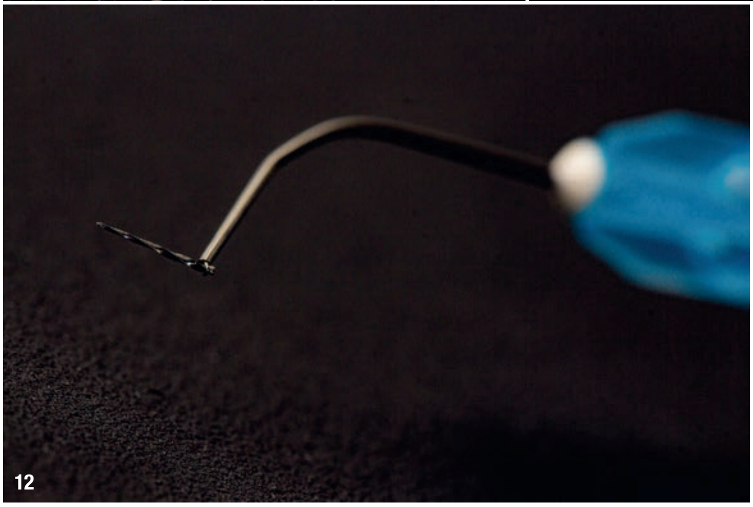
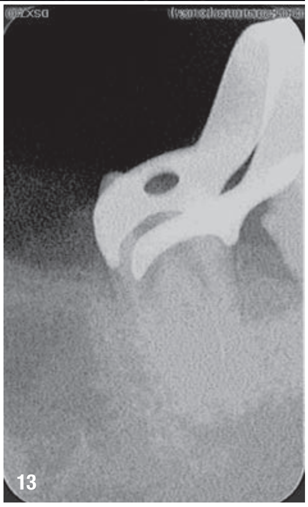


Fig. 8: Adaptation of the EndoCowboy loop device around the coronal part of the fragment. **Fig. 9:** Removed fragment attached to the loop wire.

a size 25 Endo clean tip, space was created around the fragment (exposure of the coronal 2 mm). During this stage, using the same tip, the active part (blades) of the separated instrument was smoothed in order to avoid damaging the loop wire (Figs. 7a & b).







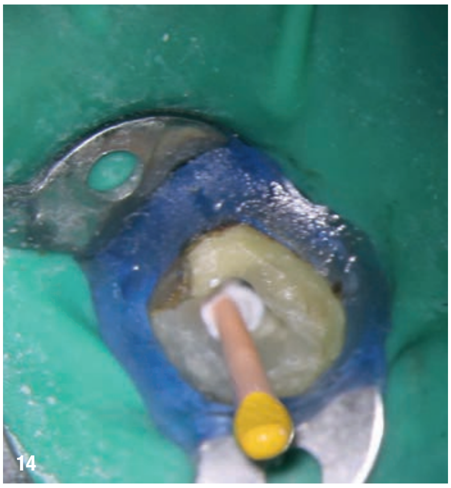
Figs. 10–12: Removed fragment. **Fig. 13:** Radiograph after removal of the fragment.

Taking into consideration the wire characteristics and resistance, the Endo-Cowboy device (which has a 0.1 mm lasso made of specially drawn stainless steel wire with higher tear resistance and a 0.4 mm cannula; Köhrer Medical Engineering) was used as a loop device, following the manufacturer's instructions (Figs. 8 & 9). Using two operators—one taking care of the loop device, controlling under the microscope the attachment of the loop around the separated fragment, and the second operator activating the device (tightening the lasso around the fragment)—the fragments were removed with up and down movements with the loop device attached to the fragment (Figs. 10–13). All canals were instrumented with a size 8, 10, 12 and 15 D Finder (MANI) to obtain a manual glide path. Cleaning and shaping were performed up to size 25/0.06 with Silk files (MANI) in all root canals and a Tri Auto ZX2 motor (Morita). Irrigation was performed throughout the treatment with 5.25 % sodium hypochlorite. A final irrigation protocol was done with 17 % EDTA and 5.25 % sodium hypochlorite, and the irrigant was activated with a manual dynamic activation technique. Obturation was performed using 4 % gutta-percha cones and BioRoot RCS (Septodont), employing the hydraulic condensation technique (Figs. 14–16). The pulp chamber was sealed with Ionoseal (VOCO), and a temporary restoration was made. The patient was referred to her dentist for the permanent coronal restoration. At a follow-up visit after six months, the tooth was asymptomatic (Fig. 17).

Discussion

The intracanal fracture of endodontic files with the possible retention of fragments in the root canal is an unwanted complication in everyday clinical practice. Fragment removal is time-consuming and technically difficult to perform and might jeopardise the outcome of the endodontic treatment. To improve the success of the file retrieval technique, most of the time, a combination of techniques is needed, and there are certain common steps to follow:

- conducting a radiographic examination with more than one angulation or with a cone beam computed tomography scan, to confirm the presence of the fragment, to reveal its location in relation to the root canal curvature, and to estimate its size and length;
- redefining the access cavity to allow better visualisation and unobstructed manipulation;
- keeping the staging platform, created with a modified Gates–Glidden bur, centered in order to allow better visualisation of the fragment and the surrounding dentinal root canal walls;
- placing PTFE tape over other exposed orifices in multicanal teeth in order to prevent dislodgement of the fragment into another root canal;
- maintaining constant visualisation using magnification during management efforts;
- taking frequent working radiographs during the retrieval procedure in order to check the level of retrieval and amount of dentine loss;



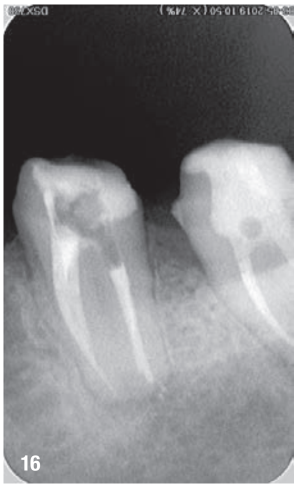
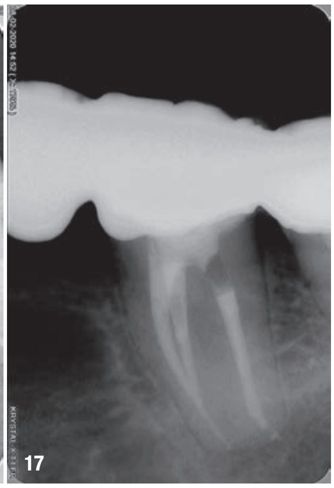



Fig. 14: Obturation with a bioceramic sealer. **Figs. 15 & 16:** Radiograph after obturation. **Fig. 17:** Nine months follow-up radiograph.

- using copious irrigation to remove all debris and dentine chips, followed by thorough drying of the canal to facilitate perfect vision;
- using sonic energy in addition to ultrasonic energy to create space around the fragment (around 2 mm deep) and thereby avoid a secondary fragment fracture (with SONICflex quick 2008 L and size 25 Endo clean tips or with SONICflex 2003 L with Micro Files Type D)—touch the coronal part of the separated instrument with a sonic tip in order to remove the active part of the instrument and thereby avoid cutting the loop wire during the removal procedure;
- activating an ultrasonic device with an ultrasonic tip (if used) at a lower power setting, with intermittent activations, touching the fragment as little as possible and avoiding removing a great deal of dentine;
- intermittent irrigation with EDTA and activation, with up and down movements with an sonic or ultrasonic tip, which helps to clean out the debris and might occasionally dislodge the fragment, flicking it out of the canal;
- conducting all sonic or ultrasonic work inside the root canal in a dry environment, giving the clinician continuous visualisation under the microscope;
- using an endodontic explorer if the coronal segment of the fractured instrument is resting against a wall of the root canal and there is not enough space to loop the fragment, in order to position it toward the center of the canal (if it is a stainless-steel file), or placing a small piece of PTFE tape on this wall, between the fragment and the wall, creating a small space to pass the loop (in nickel-titanium instruments);
- working with two operators, which allows the clinician to fully concentrate on placing the lasso around the separated instrument, while the other operator turns the adjusting wheel clockwise, tensioning the lasso around the separated instrument;
- when using the EndoCowboy device, only doing small up and down movements.

Conclusion

The clinician should be aware of the techniques and various instruments available. With proper knowledge about root canal anatomy and root canal therapy, accidents such as instrument fracture can be reduced. This report has described the combination of different techniques for a more conservative approach to treating these challenging cases.

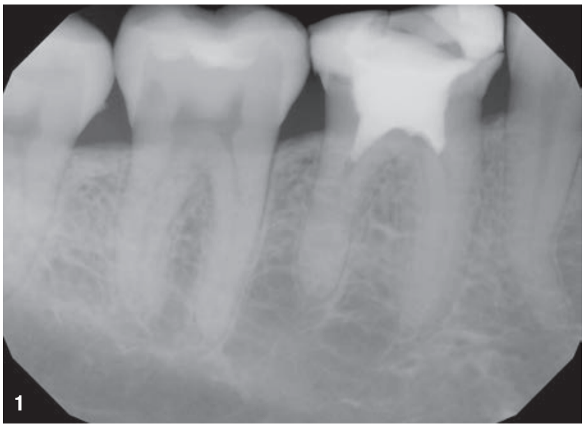
Editorial note: A list of references is available from the publisher. This article was first published in the Clinical Masters magazine*, volume 6, issue 2020.*

about

Dr Hugo Sousa Dias graduated with a DDS from University Fernando Pessoa, Porto, Portugal, and completed the postgraduate programme in endodontics at the University of Lisbon, Portugal. 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 Endodontology and the Sociedade Portuguesa de Endodontologia (Portuguese endodontic society). He has given more than 20 lectures around the world and is co-author of a chapter in the book *The Root Canal Anatomy in Permanent Dentition* (Springer, 2018).

Effective and safe endodontic treatment of teeth with curved canals

Dr Grzegorz Witkowski, Poland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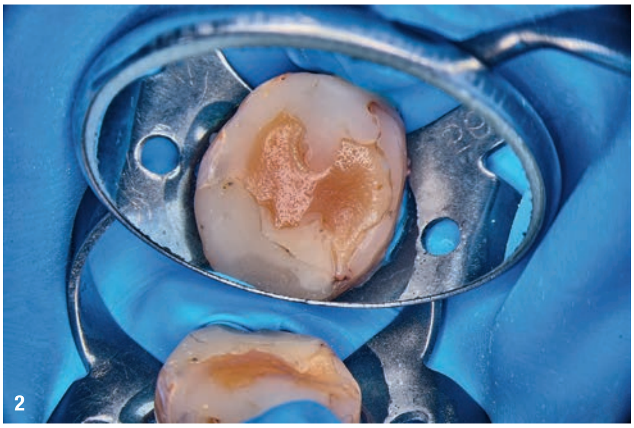
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The endodontic treatment of teeth with curved canals is always challenging for the practitioner in terms of cleaning, shaping and filling of the endodontic system. It is well known that advancements have been made in the flexibility and performance of root canal shaping nickel-titanium (NiTi) instruments, which are able to follow the anatomy of the tooth and to remove pulp tissue and bacteria, even in difficult anatomies. However, *in vitro* and *ex vivo* studies have proved that the apical third is the zone in which eradicating bacteria is the most difficult to achieve, since untreated areas after instrumentation can range from ten to fifty per cent.[1] Here, the action of irrigating solutions is of primary importance for the success of the therapy.

Safely bringing an adequate volume of irrigant as close as possible to the working length has been the target of the irrigation tips available on the market. Several designs and materials have been tested in order to give the clinician the best feel in terms of cleaning efficacy and ease of use.[2] In the following case reports, two different tips for irrigation were used.

Case 1

A 40-year-old patient was referred to our clinic for endodontic retreatment. The patient felt pain while chewing on a mandibular right first molar. The preoperative radiograph showed that the root canal lumen was visibly


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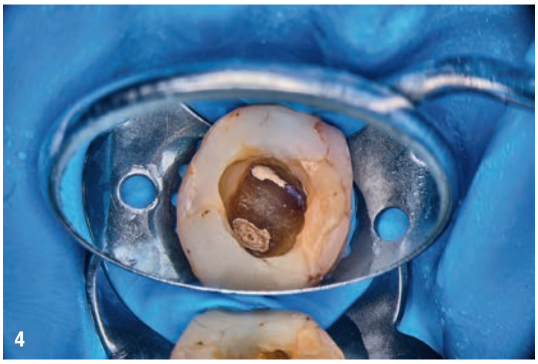
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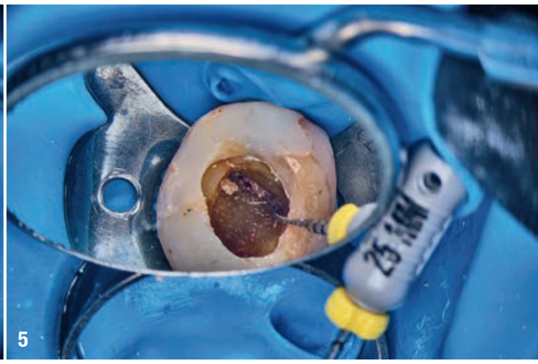
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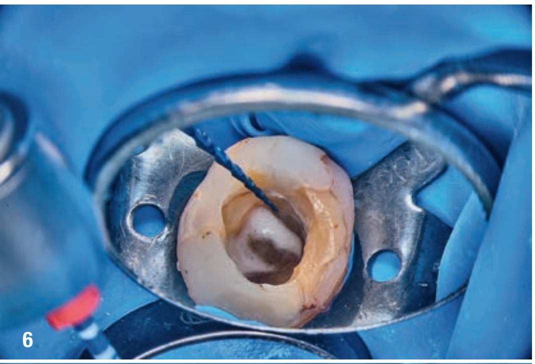
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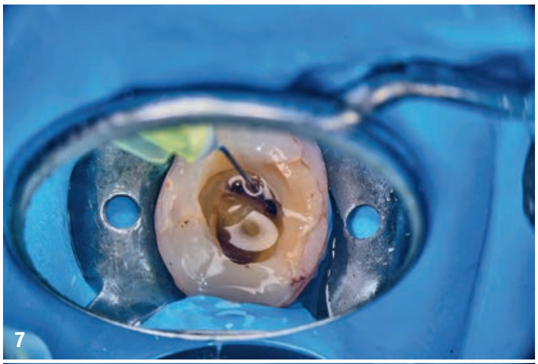
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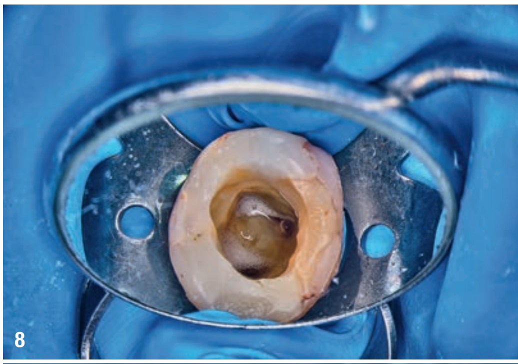
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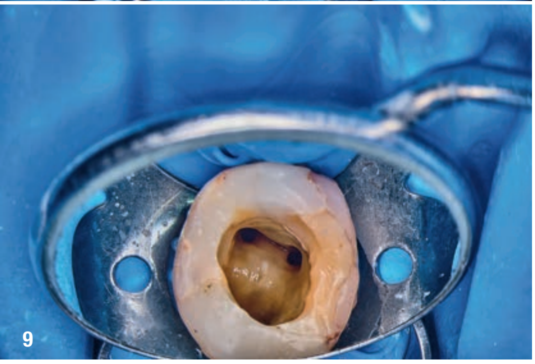
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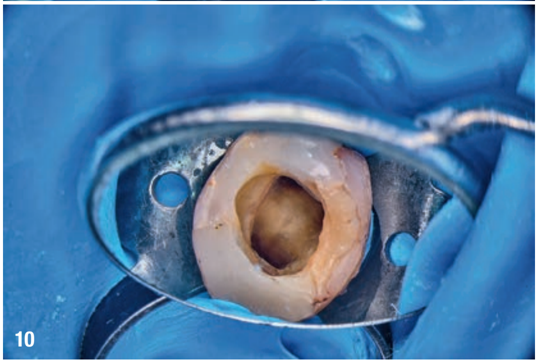
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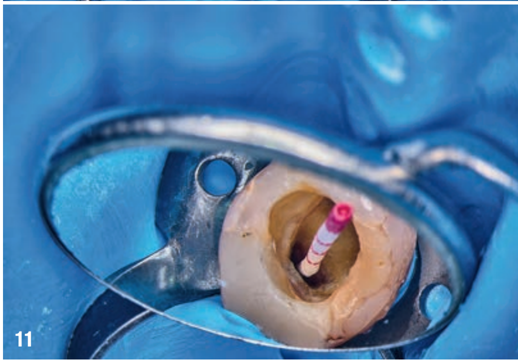
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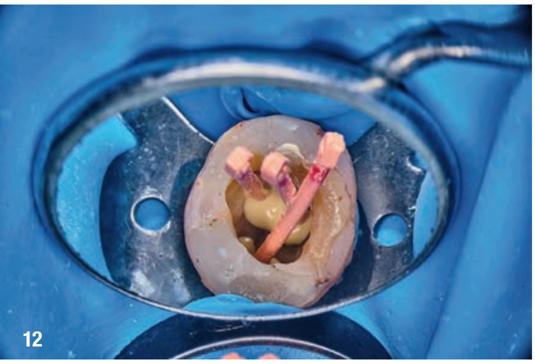
diminished and the pulp chamber had been filled with flowable composite (Fig. 1), while the clinical examination showed a large and abraded composite restoration.

A dental dam was placed on the tooth in order to isolate the operating field (Fig. 2),[3] and the root canal therapy began. The first step in the correct shaping of the root canal system is the access cavity.[4] It ideally must be the coronal projection of the root canals, and it is meant to be as small as practical. The coronal composite was carefully removed with a diamond-coated bur as soon as the pulp chamber floor was reached (Fig. 3). After creation of the access cavity, the carboxylate cement that had been placed in the root canals in the primary treatment was removed, and the root canal openings were sought and found with the help of the operating microscope (Fig. 4). Subsequently, it was managed to remove the cement from the root canals.

Since the primary treatment had not respected the basic principles of 3D cleaning, shaping and filling of the root canal system, it was necessary to consider these, as the pulp was still present in the root canals. The scouting phase was executed, first with thin stainless-steel manual instruments and NiTi rotary files (Fig. 5), and then NiTi reciprocating files were used to shape the root canal system (Fig. 6).[5]

After root canal enlargement, irrigation was performed by means of 5% sodium hypochlorite carried by a 0.3mm stainless-steel side-vented needle (Fig. 7), endeavouring to bring the needle tip as close as possible to the working length.[6] The fluid was then activated with sonic inserts[7] according to Tonini and Cerutti (Fig. 8).[8] The root canals were then dried with aspiration (Figs. 9 & 10) and paper cones (Fig. 11).

The obturation phase was carried out with warm gutta-percha according to the continuous wave compaction technique (Figs. 12 & 13). A provisional restoration was then placed, and the patient was sent back to the referring dentist for the final indirect restoration (Fig. 14).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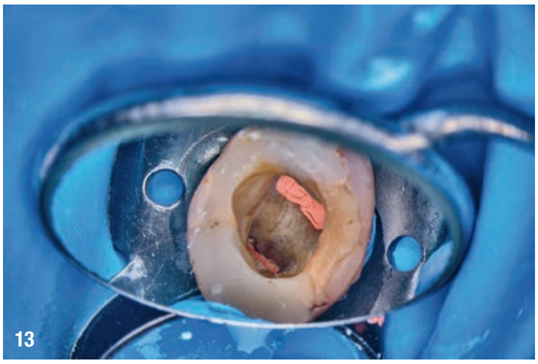
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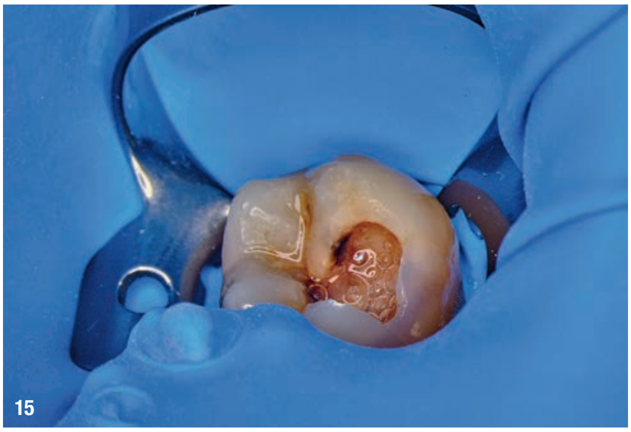
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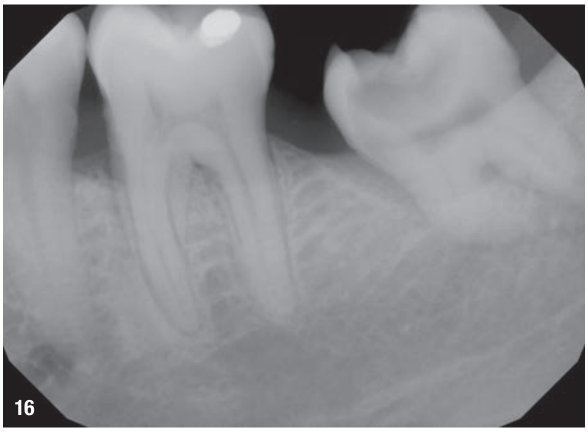
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Case 2

A 56-year-old patient came to our office complaining of intense pain at tooth #38. The tooth showed an extensive carious lesion (Fig. 15), and the radiographs confirmed that the decay was in proximity to the pulp chamber (Fig. 16).

A lower alveolar nerve block was executed and a dental dam placed. The decay was then removed under a microscope (Figs. 17–19). After removal of all the decayed tissue, the access cavity was completed, endeavouring to be extremely conservative, and the root canal openings were found and enlarged with the help of ultrasonic tips (Fig. 20). The scouting of the root canal was executed with thin hand files (Figs. 21 & 22) and then the shaping procedure was carried out by means of reciprocating NiTi files (Figs. 23 & 24).[9]

The irrigation phase was executed with IrriFlex (Produits Dentaires), a novel polypropylene irrigation tip that has two side vents back to back (Figs. 25–27) and then the irrigant activation was done with sonic tips. Shaping and irrigation were alternated until the root canals appeared clean and appropriately tapered (Figs. 28–32).[10,11]

Paper cones were then used to dry the root canals (Figs. 33 & 34), and the obturation was done with a single cone and a bioceramic sealer (Figs. 35 & 36). The access cavity was sealed with a composite material and then an indirect restoration was booked.

Conclusion

The clinical cases were executed by the same experienced practitioner, and both had a favourable outcome.


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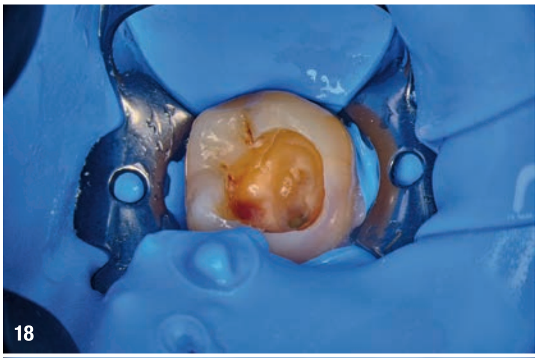
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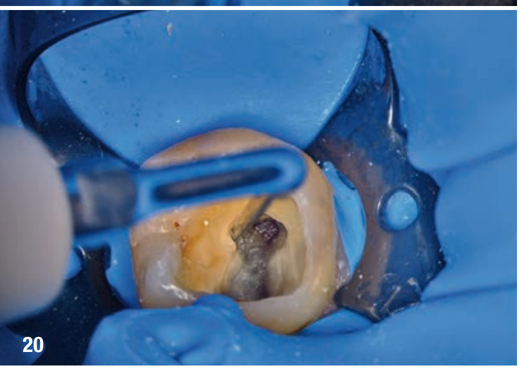
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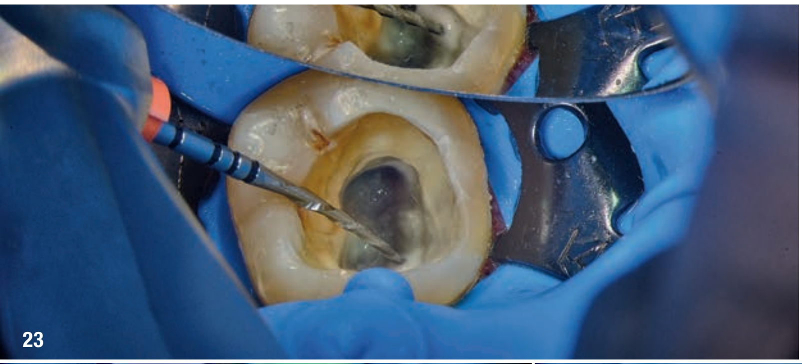
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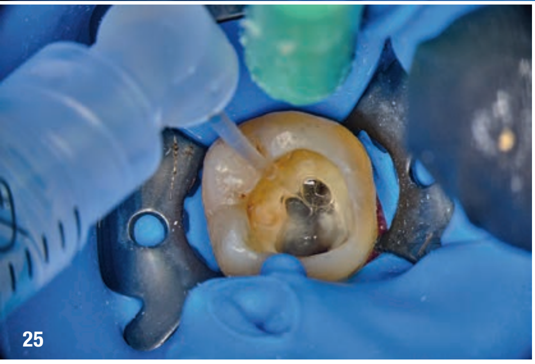
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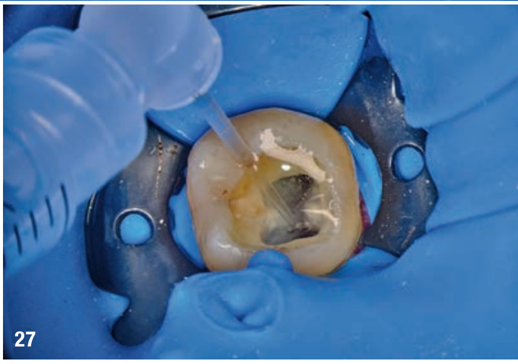
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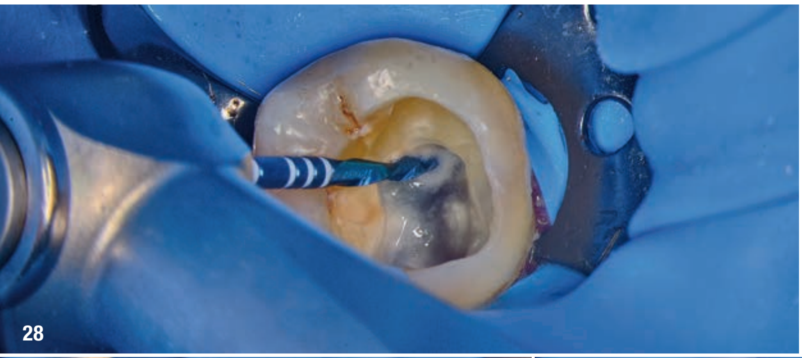
The choice relative to the clinical protocol was guided by the clinical scenario.

While there were no differences in the shaping system selected (since the combination of manual scouting and reciprocating NiTi files permitted shaping of the root canals, decreasing the risk of instrument fracture, even in presence of strong curvatures), the irrigation tip and the obturation method selected were different.

The different choice of irrigation tips was due to the availability of the products and to the anatomy of the root canals. Since it was rational to suppose that mechanical shaping alone was not able to remove *in toto* pulp remnants, the smear layer and bacteria, irrigation played an important role in both cases.

In the first case, a thin metal side-vented tip was used. The root canals were quite straight, so this kind of tip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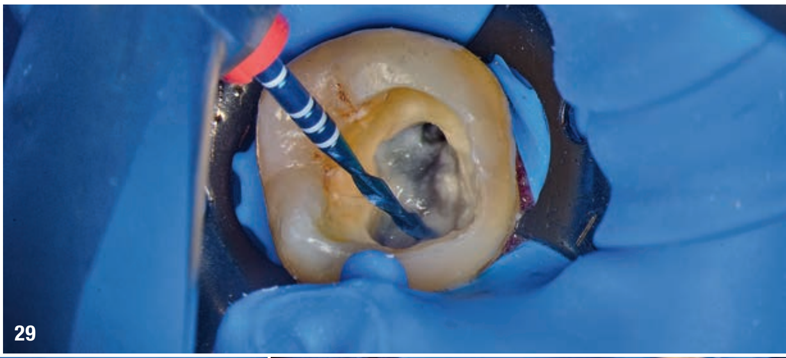
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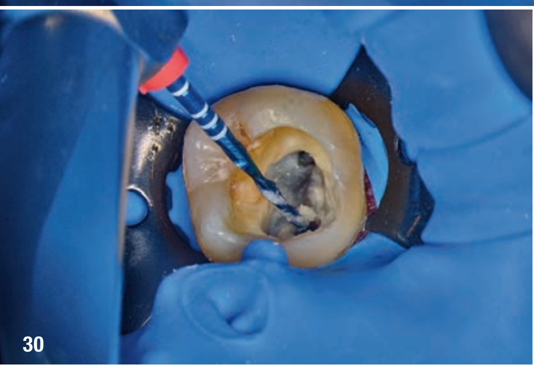
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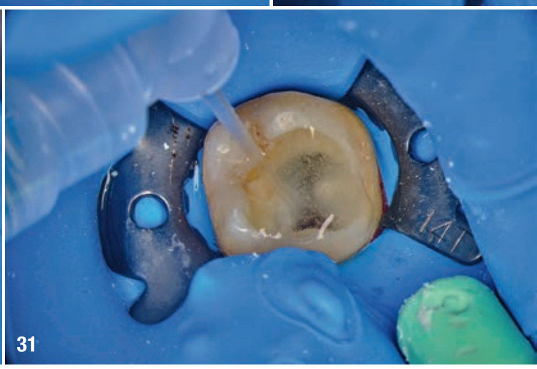
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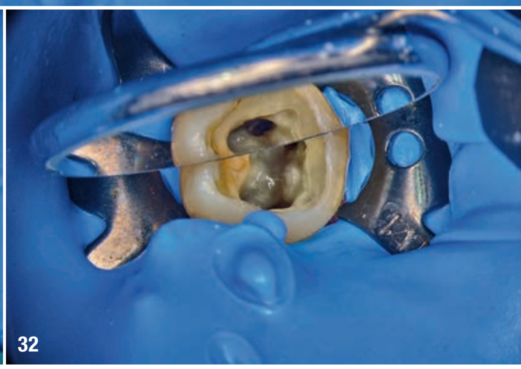
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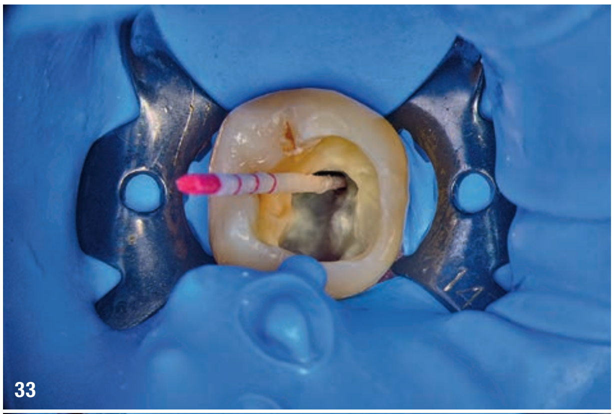
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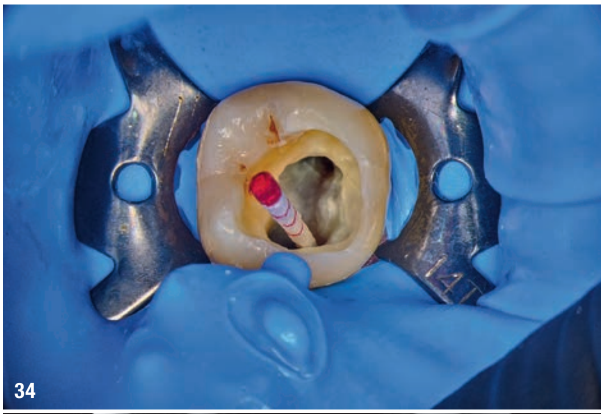
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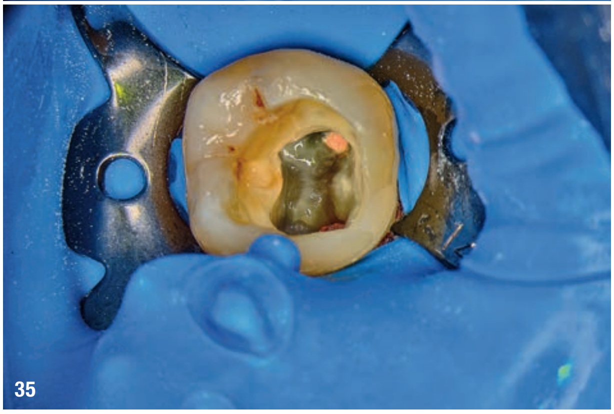
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permitted a good penetration of sodium hypochlorite into the root canal and the presence of a lateral exit for the irrigant prevented its extrusion into the periodontium.

In the second case, where the curvature of the roots was more pronounced, a metal tip (even if prebent) would not have permitted bringing of the irrigant close to the working length. This happens because metal needles tend to block towards the walls of the canal, diminishing the volume of irrigant reaching the apex and producing less effective fluid dynamics.[12] Considering this, a soft-body polypropylene irrigation tip, IrriFlex, was chosen for this case. IrriFlex smoothly reached the working length, without showing any problem of penetration into the prepared root canal, thanks to the capability of its body to follow the shape of the root and allowed bringing to the apex a high irrigant volume.

The presence of length marks on the body of the tip helped the clinician effortlessly determine the position of the needle with respect to the working length. The solution delivery was remarkably easy, as soft pressure on the syringe plunger was sufficient to irrigate. IrriFlex was effective and safe, because of the back-to-back two side vent design of the tip that prevented the irrigating solution from extruding into the peri-apical tissue and helped achieve clean canal walls (which appeared glossy under the operating microscope) in a short time.

As regards the obturation technique, the warm gutta-percha obturation permits 3D filling of the root canal system, whereas the bioceramic sealer is particularly suitable for cases in which the complex anatomy of the tooth requires a sealer with antibacterial activity and high biocompatibility.

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

about

Dr Grzegorz Witkowski graduated from the Medical University of Warsaw in Poland in 2003. Since 2004, he has run a private practice in Olsztyn in Poland focused on endodontics, CAD/CAM and aesthetic dentistry. He is a member of the European Society of Endodontology, Polskie Towarzystwo Endodontyczne (Polish association of endodontics) and Polska Akademia Stomatologii Estetycznej (Polish academy of aesthetic dentistry).

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Clinical management of maxillary second molar root canal therapy in different anatomical situations

Drs Philippe Sleiman, Lebanon & Alexey Volokitin, Ukraine

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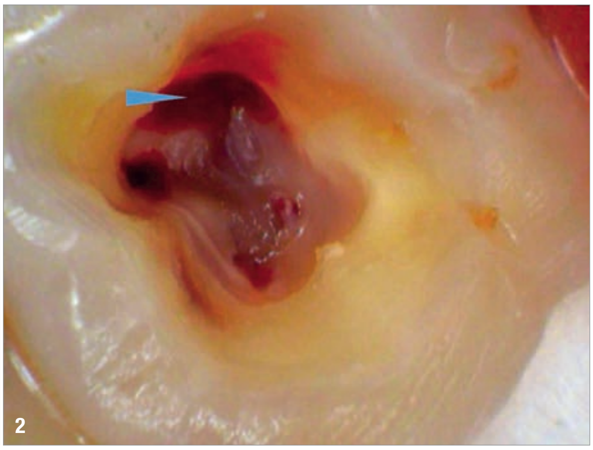

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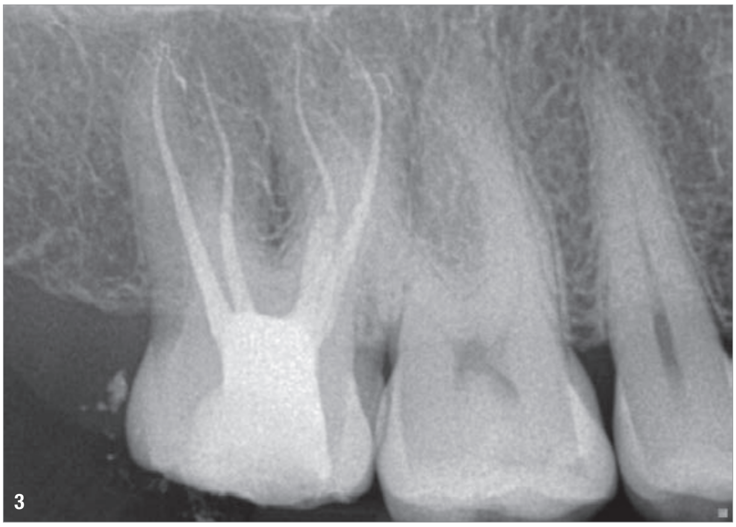
Maxillary second molars are always a challenge for root canal therapy. This difficulty is related to the location of the tooth, way back in the maxilla with limited access, and the variety of anatomical situations. In this article, we will focus on some of those anatomical variations and how to handle them.

Case 1

The preoperative radiograph (Fig. 1) revealed that the roots had an uncommon shape, particularly regarding the palatal root, the periodontal ligament and the apex of the mesial root. Upon creating the access cavity



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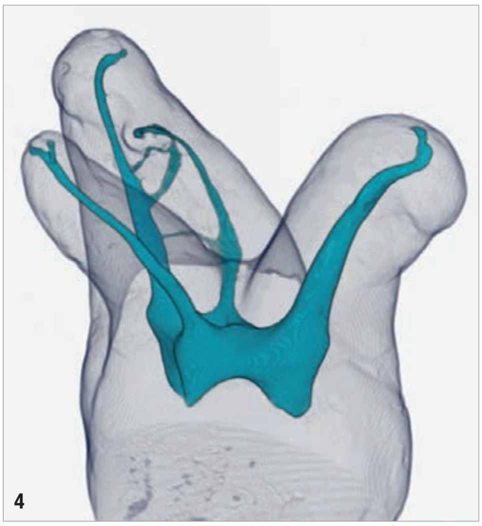

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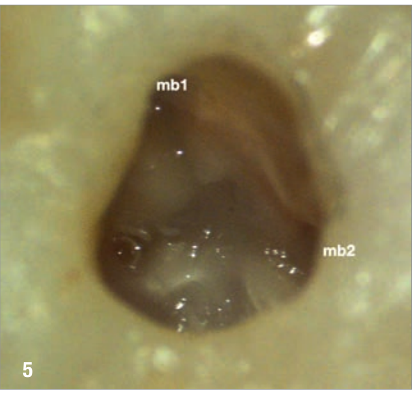

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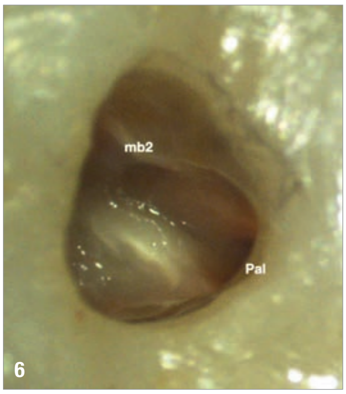

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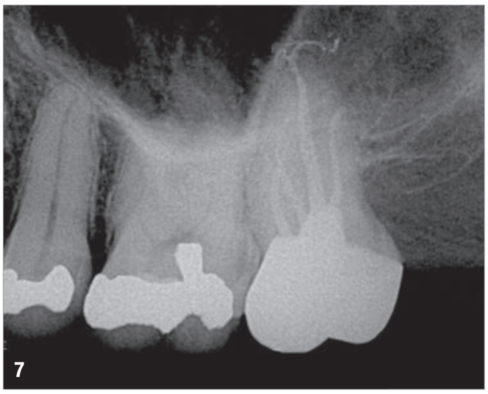
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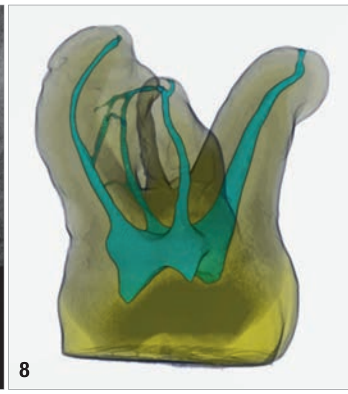
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(Fig. 2), under the operating microscope, I noticed bleeding from the mesiopalatal angle. Extending the access cavity to that side led to the discovery of a separate canal, which may have been a second palatal or an independent mesial canal.

For shaping, you need to start, after establishing a glide path, with 21 mm stainless-steel hand files. I use a 17 mm orifice opener because it allows me to work way in the back with indirect vision, and this step will shape the first part of the canal, making it easy for the remaining rotary files to follow the path that has been created.

The final radiographs revealed four separate root canals (Fig. 3). Figure 4, a micro-CT scan done by Dr Volokitin, shows almost the same anatomy.

Case 2

The patient was referred for a root canal therapy of his maxillary molar. Upon creating the access cavity under a clinical microscope, we could see that the entry to the second mesial canal was at a distance from the entrance to the first (Fig. 5). Figure 6 shows the proximity of the second mesiobuccal canal to the palatal canal. Increasingly, second mesial canals are being treated in the maxillary second molar owing to the use of the microscope, ultrasonic instruments and irrigation and of course owing to the clinical knowledge regarding the use of these and owing to the use of CBCT imaging sometimes.

Figure 7 shows an immediate postoperative radiograph of the treatment. A micro-CT scan of a similar root canal system is shown in Figure 8.

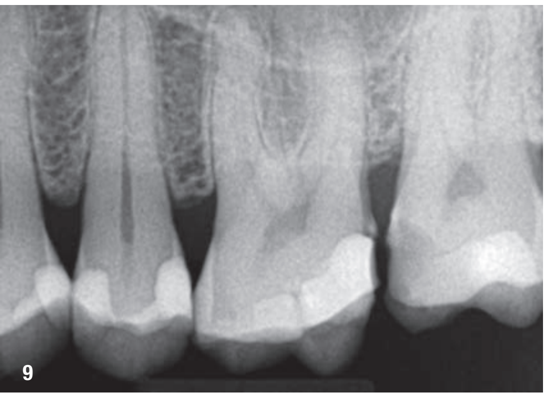
Case 3

Irreversible pulpitis was causing this patient a great deal of pain. When examining the preoperative radiograph (Fig. 9), I saw doubled periodontal ligament on the mesial root, which clearly indicated a second canal in this root. The opening of the second mesiobuccal canal was very tight and very small; nevertheless, it had a separate exit.

The immediate postoperative radiograph in Figure 10 does not show it, but an image at a further 15° angle would clearly show the independent exit of the second mesiobuccal canal. A micro-CT scan of a similar anatomy—as we can never find two identical anatomies—is illustrated in Figure 11.

Case 4

This type of anatomy is the most challenging, as it requires all your skills and high-tech equipment. The patient was referred for irreversible pulpitis of a maxillary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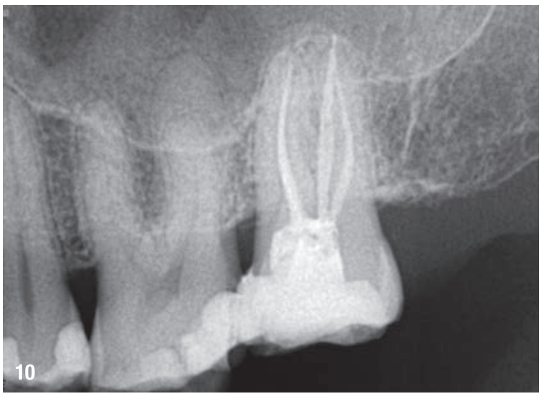
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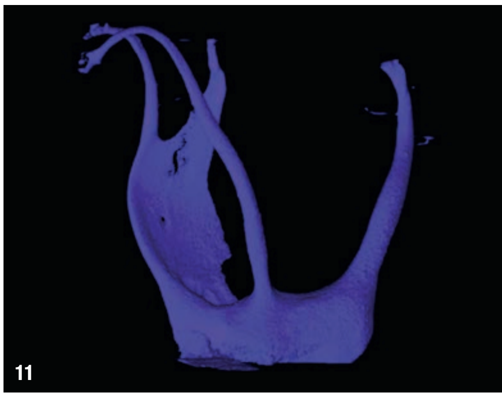
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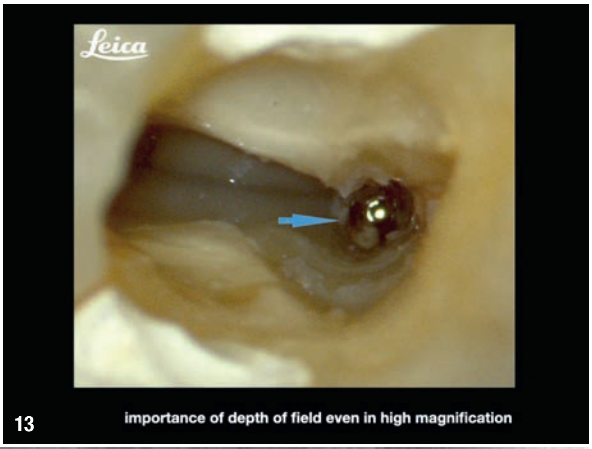

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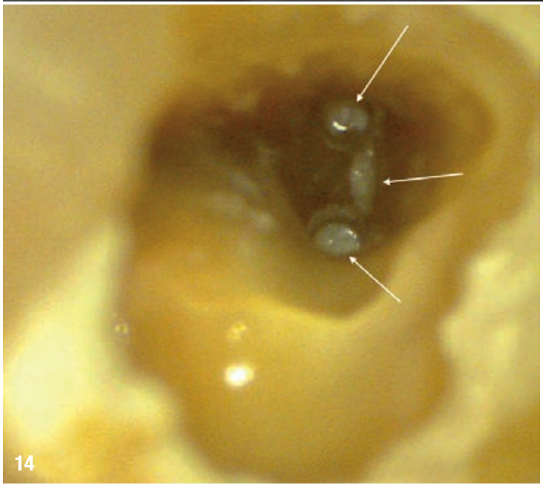
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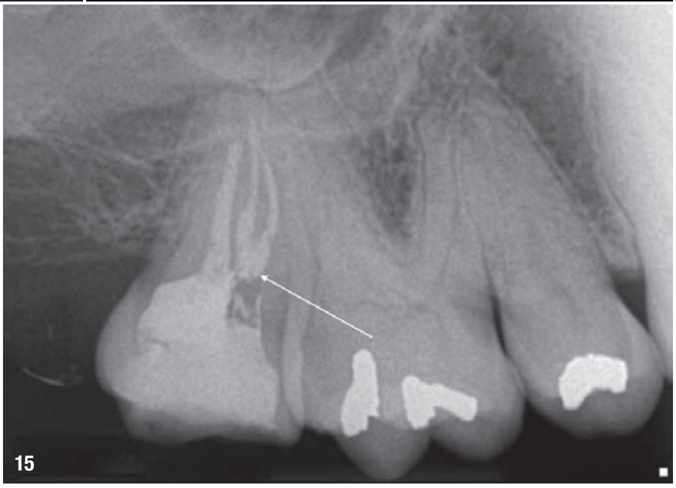
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second molar. Upon examining the preoperative radiograph (Fig. 12), we could see that the anatomy was not clear. When creating the access cavity (Fig. 13), I saw only a small opening in the centre of the buccal area of the access cavity. Using ultrasonic instruments, very carefully and gently, I extended the access cavity more to the distal side and a bit deeper, preceding very slowly. It was like creating a second access cavity inside the first one. I had to go down almost 5 mm in order to uncover the opening of the distal canal, and the mesial canal and the isthmus between the two canals can be observed in Figure 14.

The immediate postoperative radiograph (Fig. 15) shows how deep the furcation and the isthmus between the two canals were. This kind of anatomy is very difficult to establish and treat in teeth to which access is relatively easy. We could unfortunately not find a micro-CT reconstruction of such an anatomy, as performing a root canal therapy on a maxillary second molar is not common, being rather difficult. We can easily miss a canal and thereby the whole treatment is jeopardised.

It is necessary to use the proper tools, such as a good dental microscope with good-quality lenses, good-quality front surface mirrors and high definition, ultrasonic instruments that will allow you to microsurgically create good access, and a suitable file system and chemical preparation to complete the treatment.

Photos: © Dr Philippe Sleiman; Figs. 4, 8 and 11: Dr Alexey Volokitin

about

Dr Philippe Sleiman received his DDS in 1990, his MSc in 1995 and his DSc in 2006 from the Lebanese University in Beirut in Lebanon. He received his CESE in endodontics from Saint Joseph University of Beirut in 1999. He is an associate professor in the Department of Restorative and Esthetic Dentistry, and Endodontics at the Lebanese University's Faculty of Dental Medicine and an adjunct associate professor at the Adams School of Dentistry of the University of North Carolina at Chapel Hill in the US. He has a private practice in his native Beirut and is chief endodontist in three clinics in Dubai and Abu Dhabi in the UAE. Dr Sleiman is an international speaker in endodontics and is collaborating on several ongoing endodontic studies. He is a fellow of the International College of Dentists and the American Association of Endodontists.

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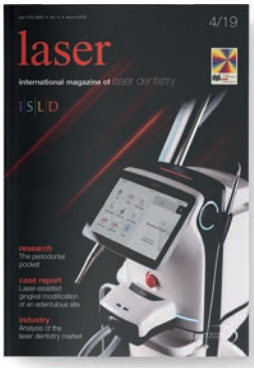

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Management of iatrogenic pulpal floor perforation in a mandibular molar with MTA and PRF: A case report

Dr Sourav Banerjee, India

Introduction

This was a challenging case with the combined issues of a failed root canal therapy and an iatrogenic perforation of the floor of the pulp chamber. Though initially the prognosis could not be evaluated effectively simply because of non-availability of peer-reviewed literature of similar cases for citation, but the case was taken on owing to the patient's desire to salvage the natural tooth. The importance of magnification and the ergonomic use of the dental operating microscope cannot be more clearly demonstrated than in this case. Perforations are quite unpredictable to deal with, and the prognosis depends upon an array of criteria, such as the location, size, time lapse between the occurrence of the perforation and the repair, pre-existing infection at the site and material used for the repair. Though there are few studies available regarding the combination of mineral trioxide aggregate (MTA) and platelet-rich fibrin (PRF), owing to their biocompatible and autologous nature, respectively, and having a follow-up of the case of over one year and a few other studies with similar follow-ups, the combination appears satisfactory.

Case report

A 56-year-old male patient was referred to our practice by a general dentist. The patient had symptomatic apical periodontitis of tooth #46 and a continuous dull aching pain that radiated to the right side of his face and neck. I took a detailed history of the case and came to learn that the tooth had first been treated two years before, and when the patient developed pain in the same tooth, he had visited a second dentist, who took an intra-oral periapical radiograph and suggested a retreatment. That dentist had performed the coronal disassembly and attempted a retreatment, but failed to locate the mesio-lingual canal, which the first general dentist too had been

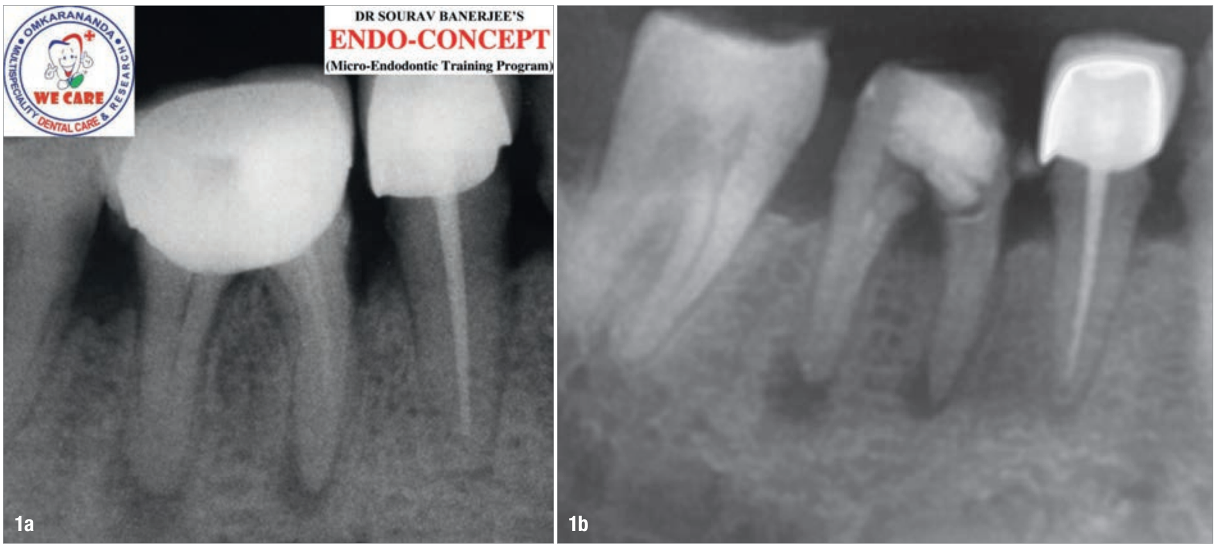
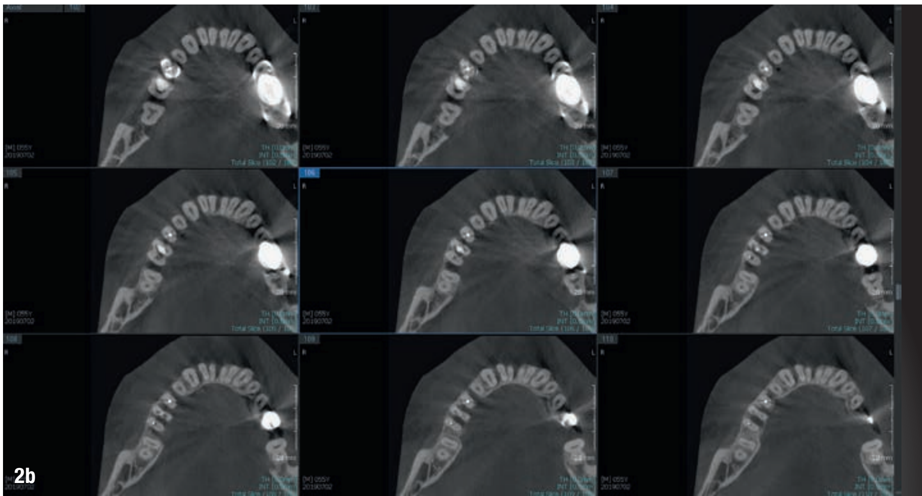


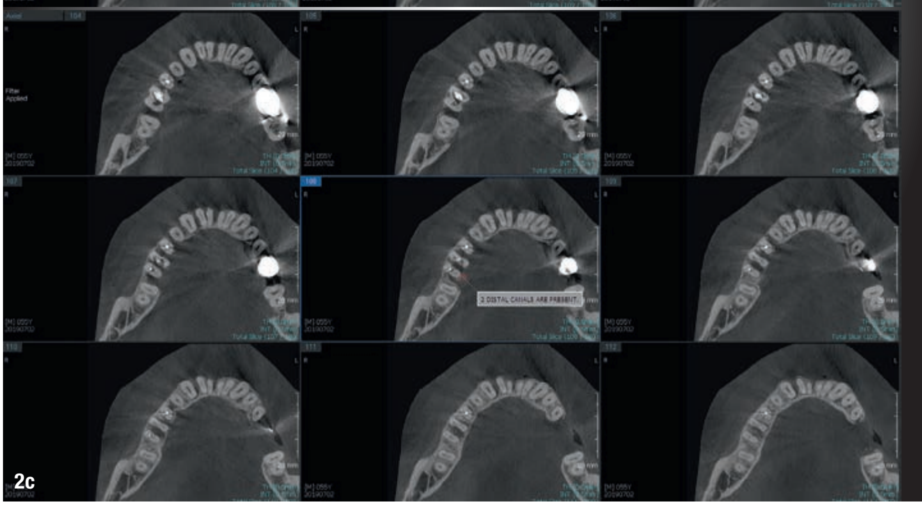
Fig. 1a: Pre-op radiograph taken by the referring dentist. **Fig. 1b:** Pre-op radiograph taken by the author in relation to tooth #46 (January 2019).

unable to locate. Subsequently, after several appointments to locate the mesiolingual canal, the second general dentist had perforated the floor of the pulp chamber. He did not inform the patient of this, but placed a temporary restoration and kept him on oral antibiotics and analgesics. After several days, the patient reported to the dentist with pain and was advised to have the tooth extracted and replaced with an implant, as it could not be saved. Since the patient was unwilling to do so, however, the dentist referred him to our practice.

When I had a close look at the preoperative radiograph from the referring dentist (Fig. 1a), I observed that there was insufficient obturation of the mesial canals and almost no obturation of the distal canal. Both roots displayed periapical radiolucency. The clinical examination revealed a Grade I mobility, and the tooth was tender to percussion. The periodontal examination ruled out any pockets and loss of attachment. We took an intra-oral periapical radiograph (Fig. 1b), from which we observed the loss of coronal structure and a large radiolucent area over the furcation area and the periapical area of both the mesial and the distal roots. A CBCT scan of tooth #46 was advised to check for any details that may have been missed in the intra-oral periapical radiograph (Figs. 2a–g). From the CBCT scan, it could be observed that there was inadequate obturation of the distal canal on the horizontal plane, no obturation beyond the middle third in the mesial canals and a breach of the floor of the pulp chamber. The questionable prognosis was explained to the patient, and written consent was obtained.

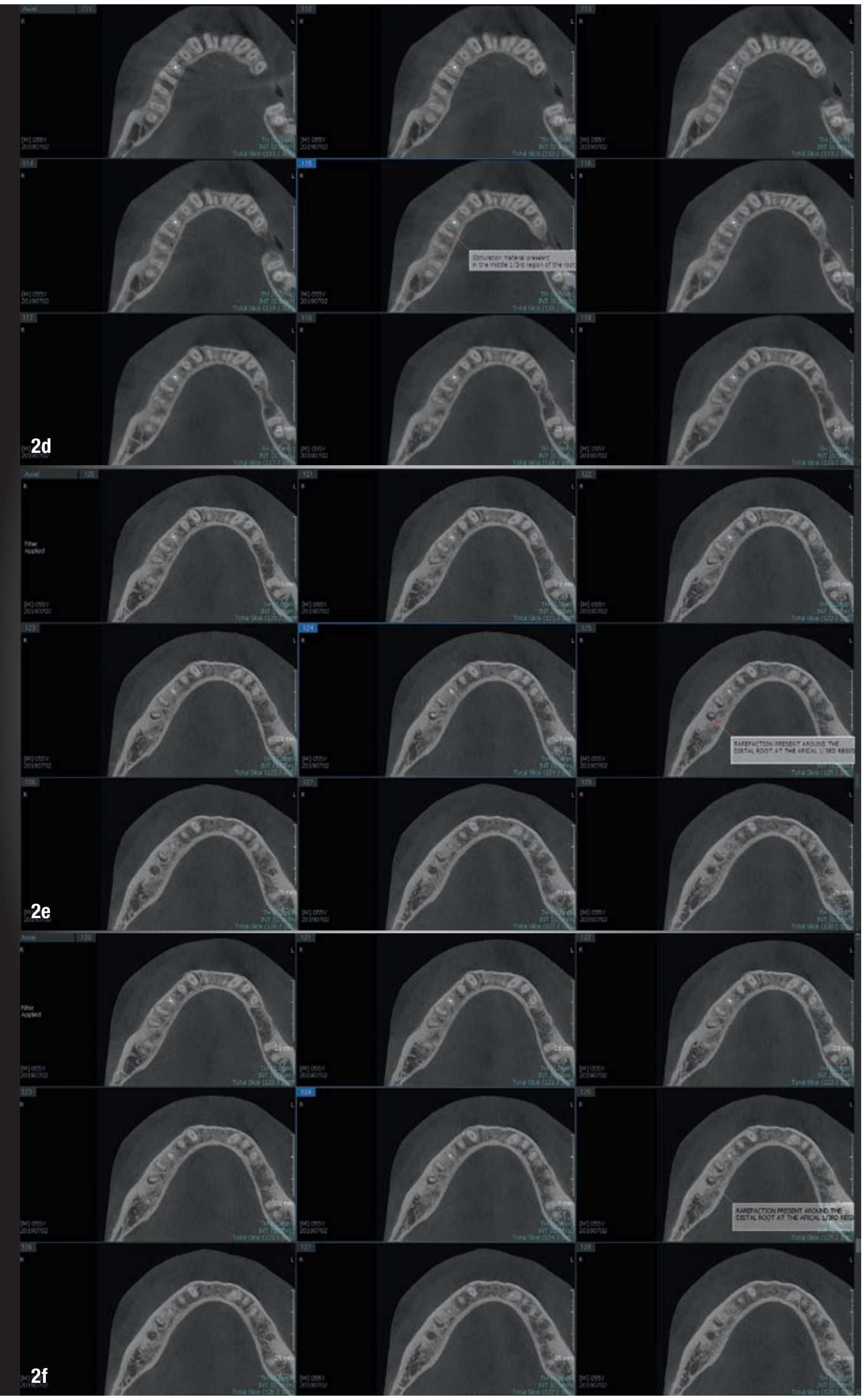
Figs. 2a–g: Pre-op CBCT images of tooth #46: No obturation material in the distal and mesiobuccal canal **(a)**; scanty obturation of the canals and breach of the floor of the pulp chamber, no obturation beyond a few millimetres down the orifice **(b & c)**; radiolucency in the furcation area and periapical region of both roots **(d–g)**.





An inferior alveolar nerve block was administered, and a dental dam was placed. When the temporary restoration was removed, blood began oozing out from the pulp chamber. After initial haemostasis, a large blood clot could be observed on the floor of the pulp chamber (Fig. 3). The clot and the underlying granulation tissue were removed with a sharp spoon excavator, and the pulp chamber was irrigated with saline. Then a sterile cotton pellet soaked in 1 % sodium hypochlorite was placed in the chamber for two to three minutes until the oozing of the blood stopped.

The mesiolingual canal was located under the dental operating microscope (Sanma Medineers) using an RS-1 ultrasonic tip (KaVo Kerr) at the #5 power setting without water, attached to a P5 NEWTRON scaler (ACTEON). The orifice was enlarged using micro-openers (DENTSPLY Maillefer). The previous obturation was removed using retreatment rotary files (Endostar, Poldent). Coronal pre-flaring was done using 25/.08 TF files (KaVo Kerr). A glide path and patency were established in all the canals with a 10/.02



K-flex file (KaVo Kerr) using a watch-winding motion and with an electronic apex locator (Apex ID, KaVo Kerr) attached to simultaneously record the EWL (electronic working length; Table I). The glide path was then widened using an intermediate size file of 12/.02 (Endostar) and a 15/.02 K-flex file (KaVo Kerr) in balanced force motion. The initial master apical file was then selected for each canal, sequentially placing larger K-flex files and checking the file that bound within 3–4 mm short of the EWL. For the mesiobuccal canal, it was 30/.02; for the mesiolingual canal, it was 35/.02; and for the distal canal, it was 40/.02. The canals were then sequentially enlarged with K-flex files in the M4 Safety handpiece (KaVo Kerr) at 5,000–6,000 rpm.

After every 0.5–1.0 mm of advancement, the canal was irrigated with a mixture of 6 % sodium hypochlorite (CanalPro, COLTENE) and HEBP (1-hydroxyethylidene-1,1-bisphosphonate) or etidronic acid Twin Kleen (Maarc Dental) at a dilution ratio of 0.9 g (two capsules) of HEBP in 10 ml of sodium hypochlorite. The solution follows the concept of continuous chelation that either prevents or minimises the formation of the smear layer, and it is especially effective in the critical apical region. The solution was placed into the canal with a 30-gauge double-side-vented needle (Master Clean 2, Ident) at a flow rate of 1 ml per fifteen seconds (Table II). Then negative pressure irrigation was performed with 10 ml per canal in two phases using EndoVac (KaVo Kerr).

Patency was checked with a 10/.02 K-flex file with the electronic apex locator attached to record any change in the working length that may have resulted from preparation of the canals. The distal canal was ovoid in shape; hence, the canal body shaping was done using 15/.02 H-type files in the circumferential filing technique. After the preparation of the canals to the initial master apical file size, the canals were sequentially merged with 4 % taper rotary files. I used Endostar Azure rotary files (Poldent) and shaped to the respective final master apical file (Table I). Since the oozing of blood had not stopped and the canals were not dry after the cleaning and shaping of the canals, it was decided to place calcium hydroxide into the canals and cover the perforation with PTFE tape that had been soaked in 2 % chlorhexidine for ten minutes, and the access was sealed with a light-polymerising temporary composite.

The patient was recalled after ten days. At the second appointment, the temporary restoration and the tape were removed. The pulp chamber and the canals were irrigated with saline to wash off the excess calcium hydroxide. The canals and pulp chamber were treated with 17% EDTA for one minute, followed by ultrasonic activation for thirty seconds with an Irrisafe tip (ACTEON) attached to a P5 NEWTRON scaler unit. Then the canals were irrigated according to the continuous chelation concept using a mixture of HEBP and sodium hypochlorite in negative pressure irrigation using EndoVac (10 ml per canal) in two phases. Figure 4 shows the pulp chamber just after the irrigation protocol. The canals were then dried using 70 % isopropyl alcohol and paper points.

2g

Table I: Canal dimensions

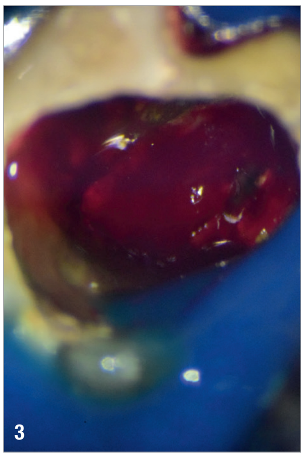
Canal	Length (mm)	Initial master apical file	Final master apical file
Mesiobuccal	21.0	30/.02	30/.04
Mesiolingual	21.0	35/.02	35/.04
Distal	21.5	40/.02	40/.04

Table II: Irrigation protocol followed

First appointment
Throughout shaping with 6% sodium hypochlorite and 18% HEBP via double-side-vented needle delivery in positive pressure irrigation at 1 ml/15 s, with exchange between every file and ultrasonic activation
Post-shaping continuous negative pressure irrigation and evacuation with EndoVac in two phases: – Phase I (macro-debridement): with same irrigation solution used during shaping, 5 ml per canal, with 0.55 mm MacroCannula until middle third of canal at 1 ml/10 s – Phase II (micro-debridement): with another 5 ml per canal of same irrigation solution with 0.32 mm MicroCannula until electronic working length at 0.5 ml/10 s
Second appointment
Irrigation with 17% EDTA for 1 min and ultrasonic activation for 30 s
Negative pressure irrigation (same protocol as for first appointment)

AH Plus sealer (Dentsply Sirona) was applied to the canal walls using the respective gutta-percha master cones. The gutta-percha cones were pre-sterilised by placing them in 2% chlorhexidine for ten minutes. The canals were then obturated by Schilder's warm vertical compaction using Touch 'n Heat (SybronEndo), heat carriers and Buchanan hand pluggers (SybronEndo). After the corono-apical downpacking, the rest of the canal was back-filled with thermoplastised gutta-percha using a System B gun (SybronEndo). The backfilling was done keeping it 3 mm short of the orifice to allow the core to form orifice plugs that would increase the retention and coronal seal by increasing the surface area for bonding (Fig. 5). Then the pulp chamber was cleaned with 70% isopropyl alcohol and treated with 17% EDTA for one minute.

Since the defect was large, it was decided to place a PRF membrane beneath the MTA. Blood (10 ml) was drawn from the cubital region and collected in two Vacutainer tubes without anti-coagulant. The tubes were then immediately placed in a portable centrifuge. The centrifuge was set at 3,000 rpm for ten minutes. The canal orifices were protected from accidental blocking with MTA by packing sterile PTFE in them. The middle layer of PRF (the bottom layer contains red blood cells and the top layer contains platelet-poor plasma) was isolated with a pair of sterile tweezers and placed in a sterile membrane-forming box then carried to the perforation site and adapted lightly. Then MTA Plus (Prevest Denpro) was mixed and placed in increments and adapted all along the margins and into the defect. Finally, a moist sterile gauze was placed over the MTA, and the access



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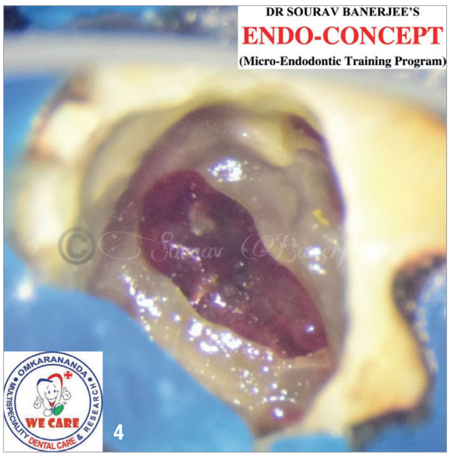

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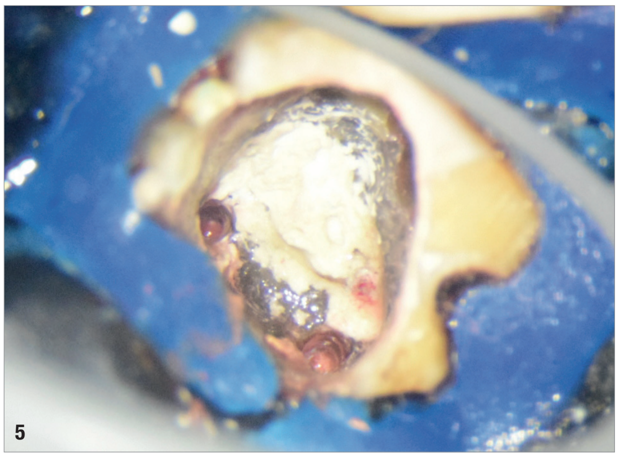

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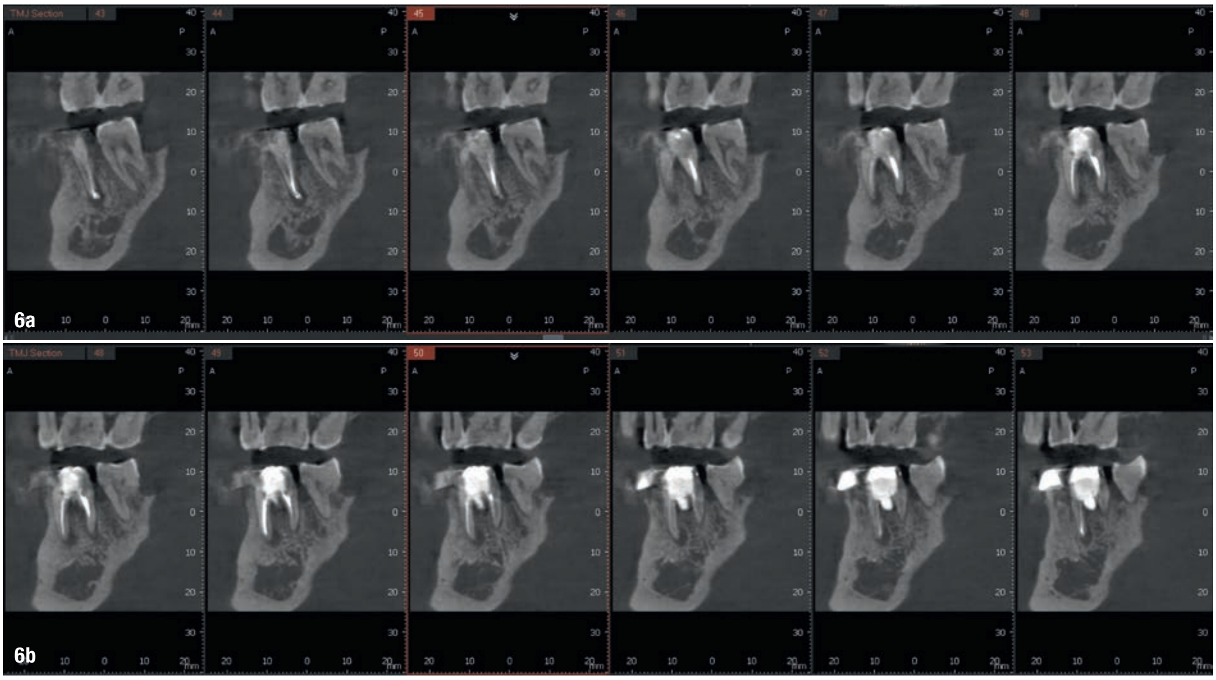
Fig. 3: Intra-op image of tooth #46 captured under the dental operating microscope at 16× magnification. **Fig. 4:** Intra-op image of tooth #46 captured under the dental operating microscope at 16× magnification showing the clean perforation defect prior to its sealing with MTA and PRF. **Fig. 5:** Intra-op image of tooth #46 under the dental operating microscope at 16× magnification showing the sealed pulpal floor perforation with MTA and the obturated mesial canals with room for orifice plugs for the core material.

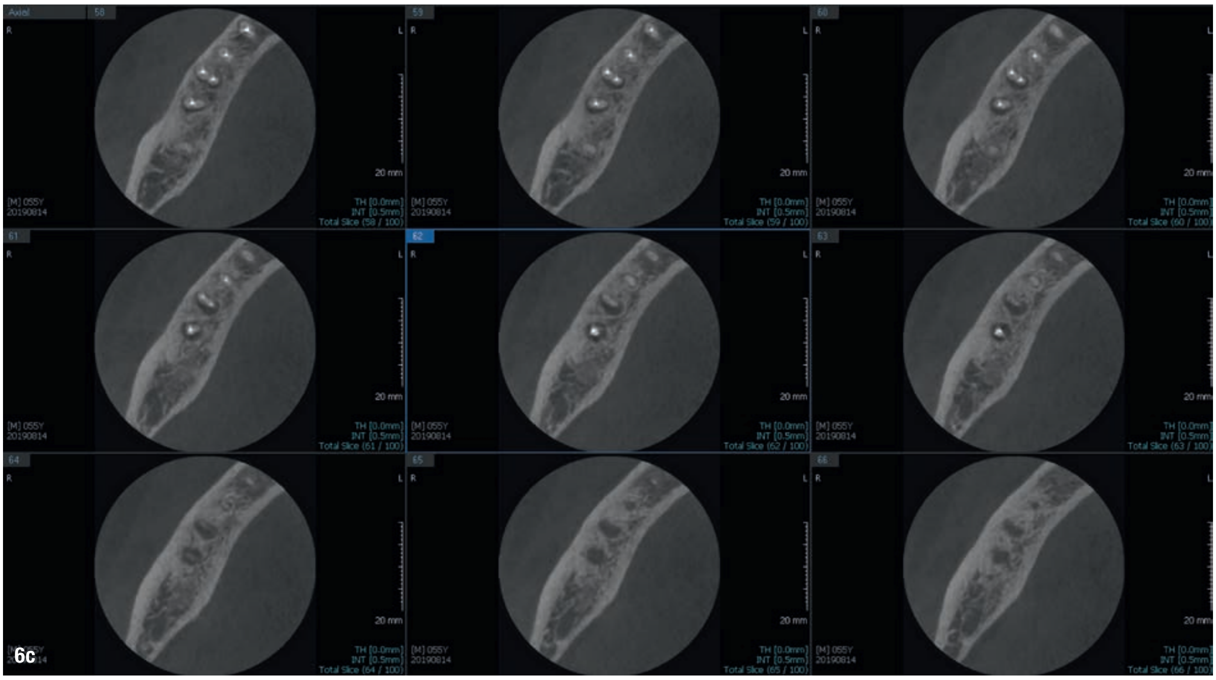


Figs. 6a–g: Post-op CBCT images of tooth #46 showing adequately obturated canals at all levels to the working length and sealing of the furcation defect.

was closed with a light-polymerising temporary composite for 24 hours.

At the next appointment, the temporary restoration was removed, and the hardness of the MTA was checked. The margins of the defect were also closely checked under the dental operating microscope to rule out any leakage. Finally, a thin layer of light-polymerising glass ionomer cement liner was placed over the MTA. Etching and bonding followed, and the core was placed using a bulk fill composite in a SonicFill handpiece (KaVo Kerr, Figs. 6a–g).

The patient was evaluated at a six- and 14-month interval. Clinically, the probing depth was fine and there was no loss of attachment but firm attached gingiva. Radiographically, both the six-month and 14-month radiographs (Figs. 7a & b) showed improvement in relation to the periapical and furcation radiolucency when compared with the pretreatment intra-oral periapical radiograph.

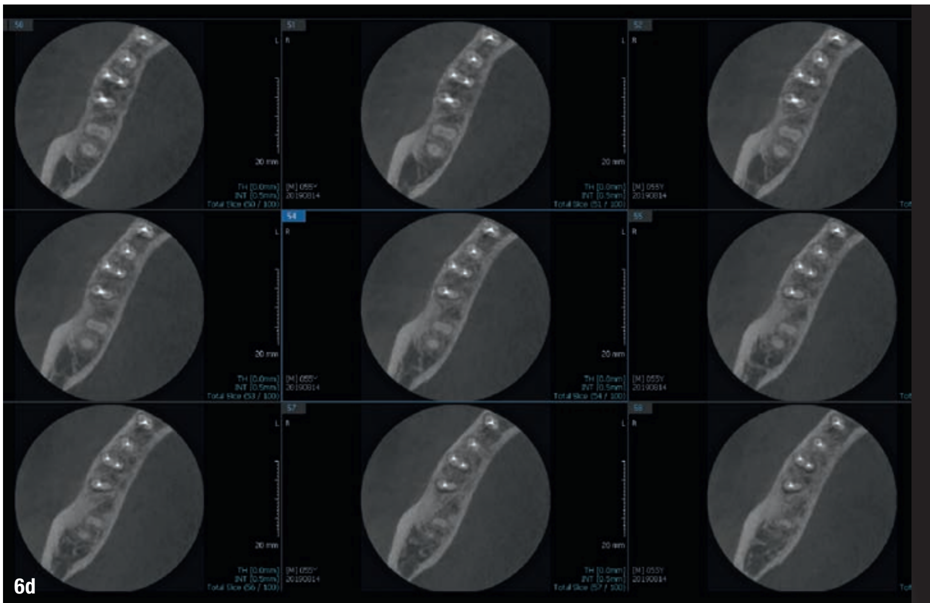


Discussion

The success of an endodontic treatment is estimated to be high, over 98 per cent for initial treatment and over 95 per cent in retreatment cases, according to peer-reviewed literature and evidence-based studies, but failures do happen for a spectrum of reasons, which include biological and technical aspects that ultimately lead to an increased bacterial load within the canal space. An endodontic treatment may be deemed to have failed if the treated tooth presents with symptoms or periapical radiolucency or both. The various reasons for failure could be coronal leakage from a poor or inadequate post-endodontic restoration, a missed canal or anatomy, incomplete instrumentation of the canals and spaces, insufficient irrigation and disinfection of the canals.

To achieve adequate cleaning in the apical region, adequate apical sizes should be created without sacrificing the precious radicular dentine. In this regard, the sequential flaring and enlargement of the canal (hybrid flaring technique) at different levels has a substantial advantage in having the benefits of all the techniques and combining them to enhance the outcome of the case. The stages of the instrumentation protocol are as follows:

1. The canals are located using 8/.02 and 10/.02 K-type files in a watch-winding motion. The files are not advanced any further than the beginning of the first curvature.
2. Coronal pre-flaring is performed with 6–8% taper orifice shapers in rotary motion until the beginning of the curvature of the canal. The canals are flooded with irrigation solution (sodium hypochlorite and HEBP).
3. The glide path and patency are established with 8 and 10 K-type files in a watch-winding motion with an electronic apex locator attached to record the EWL.
4. Widening of the glide path is done using 12/.02 and 15/.02 K-type files in manual balanced force motion, and a 10/.02 K-type file is used in between to confirm patency and irrigation solution is exchanged between files.
5. The initial master apical file is selected from any 2% taper K-type file larger than 15 that binds 3–4 mm short of the EWL.
6. Apical enlargement is done using sequential 2% taper K-type file larger than 15 to shape the canal either manually using the balanced force technique or attached to an engine-driven handpiece that uses alternating clockwise and anticlockwise motion until the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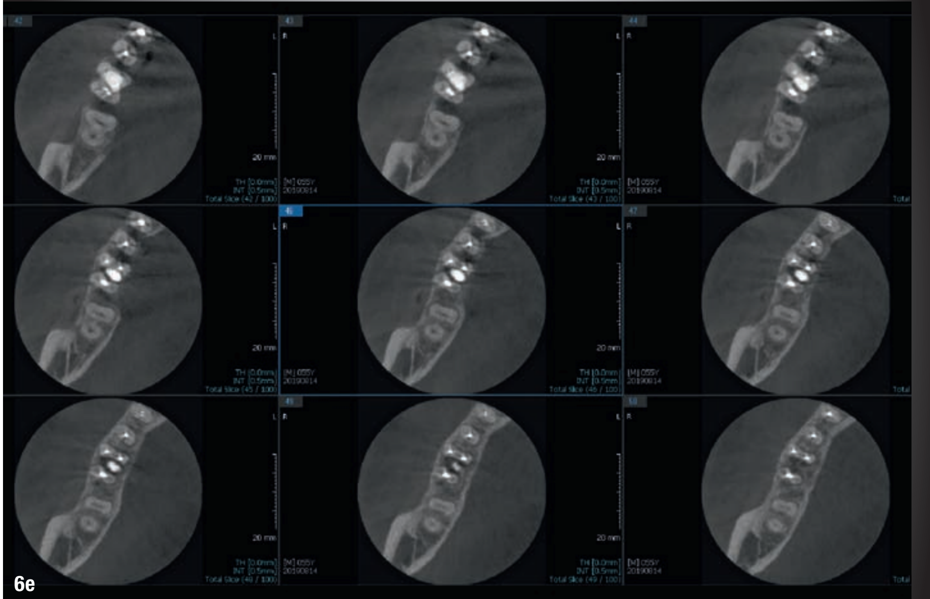
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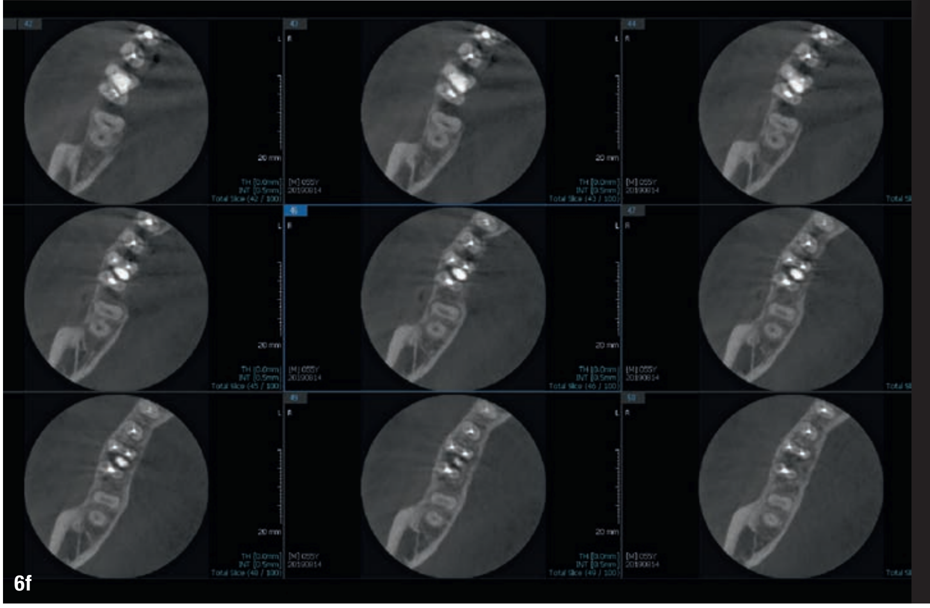
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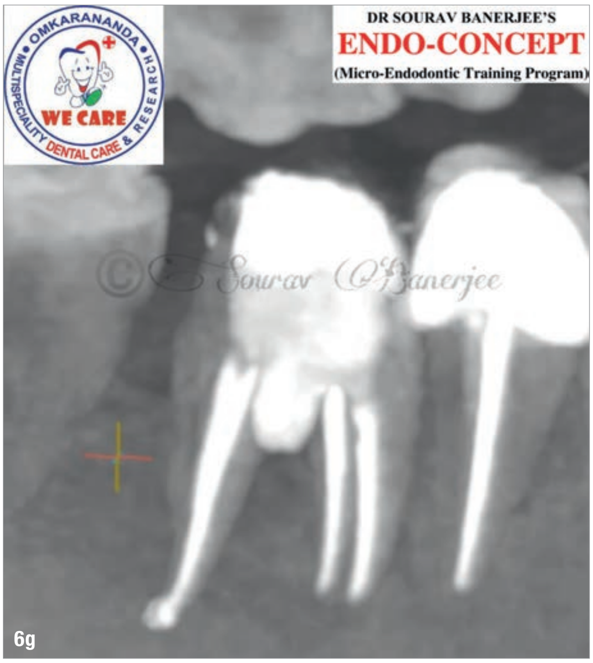

initial master apical file size is reached. In between, after 0.5–1.0 mm of advancement with each file, patency is checked with a 10/.02 K-type file and the irrigation solution is exchanged. Here either the traditional ISO sizes may be followed in the sequence or intermediate files may be used to reduce the percentage jump in the file size (the latter is recommended), for example 12/.02, 15/.02, 17.5/.02, 20/.02, 22.5/.02, 25/.02, 27.5/.02, 30/.02. This allows for a smoother transition to the next size, aiding effortless shaping of the canal along with maintenance of the original path and anatomy of the canal.

7. The apical preparation is shaped and flared with 4 % taper files until the initial master apical file size is reached. The final shaping file becomes the final master apical file (same tip size but a taper of 4 %).

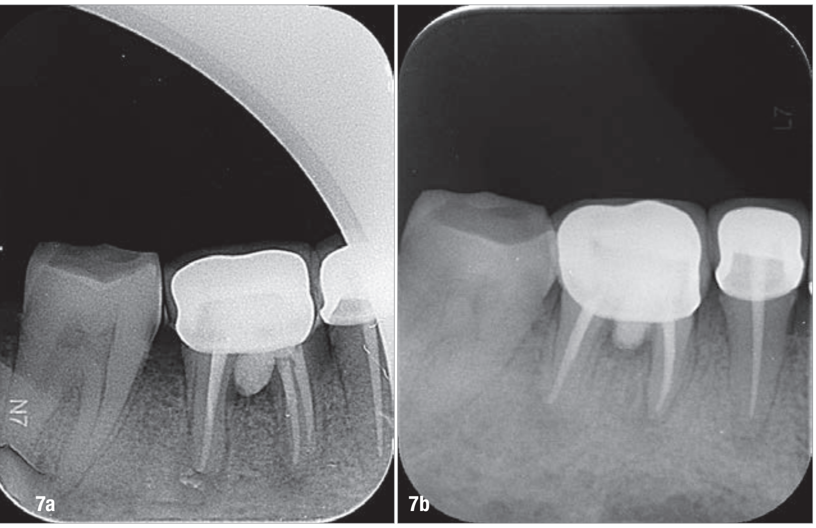

Fig. 7a: Six-month follow-up (August 2019). **Fig. 7b:** Fourteen-month follow-up (May 2020).

The hybrid flaring technique of instrumentation has the following benefits:

i. It addresses the critical apical third adequately, both mechanically and biologically.
ii. It helps achieve adequate apical size, reducing the risk of iatrogenic errors such as ledge formation, straightening of the canal, file separation and transportation, common with tapered rotary files used in continuous rotary motion, since only two per cent of files are used in balanced force motion, where the primary cutting happens in the anticlockwise turn.
iii. It promotes less packing of debris in the apical region, as coronal pre-flaring precedes apical preparation and most of the preparation is with either hand files or files attached to an engine-driven handpiece. Coronal pre-flaring actually helps reduce the active length of the subsequent file meant to shape the apical region by flaring the canal until the beginning of the first curvature and prevents instrument failure by torsion.
iv. The final preparation with 4 % taper files is made less stressful to the canal walls because of less engagement of dentine and a wider glide path, and adds to rotary safety.
v. The final taper of 4 % adequately aids in placement of the irrigation needle tip to within 1 mm of the EWL, activation of the irrigant with sonic and ultrasonic aids, and placement of the irrigation needle tip to within 1 mm of the EWL for negative pressure irrigation.

Magnification and ergonomic use of the dental operating microscope are vital in such a clinical scenario. Working at high magnification, 16× and above, needs outstanding eye–hand–mirror coordination, and precision is paramount in dealing with a similar clinical scenario.

Many materials to seal iatrogenic perforations have been tested. The ideal material used to repair perforations should be non-toxic, non-absorbable and radiopaque, should possess antimicrobial properties and should seal against microleakage through the margins of the perforation. MTA has all of these characteristics and has been employed extensively in regenerative endodontics. It is the material of choice for managing perforation repair and for regenerative endodontics. This can be attributed to its biocompatibility, low induction of inflammation, low solubility, and capacity to create a seal between the pulp chamber and periodontal tissue. The most important attributes are its antimicrobial properties and high pH of 12.5, which promote growth of the cementum and formation of bone, in turn allowing regeneration of the periodontal ligament around the site of injury. When combined with PRF in large defects, both may act in synergy in the regenerative process. PRF contains platelets, growth factors and cytokines that might enhance the healing potential of both soft and hard tissue. Though there is a lack of literature support regarding the synergistic use of MTA and PRF, owing to the osteoconductive and inductive nature of MTA and the autologous nature of PRF, their combination seems promising.

Follow-up

Though the prognosis of the case initially appeared to be poor, the six- and 14-month follow-ups showed a favourable outcome. The periapical healing was considerable and the furcation defect too had responded well. It appears that adequate cleaning and shaping of the canals and the use of a detailed irrigation and disinfection protocol and a biocompatible, autologous and tissue-conductive material to seal the perforation acted in synergy to address the biological aspect of the treatment. The aspect that remained to be evaluated was the functional one, for which there was need for more extensive follow-up.

Conclusion

From the case described, it may be concluded that, since it is in evidence that the initial endodontic treatment has a higher percentage of success compared with retreatment, all efforts should be made to deliver the best care on the first go. It was also learnt that whenever possible a decision should be taken to refer the case to a specialist rather than attempt treatment with a limited knowledge and armamentarium, as the Hippocratic oath says, "at least to do no harm". Lastly, sometimes the worst appearing case may be salvageable, and adequate cleaning, shaping, irrigation and disinfection, the use of biocompatible regenerative materials and above all the host response play a vital role.

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

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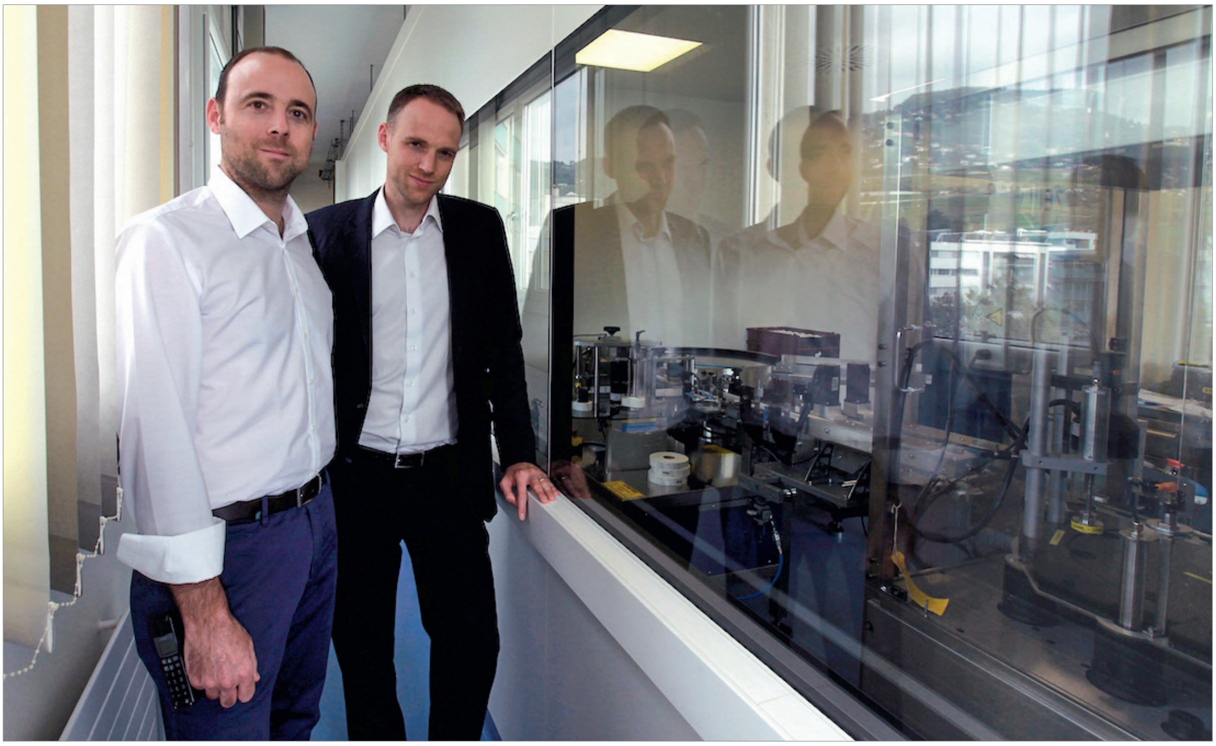
Dr Sourav Banerjee obtained a BDS from Rajiv Gandhi University of Health Sciences in Bengaluru in India and thereafter a Postgraduate Certificate in Education (PGCE) in micro-endodontics from the University at Buffalo in the US. He studied MSc in medical microbiology form Manipal and dental implantology through Nobel Biocare and later obtained a postgraduate certificate in education and a postgraduate diploma in hospital management. He is a consultant micro-endodontist and restorative dentist at Omkarananda Dental Care & Research in Jamshedpur in India. He is a fellow of the Academy of Fixed Orthodontics and director at Dr Sourav Banerjee's Micro Endodontic Training Academy. Dr Banerjee can be contacted at fde.academy@gmail.com.

Power of partnership

PD celebrates 80 years of endo-expertise



Third-generation owners of Produits Dentaires, Nicolas and Yann Gehrig (from left). *(Image: © PD)*

Produits Dentaires (PD) was founded in 1940 by William Gehrig, who had the vision of testing the boundaries of innovation. Today, this path is continued by the third-generation owners, Nicolas and Yann Gehrig, whose mission is to deliver smart yet simple solutions to help leading specialists succeed.

PD is present in over 100 markets across five continents and boasts an extensive distribution network of agents, dealers and depots. "It is thanks to our network that our products have gained international repute, synonymous with Swiss quality at its finest," said Yann Gehrig, CEO of PD. However, to maintain its position and to appeal to a new generation of dental specialists, the company needed to rethink its business model and introduce new innovative solutions.

Challenges and opportunities

For the past decades, the company's business model remained unchanged: providing products based on the needs of its distributors. But times have changed. With the arrival of new competitors and the solutions they introduced, Nicolas and Yann decided to redefine the company's approach to the products they make.

"Our mission is to become the leading provider in specialised endodontics solutions. Our innovation pipeline consists of smart yet simple devices that will revolutionise the industry as we know it," explained PD President Nicolas Gehrig.

In March 2018, the company launched IrriFlex, a unique solution to improve cleaning and disinfection in complex root canal anatomies. This was followed by the arrival of EssenSeal, an exclusive root canal obturation sealer featuring melaleuca or tea-tree essential oil. IrriFlex has been the cornerstone of the company's expansion strategy in the dental irrigation segment. "Our expertise in the design and manufacture of plastic injection moulded parts has opened doors to new opportunities in R & D," explained Yann Gehrig. "We are exploring new concepts towards improved removal of hard and soft deposits from root canals," he added.

Eighty years of collaborative R & D

But the plans for future expansion do not stop there. The R & D team is working continuously on developing a new product portfolio, while improving the existing flagship products on which the company wants to focus. "After those 80 years, we're still a family-owned company. As a business that's rooted in years of collaborative R & D, we strongly believe in the power of partnerships. And thanks to our holistic network of industry experts and change-makers, we have the ability to ignite innovation faster and more effectively than any other industry player," said Nicolas Gehrig.

www.pd-dental.com

Digital endodontic assistance

Fully automated CanalPro Jeni endodontic motor navigates through treatment

Autonomous driving, operations using a robot arm, computer-aided design (CAD)—there is hardly an area in which humans can now not be assisted by an electronic co-pilot. The more complex the application, the more useful the support via algorithms. Endodontic treatment is no exception and requires the utmost precision and reliability too. Endodontists therefore increasingly rely on the fully automatic navigation offered by the latest endodontic motors.

Electronically controlled preparation

The internationally recognised, leading dental specialist COLTENE has achieved a breakthrough with a virtually self-propelled endodontic motor: the fully automatic CanalPro Jeni, named after its developer, Dr Eugenio Pedullà (professor and clinical instructor at University of Catania), navigates the dentist through the root canal autonomously and thus accompanies mechanical and chemical preparation step by step. Via touchscreen, the Jeni connects directly to the selected nickel-titanium (NiTi) file system, such as the HyFlex CM, HyFlex EDM and MicroMega files from the COLTENE group of companies.

What is new is that the user can work forwards continuously from coronal to apical, applying only slight pressure and the motor decides independently on the progress of movement. For this purpose, the Jeni assistance system uses complex algorithms and controls the variable file movements at millisecond intervals by constantly regulating rotational movement, speed, torque and file stress. The endodontic motor adapts to the individual root canal anatomy and guides the preparation step by step. Integrated length measurement is available at the same time. The outstanding comfort and level of safety that Jeni delivers during preparation are unmatchable.

Jeni recognises the risk of a potential fatigue fracture of the file and informs the dentist with an acoustic signal that a file change is necessary. The CanalPro Jeni also provides digital assistance with the common endodontic irrigation protocol: the device records mechanical reprocessing progress and notifies the chairside dentist or assistant, acoustically, when and how often irrigation should be performed between file changes. This is incredibly important when the long-term success of treatment depends largely on thorough irrigation of the prepared root canals.

Synchronised endodontic instruments

With the CanalPro Jeni motor, the COLTENE group of companies has added another useful tool to its range of ideally matched endodontic instruments and dental materials. COLTENE has always worked closely with international scientists, practice owners, key opinion leaders and dental teams to design and realise concrete solutions for everyday treatment routines.

In addition, COLTENE offers a wide range of training courses and practical workshops to ensure the optimal use of technical aids and digital assistants. This way, even endodontic beginners will be able to achieve competent and efficient preparation after only a short time.

On the COLTENE website and social media channels, interested dentists can find out about the latest trends and ideas from the dental world.

www.coltene.com

Successful communication in your daily practice

Part XI: Attracting prospective patients from abroad

Dr Anna Maria Yiannikos, Germany & Cyprus

This series covers the most common and challenging scenarios that might arise in your dental practice and presents successful ways to deal with them in order for you to enjoy greater peace of mind. Each article of this series teaches you a new, easy-to-use specialised protocol which can easily be adapted to your own dental clinic's requirements from the outset.

Today's challenging topic deals with how you can attract patients from abroad and expand your client base as a result. Personally, I find the topic of medical tourism extremely exciting. In the following article, I will provide seven essential steps towards attaining your goals. You may have tried several companies and websites already, but not had the desired return on your investment and not attracted the number of patients you had expected to. Today, I promise that, by following the seven steps below, you will attract patients from abroad at very low cost easily and effectively.

7 essential steps

1. Accredit your clinic to international standards

Patients feel more comfortable visiting a practice that has its credentials of safety and quality accredited by independent international organisations—and correctly so. Prospective patients are more likely to travel to your country and visit your practice if they are certain that they will receive proper treatment in a safe and professional practice environment. For instance, accredit your practice to international standards, such as ISO 9001 or ISO 45001. The former comprises a variety of widely accepted quality standards and the latter is the globally recognised occupational health and safety management system.

2. Use your website to clearly show that which distinguishes your practice

Prospective patients will only take note if you tell them something useful, something that not only addresses their needs but also satisfies their desires. If you are the expert, show them. You could, for instance, inform them on the benefits to themselves of your unique dental equipment, or demonstrate your difference through the processes that you and your team employ. Show them that you offer not only a treatment but also a great experience.

3. Use before and after photographs in your promotional online channels

People are usually rather cautious about spending a great deal of money travelling abroad for treatment that they do not know the outcome of beforehand. Distributing contrastive before and after photographs and making them publicly available via online promotional tools, such as Google Ads, social media, blogs or your homepage, can be a great way to assure prospective patients that you deliver on your promises with regard to treatment outcomes.

4. Highlight your credentials

Highlighting your credentials encourages patients from abroad to visit you. When they come to you, they must feel that they already know you and that you are well educated—you need to accomplish that via your online presence.

5. Make use of your media resources

Use all your promotional media resources wisely to make your clinic visible and known. Draw up a promotional plan for every month and keep to it.

6. Ask loyal patients to submit testimonials

Video testimonials or testimonials in written form from patients who have visited you before can be a vital promotional tool for you and can greatly influence prospective patients' decisions.

7. Be prompt in your response

Do not delay in answering prospective patients' e-mails. You could have set templates for different treatments that they may ask about. Consider setting up preprogrammed e-mail responses on veneers or implants in which you explain the materials that you use, the associated price and the benefits for them. This will certainly save you time.

Isn't that easy?

Use the above-mentioned steps as a protocol in your daily practice and you will soon notice an influx of new patients from abroad and—most importantly—feel in control of this new situation. You now know the exact steps required to attract and engage with patients from other countries. Moreover, I am confident that you will most likely experience an increase in income as a consequence too. Just try it and let me know what you think!

I am sure that you are looking forward to the next issue of roots magazine, in which I will present the 12th part of this unique series on communication protocols and consider further interesting and useful topics. Are you curious about what's next? We will talk about how to retain your newly won patients from abroad and turn them into loyal advocates, who will promote your practice in their respective home countries. As you can see—we are still not done with the topic of medical tourism, as there are many more interesting aspects to explore that you, as your clinic's leader, can capitalise on. I will continue the discussion of the topic and provide five crucial points necessary to meet your goals.

Until then, remember that you are not only the dentist at your clinic but also its manager and leader. For questions and further information and guidance, don't hesitate to reach out by e-mailing me at dba@yiannikosdental.com or see our website, www.dbamastership.com. I look forward to our next step towards business growth and educational development. Let's keep in touch!

about

Dr Anna Maria Yiannikos (DDS, LSO, M.Sc., MBA) is one of the first two women worldwide to have obtained a master's degree in laser dentistry. She has owned a dental clinic for 23 years now and leads the innovative Dental Business Administration Mastership Course at RWTH Aachen University in Germany. She is an adjunct faculty member of the Aachen Center for Laser Dentistry.

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(1) J Endod. 2010 Sep;36(9):1558-62
(2) J Endod. 2017 Aug;43(8):1354-1359

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