Latest advancements in Endodontics- I

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Year 4
8/10/2019

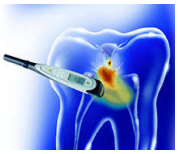
Endodontics Progress at 4 levels

- Tools : diagnosis, RCT procedures
- Materials: irrigation, obturation and restoration
- Techniques
- Concepts

Tools

Diagnosis

- Pulp vitality test
- CBCT



Pulp tests

Sensibility tests

- Cold Test
- Heat Test
- Electrical Test
- Other Tests: cavity test, anesthetic test

Shortcomings of sensibility test

- Accompanied by un-pleasant sensations for the patient
- false-positive response, the nervous system may remain reactive, even if all the surrounding tissues are degenerated
- false-negative response, in cases of calcarous (degenerescent), teeth with recent traumatisms, or teeth with open apices

Recently available pulp vitality tests

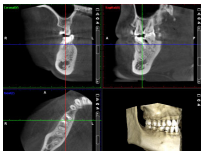
- Laser Doppler flowmetry (LDF)
- Pulp oximetry
- Measurement of temperature of tooth surface
- Transillumination with fiber-optic light
- Dual wavelength spectrophotometry
- Plethysmography
- Detection of interleukin—1 beta
- Xenon—133
- Hughes probeye camera
- Gas desaturation
- Radiolabeled microspheres
- Electromagneticflowmetry

Cohen 2016

Tools

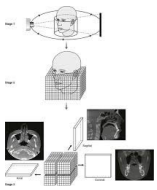
Diagnosis

Cone Beam Computed Tomography (CBCT)
Cone Beam Volumetric Tomography (CBVT)



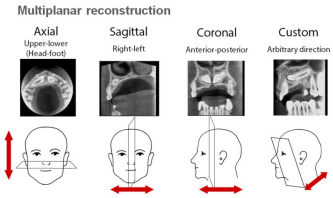
CBCT

- Uses a cone-shaped beam of radiation to acquire a volume in a single 360-degree rotation
- The volume acquired by a CBCT is composed of voxels
- A voxel is a 3-D pixel



CBCT

With the help of viewer software, the clinician is able to scroll through the entire volume and simultaneously view axial, coronal, and sagittal 2-D sections that range from 0.125–2.0 mm thick



CBCT systems

limited (dental or regional)
- The scan volume: 40 –100 µm
- Voxel: 0.1–0.2 mm^3

full (ortho or facial)
- The scan volume: 100 –200 µm
- Voxel: 0.3–0.4 mm^3

limited CBCT systems offer higher resolution and are better

Cotton, T.P., Geisler, T.M., Holden, D.T., Schwartz, S.A. and Schindler, W.G., 2007. Endodontic applications of cone-beam volumetric tomography. *Journal of endodontics*, *33*(9), pp.1121-1132.

CBCT systems

Limited CBCT is preferred for most endodontic applications:

1. Increased resolution, for (calcified/accessory canals, missed canals)
2. Focus on anatomical area of interest
3. Decreased radiation exposure to the patient
4. Time savings due to smaller volume to be interpreted
5. Smaller area of responsibility

2011

CBCT

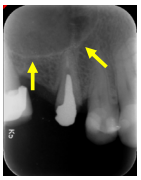
CBCT has become increasingly important in treatment planning and diagnosis for

- Implant
- Oral surgery
- Orthodontics
- Endodontics

CBCT in Endodontics

A drawback of periapical X-ray

The interpretation can be confounded due to regional anatomy as well as superimposition of both the teeth and surrounding structures



- Curvature (buccal/ ingual)
- Exact length
- Extension of lesions

Potential endodontic applications

- diagnosis of endodontic pathosis
- assessment of pathosis of non-endodontic origin

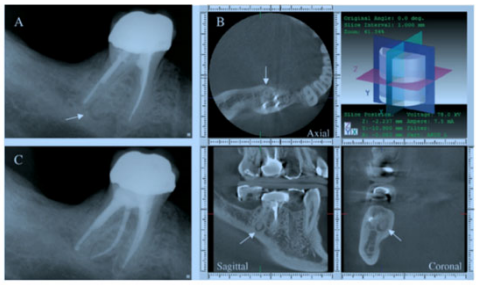
- calcified/accessory canals, missed canals
- canal morphology

- evaluation of root fractures and trauma
- analysis of external and internal root resorption
- invasive cervical resorption

- pre-surgical planning
- to determine the nature of the peri-radicular lesion (granuloma vs cyst)

CBCT in Endodontics

Missing canal

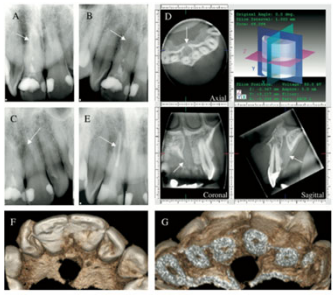


Cotton *et al.*, 2007

CBCT in Endodontics

Nasopalatine duct cyst

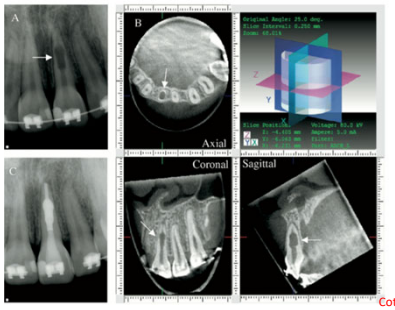
- RCT of 11
- internal resorption on #11?
- 2 PA: radiolucency shifts entirely off the root structure
- external resorptive defect? pathosis within the palatal bone?
- CBCT:



Cotton *et al.*, 2007

CBCT in Endodontics

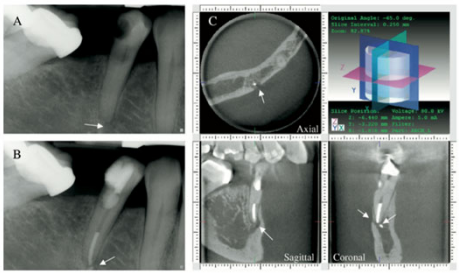
Internal resorption



Cotton *et al.*, 2007

CBCT in Endodontics

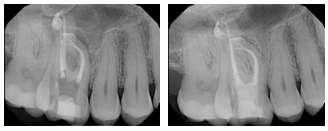
Pre-surgical anatomic assessment



Cotton *et al.*, 2007

CBCT in Endodontics

Pre-operative Calcium hydroxide dressing

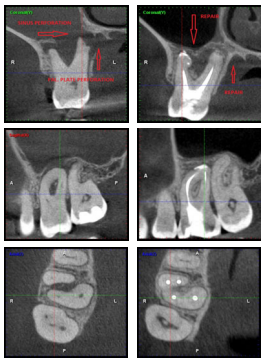


Post-operative 6 months re-call

https://endolit.com/endoappforum/

CBCT in Endodontics

Pre-operative 6 months recall



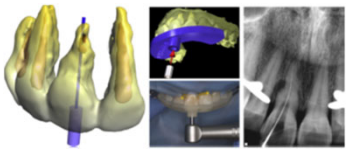
https://endolit.com/endoappforum/

CBCT in Endodontics

Dynamic Guided Endodontic

Digital impressions + CBCT scans + 3D printing

To negotiate calcified canal without perforation



van der Meer et al. (2016)

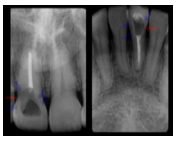
Tools

Root Canal Preparation

- Access cavity
- Irrigation
- Root canal shaping

Access cavity and canal instrumentation

Round burs ⟹ Conical carbide bur



A new concept: Minimal Invasive Endodontics

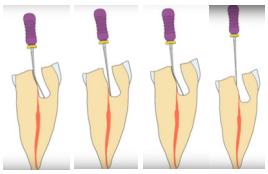
Access cavity and canal instrumentation

Conical carbide bur

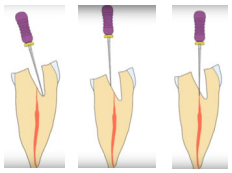
- Self centering
- Safer
- Minimal invasive

Access cavity and canal instrumentation

round burs



conical carbide bur

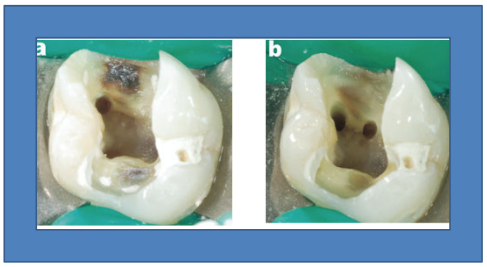


Access cavity and canal instrumentation

Ultrasonic tips (US)

- access refinement
- finding calcified canals
- removal of attached pulp stones
- removal of posts
- removal of broken instruments

Access cavity and canal instrumentation



Access cavity and canal instrumentation

Terauchi file removal kit (TFRK)

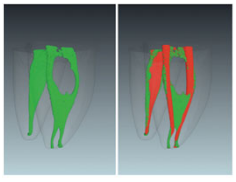
Tools

Root Canal Irrigation

Modern concepts in root canal therapy procedures

The complexity of the root canal

- Isthmus may connect the canals
- only 45-55% of canal walls are actually touched
- The manual irrigation is not sufficient
- The use of a high concentration of NaOCl or EDTA lead to only marginally better results



3D Micro CT : Canal morphology before instrumentation (green); canal walls touched using a standard NiTi file (red).

*Courtesy of Dr. Frank Paqué (Switzerland)

Sodium hypochlorite (NaOCl)

- Concentrations: 0.5% and 6%
- Both lower and higher concentrations are equally efficient in reducing the number of bacteria in infected root canals
- The time needed to inhibit bacterial growth and tissue dissolving effect of NaOcl irrigant is related to it's concentration

Sodium hypochlorite (NaOCL)

Temperature

Increasing the temperature of hypochlorite irrigant to 60^0C, significantly increases its antimicrobial and tissue-dissolving effects

Heating devices for NaOCL syringe

Irrigation Devices In Endodontic

Manual

1- Plastic syringe with needles
2- Brushes
3- Manual Dynamic Agitation

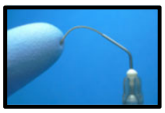
Machine Assisted

1- Rotary brushes
2- Continuous irrigation during rotary instrumentation
3- Sonic
4- Ultrasonic
5- Pressure alternating devices
6- Recent advance system

Plastic syringe with needles

Several needle-tip design have been introduced to facilitate effectiveness and minimize safety risks

Beveled Monoject Closed end



Flexiglide needle

Plastic syringe with needles

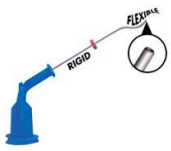
Navitip

NaviTip tip is a small, flexible cannula easily delivers endodontic irrigants and sealers

Plastic syringe with needles

Navitip

- Mostly rigid shanks, with the last 5 mm flexible to facilitate navigation through curved canals
- 29- 30 gauge, lengths 17, 21, 25 and 27 mm



Plastic syringe with needles

Navitip

✓Safe, can easily be inserted to apical third

Recent needles

Navitip FX

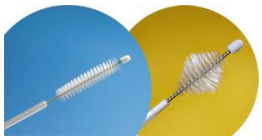
31g
Double Sideport Irrigator

www.youtube.com/watch?v=3FVXN1sCKf8

2- Brushes

Endobrush

✓ used only as an adjuncts
✓ Nylon bristles set in twisted wire



Disadvantages

× Can't be used till working length
× Dislodgement of radiolucent bristles

3- Manual Dynamic Agitation

Gutta- percha points agitation

To facilitate the penetration of solutions in the canal, gently move a well-fitting gutta-percha master cone up and down in short 2- to 3-mm strokes within an instrumented canal

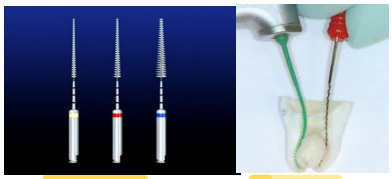
Basic principles of cleaning

To clean the table we don't need to cut its surface, but touch ALL table surface using some chemical and some force to remove dirt attached.

Root Canal Irrigation

Machine Assisted Devices

1. Rotary Brushes



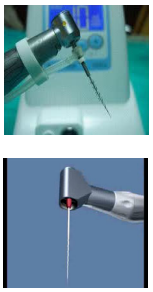
Ruddle brush Canal brush

2. Continuous Irrigation During Rotary Instrumentation

Quantec- E

✓ Self contained fluid delivery unit

✓ uses a pump console, 2 irrigation reservoirs & tubing



(Quantec-E)

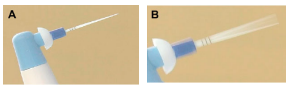
3- Sonic devices

✓ combines battery-driven vibrations (9000- 10,000 cpm)

Rispisonic file

Vibringe

Endoactivator



4- Ultrasound

i- Active Ultrasonic Irrigation **(AUI)**

It is the simultaneous combination of ultrasonic irrigation and instrumentation. it has been almost discarded in the clinical

4- Ultrasound

ii- Passive Ultrasonic Irrigation **(PUI)**

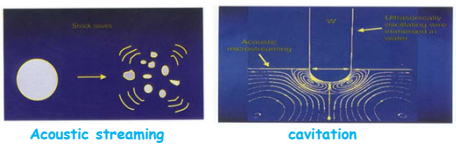
- Frequencies of 25–30 kHz
- The mechanichal energy warms the irrigant solution (NaOCl) and dislodges debris from canals

4- Ultrasound

ii- Passive Ultrasonic Irrigation **(PUI)**

✓ The energy is transmitted from an oscillating file to the irrigant in the root canal by means of ultrasonic waves

✓ The latter induces acoustic streaming and cavitation of the irrigant



Acoustic streaming cavitation

4- Ultrasound

ii- Passive Ultrasonic Irrigation **(PUI)**

- Tips are small, parallel-shaped and non-cutting and can be used in the complete root canal
- 1-3 minutes of irrigation at the end of the root canal preparation (inserted 1mm short of working length)

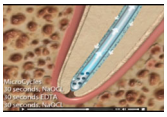
Irri-Safe Tips
Clinical Research Dental Supplies

5- Pressure Alternation Devices

i- EndoVac System

5- Pressure Alternation Devices

i- EndoVac System



- Macro Cycle 30 seconds NaOCl (up and down)
- Micro Canula to WL: 30 seconds NaOCl
  30 seconds EDTA
  30 seconds NaOCl

http://www.sybronendo.com/index/endovac-irrigation-technique

5- Pressure Alternation Devices

i- EndoVac System

- Is based on a negative-pressure approach
- The irrigant placed in the pulp chamber is sucked down the root canal and back up again through a thin needle

(+) pressure
(traditional device)

(-) pressure (EndoVac)

5- Pressure Alternation Devices

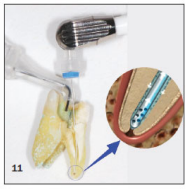
i- EndoVac System

Advantages

1.**Safety:** Less apical extrusion risk

2.**Efficacy:** Better debridement 1 mm from working length

3.**Success:** Negative apical pressure results in significantly less postoperative pain



5- Pressure Alternation Devices

i- EndoVac System

Relieve pressure from abscess

http://www.sybronendo.com/index/sybronendo-clean-endovac-02

5- Pressure Alternation Devices

ii- RinsEndo System

✓ Pressure phase: irrigant oscillating at a frequency of 1.6 Hz is drawn from an attached syringe and transported to the root canal via an adapted cannula.

✓ Suction phase (100 times per minute)

Disadvantage

× higher risk of apical extrusion of the irrigant

(Durr Dental Co)

5- Pressure Alternation Devices

ii- RinsEndo System

- Is based on a pressure-suction mechanism
- Contains:
  - * Titanium handpiece
  - * specially designed single-use cannulas
  - * A protective stopper guards against splatter and serves as a positioning device for the saliva ejector.
-

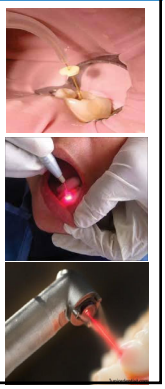
(Durr Dental Co)

6- Recent Advances in Irrigation System

i- LASERS

Nd:YAG Ho:YAG CO2 Er:YAG

- significantly reduced the number of bacteria
- It is inferior to NaOCl irrigation
- effective in removing and melting the smear layer



6- Recent Advances in Irrigation System

ii- Light-activated Disinfection (LAD)

✓ Photodynamic antimicrobial chemotherapy

✓ Photosensitizer (toluidine blue dye, methylene blue dye, etc)

✓ The canal is then filled with a photosensitizer and then illuminated with a light source (laser, white light, red light, or a light-emitting diode)

.FotoSan: comercially available LAD