



Endodontic Instrumentation and Obturation

Joseph Bernier, DDS

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Friday, June 21, 2024 1:30p-4:30p

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IMPORTANCE OF INSTRUMENTATION

Make..."a shape that facilitates optimal irrigation, debridement and placement of local medicaments and permanent root filling."





OBJECTIVES FOR INSTRUMENTATION

- INSTRUMENT DESIGN FACTORS
- SHAPING EFFECTIVENESS OF VARYING TAPERS
- FLEXIBILITY AND FATIGUE RESISTANCE/METALLURGY
- USAGE RULES AND PROTOCOLS

ENDODONTIC FILE DESIGN ELEMENTS

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ROTATION - RECIPROCATION



NITI AND METAL TREATMENTS



METALLURGICAL CONSIDERATIONS

- INSTRUMENT WEAR
- MECHANICAL PROPERTIES
 - CYCLIC FATIGUE
 - TORSIONAL RESISTANCE
- CUTTING EFFICIENCY
- CORROSION
- STERILIZATION

METALLURGIC CONSIDERATIONS - CORROSION



 SHORT TERM CONTACT BETWEEN NAOCL AND EDTA CAUSED ALTERATIONS IN THE SURFACES





CARDINAL RULES - STRAIGHT LINE ACCESS





CARDINAL RULES - GLIDE PATH AND PATENCY



CARDINAL RULES - GLIDE PATH AND PATENCY



CARDINAL RULES - ABUNDANT IRRIGATION



CARDINAL RULES - MINIMAL APICAL PRESSURE

CARDINAL RULES - MINIMAL APICAL PRESSURE



CARDINAL RULES - INSTRUMENTATION TIME







CARDINAL RULES - INSPECT AND CLEAN FILES



WHAT IS... AND WHY CREATE A GLIDE PATH

of root

Each

Printed in L Vol. 28, No. 7, July 2 Journal of Endodontics The Effect of Preflaring on the Rates of Separation for 0.04 Taner Nickel Titanium Rotary Instruments ucing the chance for binding The Effect of Preflaring on the Rates of Separation for 0.04 Taper Nickel Titanium Rotary Instruments to be the case. Two size #2 broke on first use. Even if nts after one use, separation ed on our results, a statis-David D. Roland, DDS, Wallis E. Andelin, DDS, David F. Browning, DDS, G-Hong Robert Hau, DDS, and Mahmoud Torabinejad, DMD, MSD, PhD akage would occur when ion of preflaring followed aration of ProFiles uently observed to have rotary instruments in the el-titanium endodontic files. Oral after the first several Influence of rotational speed, it experiencing separafailures. Int Endod J 2001;34: pint, we nullified the mparison of the effect of modution (18), as well as I canal configuration: part II. J slip band formation using the manufacturer's recontion of passive step-back tech-11). This was found David D. Roland, DDS, Wallis E. Andelin, MSD, PhD Mahmoud Torabinejad, DMD, MSD, PhD Powell et al. (19) ch preparation will dividual operator. use caper series measurements, esime mended technique, with a combinatio menaea technique, with a combination nique and rotary NiTi instrumentation. that affect the The purpose of this study was to compare the rates nd losing feel for MATERIALS AND METHODS The purpose of this study was to compare the rates of separation of 0.04 taper nickel titanium (NiTi) of separation of 0.04 taper nickel titanium instrumente rotary instrumente using two different instrument human molars torsional failure. Estracted maxillary or mandibular permanent human molars between 18 and 25 mm in length with fully formed apices and no previous root canal treatments were used in this study. Esperimenof separation of 0.04 taper nickel tranum (NIII. rotary instruments using two different instrument tation techniques Twenty extend to A taner profile with the smaller rotary instruments using two different instrumen-tation techniques. Twenty sets of 0.04 taper profile estate 20 rotary instrumente eizee 2 to 6 ware used tation techniques. Twenty sets of U.U4 taper Profile Series 29 rotary instruments, sizes 2 to 6 were used in the medial Imandinulari or hundal Imavillarit na in the medial Imandinulari or hundal Imavillarit is necessary to united to mestal roots of manufoldar molars and to have a of masillary molars. The roots had to have a of masillary molars. Series 29 rotary instruments, sizes 2 to 6 were used in the mesial (mandibular) or buccal (maxillary) ca-in the mesial (mandibular) or buccal (maxillary) ca-role of everyonded human medane with a on to a canal with a of mastellary molars. The roots had to have a 20 and 30 degrees according to the method of In the mesial (mandibular) or buccal (maxillary) ca-als of extracted human molars with a connectaer degree root curvature according to the connectaer ed to confirm nals of extracted numan molars with a 20 to 30 degree root curvature according to the Schneider degree root curvature according to the schneider in degree the stime the retary instruments were used in rency or me experimental canal in Series 29, 0.02 taper, hand file previous root canal treatmen Tool curvature according to the octimeteen seed up cation. The rotary instruments were technicity classification. The rotary instruments were used up to 20 times either with the crown-down technique recommended by the manufacturer or with a name Tulsa Dental Products, Tulsa, OK), Standard access s were made to allow straight-line access to the canals residents; Dr. eparations were made to allow straight-line access to the canals eparations were made to allow straight-line access to the conded when Working length was visually established and recorded for outeney file was seen emerging through the anical foramen of nateney file was seen emerging through the anical foramen of mes either with the crown-down technique hended by the manufacturer or with a comcanals were Endodontics, ntistry, Loma recommended by the manufacturer or with a com-bination of preflaring with hand files in a passive bination of preflaring with how of hur reference instrument curvature between Roland, Dethe buccal bination of pretiaring with hand tiles in a passive step-back technique followed by folary instrument that tation. Statistical analysis of the data enough that tistry, Loma step-back technique followed by rotary instrumen-tation. Statistical analysis of the data showed that the combinestion technique allowed more tiese ho 2 to 6 rotary Schneider tation. Statistical analysis of the data showed that the combination technique allowed more uses be-fore senaration remnared with the province of the technique allowed techniq were used. 0.04 taper Profile Series 29 sizes the combination technique allowed more uses be-fore separation compared with the crown-down-technique recommended by the manufacturer of larger Tulsa Dental Products) (Dentsply fore separation compared with the crown-down technique recommended by the manufacturer p < 2 to 6 have tip dian ators were (13). (Dentsply 46-51. 360. respe rome series 27 insumments and 0.31 (0.129, 0.167, 0.216, 0.219, 0.103) into two sels were divided equally until the size After initial) file was able to reach the working length. After initial a, the rotary instruments were used in the crown-down b, the rotary instruments were used in the a first anisot performanced by the manufacture to a first anisot a real course acce interval instrumences vises #1 (0.10), #2 (0.129), and #3 (0.167)). band tiles (Sizes #1 (0,10), #2 (0,129), and #3 (0,167)). B3 (0,167) file was able to reach the working length, in premovation, the reduce instrumente work work in the ene introduction of rolary nickel itanium (NIT)) instruments iffeanity affected endodonite cleaning and shaping procedu iffeanity affected endodonite cleaning and shaping or endodonites. It outry instruments were used in the crown-down bended by the manufacturer to a final apical nected endounnie cleaning and snaping procedures. sample sizes were adequ NTE instruments were first introduced to endodontics, they commended as an alternative to stainless steel first management commended as an alternative management management and the state of the state 0.0001. five sets of insti such as transportation and size #2 length. After preflaring ne working rengin, outer premaring the was the final canal shape was more centered in the canal.) paration size #4 (0.216). ten-back enlargement to an oup B, all canals were a passive technique and remain in the can procedural accidents, technique reco When NiTi ins rotary NiTi I Id pose a threat to thed the working their separation.

 "...PREFLARING IS NECESSARY TO MINIMIZE THE CHANCE OF PERMANENTLY BLOCKING A CANAL WITH A BROKEN **ROTARY INSTRUMENT.**"

GLIDE PATH OPTIONS



TRADITIONAL TECHNIQUE



FIRST: "OPENING THE GLIDE PATH"

The road map to the apex...follow gently...

TIME TO GIVE CREDIT ...

• THE INFORMATION ABOUT GLIDEPATH IS MOSTLY FROM DR. JOHN WEST AND TWO ARTICLES HE WROTE IN DENTISTRY TODAY IN SEPTEMBER OF 2010 AND JANUARY OF 2011.

- WEST, J.D. "THE ENDODONTIC GLIDEPATH: "SECRET TO ROTARY SAFETY". DENTISTRY TODAY. 2010: 86-93.
- WEST, J.D. "MANUAL VERSUS MECHANICAL ENDODONTIC GLIDEPATH". DENTISTRY TODAY. 2011: 136-145.

REMEMBER: ALL ROTARY INSTRUMENTATION BEGINS WITH A HAND FILE!

WHY DO WE NEED TO KNOW ABOUT HAND FILING?

- NO ROTARY INSTRUMENT SHOULD ENTER A CANAL FIRST
- USE SMALL HAND FILES TO EXPLORE THE CANAL
- DETERMINE WORKING LENGTH WITH A HAND FILE
- A GLIDE PATH FOR THE ROTARY INSTRUMENTS SHOULD BE CREATED FIRST WITH HAND FILES
- A #10 HAND FILE SHOULD BE SUPER LOOSE IN THE CANAL AT WORKING LENGTH

INSTRUMENTATION BEGINS WITH HAND FILES BECAUSE..

- SMALL FLEXIBLE HAND FILES CAN BE PRE-CURVED
- WE MUST CREATE A GUIDE PATH FOR ROTARY FILES
- THEY MAP THE ANATOMY OF THE CANAL SYSTEM

WHY STAINLESS STEEL?

PROPERTIES OF STAINLESS STEEL

- STRONG (FRACTURE RESISTANT)
- FLEXIBLE-ACCEPTS PRE-CURVING



CURVED VS. KINKED





CURVED VS. KINKED





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MANUAL GLIDEPATH ISSUES



RISK OF MANUAL GLIDE PATH CREATION







Courtesy of Dr. Arnaldo Castellucci

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MECHANIZED CREATION OF THE GLIDE PATH

GLIDE PATH OPTIONS







SEMI-ACTIVE TIP - ISO 015









OFF SET DECTAN

6/20/2017 mag □ HV spot vacMode WD ------ 100 μm ------9:31:26 AM 600 x 20.00 kV 3.0 High vacuum 12.2 mm





VARIABLE HELICAL ANGLES







Vortex 30/12 Orifice Opener

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WORKING LENGTH









SO HOW DO WE FIND THIS APICAL CONSTRICTION ACCURATELY?... ()

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RADIOGRAPHIC WORKING LENGTH



Best guess?

RADIOGRAPHIC WORKING LENGTH



• ACTUALLY ... WE ARE WRONG AND LONG!

RADIOGRAPHIC WORKING LENGTH





DETERMINE WORKING LENGTH















WAVEONE GOLD DESIGN PRINCIPALS

- RECIPROCATION REDUCES STRESSES
- APICAL CONSTRICTIONS ARE GENERALLY SMALL
- BACTERIA IN APICAL DENTINAL TUBULES
- SUFFICIENT TAPER ALLOWS FOR GOOD IRRIGATION
- BETTER METALLURGY IMPROVES PERFORMANCE

SAFETY FACTOR OF RECIPROCATION

Safety of the Factory Preset Rotation Angle

of Reciprocating Instruments

Introduction: This study aimed to investigate the ' Introduction: This study almed to investigate the torsional resistance of 2 reciprocating nickel-trainium in commany. Animice Commany and and torsional resistance of 2 reciprocating nickel-transum In-struments (Reciproc /VDW, Munich, Germany) and struments (necproc (vuw, Munico, Germany) and // WaveOne (Dentsply Maillefer, Ballaigues, Switzerland))

Waveune (version of managers, battering vers, or version of the maximum rotating angle in a proposition of motor. Methods: With the file tip secured at various, $L_{aude, f, S} \neq c_{aux}$ and c_{aux} and c_{a

Motor: Methods: With the tile up secured at various / levels (3, 4, or 5 mm) of Reciproc R25 and WaveOne Pri-

evens (3, 9, or 5 mm) or neceptoc Kz5 and WaveUne Pri-may, the distortion angles and torsional loads were

Inary, we usuarian angles and wasking routs when in monitored during counterclockwise movement at a second for the second fore

monutoreo ouning counterclockwise movement at 2 rpm until facture $(n \ge 10)$ at each level) for a load.

 \leq fpm unus fracture ($n \approx 10$ at each levery for a load / distortion graph. The totation angles and loads at the second secon astortion graph. Ine rotation angles and rotation at the beginning point of the plateau, the utimate toxical at the state of the state Deginning point of the praceas, the Uninduct University Strength, final facture angle, and toughness were deter-

strength, final fracture angle, and toughness were over in mined. The data were analyzed using 1-way analysis of

intree. Ine cara were analyzed using i-way analyses of variance and the Tukey post hoc test at $\alpha = .05$. The interval interval sectors and the forward sectors for any sectors in the sectors of the sectors interval sectors in the sectors in the sectors interval sectors in the sectors in the sectors in the sectors interval sectors in the sectors in th

Variance and the luxey post loc test of $\alpha = N_0$, life lateral longitudinal aspect and the fracture crossateral longituanial aspect and the fracture cluss section of each specimen were examined by scanning

sector) or each spectreen were examined by scanning of electron microscopy after the test, Results: The rotation

electron microscopy arter the test. Nestuts: The rotation // angle at the beginning point of the plateau was signifi-randu oreaster for a hierding cite forther survey form the time randu or survey for a hierding cite for the plateau was signifiangle at the beginning point or the plateau was signifi-cantly greater for a binding site farther away from the tip of the interview for Arther away from the tip

Cataly greater tor a binding site tartner away hom the tip of the instrument for both systems (P < OS), and all of the instrument for both systems (P < OS), and all of the systems (P < OS).

the instrument for both Systems in the dedicated motors of the second states of the second states of the second states of the second states and twices.

Were greater than 1 /U⁻ (preset in the dedicated motion from manufacturer). The ultimate strength and tough

hum manufaculieri, ine usumare svengun aus usugn. // ness also increased significantly at levels farther away These states increased signmeanly at levels farther away / from the instrument tip (p < .05). All specimens showed

from the instrument tip (P < .05). All specimens showed by the second second second fracture of torsional fracture.

typical topographic features or torsional fracture; / including the circular abrasion marks and fibrous J the Uncurat advastion marks and instructs i flear the rotation Center after the test interviewed to the data the test of test computes near me rotation center arter the test. / Conclusions: It was determined that the 2 brands of

Conclusions: it was determined that the 2 brands of reciprocating files are safe when operated at the rota-

esupresating mes are sate when operated at the rota-banal angle in the proprietary motor. (/ Endod 2014;40:1671–1673)

Astartion, Reciproc, reciprocating nickel-titanium file, visional recisionen Waysonen

JOF - Volume 40, Number 10, October 2014

Jin-Woon Kim, DDS, MS, PbD, * Jung-Hong Ha, DDS, MS, PbD, * Garv Shim-Pan Cheuno. BDS, MDS, MSC, PbD, * Antheunis Vers Jin-Woon Kim, DDS, MS, PbD, * Jung-Hong Ha, DDS, MS, PbD, * Gary Shun-Pan Cheung, BDS, MDS, MSC, PbD, * Antheunis Versluis, PbD, * Sang-Won Kwak, DDS, MS, * and Hyeon-Cheol Kim, DDS, MS, PbD, * Gary Sbun-Pan Cbeung, BDS, MDS, MSc, PbD,* Antheunis Versituis, P Sang-Won Kwak, DDS, MS,* and Hyeon-Cheol Kim, DDS, MS, PbD*



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Basic Research—Technology

/ Mickel-diantum (NTI) rotary files are now an important adjunct in endodonic thermans offer many advantages over stainless steel files, including excellent flexibility

I vapy and are used estensively by both specialists and general dentists. NIT instru-ments offer many advantages over stabiless steel files, including excellent flexibility and immoved cutting efficiency (1, 2). The superclassicity of NT neury instruments

nents offer many advantages over stainless steel files, including excellent flexibility and improved cutting efficiency (1, 2). The superelasticity of NTI notary instruments alrows newservation of the most canal anatomy and curvature while conserving more

and improved cutting efficiency (1, 2). The superelasticity of NiTi rotary instruments allows preservation of the root canal anatomy and curvature while conserving more root structure (1-3). Desnite these advantages. NITi instruments appear to be

terable to separation (4, 5). The separation modes of rolary NITI instruments can be categorized as either of: e flexmal fations or investoral failure (5, 6). In the clinic, the semantion of WiTi The separation modes of rotary NITi instruments can be categorized as either of dic flexural faigue or torsional failure (5, 6). In the clinic, the separation of NTi instruments, orobabily, occurs, under the simultaneous influence of torsion and

dic flexural fatigue or torsional failure (5, 6). In the clinic, the separation of NTI / flexure resulting in nurved mode failure (6, 7). Revent-bers and manufacturers have

/ Instruments probably occurs under the simultaneous influence of torsion and feature, resulting in mixed mode failure (6, 7). Researchers and manufacturers have are no increase failure residance as well as chinical officiency.

Beaure, resulting in mixed mode failure (6, 7). Researchers and manufactures have explored various ways to increase failure resistance as well as clinical efficiency. (2,15) commerce characteristics heat treatments and surface treatments have all the statements have all surface treatments have all the statements have all the statement have all the statement

explored vanous ways to increase tablure resistance as well as clinical efficiency (8-15). Geometric characteristics, heat treatments, and surface treatments have a been chrown to have a considerable offer on the mechanical mechani (8–15). Genmetric characteristics, heat treatments, and surface treatments have all been shown to have a considerable effect on the mechanical properties and clinical nerformances of NTT incomments (0–17).

formances of NTI instruments (9–17). Recently, a different form of motion has been proposed for NTI instruments. Inset (18) provided the two of a recimension technicus and managed to abate a Recently, a different form of motion has been proposed for NIT instruments. / Yared (18) reported the use of a reciprocating technique and managed to shape a root canal successfully with only 1 instrument. Since then, 2 NIT systems have been

Yared (18) reported the use of a reciprocating technique and managed to shape a root canal successfully with only 1 instrument. Since then, 2 NIT systems have been introduced to the market that use the reciprocation concent: Reciproc (VDW, Munich.)

Pool canal successfully with only 1 instrument. Since then, 2 NIT systems have been introduced to the market that use the reciprocation concept: Reciproc (VDW, Manile, Commons) and Waysons, (Denotedv Mathefier, Ralainus, Surgerind, These manufact.)

Introduced to the market that use the reciprocation concept: Reciproc (VDW, Multich, Germany) and WaveOne (Dentsphy Mailleder, Ballatgues, Switzerland). These manufac-/ inverse claim that the review extension metions metions metions in the twee the investional feastures have new variationality.

Germany) and WaveOne (Dentsply Matilefer, Balatignes, Switzerland). These manufactures claim that the reciprocating motion reduces the torsional fracture by periodical reviews in the notation directions of the file (10). Several studies have shown that recip-

Crease clinical efficiency compared with continuous rotation (20-23). The life stan (extension may be explained by the reduced effect of cyclic stress buildup that con measured influences the failure resisting resistance for continuous retained intermentation of the state of expansion may be explained by the reduced effect of cyclic stress buildup that can negatively influence the fatigue resistance for continuously rotating instruments. On the other hand, little information is available on the torsional resistance of NTT files

negatively influence the fatgue resistance for continuously rotating instruments. On / the other hand, little information is available on the torsional resistance of NIT files concrating in the recinencesting mode describe the manufacturers' claim. The the other hand, little information is available on the torsional resistance of NII these operating in the reciprocating mode despite the manufacturers' claim. The recinoneating file continues to be suscentible to borsional breakage, at least in theory. operating in the reciprocating mode despite the manufacturers' (Calin, The reciprocating file continues to be susceptible to bristonal breakage, at least in theory . The torsional mesksance of an instrument varies acrowriting to the cross-sectional .

proceeding the continues to be susceptible to torsional breakage, at least in theorem to and area which may different lands of the incrementation of the increment of the increm The torsional resistance of an instrument varies according to the cross-sectional angles under struck with may differ at different levels of the instrument (19). The rotation angle surviv will affer the internal stress huilt un in three instruments. However, the

/ angle surely will affect the internal stress built up in these instruments. However, the dedicated motors of these systems possess only 1 preprogrammed seeing for the response revention of a construction which wave revented in a dedicated motors of these systems possess only I preprogrammed setting for the recip-forcating files (170° Counterclockwise and 50° clockwise, which were recorded in a nethannerv study using a bioh-sneed video camera INTS 11 vits canon tokyo bana 1 prediminary study using a high-speed video camera [DUS 11518; Canon, Tokyo, Japan] at 240 frame/s). Therefore, the aim of this study was to investigate the torsional preliminary study using a high-speed video camera [JXUS 115HS; Catoon, Tokyo, Japan] at 240 frame/s). Therefore, the aim of his study was to investigate the torsional resistances of the reciprocettine instruments at various levels by messurine torsional

Occase dinical efficiency compared with container to a state of the state of the

sugle and area, which may duter as different levers of the abstrational angle surely will affect the internal stress built up in these instrument of the surely of the sur

From the "Department of Conservative Danking, School of Dentistry, Posan National University, Dental Research Institute, Vangean, National Vangean, and Department of Biocecience Research (Rational University), Dental Research Institute, Vangean, National Vangean, School of Conservative Dentistry, School of Dentistry, School of Dentistry, National Vangean, School of Conservative Dentistry, School of Dentistry, School of Dentistry, School of Dentistry, National Vangean, School of Dentistry, Dental Research Institute, Vangean, National Vangean, School of Dentistry, School of Conservative Dentistry, School of Dentistry, School of Dentistry, Dental Research Institute, Vangean, National Vangean, School of Dentistry, School of Conservative Dentistry, School of Dentistry, Face of Endodontics, Faculty of Research Institute, Vangean, National Vangean, School of Dentistry, School of Dentistry, National Vangean, National Vangean, School of Dentistry, School of Research Research Institute, Vangean, National Vangean, School of Dentistry, School of Research Vangean, National Vangean, National Vangean, School of Dentistry, School of Research Research Institute, Vangean, National Vangean, School of Dentistry, School of Research Vangean, National Vange

allows preservation of the root canal anatomy and curvature while conserving more f root structure (1-3). Despite these advantages, NTT instruments appear to be vulnerable to senaration (q, 5).

"...even when the apical 3mm of the instrument was bound and remained stationary, the instrument still had sufficient strength to endure the torsional load generated by the reciprocating movements."

• BACK TO WHY THE WAVE ONE GOLD FILE IS THE SIZE IT

IS...





Current Scientific Evidence in Endodontic Therapy

Instrumentation





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RATIONALE FOR APICAL TIP SIZE

- DIAMETER OF APICAL FORAMINA
- BACTERIAL PENETRATION IN APICAL DENTIN
- TIP DIAMETER VS. PREPARATION TAPER



Percentage of debris remaining after instrumentation





Pathways 9th ed 2006

Albrecht JOE 2004

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Morphology of the Physiological Foramen: I. Maxillary and Mandibular Molars

Benjamín Briseño Marroquín, Prof. Dr. med.dent., Mohammed A. A. El-Sayed, Dr. med.dent., and Brita Willershausen-Zönnchen, Prof. Dr. med.dent.

Information concerning the anatomy of the physiological foramen is limited. The aim of this study was to investigate the distance between the physiological and anatomical apex, accessory foramina frequency, and the shape and diameter of the physiological foramen in maxillary and mandibular molars. The apical anatomy of 523 maxillary and 574 mandibular molars from an Egyptian population was investigated by means of a computer-aided stereomicroscope ($40 \times$ magnification). The following results were obtained:

- (a) There was a high percentage of two physiological foramina in mesial (87.06%) and mesiobuccal (71.15%) roots of mandibular and maxillary first molars, respectively.
- (b) There was a high frequency of accessory foramina in maxillary mesiobuccal (33%) and mandibular mesial (26%) roots.
- (c) The most common physiological foramen shape was oval (70%).
- (d) The mean of the narrow and wide physiological foramen diameters was as follows:
- 0.20 to 0.26 mm in mandibular molars
- 0.18 to 0.25 mm in the maxillary mesiobuccal and distobuccal root
- 0.22 to 0.29 mm in the maxillary palatal root

information about the apical area. Typically, the root canal narrows toward the apex into the apical constriction or physiological foramen and expands to form the physiological foramen (3). Yet, Wu et al. (8) reported that an apical constriction was found in less than half of the teeth they examined. Moreover, the most apical portion of the root canal has been reported to have not only tapered but also parallel walls (9). Other authors have suggested that the apical constriction is often not present, particularly when apical pathosis and root resorption are present (1). Few studies concerning the root anatomical apex and anatomical foramen morphology have been conducted, and they mainly discuss the distance between these two entities (3, 9, 10). Even fewer studies concerning the diameter (2, 11) and shape (12) of the anatomical foramen have been conducted.

The aim of the study was to investigate the distance between the physiological and anatomical apex; accessory foramina frequency; and the number, shape, and diameter of the physiological foramen in the roots of maxillary and mandibular first, second, and third molars.

MATERIALS AND METHODS

A total of 1097 extracted human permanent molars from an Egyptian population were obtained and stored in 5.25% sodium hypochlorite. The teeth had to show an intact or almost intact crown for clear identification of the tooth type and location (13, 14). Primary teeth and roots evidencing fractures, resorption, or underdevelopment (40× magnification) or that had received any previous endodontic treatment were discarded. The teeth were

J Endod 2004:30:321

Morphology of the Physiological Foramen: I. Maxillary and Mandibular Molars

Benjamín Briseño Marroquín, Prof. Dr. med.dent., Mohammed A. A. El-Sayed, Dr. med.dent., and Brita Willershausen-Zönnchen, Prof. Dr. med.dent.

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TERMES AND METHOD

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Regional Variation in Root Dentinal Tubule Infection by Streptococcus gordonii

Robert Matthew Love, MDS

The purpose of this study was to investigate the pattern of bacterial invasion of dentinal tubules at different regions in human roots. Specimens were obtained from single-rooted teeth that had their root canals prepared in a standard manner. Roots were then sectioned longitudinally through the canals and the resulting specimens chemically treated to remove the smear layers. Specimens were immersed in a suspension of Streptococcus gordonii for 3 weeks and then prepared for histological analysis. Sections from the cervical, midroot, and apical areas were examined. The pattern of bacterial infection of the cervical and midroot areas was similar, characterized as a heavy infection with bacteria penetrating as deep as 200 µm. Invasion of the apical dentin was significantly different, with a mild infection and maximum penetration of 60 µm.

the teeth were cleaned to remove adherent hard and soft tissues, with care being taken not to damage the cementum, and stored in 5% formalin. Using a rotating diamond saw (Isomet Saw, Buhler Ltd., Evanston, IL) with water irrigation, the crowns were removed to produce roots of equal length. Roots were inspected for root fractures or lateral canals with a stereomicroscope at 12 times magnification, and canal patency was confirmed by passing a #15 K-file through the apex.

Canals were instrumented with a step-back circumferential filing technique using K-files and copious irrigation with 17% EDTA and 5.25% sodium hypochlorite (NaOCl). An apical stop was prepared 1 mm from the apex to three file sizes larger than the first file to bind, or at least to size 30. Roots were then sectioned longitudinally through the root canal with the diamond saw to produce two matching specimens. Ten of these specimens plus three controls were used in this study.

To ensure complete removal of the smear layers, the specimens were placed in an ultrasonic bath (Metason 120, Struers) with 17% EDTA for 4 min, followed by 5.25% NaOCl for 4 min. One

J Endod 1996;22:290-3


imum penetration of 60 μ m.

pattern of bacterial invasion of dentinal tubules at different regions in human roots. Specimens were obtained from single-rooted teeth that had their root canals prepared in a standard manner. Roots were then sectioned longitudinally through the canals and the resulting specimens chemically treated to remove the smear layers. Specimens were immersed in a suspension of Streptococcus gordonii for 3 weeks and then prepared for histological analysis. Sections from the cervical, midroot, and apical areas were examined. The pattern of bacterial infection of the cervical and midroot areas was similar, characterized as a heavy infection with bacteria penetrating as deep as 200 μ m. Invasion of the apical dentin was significantly different, with a mild infection and max-

The purpose of this study was to investigate the

Robert Matthew Love, MDS

Regional Variation in Root Dentinal Tubule Infection by Streptococcus gordonii

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DESIGN RATIONALE – BACTERIAL MIGRATION



DESIGN RATIONALE – SMALL ANATOMY

information about the apical area. Typically, the root c

toward the apex into the apical constriction or physic men and expands to form the physiological foramen then and expands to form the physiological relation et al. (8) reported that an apical constriction was four half of the teeth they examined. Moreover, the most of the root canal has been reported to have not only t

I. Maxillary and Mandibular Molars Benjamín Briseño Marroquín, Prof. Dr. med.dent., Mohammed A. A. El-Sayed, Dr. med.dent., and Brita Willershausen-Zönnchen. Prof. Dr. med.dent. וואס אוזיזיטקעווו, רנטו. אוז med.aent, א Brita Willershausen-Zönnchen, Prof. Dr. med.dent.

following results were obtained:

(a) There was a high percentage of two physiolog-

i nere was a nign percentage of two pnysiolog-ical foramina in mesial (87.06%) and mesiobuc-

cal foraliting in mesial for Job 701 and mesionade cal (71.15%) roots of mandibular and maxillary (b) There was a high frequency of accessory fo-Inere was a nigh frequency of accessory foramina in maxillary mesiobuccal (33%) and manibular mesial (26%) roots. The most common physical formation for the second sec

(c) The most common physiological foramen

snape was oval (70%). (d) The mean of the narrow and wide physiological

foramen diameters was as follows:

Morphology of the Physiological Foramen:

Information concerning the anatomy of the physiological foramen is limited. The aim of this study

ological toramen is limited. The aim of this study was to investigate the distance between the physof the root canal has been reported to have not only t parallel walls (9). Other authors have suggested was to investigate the distance between the physical and anatomical apex, accessory foramina constriction is often not present, particularly when frequency, and the shape and diameter of the and root resorption are present (1). Few studies con anatomical apex and anatomical foramen morpho trequency, and the snape and diameter of the physiological foramen in maxillary and mandibular molars. The apical anatomy of 523 maxillary and molars. The apical anatomy of 525 maximary and 574 mandibular molars from an Egyptian popula-5/4 mandibular molars from an Egyptian popula-tion was investigated by means of a computer-aided stereomicroscope (40× magnification). The following results were obtained:

conducted, and they mainly discuss the distance be conducted, and they mainly discuss the distance be entities (3, 9, 10). Even fewer studies concerning 11) and shape (12) of the anatomical forar The aim of the study was to investigate the dist the aim of the study was to investigate the dist physiological and anatomical apex; accessory for and the number, shape, and diameter of the phys

in the roots of maxillary and mandibular first,

molars.

A total of 1097 extracted human permane Egyptian population were obtained and store hypochlorite. The teeth had to show an int crown for clear identification of the tooth ty 14). Primary teeth and roots evidencing fra underdevelopment (40× magnification) or § previous endodontic treatment were discar



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- 0.20 to 0.26 mm in mandibular molars 0.18 to 0.25 mm in the maxillary mesiobuccal and 0.22 to 0.29 mm in the maxillary palatal root





Studio MAX 2.0 [Build : 37486_64 bit] : G:\Maillefer Tulsa VDW\Sample 050\50 SERGIO. 🔁 🗲 💠 🔩 🐙 🖉 🖉 🖉 👘 🐐 🐐 🔹 🔶 👘 🖉 🚛 🖓 👘 🛫 1 9 CH X Scene Camera 1 -10 V Clight source 1 -10 V Clight source 2 Wolume 1 [2]: 50 Coordinate Mea · instruments Distance 1: 1.03 mm Distance 2 1.38 mm Distance 3 1.47 mm Distance 4: 1.33 mm Distance 5: 0.45 mm Distance 6: 0.71 m Distance 8: 0.14 mm - RED CANALS · Region 1 Volume 1: 50 post-- Coordinate Mean - instrument • 图• lect an entry from the list pacity manipulation area ppearance Ambient Diff. | Spec.. | Trans.. | Swap | tensity: 60 \$ endering setting versampling: 1.0 🛊 🔽 Normalize gradients *** 48 28 18 © 꼬 Soan Off 5 0 0 0 0 0 0 0 748 PM 📄 🖉 🖀 🗐 💿 📄 Measurement 😻 VGStudo MAX 2.0 (B... 🎑 Medidas 044 0









WaveOne Gold covers a maximum of clinical cases







Variable tapers along the active part of the files









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WAVEONE GOLD OVERVIEW

- GOLD RESULTS FROM POST-GRIND HEAT TREATMENT
- MORE FLEXIBILITY
- HIGHER RESISTANCE TO CYCLIC FATIGUE









Large Canals





KEY LEARNING POINTS



- ACTIVE INSTRUMENTS ARE MORE EFFICIENT
- VARYING TAPERS IMPARTS OPTIMAL SHAPES
- THERMAL TREATMENTS IMPROVE FLEXIBILITY AND FATIGUE RESISTANCE
- ALWAYS ESTABLISH A GLIDEPATH
- APPLY MINIMAL PRESSURE
- CLEAN INSTRUMENT FREQUENTLY

TAKE AWAY MESSAGE:

• WIG PRIMARY FILE

• WHY IS IT 0.25 WITH 7% OF TAPER?



























IMPORTANCE OF OBTURATION

A Well Shaped and Cleaned Canal Must Be Filled as Completely as Possible to Limit the Entrance of Nutrients or Oral Microorganisms.

OBTURATION

THE PURPOSE OF OBTURATION IS TO:

- 3-DIMENSIONALLY FILL THE CANAL SPACE
- ENCAPSULATE THE VESTIGES OF TISSUE AND BACTERIA THAT REMAIN
- MINIMIZE APICAL PERCOLATION
- CREATE AN OPTIMAL CORONAL SEAL

OBTURATION OPTIONS



CLINICAL EXAMPLE...OF A "SIMPLE" MOLAR CASE...





LEARNING OBJECTIVES

- OBTURATION PURPOSE
- SUCCESS FACTORS
- PURPOSE OF SEALER
- TECHNIQUE DIFFERENCES

PURPOSE OF OBTURATION



Seal In Irritants

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SUCCESS DEPENDS ON...

- QUALITY OF SHAPING AND CLEANING
- CLINICIAN'S SKILLS
- MATERIALS
- RADIOGRAPHIC INTERPRETATION
- **RESTORATION**



CHARACTERISTICS OF AN IDEAL ROOT CANAL FILLING MATERIAL

- GUTTA-PERCHA IS
 MATERIAL OF CHOICE
- SEALER / CEMENT REQUIRED
- SOME COMPACTION REQUIRED






CONTEMPORARY SEALERS/CEMENTS

ALL ROOT CANAL FILLING TECHNIQUES RESULT IN A TIGHTER ROOT CANAL OBTURATION, IF APPLIED IN CONJUNCTION WITH A SEALER.



PURPOSE OF ROOT CANAL SEALER

THE ROOT CANAL FILLING SHOULD CONSIST OF A (SEMI-) SOLID MATERIAL IN COMBINATION WITH A ROOT CANAL SEALER TO FILL THE VOIDS BETWEEN THE (SEMI-) SOLID MATERIAL AND ROOT CANAL WALL.



CONTEMPORARY SEALERS/CEMENTS

BIOCOMPATIBLE AND ANTIMICROBIAL

AH Plus[®] Bioceramic Sealer

A tricalcium silicate-based root canal sealer It does not contain resin, silicone or other fillers

Free of bismuth oxide It does not discolor the tooth

High flowability Allows for control of hydraulics when used with Conform Fit[®]

A convenient, easy-to-use 3gr syringe With a 24-gauge cannula that can be placed directly into the canal



The bioactivity you expect from a bioceramic sealer

...calcium silicate-based sealers are considered to be bioactive materials because they can induce hard tissue formation in both the periodontal ligament (PDL) and bone.¹

Most research has concluded that calcium silicate sealers show stronger bioactive effects on PDL, osteoblasts, and stem cells than other sealers.¹



Clinical Insight: AH Plus[®] Bioceramic Sealer provides the ideal environment for the formation of hydroxyapatite which induces the healing response.

AH Plus Bioceramic Sealer promotes hard tissue formation around the infected tooth.

1. Miyoung Lim. Calcium silicate-based root canal sealers: a literature review. Restor Dent Endod. 2020 Aug; 45(3):e35



AH Plus[®] Bioceramic Sealer

A sealer that predictably sets 60% faster than the EndoSequence BC Sealer

A sealer that is dimensionally stable Low solubility (0.11%) that does not shrink or resorb after setting

A sealer that is highly radiopaque 25% more radiopaque than the EndoSequence/TotalFill BC Sealer

A sealer that is retreatable Can be easily removed using a standard retreatment protocol





BEST WAY TO FILL IRREGULARITIES?



WAVEONE GOLD AND MATCHING GUTTA-PERCHA

Select Based on MAF Used





ALL GUTTA-PERCHA CONES ARE NOT THE SAME



MATCHING GUTTA-PERCHA

- Micronized Formula
- Heat Transfer to 4mm
- Sized to Match Files

DENTSPLY SIRONA MICRONIZED GP THERMAL PROFILE



CONFORM FIT GUTTA-PERCHA

- Micronized Formula
- Heat Transfer to 4mm
- Cones Sized to Match Files

CONFORM FIT GUTTA-PERCHA THERMAL PROFILE



THE PACK HANDPIECE 360° Activation cuff Annealed stainless steel electric heat pluggers Audible tone sounds when tip is activated Band lights "BLUE" when Pack **Battery level** HP is activated Bluetooth indicator On / Off

THE FLOW HANDPIECE

Removable Heating Element (HTR)

Single use cartridges with Conform Fit gutta-percha

Band lights "BLUE" when Flow HP is activated

360° activation cuff

Gutta-percha level indicator

Bluetooth indicator

Heater status indicator

Battery level indicator

On / Off 🗠

ATTACHING HEAT PLUGGER TO PACK





PLUNGER PUSHES GUTTA-PERCHA



BASE STATION TOUCH SCREEN

Touch to adjust temperature

Indicates which handpiece is currently active on display



Indicates if EHP (Pack) or HTR (Flow) is installed and working properly

Dentspi)

Sirono

Touch to adjust volume (Pack) Touch to adjust GP flow rate (Flow)

• Either handpiece can be placed in either side of the base station and automatically recognized

GUTTACORE

- TRANSFORMED GUTTA-PERCHA
 - CENTRALLY CONDENSED
 - FLOWABLE TO APEX
 - REMOVES WITH EASE





GUTTACORE CROSSLINKING

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TECHNIQUE KEYS

- COMPLETE CLEANING, SHAPING, AND DISINFECTION
- USE SIZE VERIFIER MUST ROTATE FREELY
- DRY CANALS
- SELECT OBTURATOR TO MATCH VERIFIER
- MINIMAL SEALER PLACED TO WORKING LENGTH





Simple example of a clinical outcome...

Post op



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Six months later

Courtesy: Dr. Michael Nimmich

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A MORE DIFFICULT CLINICAL EXAMPLE...



Courtesy: Dr. Michael Nimmich









How would you obturate?

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Courtesy: Dr. Michael Nimmich

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KEY LEARNINGS - GUTTACORE

- EXTERIOR WARM FLOWABLE GP
- INTERIOR SOLIDIFIED GP
- LIGHT COAT OF SEALER ACTS AS LUBRICANT
- EASY POST SPACE CREATION / RETREATABILITY
- ALWAYS USE SIZE VERIFIER PASSIVE ROTATION
- ALWAYS SEAL CORONAL REGION

OF THE WEEK QUOTE ÉVERYBODY'S SORE. ÉVERYBODY'S TIRED. EVERYBODY HAS AN EXCUSE. PON'T BE EVERTBODY. -LEWIS CARALLA

PLEASE

Thank you for listening and sharing your time with me. Good luck on your next endodontic case!

ENDODONTIC ASSOCIATES OF BELLAIRE

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