

Shape Less, Seal Better

A Modern Minimally Invasive Endodontic Concept



Esthetic Dental Story Vol. 3 | Hotel Mövenpick, Sarajevo
06-07. februar 2026.

Shape Less, Seal Better

A Modern Minimally Invasive Endodontic Concept

ENDODONTIC GOALS

Structure Preservation Shaping
Biologically Driven Irrigation
Bioactive Obturation



**GO BACK TO
THE BASICS**



Cleaning and Shaping the Root Canal

Herbert Schilder, D.D.S.*

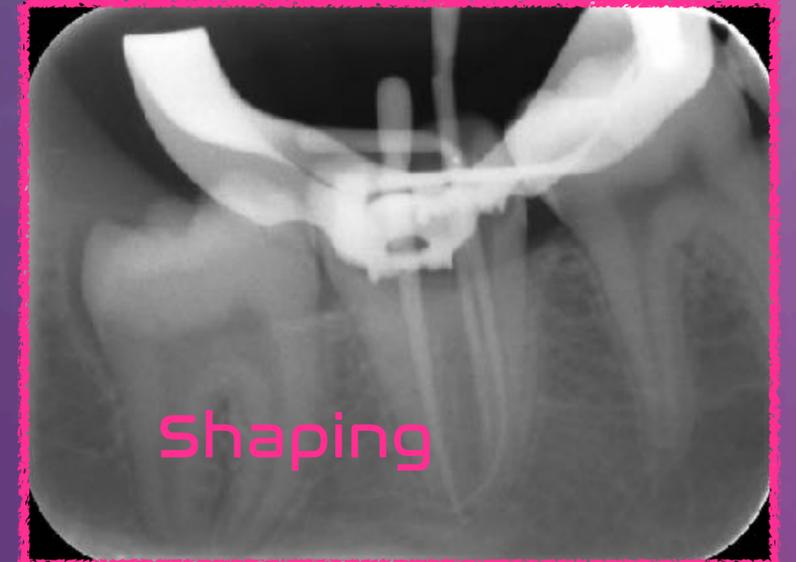
The need for some manner of root canal preparation prior to root canal filling has long been recognized as an essential step in endodontic treatment. Concepts concerning the role and purpose of this canal preparation, however, have differed remarkably at different times in the development of endodontics and in the hands of different practitioners and teachers.

Initially, root canals were manipulated primarily to allow placement of intracanal medicaments, with little attempt to remove completely the organic contents of the root canal system. In spite of elaborate modifications over the years, many methods of preparing root canals mechanically still fail to cleanse root canal systems effectively. In time, the concept of modifying root canal preparations to facilitate the placement of root canal fillings became part of accepted endodontic practice, but the methods employed for these procedures remained, for the most part, empirical. The true anatomy of root canal systems and to the materials with which the root canals were prepared were not known.

For many decades that, while reasonable concepts had been accepted almost universally in root canal preparation remained empirical. The physical and biologic requirements for endodontic preparation has been described in a variety of ways.

Instrumentation, biomechanical instrumentation, and biologic thinking and practice and tended to progress as each modification was introduced. Root canal preparation implied that instruments designed specifically for

*Chairman, Department of Endodontics, Boston University School of Dentistry, Boston, Massachusetts



Schilder 1974

CLEANING

SHAPING

OBTURATION

Minimally Invasive Endodontics

Minimally invasive endodontics: challenging prevailing paradigms

A. H. Gluskin,*¹ C. I. Peters¹ and O. A. Peters¹

VERIFIABLE CPD PAPER

The primary goal of endodontic therapy is the long-term retention of a functional tooth free of apical periodontitis. However, there are many other factors that impact endodontic outcome, including restoration and structural integrity of the tooth after root canal preparation. Contemporary research is directed to better understanding dentin behaviour and structure during aging and function, and to minimise structural changes during root canal therapy, which may result in a new strategy for 'minimally invasive endodontics'. This review addresses current clinical and laboratory data to provide a new endodontic paradigm.

IN BRIEF

- Explains the structural weakening that occurs as a result of endodontic and restorative procedures.
- Recognises fracture susceptibility in all endodontically treated teeth and the predisposition for damage in functioning roots.
- Reflects upon the principles of cervical dentin preservation in stabilising load transfer to roots after endodontic procedures.

PRACTICE

“Minimally Invasive Endodontics aims to preserve the maximum of tooth structure during root canal therapy”

2015



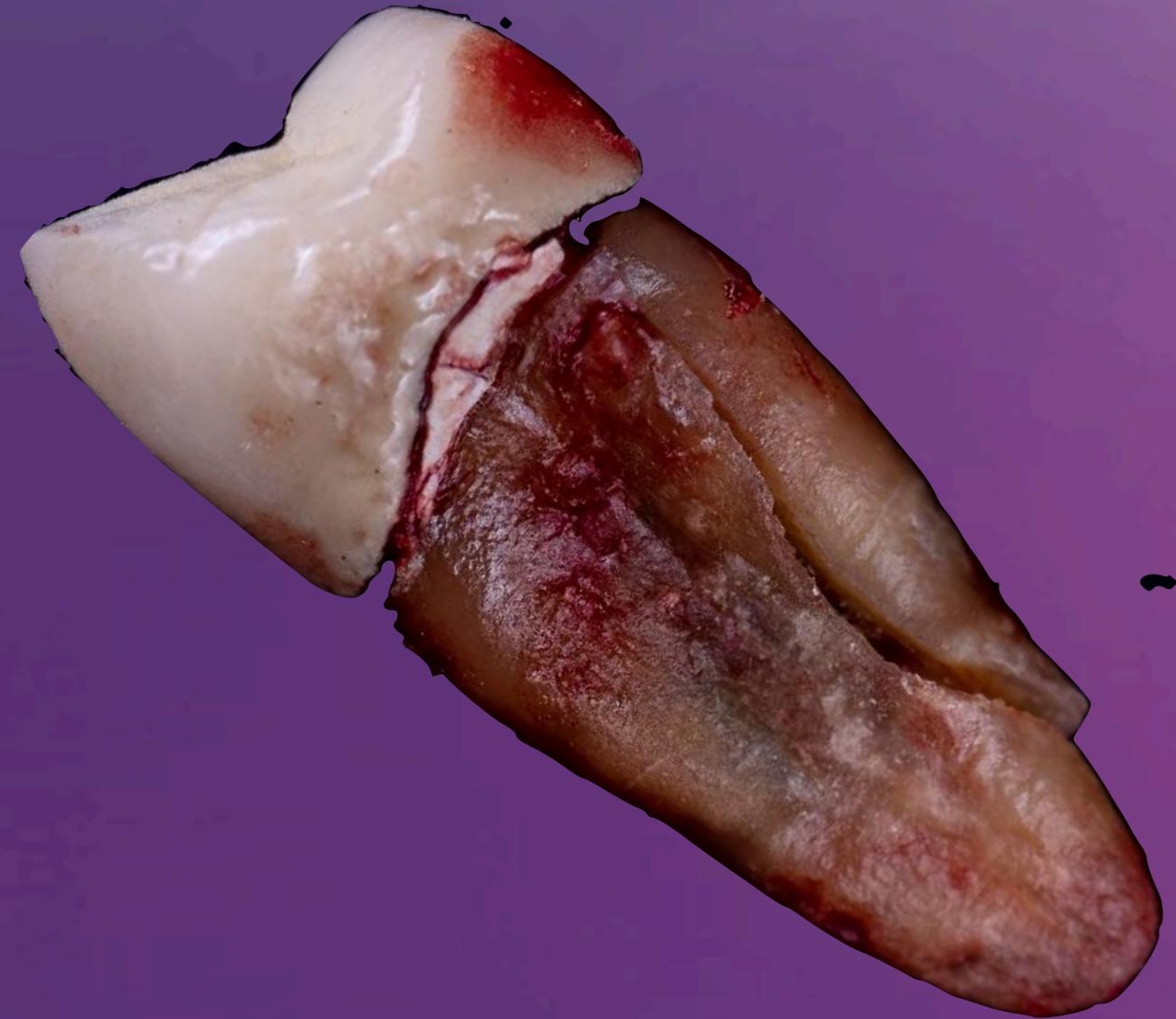
Vertical root fractures in endodontically treated teeth: diagnostic signs and clinical management

“PREDISPOSING FACTORS INCLUDE **LOSS OF HEALTHY TOOTH SUBSTANCE**, ... WHICH INCREASES THE RISK FOR CRACKS IN THE BODY OF DENTIN THAT CAN LATER PROPAGATE TO FRACTURE “

“...CUTTING DENTIN TO **STRAIGHT LINES AT CURVATURES WEAKENS THE ROOT STRUCTURE ...** IN THE INFECTED ROOT CANALS ESPECIALLY, A **BALANCE BETWEEN THE NEED TO REMOVE INFECTED DENTIN AND MAINTAINING SUFFICIENT ROOT THICKNESS** TO WITHSTAND THE FORCES OF MASTICATION SHOULD THEREFORE BE SOUGHT. “

“SPECIAL ATTENTION TO SECURING **SUFFICIENT REMAINING DENTIN** SHOULD BE GIVEN TO THE TEETH AND ROOTS MOST SUSCEPTIBLE TO FRACTURE, I.E., **THE MAXILLARY AND MANDIBULAR PREMOLARS AND THE MESIAL ROOTS OF THE MANDIBULAR MOLARS**”

TAMSE 2006



WARNING

diagnosis

new technologies

Structure

tools

Tips & tricks

Preservation

skills

knowledge

research

new materials

longevity

Treatment
Plan

ANATOMY

diagnosis

knowledge

skills

Tips & tricks

Structure
Preservation

tools

longevity

new technologies

research

Roentgenographic investigation of frequency and degree of canal curvatures in human permanent teeth.

Schäfer E¹, Diez C, Hoppe W, Tepel J.

+ Author information

Abstract

Canal curvatures of 700 permanent teeth were investigated. The curvature of each part of the canal. For each type of tooth, a silver point was inserted into the canals, and the teeth were radiographed. The radiographs were processed by computerized digital image processing with radii < 40 mm. Thirteen percent of the teeth investigated had curves > 35 degrees. To define the canal curvature mathematically,

the curvatures and the length of the curved part were measured. Size 08 silver points were inserted into the canals by the technique. All radiographs were analyzed by a computer. 65% showed an angle ≤ 27 degrees, 30% showed an angle between 27 and 35 degrees, and 9% of all canals that were investigated had curves > 35 degrees with a radius of 2 mm. To define the canal curvature mathematically, the angle of the curve should be given.

**1163 roots examined:
980 (84%) curved**

**65% angle $< 27^\circ$
30% angle 27-35°
9% angle $> 35^\circ$**



Minimally Invasive



Better Respect of root canal anatomy

Preservation of dentin

Functional, not aggressive shaping

PERICERVICAL DENTIN

Pericervical dentin is generally located 4mm coronal and apically to the alveolar crest

Pericervical dentine is irreplaceable



REVIEW

The ferrule effect: a literature review

Stankiewicz¹ & P. R. Wilson²

¹General Dental Practice, B... ²Dental... Univer... Burne, Austr...

Abstract

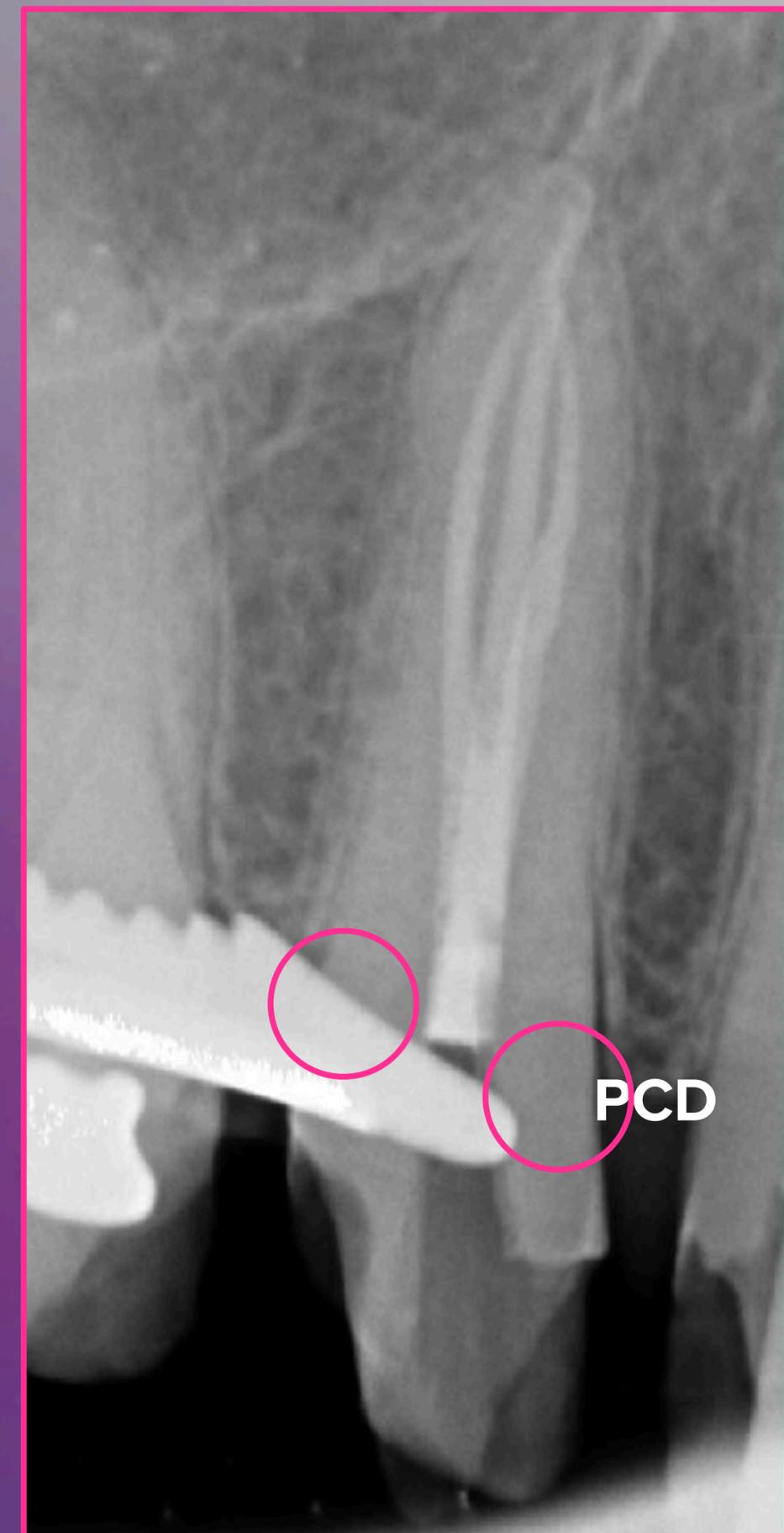
Stankiewicz NR, Wilson PR. The ferrule effect: a literature review. *International Endodontic Journal* 2002; 35: 200.

Literature review A ferrule is a metal ring or cap used to strengthen the end of a stick or tube. It has

demonstrates that ferrule effect occurs owing to the artificial crown bracing against the dentine extending coronal to the crown margin. Overall, it can be concluded that a ferrule is desirable, but should not be provided at the expense of the remaining tooth/root structure.

Conclusions

Laboratory evidence shows in some circumstances that a ferrule effect occurs owing to the crown bracing against the dentine extending coronal to the crown margin. Furthermore, a significant increase in resistance to failure in single rooted teeth is observed where this dentine extends at least 1.5 mm. However, the cost of getting this support in teeth with no coronal dentine is loss of tooth tissue. When assessing a tooth prior to root treatment and subsequent restoration with a crown (if needed), a ferrule would be desirable but not at the expense of the remaining tooth/root structure.





DAILY PRACTICE

Dentine Preservation

CAVITY ACCESS

SHAPING

POST-SPACE

RESTORATION

[J Prosthet Dent](#). 2008 Apr;99(4):267-73. doi: 10.1016/S0022-3913(08)60059-1.

Residual dentin thickness in bifurcated maxillary first premolars after root canal and post space preparation with parallel-sided drills.

[Pilo R](#), [Shapenco E](#), [Lewinstein I](#).

[Int Endod J](#). 2009 Dec;42(12):1071-6. doi: 10.1111/j.1365-2591.2009.01632.x.

Micro-computed tomography of tooth tissue volume changes following endodontic procedures and post space preparation.

[Ikram OH](#), [Patel S](#), [Sauro S](#), [Mannocci F](#).

[J Endod](#). 2006 Mar;32(3):202-5.

Residual dentin thickness in bifurcated maxillary premolars after root canal and dowel space preparation.

[Katz A](#), [Wasenstein-Kohn S](#), [Tamse A](#), [Zuckerman O](#).

Dentine Preservation

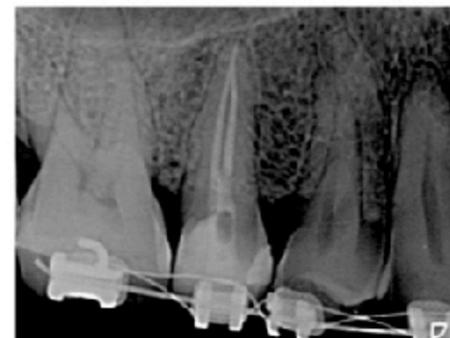
CAV
SHA
POS
RES



space preparation



cedures and post



space preparation.



Minimally Invasive Endodontics

Modern Molar Endodontic Access and Directed Dentin Conservation

David Clark, DDS^{a,*}, John Khademi, DDS, MS^b

KEYWORDS

• Molar • Endodontic • Access • Dentin

During patient treatment, the clinician needs to consider many factors that will affect the ultimate outcome. In simple terms, these factors can be grouped into 3 categories: **the operator needs, the restoration needs, and the tooth needs.** The operator needs are the conditions the clinician needs to treat the tooth. The restoration needs are the prep dimensions and tooth conditions for optimal strength and longevity. The tooth needs are the biologic and structural limitations for a treated tooth to remain predictably functional. This article discusses molar access and failures of endodontically treated teeth that occur not because of chronic or acute apical lesions but because of structural compromises to the teeth that ultimately renders them useless. What both authors have discovered in their respective practices through careful observations of failing cases and modes of failure, and observation of the truly long-term (decades) successful cases, is that the current models of endodontic treatment do not lead to long-term success. The authors want to coronally shift the focus to the cervical area of the tooth and create awareness for an endorestorative interface. This article introduces a **set of criteria that will guide the clinician in treatment decisions to maintain optimal functionality of the tooth and help in deciding whether the treatment prognosis is poor and alternatives should be considered.** This article is not an update on traditional endodontic access, as the authors believe the traditional approach to endodontic access is fundamentally flawed. Traditional endodontic access has been endodontic centric, primarily focused on operator needs, and has been decoupled from the restorative needs and tooth needs. Central to our philosophy is that balance needs to be restored to these 3 needs, which are almost always in conflict when performing complete cusp-tip to root-tip treatment.

Disclosure: Drs Clark and Khademi will receive a royalty from the sales of CK Endodontic Access burs. <http://www.sswhiteburs.com>.

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* Corresponding author.

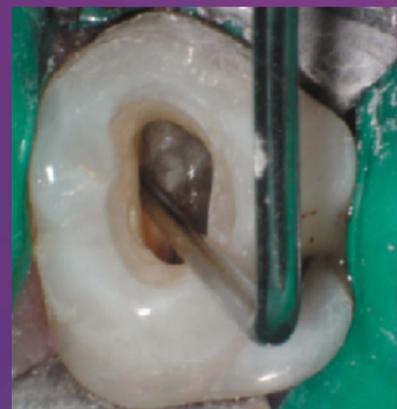
E-mail address: drclark@microscopdentistry.com

Dent Clin N Am 54 (2010) 249–273

doi:10.1016/j.cden.2010.01.001

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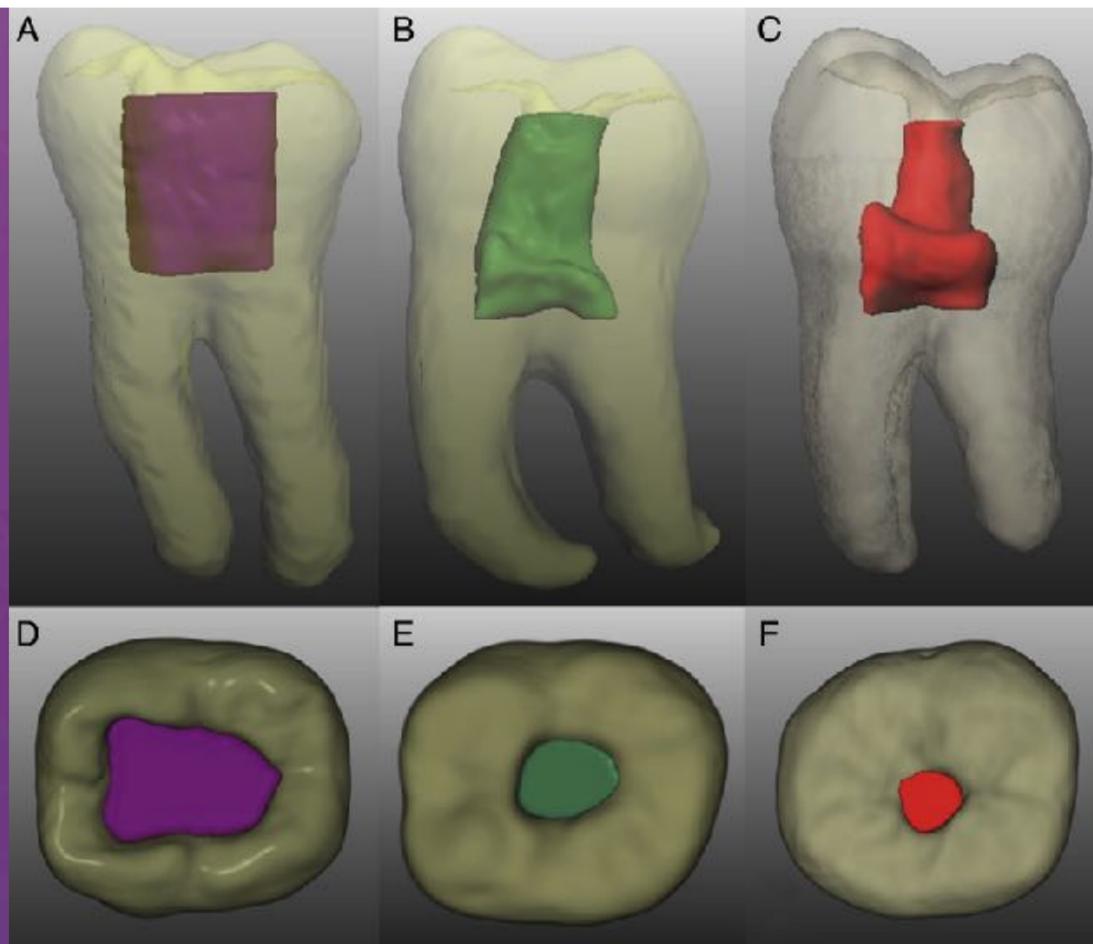
dental.theclinics.com



Conservative vs Ninja Access

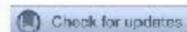
WARNING

Fracture Strength of Endodontically Treated Teeth with Different Access Cavity Designs



NINJA ACCESS CAVITY DOES NOT IMPROVE BIO-MECHANICAL RESISTANCE TO FRACTURE MORE THAN CONSERVATIVE ACCESS CAVITY

The Effect of Endodontic Access Cavities on Fracture Resistance of First Maxillary Molar Using the Extended Finite Element Method



Yiyi Zhang, PhD, DDS, Yuxuan Liu, DDS, Yahu Sbe, DDS, Ye Liang, PhD, DDS, Fei Xu, PhD, DDS, and Changyun Fang, PhD, DDS

Abstract

Introduction: The purpose of this study was to predict the fracture resistance of an endodontically treated first maxillary molar with diverse access cavities using the extended finite element model (XFEM). **Methods:** Based on micro-computed tomographic data of first maxillary molars, the model of a natural tooth and 3 endodontically treated teeth with conservative endodontic cavity, modified endodontic cavity, and traditional endodontic cavity were generated. Four static loads (800 N in total) were applied vertically to the contact points. The distributions of von Mises stress and maximum principal stress were calculated. XFEM was performed to simulate crack initiation and propagation in enamel and dentin. **Results:** In the cervical region, larger stress concentration areas were found in the modified endodontic cavity and the traditional endodontic cavity compared with the natural tooth and the conservative endodontic cavity. Von Mises stress was concentrated around the palatal root, and tensile stress was concentrated in the mesial root. The XFEM results indicated that the cracks in the enamel were propagated from the mesial groove, propagated to the cervical area, and finally propagated to the dentin. **Conclusions:** The fracture resistance of endodontically treated tooth was increased by preparing the conservative endodontic cavity. The fracture of the maxillary first molar originated from the mesial groove of the enamel, propagated through the groove, and finally induced the damage in the dentin. (*J Endod* 2019;45:316–321)

Key Words

Access cavity, extended finite element method, fracture failure, minimally invasive endodontics

Increasing the long-term success of endodontically treated teeth is still a great challenge because of their reduced fracture resistance. Recently, tooth structural integrity was considered as the dominant factor impacting the fracture resistance of endodontically treated teeth (1). To preserve the maximum tooth structure and the optimized biomechanical behavior of endodontically treated teeth, minimally invasive endodontics (MIE) was proposed (2).

Following the trend of MIE, Clark and Khademi (3) reported a conservative endodontic cavity (CEC) focusing on minimizing tooth structure removal. Unlike the traditional endodontic cavity (TEC), which required removal of the entire chamber roof and part of the cervical dentin protrusions to provide straight-line access to the middle third of root canals (4), the CEC only provided curved paths for endodontic instrumentation entering into each root canal orifice and preserved dental hard tissue to the greatest extent (5). However, although straight-line access, the CEC added the difficulty of endodontic instrument insertion and increased the risk of iatrogenic complications (6–7). In recent years, a number of researches had attempted to improve the fracture resistance of endodontically treated teeth by comparing the CEC with the TEC. However, the study results remained controversial. Some studies insisted that the fracture resistance of endodontically treated teeth was increased by preparing the CEC, especially the significance of preserving pericervical dentin, whereas some studies held opposite opinions (9). They insisted that the defect of dental hard tissue, such as the loss of the marginal ridge or dental cusp, resulted in a reduced fracture resistance of endodontically treated teeth compared with the TEC (9). Thus, full understanding of the effect of the CEC on the fracture resistance of endodontically treated teeth seems to be particularly important.

Finite element analysis is a promising method to investigate the dental biomechanical process (10). However, traditional finite element analysis, which was frequently used in dental biomechanical studies, could not simulate the dental mechanical process thoroughly. These studies all assumed the model would stay intact during the whole loading period and ignored the most important mechanical process—fracture and fatigue (11). A new modeling technique named the extended finite element method (XFEM) was used in this study to simulate crack initiation and propagation in dental hard tissue. XFEM is a method developed for computationally predicting crack initiation and propagation in brittle materials (12). The main advantage of XFEM is that it not only allows modeling of crack initiation and propagation automatically but also reduces

Significance

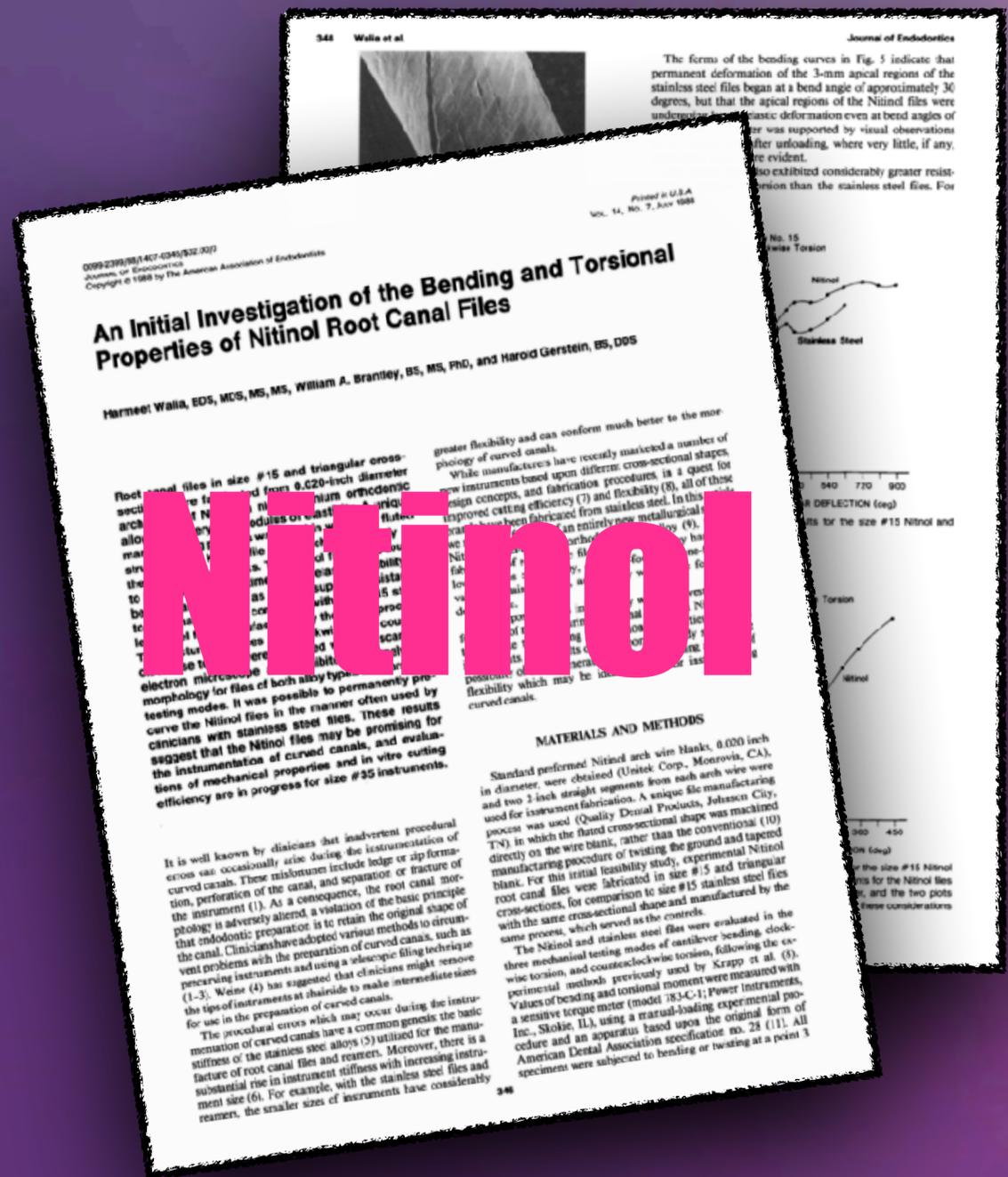
The conservative endodontic cavity reduced the stress concentration in the cervical region and increased the fracture load of dentin. Reducing the removal of dental hard tissue is a practical approach to increase the fracture resistance of endodontically treated teeth.

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0099-2399/\$ - see front matter
Copyright © 2018 American Association of Endodontists.
<https://doi.org/10.1016/j.joen.2018.12.006>

CEC IS A DOUBLE-EDGED SWORD. IT PRESERVES DENTAL HARD TISSUE AT THE EXPENSE OF INCREASING THE CURVATURE OF ENDODONTIC INSTRUMENTS. WHEN ROOT CANAL ANGLES ARE WIDE, CEC SHOULD BE RECONSIDERED.



STAINLESS STEEL



Nitinol

An Initial Investigation of the Bending and Torsional Properties of Nitinol Root Canal Files

Harmeeh Walia, EdS, MGS, MS, MS, William A. Brantley, BS, MS, PhD, and Harold Gerstein, BS, DDS

Root canal files in size #15 and triangular cross-section... While manufacturers have recently marketed a number of new instruments based upon different cross-sectional design concepts, and fabrication procedures, it is a quest for improved cutting efficiency (7) and flexibility (8), all of these instruments have been fabricated from stainless steel. An entirely new metallurgical alloy (9), Nitinol, has been developed which has a unique property of shape memory and superelasticity. This alloy has a greater flexibility and can conform much better to the morphology of curved canals. While manufacturers have recently marketed a number of new instruments based upon different cross-sectional design concepts, and fabrication procedures, it is a quest for improved cutting efficiency (7) and flexibility (8), all of these instruments have been fabricated from stainless steel. An entirely new metallurgical alloy (9), Nitinol, has been developed which has a unique property of shape memory and superelasticity. This alloy has a greater flexibility and can conform much better to the morphology of curved canals.

MATERIALS AND METHODS

Standard performed Nitinol arch wire hooks, 0.020 inch in diameter, were obtained (Unitek Corp., Monrovia, CA), and two 2-inch straight segments from each arch wire were used for instrument fabrication. A unique file manufacturing process was used (Quality Dental Products, Johns Creek, GA) in which the flat cross-sectional shape was machined directly on the wire blank, rather than the conventional (10) manufacturing procedure of twisting the experimental Nitinol blank. For this initial feasibility study, experimental Nitinol root canal files were fabricated in size #15 and triangular cross-sections, for comparison to size #15 stainless steel files with the same cross-sectional shape and manufactured by the same process, which served as the controls. The Nitinol and stainless steel files were evaluated in the same process, which served as the controls. The Nitinol and stainless steel files were evaluated in the same process, which served as the controls. The Nitinol and stainless steel files were evaluated in the same process, which served as the controls.

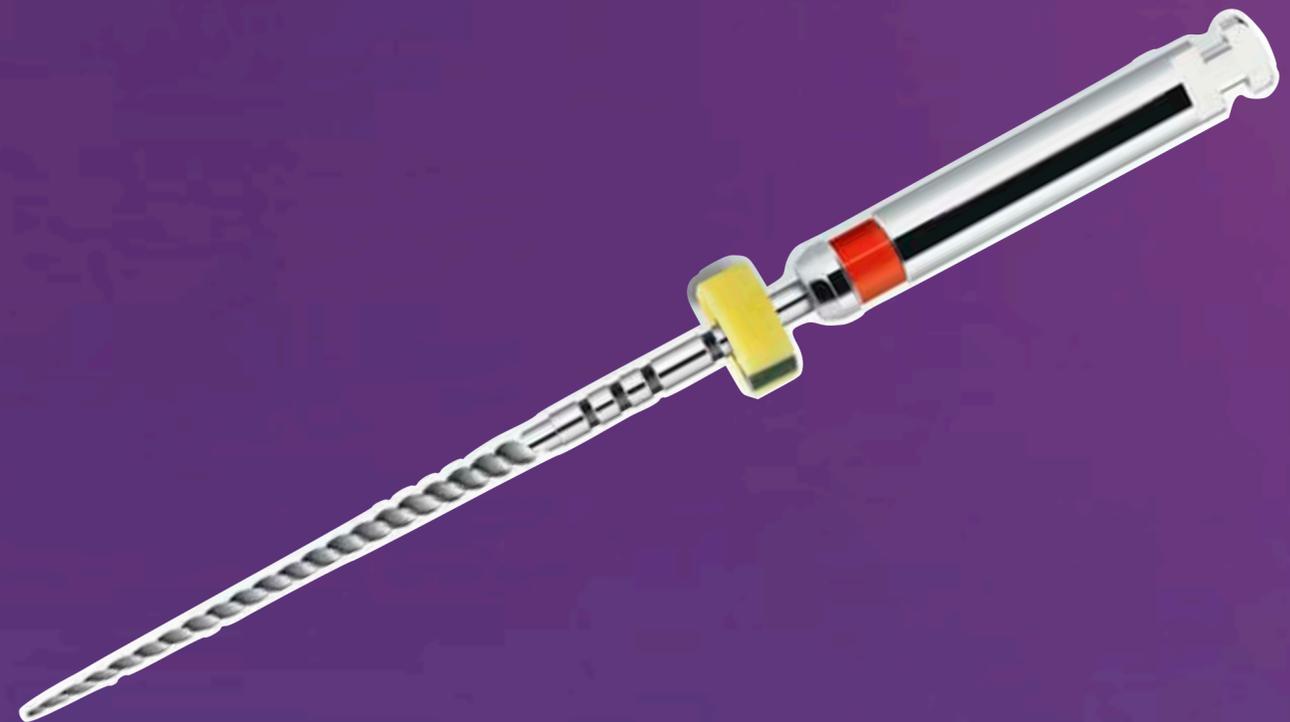
1988

WALIA ET AL JOE

Nitinol More Flexible

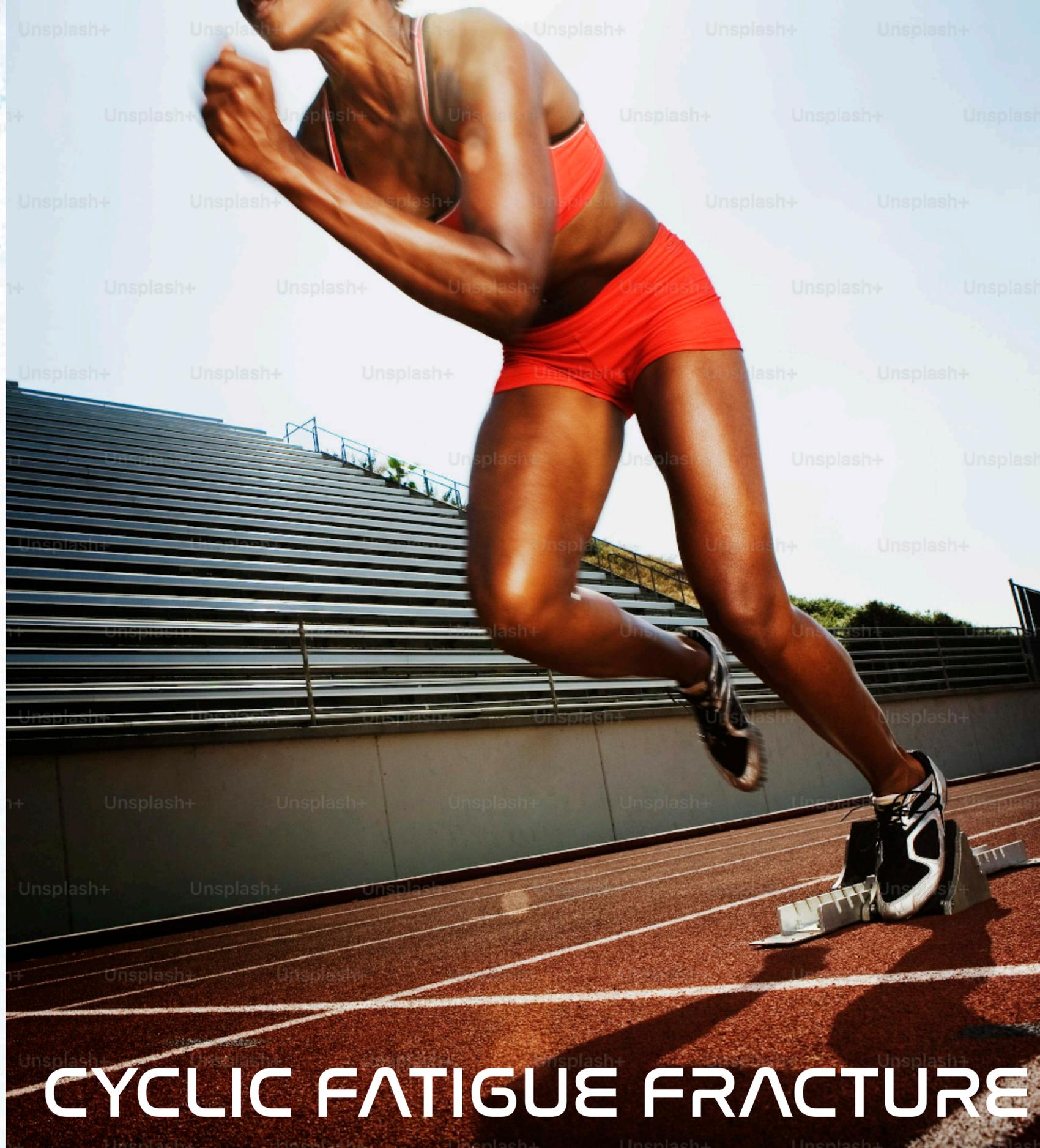
VS More Resistant

**Stainless
Steels**



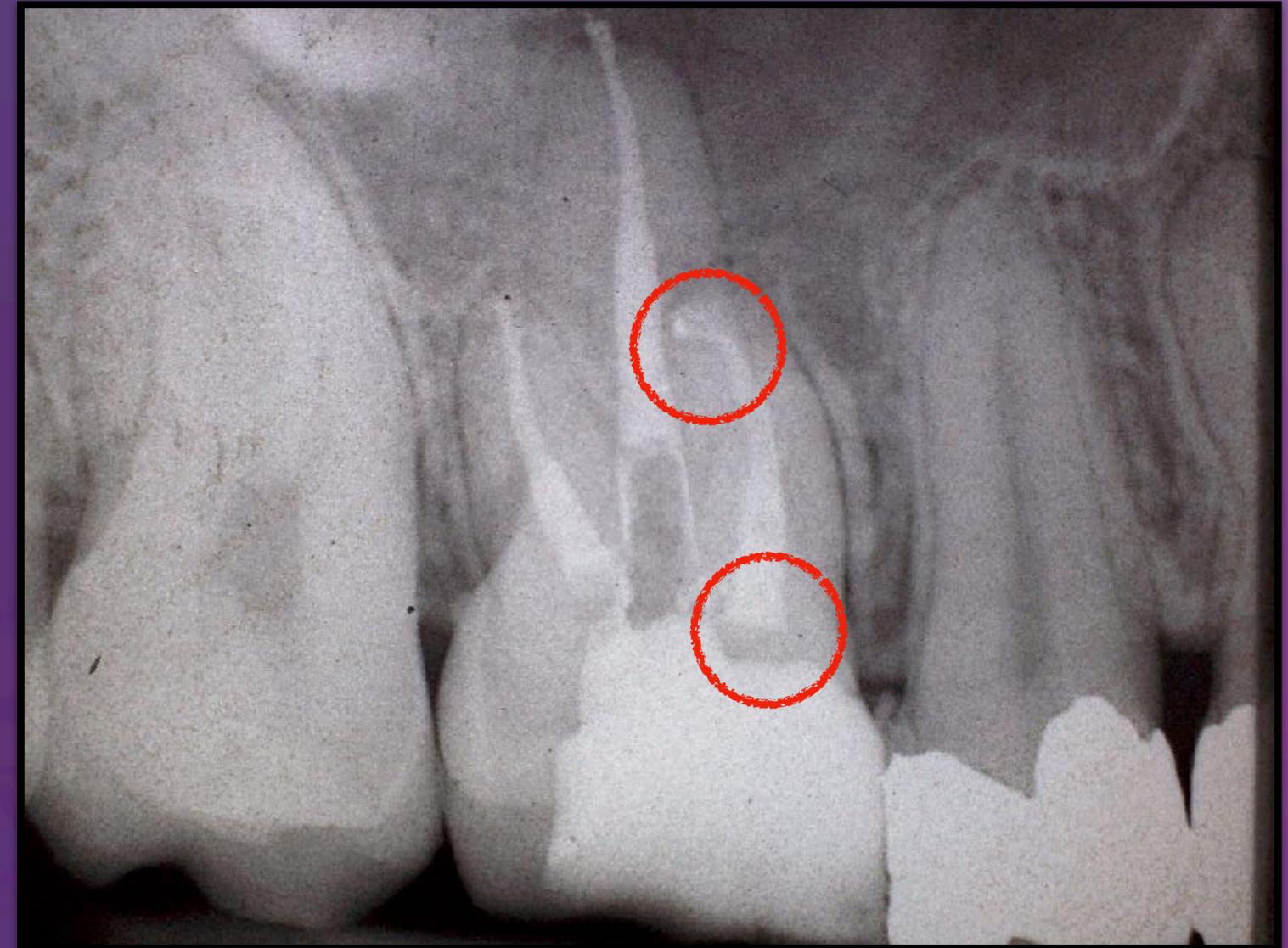


TORSIONAL FRACTURE



CYCLIC FATIGUE FRACTURE

Superelastic Ni-Ti Rotary Files



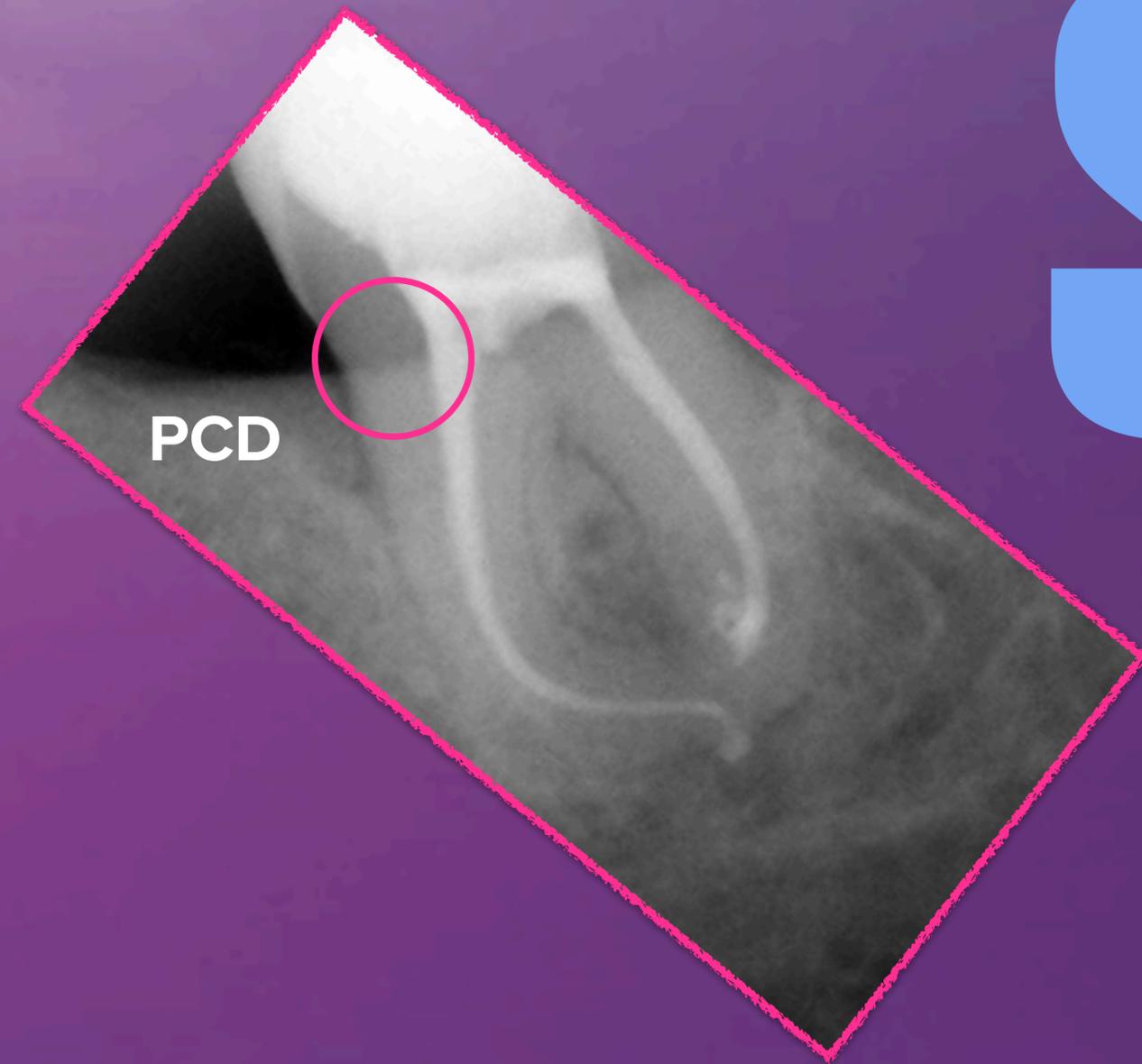
ACCESS CAVITY

SAFETY



What We Need ?

SAFETY



Bending...not breaking

Rotary NiTi Instrument Fracture and its Consequences

2006

This has led to changes in instrument design, instrumentation protocols, and manufacturing methods.

In addition, factors related to clinician experience, technique, and competence have been shown to be influential

NiTi Instrument Fracture and its Consequences

Peter Parashos MDS, PhD, and Harold H. Messer MDS, PhD

Abstract
Fracture of endodontic instruments is a procedural problem creating a major obstacle to normally routine therapy. With the advent of rotary nickel-titanium (NiTi) instruments this issue seems to have assumed such prominence as to be a considerable hindrance to the adoption of this major technical advancement. Considerable research has been undertaken to understand the mechanisms of failure of NiTi alloy to minimize its occurrence. This has led to changes in instrument design, instrumentation protocols, and manufacturing methods. In addition, factors related to clinician experience, technique, and competence have been shown to be influential. From an assessment of the literature presented, we derive clinical recommendations concerning prevention and management of this complication. (*J Endod* 2006;32:1031-1043)

Key Words

fracture, instrument design, instrumentation protocols, rotary nickel-titanium instruments

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American Association of Endodontics

In the practice of endodontics, clinicians may encounter procedural accidents and obstacles to normally routine therapy (1). One of these procedural problems is instrument fracture. Fractured root canal instruments may include endodontic files, hand files, lateral or finger spreaders, and paste fillers (Fig. 1), and may be made of nickel-titanium (NiTi), stainless steel or carbon steel. Fracture may result from correct use or overuse of an endodontic instrument (2), and is commonly in the apical third of a root canal (3-6). The incidence of fracture of rotary NiTi root canal instruments has led to a perceived high incidence of instrument fracture (6). Furthermore, fracture of rotary NiTi instruments may be preceded by instrument distortion serving as a warning of impending fracture (7-10), even with brand new instruments, whereas fracture of stainless steel instruments is often preceded by instrument distortion (11-13).

The potential difficulty in removing instrument fragments and the adverse prognostic effect of this procedural complication have led to reluctance to adoption of this innovation (6, 16). Consequently, considerable research has been undertaken to understand the reasons for instrument fracture, to prevent rather than treat. The purpose of this review is to provide an understanding of the prevalence, causes, management of instrument fracture, its impact on prognosis, and to make recommendations concerning prevention and management of instrument fracture associated with fractured rotary NiTi instruments.

Prevalence

A common clinical belief within the dental profession is that rotary instruments fracture more frequently than stainless steel hand instruments. This belief is based primarily on anecdotal evidence diffused via informal communication (16), on *in vitro* or *ex vivo* research (17), but not on systematic examination of clinically discarded instruments (13). A study of 131 discarded rotary NiTi instruments found a fracture frequency of 21% from 378 discarded instruments over a six-month period from a specialist endodontic clinic (13). A study of 100 discarded rotary NiTi instruments found a fracture frequency of 10% (14).



STEP 3

STEP 2

Heat treated rotary files

STEP 1

Ni-ti Rotary files

Stainless steel



ENDODONTIC FILES EVOLUTION

2013

Current Challenges and Concepts of the Thermomechanical Treatment of Nickel-Titanium Instruments

Ya Shen, DDS, PhD,* Hui-min Zhou, DDS, PhD,[†] Yu-feng Zheng, PhD,[‡] Bin Peng, DDS, PhD,[§] and Markus Haapasalo, DDS, PhD*

Abstract

The performance and mechanical properties of nickel-titanium (NiTi) instruments are influenced by their cross-section, flute design, and manufacturing processes. Many

Key Words

Controlled memory wire, endodontic instrument, fatigue, heat treatment, M-wire, nickel-titanium, R-phase, torque

Over the past 2 decades, nickel-titanium (NiTi) instruments have become an important part of the armamentarium for root canal treatment. They are increasingly used by dentists and specialists to facilitate the cleaning and shaping of "unexpected" root canal systems. Even though there have been considerable improvements in the design and manufacturing methods on endodontic rotary instruments, the occurrence of instrument separation caused by the relative

Heat treatment toward adjusting the fatigue thermomechanical properties to optimize the processed endodontic instruments (Caryahoga Falls, OH), Dentsply Tulsa Dental Blue (Dentsply Tulsa), TYPHOON Infinite Flex (Dentsply Tulsa), Twisted Files (Dentsply Tulsa), Mailefer, Ballauges, and other different raw materials are even more imperative for instrument and achieving the

TABLE 1. A List of Literature on the Mechanical Properties of Thermomechanically Treated NiTi Instruments with Continuous Rotation

	Phase transformation	Flexible property	Cyclic fatigue	Torsional fracture
CM Wire (HyFlex CM, TYPHOON Infinite Flex NiTi)	Shen et al, 2011 (44)	Testarelli et al, 2011 (105); Zhou et al, 2012 (42)	Shen et al, 2011 (39); Shen et al, 2012 (40); Peters et al, 2012 (92)	Casper et al, 2011 (95); Peters et al, 2012 (92)
M-Wire (ProFile GT Series X, ProFile Vortex, Vortex Blue)	Alapati et al, 2009 (47); Shen et al, 2011 (44); Ye and Gao, 2012 (45)	Gao et al, 2012 (41)	Gambarini et al, 2008 (66); Johnson et al, 2008 (68); Johnson et al, 2008 (68); Larsen et al, 2009 (69); Kramkowski and Bahcall, 2009 (90); Gao et al, 2010 (38); Al-Hadlaq et al, 2010 (67); Hilfer et al, 2011 (84); Gao et al, 2012 (41); Plotino et al, 2012 (86)	Johnson et al, 2008 (68); Kramkowski and Bahcall, 2009 (90); Casper et al, 2011 (95); Bardsley et al, 2011 (100); King et al, 2012 (96); Gao et al, 2012 (41)
R-phase wire (K3XF, TFs)	Hou et al, 2011 (43); Shen et al, 2011 (44)	Gambarini et al, 2008 (48); Hou et al, 2011 (43)	Gambarini et al, 2008 (66); Larsen et al, 2009 (69); Kim et al, 2010 (70); Bhagabati et al, 2011 (71); Rodriguez et al, 2011 (72); Pedullà et al, 2011 (73); Hilfer et al, 2011 (84)	Gambarini et al, 2009 (98); Park et al, 2010 (93); Gambarini et al, 2010 (97); Casper et al, 2011 (95); King et al, 2012 (96)

into a single process. The newly developed thermomechanical treatment of NiTi files gives them better flexural fatigue resistance than files of similar design and size made from conventional NiTi alloy. The unique material properties make them particularly suited for endodontic treatment. Although the details of the thermomechanical



Figure 2. Photomicrographs of a fracture surface of TYP files with the region of fatigue crack propagation and dimple area outlined (dotted line) with crack origins (arrows). (A) The overall view of the TYP file ($N_f = 315$, dimple area is 69%). (B) A high-magnification view of the crack origin (arrow). (C) An overall view of the TYP CM file with 2 crack origins (arrows) ($N_f = 1280$, dimple area is 36%). (D) A high-magnification view of 1 crack origin (arrow).

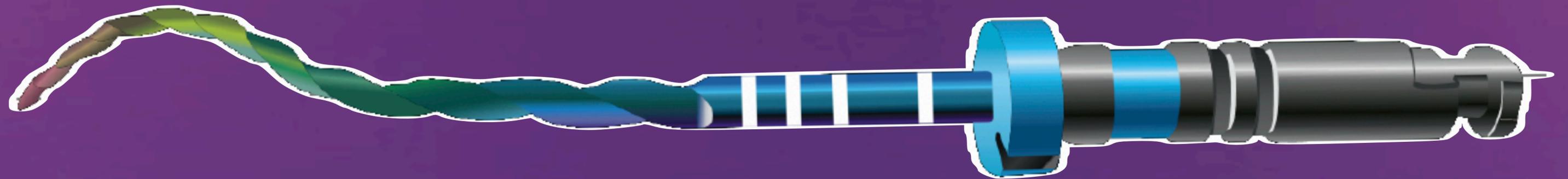
YA SHEN et AL

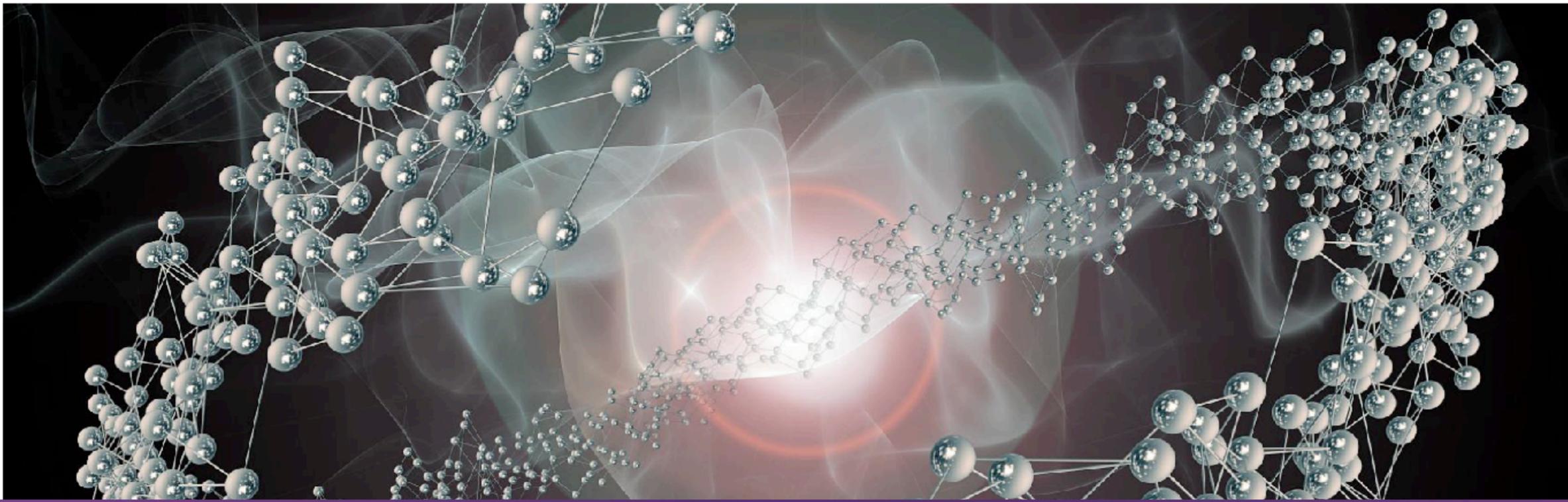




**MARTENSITIC FILES ARE MORE
RESISTANT TO CYCLIC FATIGUE... IN CURVED
CANALS**

ONE MORE STEP





Nano-coated NiTi instruments



PDF of Nanoparticle coatings of Ni-Ti alloy and possibilities in Endodontics: A narrative review

Nanoparticle coatings of Ni-Ti alloy and possibilities in Endodontics: A narrative review

Ali Imad Abdulkareem¹, Ahmed Hamid Ali^{1*}, Francesco

PDF of Nanoparticle coatings of Ni-Ti alloy and possibilities in Endodontics: A narrative review

Table 2: Classification types of Nanoparticles.

Origin	Size	Structure	Composition	Shape
Natural	-Zero-dimensional	- Carbon-based	- Inorganic	- Particles
	-One-dimensional nanorods	- Metal	- Metals	- Spheres
Artificial	-Two-dimensional thin films	- Dendrimers	- Polymeric	- Rods
	-Three-dimensional nanocones	- Composites	- Quantum dots - Modified	- Plates



FUTURE POSSIBILITIES AND CHALLENGES NANOPARTICLES' COATINGS HAVE REMARKABLE OPPORTUNITIES FOR ENHANCEMENT OF THE MECHANICAL QUALITIES,



UNIVERSITÀ DEGLI STUDI DI CATANIA

DIPARTIMENTO DI CHIRURGIA GENERALE E SPECIALITÀ MEDICO-CHIRURGICHE

CORSO DI LAUREA MAGISTRALE IN ODONTOIATRIA E PROTESI DENTARIA

RANDISI SALVATORE

**EFFICIENZA DI TAGLIO DOPO USO MULTIPLO DI
STRUMENTI ENDODONTICI REALIZZATI CON DIVERSI
TRATTAMENTI**

TESI DI LAUREA

RELATORE

Prof. Eugenio Pedullà

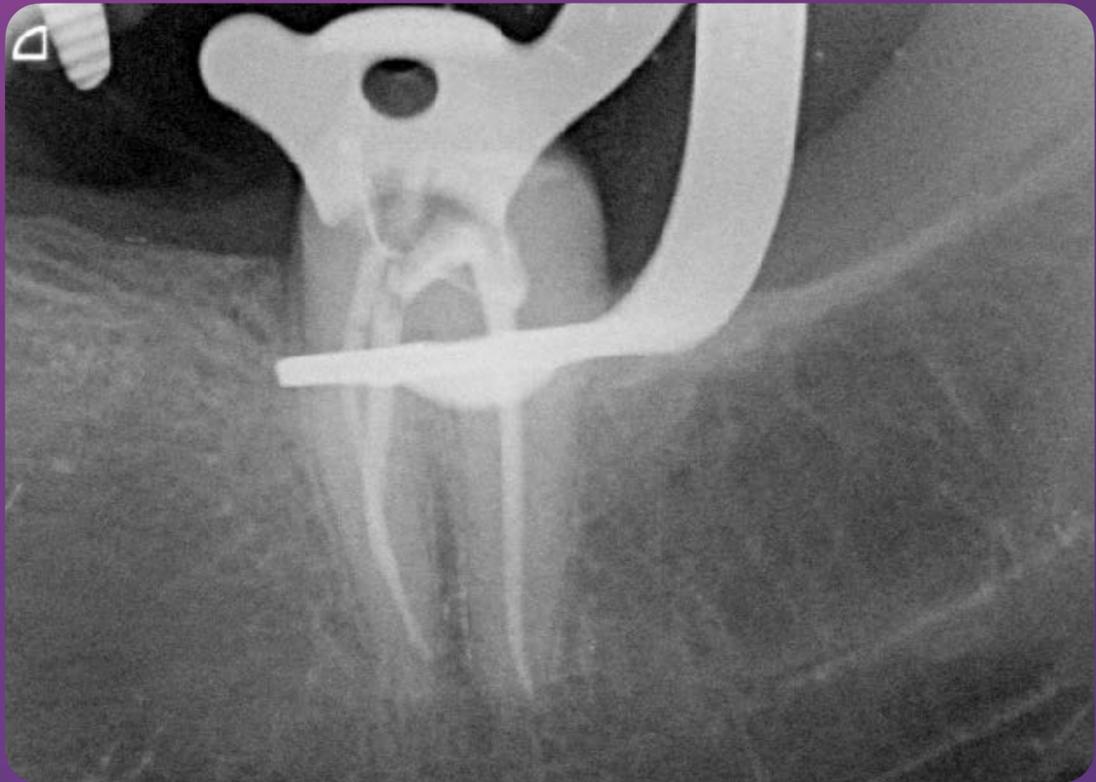
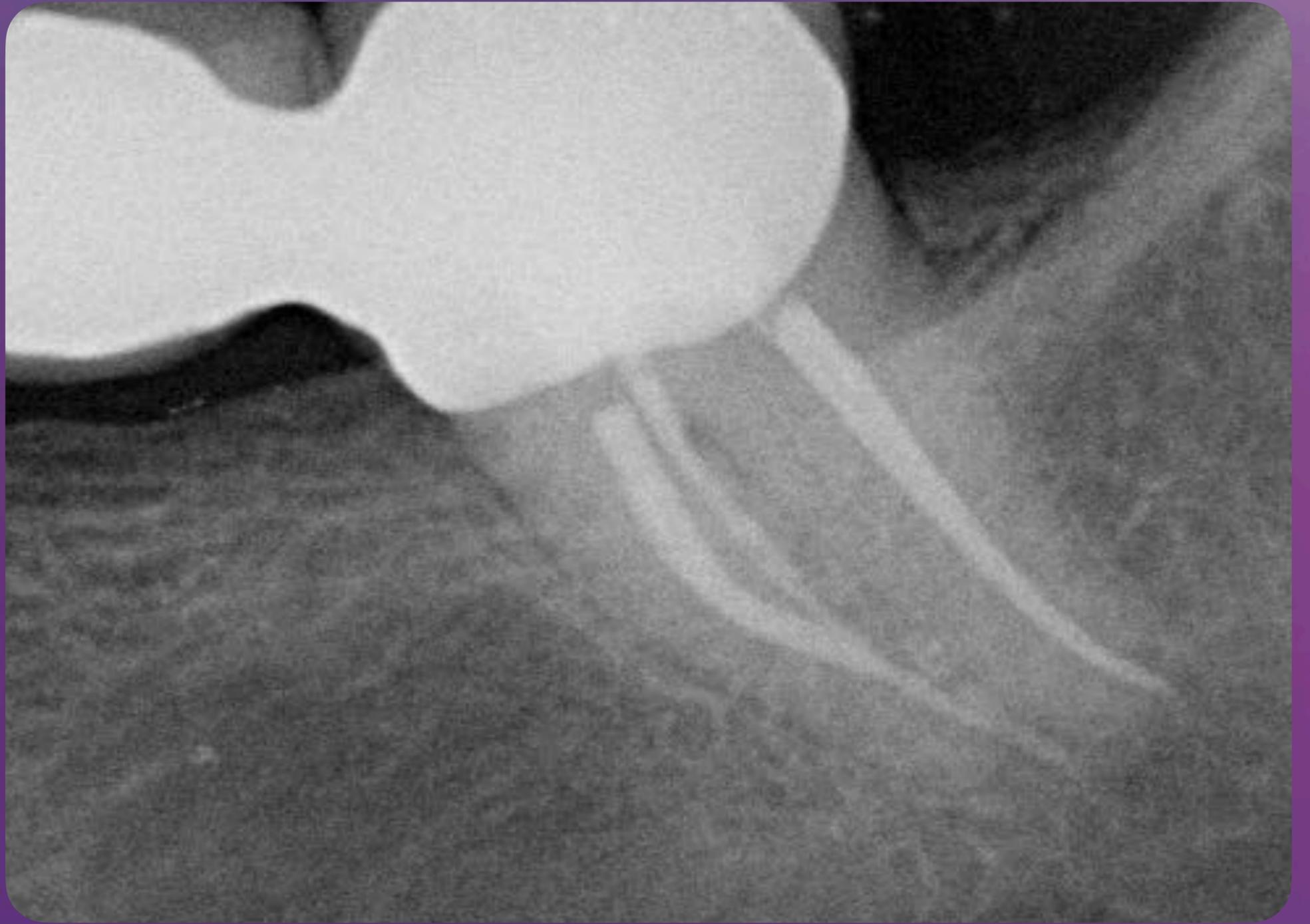
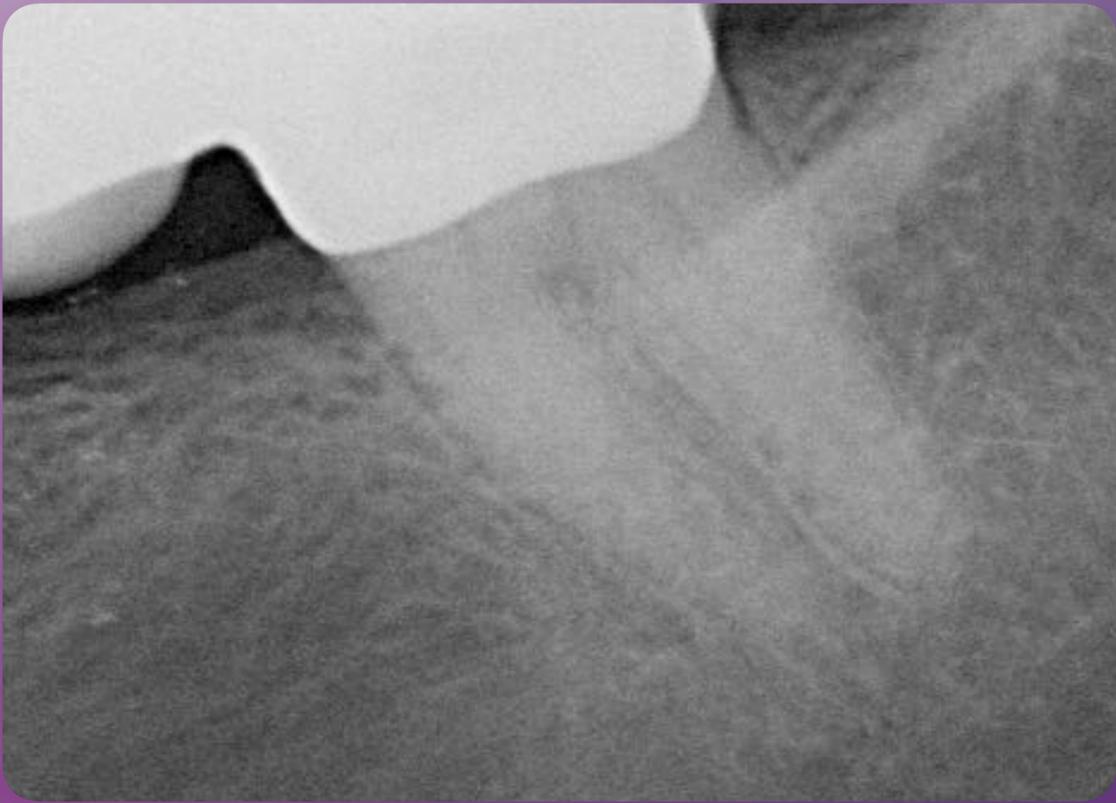
Proflex N.H.A. appears
to offer a clear
advantage in terms of
durability and
consistent cutting
performance,
particularly when the
tools are reused
multiple times

UP TO 10 TIME INCREASED RESISTANCE

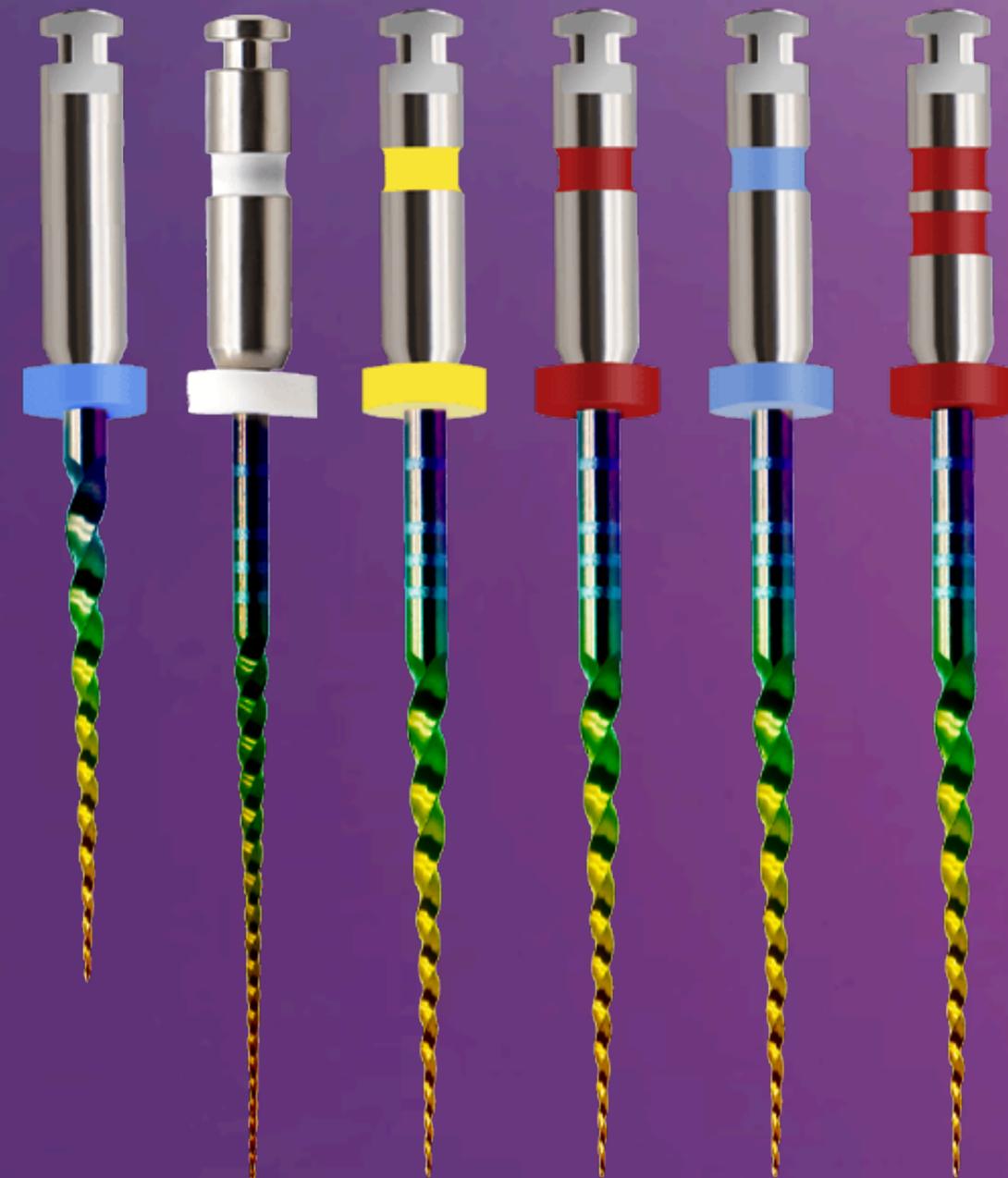
**NANO-COATING CREATES BETTER
SURFACE-LESS DEFECTS**







- MORE UNIFORM SURFACE
- FLEXIBILITY (CURVATURES)
- CONSERVATIVE APPROACH (0.4 SHAPING)
- MORE RESISTANT TO FRACTURE
- IMPROVED CUTTING EFFICENCY
- DEEP SHAPE (30.4...)



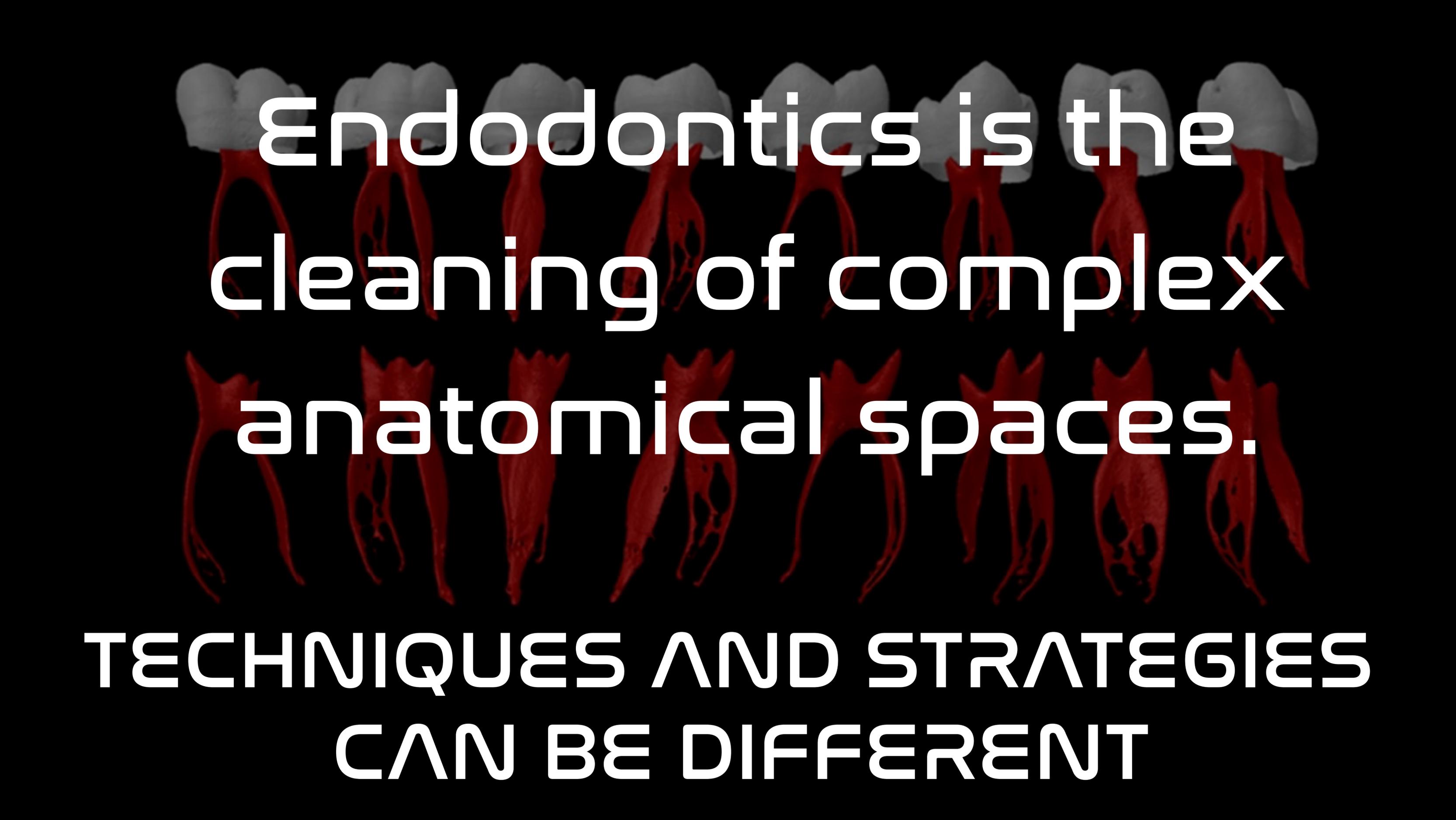
THE GAME CHANGER STEP

WARNING

Root canal instrumentation alone is unable to contact the entire canal surface; a significant portion of the canal walls remains untouched, regardless of the instrumentation system used.”

Peters OA. Versiani et Al

“Studies report that approximately 35–50% of the root canal walls are not contacted by endodontic instruments during mechanical preparation.”

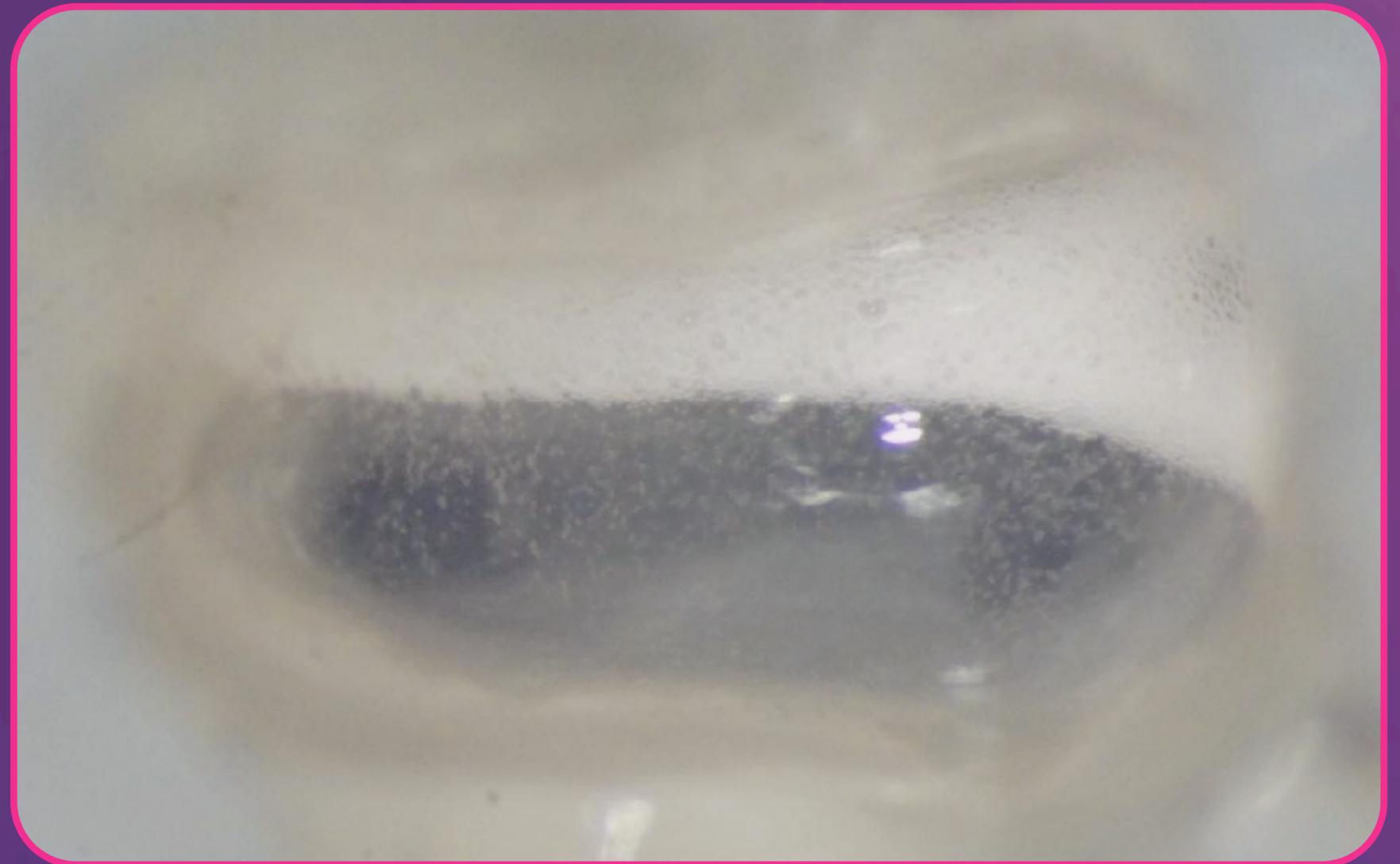


Endodontics is the
cleaning of complex
anatomical spaces.

TECHNIQUES AND STRATEGIES
CAN BE DIFFERENT

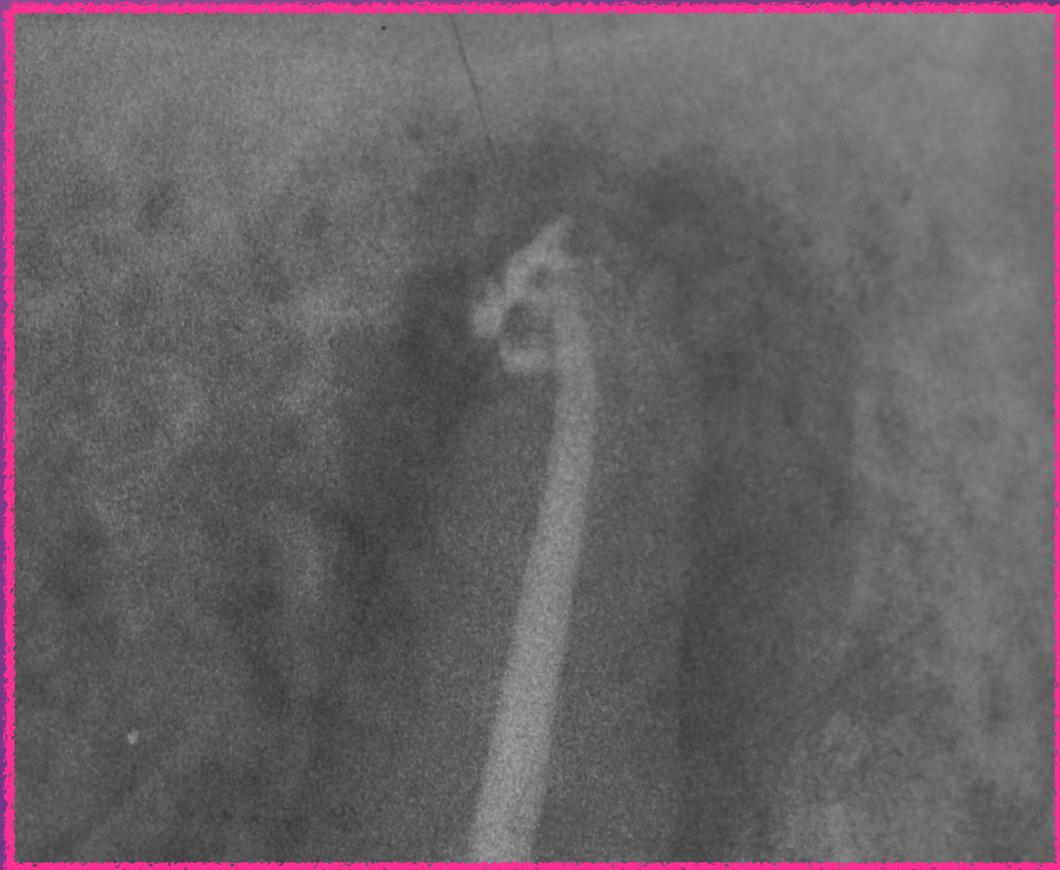
Disinfection Protocol to Reduce the bacterial Load Beneath A Subcritical threshold

If We Shape Less...We Must Irrigate Better

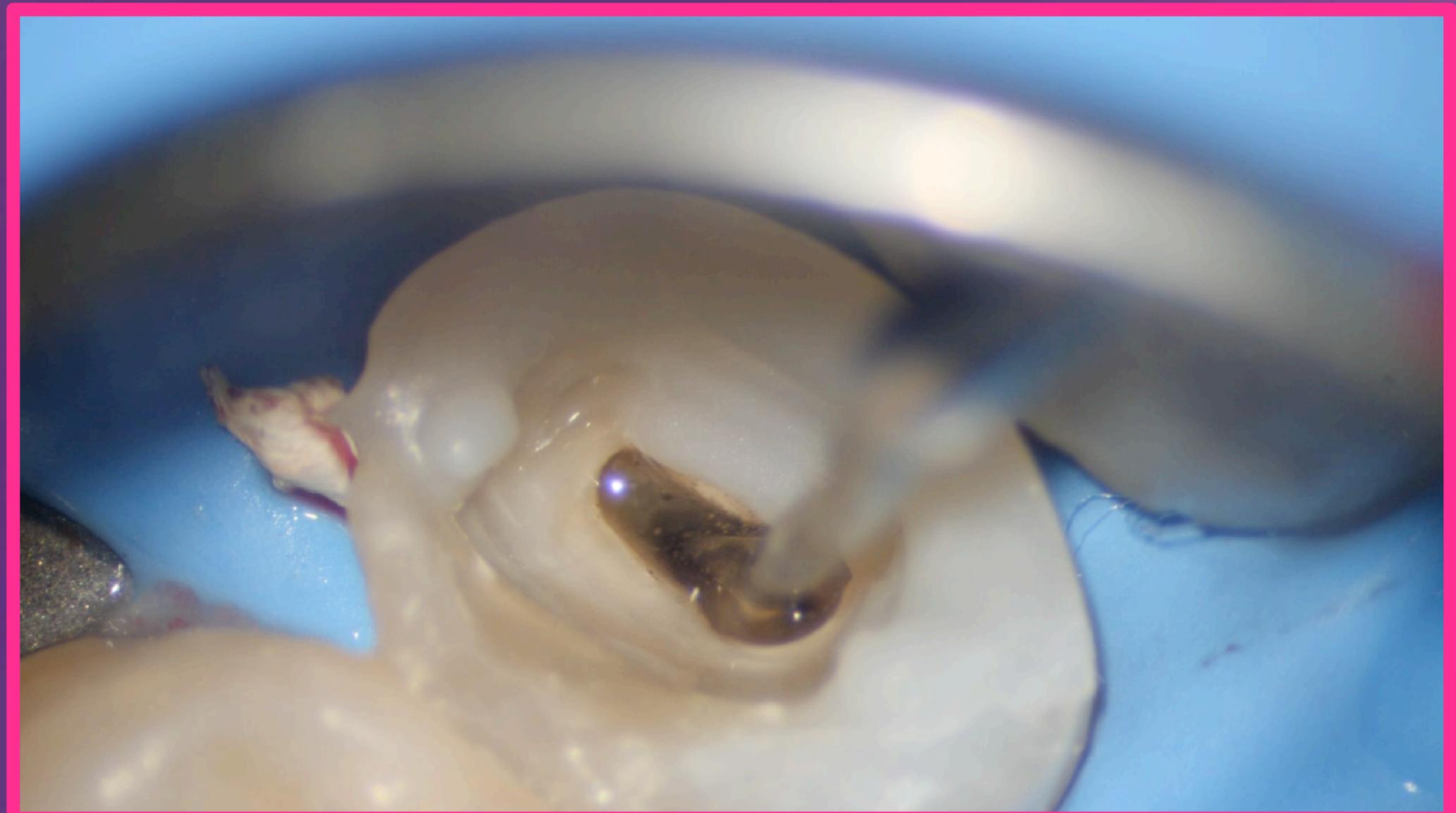


Disinfection Protocol to Reduce the bacterial Load Depends on Volume-Time-Activation

We must activate irrigants



Siqueira et AL. Braz Dent Journ. 2007



REVIEW

Master apical file size – smaller or larger: a systematic review of healing outcomes

A. Aminoshariae¹ & J. C. Kulild²

¹Department of Endodontics, Case School of Dental Medicine, Cleveland, OH and ²Dental School, UMKC, Kansas City, MO, USA

Abstract

Aminoshariae A, Kulild JC. Master apical file size – smaller or larger: a systematic review of healing outcomes. *International Endodontic Journal*, 48, 639–647, 2015.

The purpose of this systematic review was to determine in patients undergoing root canal treatment, whether apical enlargement affected the healing outcome. A PICO (population, intervention, comparison and outcome) strategy was developed to identify studies dealing with apical size of canal and healing outcome as measured clinically and radiographically. The MEDLINE, Embase, Cochrane and PubMed databases were searched. Additionally, the bibliography of all relevant articles and textbooks was manually searched. Based on inclusion and exclusion criteria,

two reviewers independently articles. Four articles were included. There were apical enlargement and cone beam computed tomography systematic review confirmed research in this area is needed. The best available evidence suggests that for and periapical lesions, enlargement would result in an improvement in terms of clinical and radiographic

Keywords: apical enlargement, healing outcome, master apical file size

Received 26 June 2014; accepted 10 October 2014

Introduction

The primary objective of root canal treatment is to eliminate microorganisms and pathologic debris from the root canal system (Kakehashi *et al.* 1969) and to prevent its reinfection (Nair 2004). Gutierrez & Garcia (1968) reported that root canal systems are often improperly cleaned and shaped.

Byström & Sundqvist (1981) cultured 15 teeth with necrotic pulps after instrumentation accompanied with saline irrigation. They reported a 100- to 1000-fold reduction in the bacterial counts, yet no teeth

cultured bacteria-free. Chemomechanical preparation devices promote but is not able to (Dalton *et al.* 1998, 2005, Alves *et al.* 2013).

In a quest for the contaminants from authors have suggested that irrigation may be improved (Ørstavik *et al.* 1995, Shulkin 1995, Shulkin & Rollison *et al.* 2002). They defined the maximum size of the apical preparation larger than the master apical file size. This was associated with

The Role of Apical Instrumentation in Root Canal Treatment: A Review of the Literature

Dean Rugh, DDS, and James Wallace, DDS, MSD, MS

Abstract

The issue of final apical preparation size remains controversial despite considerable clinical and in vitro research. The astute clinician must be aware of the research before choosing any instrumentation system because the informed clinician's decision must be guided by the best available evidence-based information. This review article generated a Medline-based search strategy to discuss these studies and provides a critique and summary of the results.

From the University of Pittsburgh School of Dental Medicine, Pittsburgh, Pennsylvania.
Address request for reprints to Dean Rugh, DDS, E-mail address: drugh@pitt.edu.
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The most important objective of root canal therapy is to minimize the number of microorganisms and radiologic debris in root canal systems to prevent or treat apical periodontitis. This process of chemomechanical debridement, or cleaning of the root canal system, has been described as the removal of all of the contents of the root canal systems before and during shaping. Grossman (1) described mechanical cleaning as the most important part of root canal therapy. Schilder (2) also considered cleaning and shaping as the foundation for successful endodontic therapy.

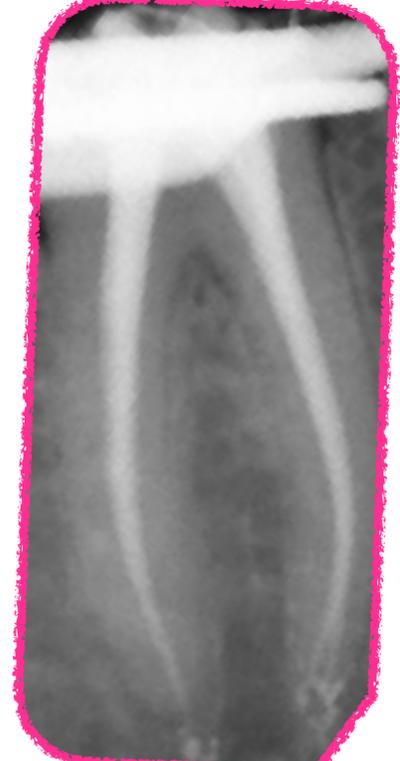
Thorough instrumentation of the apical region has long been considered to be an essential component in the cleaning and shaping process. It was discussed as a critical step as early as 1911 by Grouse (3). Simon (4) later recognized the apical area as the critical zone for instrumentation. Other authors (5, 6) concluded that the last few millimeters that approach the apical foramen are critical in the instrumentation process. Mechanical instrumentation and irrigation are sound endodontic principles and essential components of successful endodontics (7, 8). Research has shown that mechanical instrumentation greatly reduces the number of microorganisms remaining in the root canal system. Mechanical instrumentation (9) has been shown to reduce bacterial count even without irrigants or dressings. A combination of mechanical instrumentation and irrigation (9, 10) further reduced the number of microorganisms by 100 to 1000 times. However, mechanical instrumentation with irrigation does not reliably disinfect an infected root canal system (11–14).

Manufacturers developed nickel-titanium rotary instrumentation systems to facilitate the cleaning and shaping process. They are popular because of their apparent ease of use and reduced number of instruments. However, Spangberg (6) noted that the strong emphasis on reducing the number of instruments and limiting apical preparations to small size does not produce clean apical preparations in diseased teeth. Given this controversial and important topic, we conducted a broad-based Medline search of the literature to characterize the major factors involved in apical canal instrumentation. Table 1 provides the Medline search strategy used to identify relevant articles for this review. A secondary search was then conducted using the references from the computer-generated list of articles. We have organized this review to cover the major factors impacting the selection of the final apical size, namely the anatomy of the apical constriction, apical canal diameter, apical instrumentation, and bacteria.

The Apical Constriction

The apical constriction (cementodentinal junction or CJ) has long been advocated as the terminal end of instrumentation and obturation (3, 4). It is in theory the narrowest part of the canal and the location where the pulp ends and the periodontium begins. Ricucci (15) advocated instrumenting to the apical constriction because impingement outside this junction may delay wound healing or result in adverse effects on the outcome of endodontic therapy. Materials or medications extruded beyond the constriction may promote inflammation and a foreign body reaction. Ricucci and Langrand (16) showed that instrumentation and obturation to the apical constriction gave the best prognosis. A poorer prognosis was observed when obturating material extended beyond the apical constriction. A literature review by Wu *et al.* (17) agreed with the major findings of Ricucci and Langrand. However, it is worth noting that the apical constriction may not always be present or easily identifiable (4, 18).

Better microbial removal and more effective irrigation occurs when canals are instrumented to larger apical sizes



30-35

AMINOSHARIE 2015

BAUGH 2005

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the evolution of Ni-ti
allows us to have
reduced tapers and
larger apical diameters

Increasing diameter



Decreasing taper



INTERNATIONAL ENDODONTIC JOURNAL

The official journal of the British Endodontic Society and the
European Society of Endodontology

REVIEW |  Open Access |   

Present status and future directions: Canal shaping

Ana Arias, Ove A. Peters 

First published: 04 February 2022 | <https://doi.org/10.1111/iej.13698>



There are currently more than 250 brands of instrument systems marketed for root canal preparation.

*Adapting The Anatomy
to the File/Sequence ?*

Or

*Adapting The FileSequence
to the Anatomy ?*



WARNING

“Tailored”

Endodontics



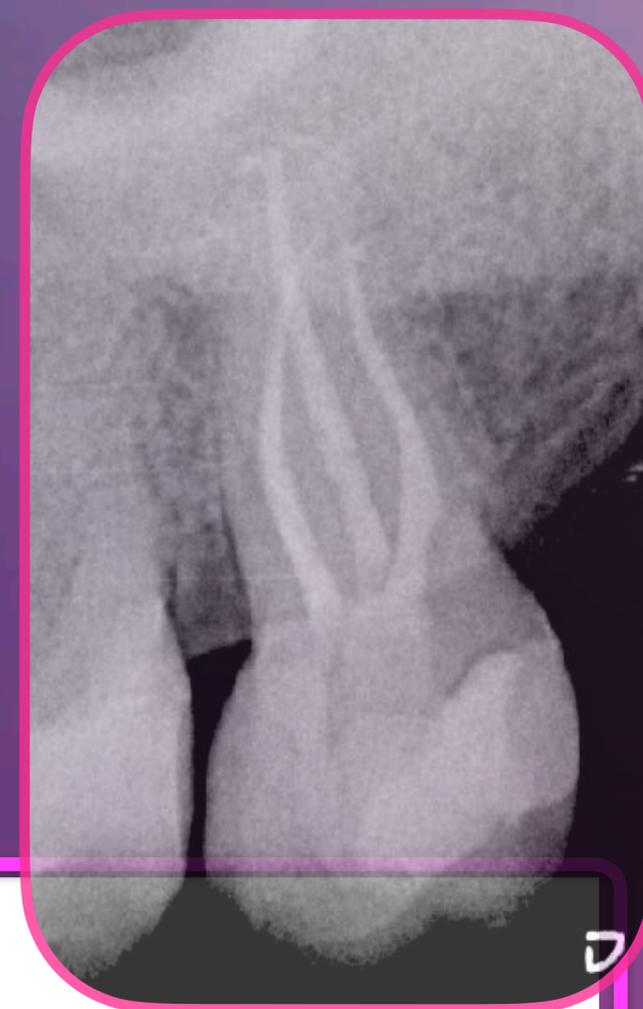
THE FINAL STEP

HYDRAULIC
CONDENSATION
-0,4 TAPER-

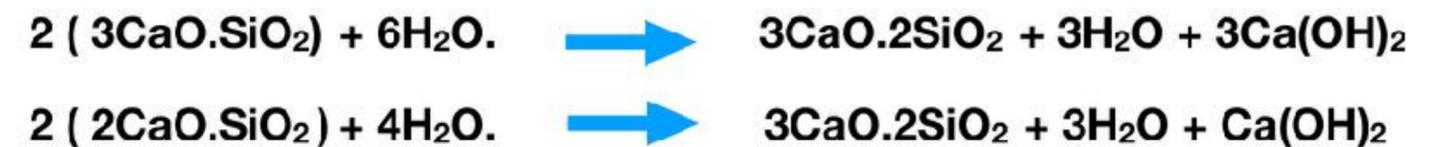


ADVANTAGES

- High Biocompatibility
- Non-toxic
- Hydrophilic
- Radiopacity
- Adhesion to dentin
- Dimensionally stable
- Bioactive and Osteoinductive
- Low inflammatory response
- Hydroxyapatite formation
- Antibacterial (basic pH)
- Easy to use and handle



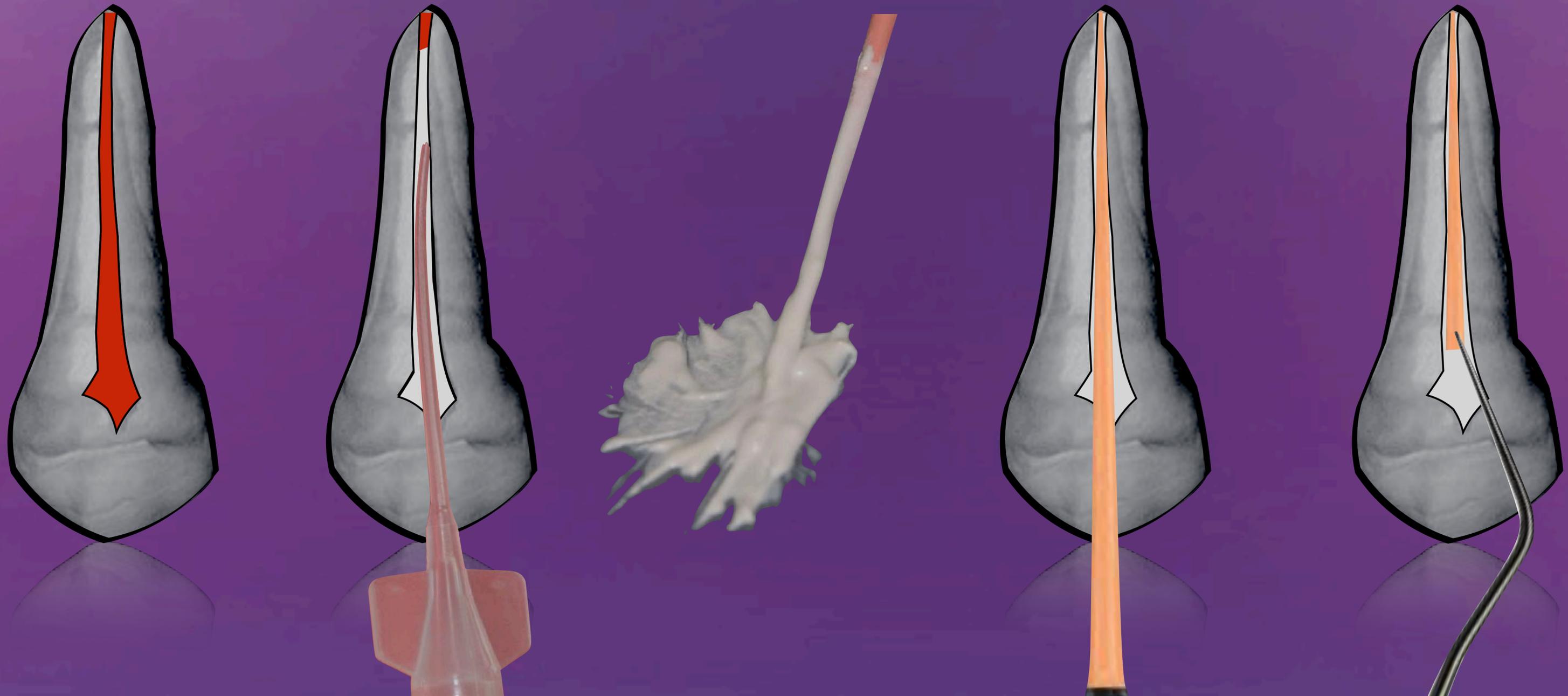
IDRATATION



PRECIPITATION



Single cone technic: Coherent Endodontic Strategy





- Reduced mechanical stress
- Simplified and controlled obturation
- Sealer-centered concept
- Flow into irregularities



HYDRAULIC CONDENSATION



APRIL 2022



SEPTEMBER 2025



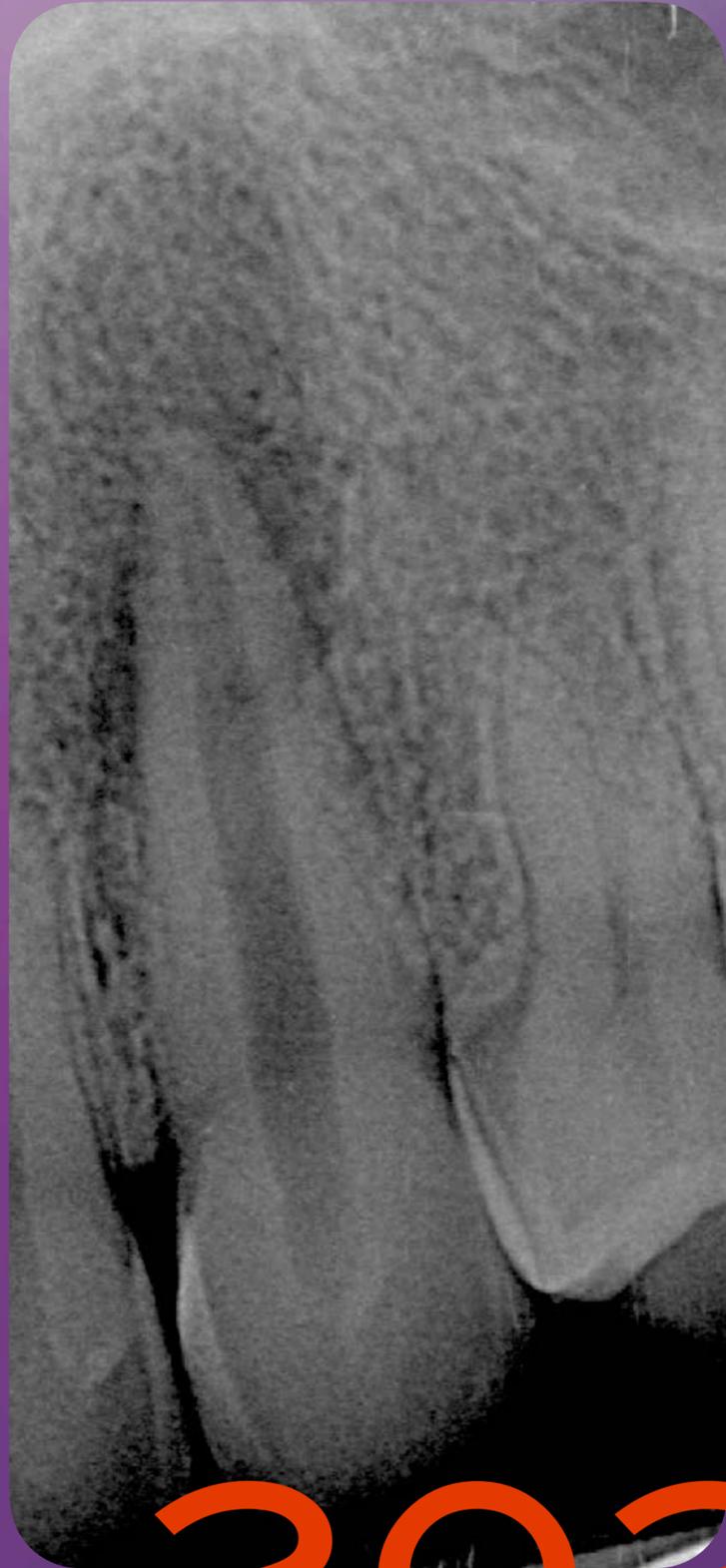
2022



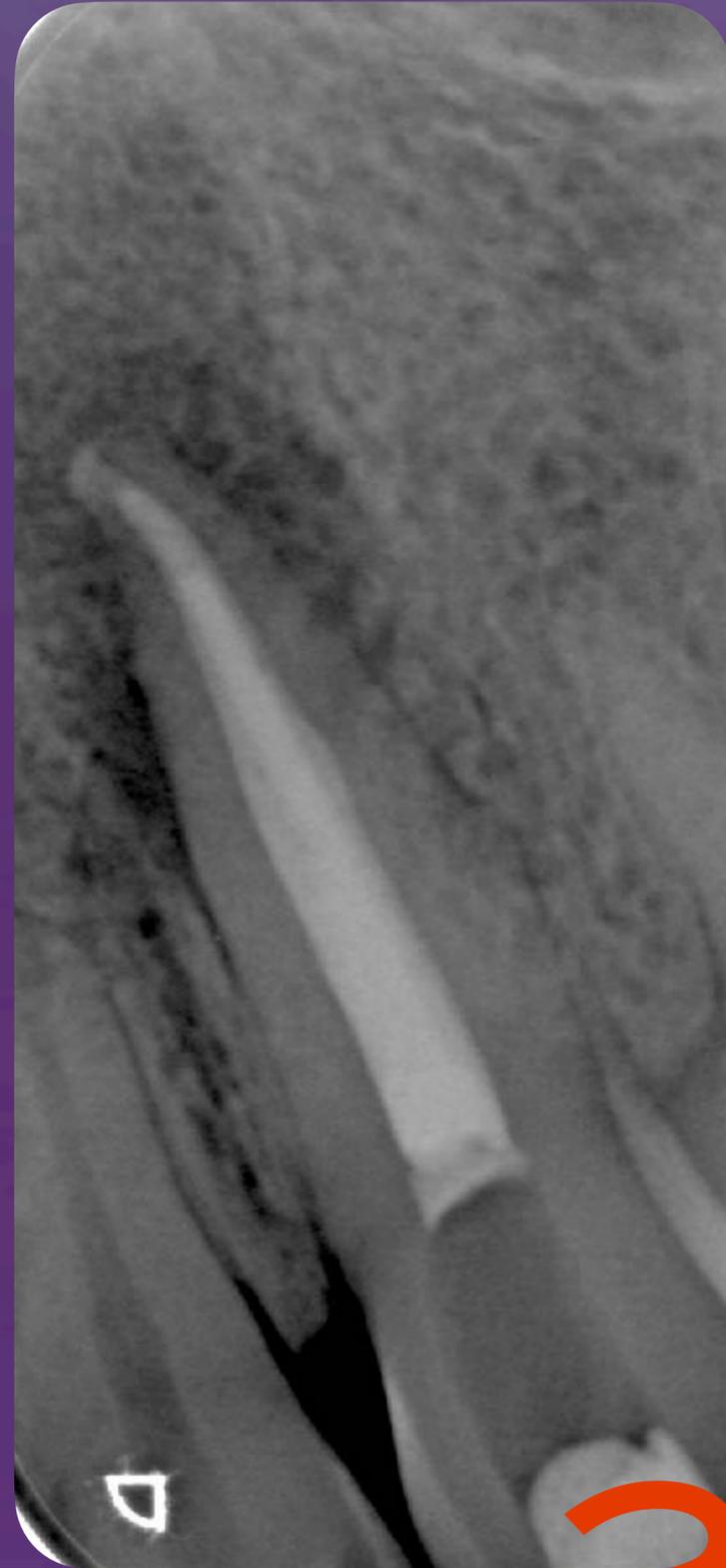
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IDRAULIC CONDENSATION



2021



2024

WARNING



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European Society of Endodontology

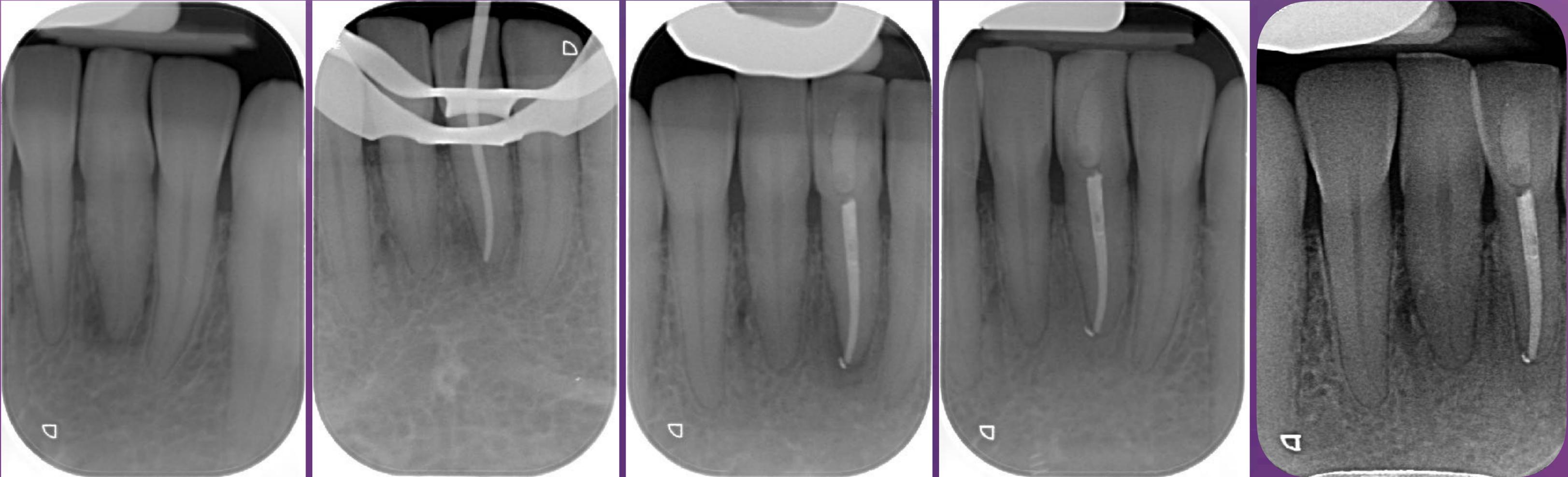
EDITORIAL | [Open Access](#) |  

The Paradox of Calcium Silicate-Based Sealers: A Reflection on Bioactivity, Solubility and Clinical Meaning

[Emmanuel João Nogueira Leal da Silva](#) ✉ [Marco A. Versiani](#)

Limitations of Current Standards
The Paradox—Bioactivity Versus Stability

HYDRAULIC CONDENSATION



2019

50.3

2025

2015

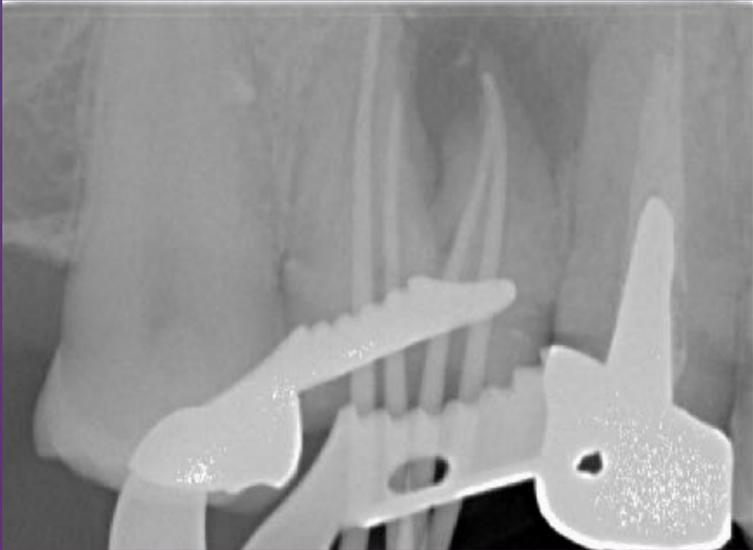
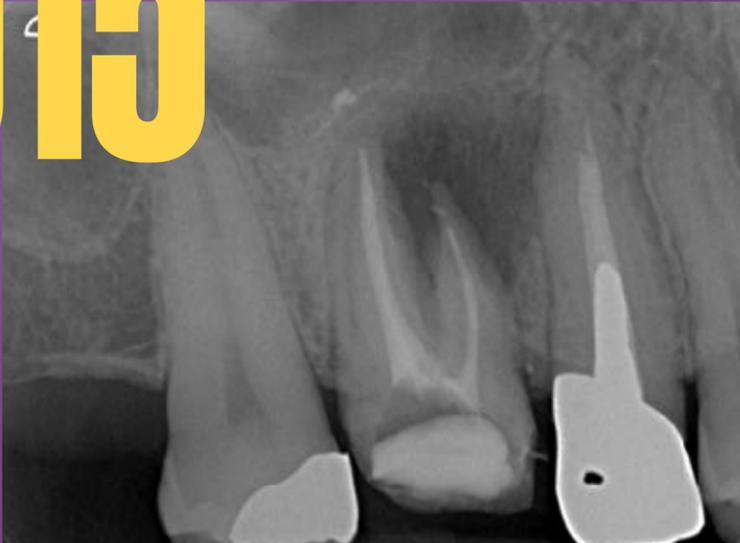
2025



HYDRAULIC CONDENSATION

HYDRAULIC CONDENSATION

2015



2025



URGENT MEIENDO DONTIC



Key points

Shape less to increase Tooth Survival

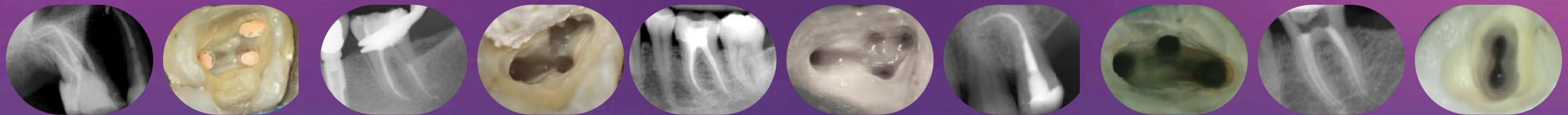
Safe Shaping and customized apex

Irrigate better.”

Easier and smarter Filling



The end



Esthetic Dental Story Vol. 3 | Hotel Mövenpick, Sarajevo

06-07. februar 2026.

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THANK YOU

Gianluca

