ENGO UPTADE:
NEGATIVE APICAL PRESSURE IRRIGATION
ROATORY/RECIPROCATION INSTRUMENTATION
CONTINUOUS WAVE OBURATION

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Diplomate, American Board of Endodontics
Past President, American Association of Endodontists
Past General Chairperson, ADA 2004 Orlando

ENDOLOGICS
Colleagues for Ade

AAE Endodontic Case Difficulty Assessment Form and Guidelines

PATIENT INFORMATION

<table>
<thead>
<tr>
<th>DISPOSITION</th>
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<tbody>
<tr>
<td>Name:</td>
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<tr>
<td>Address:</td>
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<tr>
<td>City/State/Zip:</td>
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<td>Phone:</td>
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<td>Date:</td>
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</table>

MINIMAL DIFFICULTY
Preoperative condition indicates routine complexity (uncomplicated). These types of cases would provide care at a consistently predictable level and impact the appropriate provision of care and quality assurance.

LEVELS OF DIFFICULTY

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal</td>
<td>Preoperative condition is complicated, exhibiting one or more patient or treatment factors listed in the MODERATE DIFFICULTY category or at least one in the HIGH DIFFICULTY category. Achieving a predictable treatment outcome will be challenging for even the most experienced practitioner with an extensive history of favorable outcomes.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Preoperative condition is complicated, exhibiting several factors listed in the MODERATE DIFFICULTY category or at least one in the HIGH DIFFICULTY category. Achieving a predictable treatment outcome will be challenging for even the most experienced practitioner.</td>
</tr>
<tr>
<td>High</td>
<td>Preoperative condition is exceptionally complicated, exhibiting several factors listed in the HIGH DIFFICULTY category. Achieving a predictable treatment outcome will be challenging for even the most experienced practitioner.</td>
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</tbody>
</table>

Guidelines for Using the AAE Endodontic Case Difficulty Assessment Form

The AAE designed the Endodontic Case Difficulty Assessment Form for use in endodontic curricula. The Assessment Form makes case selection more efficient, more consistent and easier to document. Dentists may also choose to use the Assessment Form to help with referral decision making and record keeping.

Conditions listed in this form should be considered potential risk factors that may complicate treatment and adversely affect the outcome. Levels of difficulty are sets of conditions that may not be controllable by the dentist. Risk factors can influence the ability to provide care at a consistently predictable level and impact the appropriate provision of care and quality assurance.

The Assessment Form enables a practitioner to assign a level of difficulty to a particular case.

LEVELS OF DIFFICULTY

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimal</td>
<td>Preoperative condition indicates routine complexity (uncomplicated). These types of cases would provide care at a consistently predictable level and impact the appropriate provision of care and quality assurance.</td>
</tr>
<tr>
<td>Moderate</td>
<td>Preoperative condition is complicated, exhibiting one or more patient or treatment factors listed in the MODERATE DIFFICULTY category. Achieving a predictable treatment outcome should be attainable by a competent practitioner with limited experience.</td>
</tr>
<tr>
<td>High</td>
<td>Preoperative condition is exceptionally complicated, exhibiting several factors listed in the HIGH DIFFICULTY category. Achieving a predictable treatment outcome will be challenging for even the most experienced practitioner.</td>
</tr>
</tbody>
</table>

Review your assessment of each case to determine the level of difficulty. If the level of difficulty exceeds your experience and comfort, you might consider referral to an endodontist.
Conclusions:
Most of the respondents are using full-strength sodium hypochlorite and are routinely removing the smear layer during endodontic treatment. In addition, almost half of the respondents are using an adjunct, such as ultrasonic activation, to aid in their irrigation technique.

Conclusions
The killing of bacteria in infected dentin by disinfecting solutions is time-dependent. However, little additional killing is obtained after the first 10 minutes of exposure.

Conclusions
Dilution of NaOCl decreases its pulp dissolution capacity. Refreshing the solution is essential to counteract the effects of dentin. In this study, NaOCl did not have a significant effect on dentin flexural strength or modulus.
Results: Data were analyzed with Kruskal-Wallis and Dunn tests. The continuous rinse group presented more debris-free surfaces when compared with the rinse and soaking group (P< .01). When the root canal areas were compared within the groups, no statistical differences were found (P> .05).

Conclusions: It can be concluded that a continuous rinse with 5 ml of EDTA for 3 minutes can more efficiently remove the smear layer from root canal walls.

Conclusions
The smear layer reduces the effectiveness of disinfecting agents against E. faecalis in infected dentin. Solutions containing 6% NaOCl and/or QMiX showed the highest antibacterial activity.

Conclusions
The frequency of apical extrusion of NaOCl was dependent on the type of root canal irrigation system and apical preparation size. The extent of extrusion depended on the irrigation system, with syringe and slotted-needle irrigation resulting in the greatest extent of extrusion.

Conclusions:
PUI and EndoVac are more effective than the conventional endodontic needle in delivering irrigant to WL of root canals.
### Comparison of the Time Required to Create Secondary Fracture of Separated File Fragments by Using Ultrasonic Vibration under Various Canal Conditions

**Methods of Irrigation**

- **Positive**
  - Push/Inject

- **Negative**
  - Pull/Suction

### Ultrasonics

- **Title**: A Comparison of the Dentin Cutting Efficiency of 4 Pointed Ultrasonic Tips
  - **Abstract**: A 1-factor analysis of variance and Tukey post hoc analysis of dentin removal revealed a statistically significant difference between the 4 ultrasonic tips ($P < .05$). The CPR-3D removed more dentin than the other 3 tips, whereas the BLA removed more dentin than the WH1. Scanning electron microscopic analysis revealed the CPR-3D as having the least change to tip shape and topography as compared with the other tips.

  **Results:**
  - A 1-factor analysis of variance and Tukey post hoc analysis of dentin removal revealed a statistically significant difference between the 4 ultrasonic tips ($P < .05$). The CPR-3D removed more dentin than the other 3 tips, whereas the BLA removed more dentin than the WH1. Scanning electron microscopic analysis revealed the CPR-3D as having the least change to tip shape and topography as compared with the other tips.

  **Conclusions:**
  - Within the limits of this study, CPR-3D showed the greatest dentin removal, which may be linked to the stability of the CPR-3D tip shape and topography.

### Potential Correlation between Statins and Pulp Chamber Calcification

- **Results:**
  - Three of the 45 mandibular molars in the test group exhibited almost complete pulp chamber obliteration. There was a significant reduction in pulp chamber height ratio shown in the statin group compared with the control group ($P < .0001$). When the mesiodistal width was compared between the 2 groups, there was no significant difference ($P = .3730$).

  **Conclusions:**
  - The significant increase of calcification and loss of vertical height of the pulp chamber observed in mandibular molars in patients on statin medication indicated a possible increased odontoblastic activity. Therefore, systemic statins could be a contributing factor for pulp chamber calcification.

### Effects of Piezoelectric Units on Pacemaker Function: An In Vitro Study

- **Results:**
  - In the positive control (direct contact between either the electrode or the generator and the ultrasound device when this was switched on), the pacemaker detected electrical activity as false heart activity. When all the scenarios and distances had been covered, no EMI was produced by the ultrasound units.

  **Conclusions:**
  - No EMI was detected during the testing of the piezoelectric or magnetostrictive units in this in vitro model of pacemaker use.
Walton and Torabinejad stated that “Perhaps the most important factor is the delivery system and not the irrigating solution per se.” Furthermore, it was found that the volume of the irrigant is more important than the concentration or type of irrigant.\textsuperscript{264} Chow found that there was little flushing beyond the depth of the needle, unless the needle was “bound” in the canal.

**Results:** EndoVac Microcannula was the only device that was capable of delivering negative apical fluid pressures, in the range of $-35$ mm Hg, at all fluid flow rates. All other devices generated positive apical pressures that increased nonlinearly with increasing fluid flow rates. These 4 positive pressure delivery devices were capable of generating pressures that exceeded the human central venous pressure ($5.88$ mm Hg). VPro EndoSafe differed from the other positive pressure delivery devices in that it generated significantly higher positive pressures at all flow rates ($P < .0008$).

**Conclusions:** Positive apical irrigation pressures in excess of the central venous pressure may be generated by some canal cleansing devices when irrigants are delivered at flow rates higher than $1$ mL/min, even when the irrigation needle is not wedged into the canal walls.
Results:
EndoVac Microcannula was the only device that was capable of delivering negative apical fluid pressures, in the range of ~35 mm Hg, at all fluid flow rates. All other devices generated positive apical pressures that increased nonlinearly with increasing fluid flow rates. These 4 positive pressure delivery devices were capable of generating pressures that exceeded the human central venous pressure (5.88 mm Hg). VPro EndoSafe differed from the other positive pressure delivery devices in that it generated significantly higher positive pressures at all flow rates (P < .0083).

Conclusions:
Positive apical irrigation pressures in excess of the central venous pressure may be generated by some canal cleansing devices when irrigants are delivered at flow rates higher than 1 mL/min, even when the irrigation needle is not wedged into the canal walls.

Results:
The median amount of debris remaining at 1 mm was 0.05% for the EndoVac group and 0.12% for the conventional irrigation group (P < .05). The median amount of debris remaining at 3 mm was 0.09% for the EndoVac group and 0.12% for the conventional irrigation group (P < .05).

Conclusions:
EndoVac irrigation resulted in significantly less debris at 1 mm from WL compared with conventional needle irrigation. There was no significant difference at the 3-mm level.

Conclusions:
The EndoVac irrigation system significantly improved the sealer penetration at the 1- to 3-mm level over that of conventional endodontic needle irrigation.
Rotary & Reciprocation Instrumentation

Instrumentation

- K-Flex: #08, #10, #15, #20
- M4 Reciprocating Handpiece
- Orifice Opener: TF .12/25, Pezzo #2, GG#2
- Apex Locators
- Twisted File Green→Yellow→Red with new Adaptive Handpiece and Motor

K-Flex Files

M-4 Handpiece

Orifice Openers

Gates Glidden
- #1=40 ISO File
- #2=60
- #3=80
- #4=100
- #5=120
- #6=140

Pezzo #2
Twisted File # .12/25
Current Challenges and Concepts of the Thermomechanical Treatment of Nickel-Titanium Instruments

Ya Shen

The aim of this review was to provide clinicians with the knowledge necessary for evidence-based practices, maximizing the benefits from the selection and application of NiTi rotary instruments for root canal treatment.

Results:
This review summarizes the metallurgical properties of next-generation NiTi instruments, the impact of thermomechanical treatment on instrument flexibility, and the resistance to cyclic fatigue and torsion.

Conclusions:
The aim of this review was to provide clinicians with the knowledge necessary for evidence-based practices, maximizing the benefits from the selection and application of NiTi rotary instruments for root canal treatment.

ISO Endodontic Instruments

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<th>Feature</th>
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<th>Root ZX Mini</th>
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<td>✔️</td>
<td>✔️</td>
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<td>★</td>
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<tr>
<td>User-Set Zero Point</td>
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<td>Warranty: 3 year device, 6 mo. cords</td>
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<td>★</td>
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</table>

As accurate as the Root ZX, with a superior warranty and lower price

TF Resist Fracture

Cyclic fatigue testing device consists of a main frame mobile plastic support allowing precise and reproducible placement of each instrument inside the artificial canal.

Data on file, Sybron Dental Specialties, Inc. Data from Gambarini G and Garala M, University of Rome, Sapienza, Italy. 2008. Cyclic fatigue and flexibility testing.

Gianluca Gambarini, DDS
University of Rome, La Sapienza
Rome, Italy

Not All Electronic Foramen Locators Are Accurate in Teeth with Enlarged Apical Foramina: An In Vitro Comparison of 5 Brands

Markus Haapasalo

Abstract
Introduction:
Electronic working length measurement during root canal treatment is a challenge. The aim of this in vivo study was to assess the influence of foramen widening on the accuracy of 5 different electronic foramen locators (EFLs) and to compare the accuracy of EFLs in different foramen sizes.

Conclusions:
Foramen diameter did not influence the accuracy of MiniApex, Root ZXII, and Elements Apex Locator EFLs. iPex and Propex II showed decreased accuracy as foramen size increased.
Cyclic Fatigue Study Results

In a comparison of cyclic bending fatigue, TF performed two to three times better than traditional NiTi files.

Flexibility Study Results

TF is up to 70% more flexible than traditional NiTi files.

TF Adaptive: What is it?

- TF Files used with a new motion
- TF Adaptive is an improvement to Wave One® and Reciproc®
- 1 or 2 files possibly 3
- Complete system with gutta percha, obturators and paper points.

Results:
The PT system removed a significantly higher amount of dentin than the other systems (P = .025). At the 1.3-mm level, there was no significant difference in canal transportation and centering ratio among the groups. However, at the other levels, TF maintained the original canal curvature recording significantly the least degree of canal transportation as well as the highest mean centering ratio.

Conclusions:
The TF system showed superior shaping ability in curved canals. Revo-S and GTX were better than ProTaper regarding both canal transportation and centering ability.

Twisted File manufacturing process: Higher cyclical fatigue

The new manufacturing process produced nickel-titanium rotary files (TF) significantly more resistant to fatigue than instruments produced with the traditional NiTi grinding process.
**What are the Improvements?**

- TF Adaptive Movement adjusts based on file load
- Twisted not Ground
- R-Phase Heat Treatment Technology
- Advanced Surface Treatment

**Rotary when you want it... Reciprocation when you need it**

- Adaptive Motion changes the motion of the file based on the applied load.
- When file is outside the canal or lightly loaded, the motion is rotary.
- When the file is in the canal (loaded) the motion changes from rotary to reciprocation

**Innovation-TF Adaptive Movement**

- TFA: Reciprocating angles vary:
  - No load: 600° forward, 0° reverse
  - Loaded: 370° forward and up to 50° reverse
- Wave One® & Reciproc®:
  - 150° forward / 30° backwards

**Complete System**

**Obturation Gutta Percha**

- Small Single Color Band
- No obturation for SM1
- Medium / Large Double Color Band
### TF Adaptive vs Wave One® & Reciproc® Motors

<table>
<thead>
<tr>
<th>Feature</th>
<th>Elements</th>
<th>Tulsa e-3®</th>
<th>Reciproc®</th>
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<td>Motion</td>
<td>Adaptive</td>
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<td>Torque Range</td>
<td>100-800 g-cm</td>
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</table>

### Heat Treat
- TF Adaptive: Yes, R-Phase
- Wave One®: No
- Reciproc®: Yes, M-Wire®

### Cross Section
- TF Adaptive: Triangular
- Wave One®: Convex triangular
- Reciproc®: S shape

### File Sizes
- TF Adaptive: 6
- Wave One®: 3
- Reciproc®: 3

### Single Use
- TF Adaptive: No
- Wave One®: Yes
- Reciproc®: Yes

### Pre Sterilized
- TF Adaptive: No
- Wave One®: Yes
- Reciproc®: Yes

### File Facts

<table>
<thead>
<tr>
<th>Feature</th>
<th>TF Adaptive</th>
<th>Wave One®</th>
<th>Reciproc®</th>
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<tbody>
<tr>
<td>Cross section</td>
<td>Triangular</td>
<td>Convex triangular</td>
<td>S shape</td>
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</table>

### Wave One® Technique
Recipient® Technique

1. Selecting the Correct Instrument

Pre-Operative Radiograph Decision

- Canal is completely filled
- Canal is partially or completely filled
- Wide or medium canal
- Narrow canal
- Canal instrumentation ISO 25 gauge passively to working length
- Canal instrumentation ISO 25 gauge passively to working length

*Passively means that the instrument goes exactly to working length with a gentle wash without forced movement.

TF Adaptive Technique

Canal size and file sequence determination:

If you struggle to get a #15 K-File to WL then the canal size is Small.

If a #15 K-File is loose then the canal size is Medium / Large.

Evidence Based Endodontics

Advantages of reciprocation...

- Increased cyclical fatigue → Single file?
- Better file control (“Pull down” feel)

Evidence Based Endodontics

Disadvantage of reciprocation...

- Apical debris extrusion

Influence of Different Angles of Reciprocation on the Cyclic Fatigue of Nickel-Titanium Endodontic Instruments

Results:

All reciprocating groups (groups 1–4) showed a significant increase in time to failure when compared with group 5 (continuous rotation) (P < .05). Mean time was significantly higher in group 1, followed by group 2. No significant difference was found between groups 3 and 4 (P = .251). Increasing the clockwise angle of reciprocation and consequently increasing the angle of progression for each reciprocation cycle reduced the resistance to cyclic fatigue.

Conclusions:

Movement kinematics (reciprocating movements in various angles) had a significant influence on the cyclic fatigue life of the tested nickel-titanium instruments.
Results:
The reciprocating files produced significantly more debris compared with both rotary systems ($P < .05$). Although no statistically significant difference was obtained between the 2 rotary instruments ($P > .05$), the reciprocating single-file system Reciproc produced significantly more debris compared with all other instruments ($P < .05$). Instrumentation was significantly faster using Reciproc than with all other instruments ($P < .05$).

Conclusions:
Under the condition of this study, all systems caused apical debris extrusion. Full-sequence rotary instrumentation was associated with less debris extrusion compared with the use of reciprocating single-file systems.

Results:
The TF-Adaptive group developed no pain, the TF instrumentation technique showed significantly lower SS and less canal center transportation at the site-specific manner.

Conclusions:
The curved canals prepared using TFA exhibited lower SS and less canal center transportation at the apical section than the WO and PTN systems. SS generated during canal shaping correlated with canal center transportation in a site-specific manner.
Conclusions:
The enlargement of the canal to 3 sizes larger than the FABF is adequate, and further enlargement does not provide any additional benefit during endodontic treatment.

Coronal Access & Glide Path Technique
1. Place rubber dam.
2. Obtain straight line access to the coronal 1/3 of the canal.
3. Active patency and establish an apical glide path using #40 through at least #19 file. We recommend using the #6 Safety® Handle and SlickGel® as your lubricant. Irrigate with NaOCl or EDTA.
4. Canal size and file sequence determination:
   - Small Canals (SM): Using tactile feel, if you struggle to get a #06 K-File to #06, then the canal size is Small. Use the Small Pack (two color bands) and instrument sequence.
   - Medium / Large Canals (ML): Using tactile feel, if a #06 K-File is loose then the canal size is Medium/Large. Use the Medium/Large Pack (two color bands) and instrument sequence.
5. Establish working length using an apex locator. A radiograph may be taken to assist in length determination.

TF Adaptive Canal Shaping Technique
6. Use the "TF Adaptive" setting on your Elements Motor.
7. Ensure the pulp chamber is flushed with NaOCl or EDTA and make sure the file is rotating as you enter the canal.
8. Slowly advance the green (SM1 or ML1) file with a single controlled motion until the file engages dentin then completely withdraw the file from the canal. Do not force apically. Do not peak.
9. Wash off the flutes. Deliver irrigant to the pulp chamber and confirm canal patency with a #15 K-File.
10. Repeat steps 8 and 9 using the file you started with until working length is achieved.
11. Repeat steps 8 and 9 with the yellow (SM2 or ML2) until the file reaches working length. If the selected apical size is achieved the sequence is complete.
12. For larger apical sizes, repeat steps 8 and 9 with the red (SM3 or ML3) and the file reaches working length.

Irrigate & Dry
13. When irrigating with EndoVac®, in small canals, you must take #25/0.06 to working length. In medium/large canals, you must take at least ML2 to working length.

Obturate
15. Use TF Adaptive matching Gutta Percha or Obturators.

File size reference chart

Gutta Percha
- 66% zinc oxide (filler)
- 20% gutta-percha (matrix)
- 11% heavy metal sulfates (radiopacifier)
- 3% waxes and/or resins (plasticizer)
## Continuous Wave Downpack Units

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## Continuous Wave Backfill Units

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## Equipment Needed for the Continuous Wave Technique

- **Sealers**
- **Cordless System**
Restoration

- Eliminate Man-made, Keep God-given parts
- Dimple-down / Buildup
- Post-space / Fiberpost
- Reduce Occlusion
- Emphasize Need For Coronal Coverage

SonicFill