

ENDO

1. 6% Sodium Hypochlorite provides which of the following:

1. gross removal
2. lubrication
3. destruction of microbes
4. dissolution of tissues
5. ****Adding a chelating agent (like EDTA) adds for the removal of the smear layer.**

- a. 1,2
- b. 3
- c. 2,3
- d. **1,2,3,4,5**

Dilution of NaOCl reduces the dissolution power. The smear layer consists of organic and inorganic debris present on the surface of dentin after instrumentation. It represents dentinal shavings, tissue debris, odontoblastic processes, and (in previously infected root canals) microbial elements. There is a controversy over whether or not to remove this layer before obturation. The smear layer biologically, has been postulated as the avenue for leakage and a source of substrate for bacterial growth and ingress. Chelating agents remove the smear layer, soften dentin, and facilitate the removal of calcified obstructions. If sealed in the canal, they can soften the dentin throughout the canal system in between visits.

Methods for the removal of the smear layer before obturation have primarily focused on the alternating use of a chelating agent (i.e. disodium ethylene diamine tetra-acetic acid [EDTA]) or weak acid (i.e., 10% citric acid), followed by thorough canal rinsing with 3% to 5% sodium Hypochlorite (NaOCl). The routine use of these techniques, however, has not been universally advocated, and the long-term value of smear layer removal has not been elucidated.

Disadvantages:

If expressed significant pain is experienced.

Foul tasting

Greater than size 25 file and you may express it if you use force.

Corrosive to plumbing.

The answer is d all the above.

Source: Pathways to the Pulp 8th Edition p. 545-546.

2. Patient presents with a sinus tract leading to the base of a periodontal pocket of tooth #3 and there is calculus present on the root surface. The tooth tests non-vital. What is your sequence of treatment?

- a. Periodontal therapy, initiate NSRCT at the same visit
- b. Periodontal therapy, wait 10-12 weeks then NSRCT
- c. NSRCT and gross scaling; periodontal therapy 10-12 weeks
- d. Either of the above treatment is appropriate

The correct answer is c. NSRCT and gross scaling; periodontal therapy 10-12 weeks.

Classification of Endodontic-Periodontic Lesions

1. Primary Endodontic lesions
2. Primary Endodontic lesion with secondary periodontal disease
3. Primary periodontal lesion
4. Primary periodontal lesion with secondary Endodontic involvement
5. True combined endo and perio lesions

Lesions	Etiology	Characteristics	Treatment
Primary Endo	1. Necrotic pulp	1. Necrotic pulp 2. Sinus tract +/- 3. No calculus 4. Narrow periodontal pocket +/-	1. NSRCT
Primary endo with secondary perio	1. Necrotic pulp with subsequent perio 2. Long-standing pulpal disease. 3. Plaque and calculus results in formation of periodontal pocket.	1. Necrotic pulp 2. Loss of attachment 3. Plaque and calculus 4. Not consistent with periodontal health 5. Angular defect may be present in area of endodontic problem	1. NSRCT 2. If calculus is present, gross scaling 3. Healing not complete in 10-12 weeks – periodontal therapy
Primary perio	1. Periodontal disease	1. Vital pulp 2. Periodontal disease 3. Pockets – broader and more coronal 4. Sinus tract traces to base of pocket 5. Plaque and calculus present at root surface	Periodontal therapy

Primary perio with secondary endo	Periodontal disease causes pulpal necrosis	<ol style="list-style-type: none"> 1. Necrotic/irreversible pulpitis 2. Periodontal disease 3. Probe: broader and more coronal 4. Sinus tract to base of the pocket 5. Plaque and calculus present on root surface 	<ol style="list-style-type: none"> 1. NSRCT 2. Gross scaling if calculus present 3. If complete healing not observed after 10-12 weeks, institute periodontal therapy
True combined endo and perio lesions	<ol style="list-style-type: none"> 1. Independent endo and perio lesion 2. Chronic perio and long standing periradicular pathosis 3. Vertical root fracture 4. Maxillary laterals-palatal grooves. 	<ol style="list-style-type: none"> 1. Necrotic pulp 2. Periodontal disease 3. Plaque and calculus present 4. Radiographic “tear drop” or ”J” 	<ol style="list-style-type: none"> 1. NSRCT 2. Gross scaling if calculus is present 3. If complete healing is not observed after 10 to 12 weeks, institute periodontal therapy. 4. Vertical root fracture – extraction

Periodontal lesions: usually wide base, swelling usually involves the attached gingiva above the mucogingival junction.

Endodontic lesions: usually are vestibular occurring below the mucogingival junction.

Taken from Cohen S, Burns RC, (2002) *Pathways of the Pulp 8th Ed.* Mosby

3. Which of the following techniques would you employ when treating a C-shaped canal?

- a. the use of ultrasonics for debridement
- b. chemically softened gutta percha
- c. heat softened gutta percha
- d. a,b
- e. a,c

The correct answer is e. the use of ultrasonics for debridement and heat softened gutta percha. Chemically softened gutta percha is used for blunderbuss roots with the eucapercha technique.

Ref: Cohen and Burns: Pathways of the Pulp by, 7th Ed

Melton DC et al: "Anatomical and histological features of C-shaped canals in mandibular second molars." J Endod 17(8): 384-8

C-shaped canals have a wide variation of canal anastomoses, webbings, and irregular communications. The wide orifices and small surface area of these canals preclude completed debridement using traditional hand instrumentation techniques. Alternative canal cleaning techniques are more effective; these include ultrasonics to increase the removal of debris in inaccessible areas of the root canal system, and an increased volume of irrigants. These canal systems are better obturated using techniques that heat soften the gutta-percha and enhance its movement into the canal irregularities.

Incidence of C-shaped canals:

4% of mandibular second molars had one root with a C-shaped canal.

In the study by MELTON, it was found that there was a considerable amount of debris and un-instrumented canal space in the middle and apical 1/3 of the root. Due to this material remaining, root non-instrumentation, thinness of root remaining and possible perforations may explain why some second molar root canal treatments fail.

4. Which statement(s) concerning Periodontal Ligament Injection are correct:

- 1. A 27-gauge short needle is firmly placed into the periodontal space between the root of the tooth and the interseptal bone.**
 - 2. A volume of 0.2 ml of anesthetic is slowly deposited on each root of the tooth.**
 - 3. The most significant contraindication to PDL injection administration is the presence of infection or inflammation in the areas of needle insertion.**
 - 4. Successful PDL injection anesthesia is indicated by the presence of resistance to anesthetic deposition**
 - 5. Successful PDL injection anesthesia is indicated by ischemia (whitening) of the soft tissues in the immediate area on injection of the anesthetic.**
- a. 1, 3, & 4**
 - b. 1, 2, & 5**
 - c. 1, 2, 3, & 4**
 - d. All of the above are correct**

A: c. 1,2,3,4 are correct

The PDL injection, or intraligamentary injection (ILI), is frequently used in restorative dentistry when isolated areas of inadequate anesthesia are present. It may also be used alone to achieve pulpal anesthesia in a single tooth. Although the PDL injection may be used on any tooth, its primary importance lies with mandibular molars, when no nerve block technique has proven to be effective. Advantage to the use of the PDL injection in this way include adequate pulpal anesthesia with a minimal volume of anesthetic (0.2 to 0.4 ml) and the absence of lingual and lower lip anesthesia.

A 27-gauge short or 30-gauge ultrashort needle is firmly placed into the periodontal space between the root of the tooth and the interseptal bone. Although bevel orientation is of little significance in the PDL injection, the author recommends the bevel face the root of the tooth. A volume of 0.2 ml of anesthetic is slowly deposited on each root of the tooth. Successful PDL injection anesthesia is indicated by (1) the presence of resistance to anesthetic deposition and (2) ischemia (whitening) of the soft tissues in the immediate area on injection of the anesthetic is not an indication of successful anesthesia.

The most significant contraindication to PDL injection administration is the presence of infection or inflammation in the areas of needle insertion. This might prove a significant impediment in endodontics, where periapical infection exists or where periodontal infection is present. It is also contraindicated with primary teeth, where permanent tooth bud is present. The concern is noted on whether to perform a PDL injection on a vital tooth- Walton and Garnik in JOE 1982 Vol 8 p 22-26, states that it is safe to perform on a vital tooth. There will be an area of repair at the area of injection but no damage is done to the periapical area. To be safe if a tooth has a reversible pulpitis it may be safest to avoid a PDL injection so as not to add further insult to the tooth. The vasoconstrictor has no deleterious effect on the periapical tissue. (Also can refer to Malamed's handbook of Local Anesthesia section on PDL injections.

Pathways of the pulp by Cohen and Burns, 7th Ed.

5. WHAT ARE INDICATIONS FOR SPLINTING? WHICH OF THE FOLLOWING ARE TRUE??

- 1. When a tooth suffers a concussion, you must splint it for a minimum of three weeks.**
- 2. For a subluxation injury, hemorrhage may be seen and the tooth is usually mobile.**
- 3. In a lateral luxation injury the tooth is displaced laterally and is mobile in the socket.**
- 4. In an intrusion injury you will have a HIGH metallic sound (as you will in a lateral luxation injury) and the tooth will not be loose.**
- 5. In an extrusion injury the tooth is elongated and needs splinted up to three weeks.**
- 6. Root fractures need splinted for 6-8 weeks.**
- 7. Alveolar fractures need splinting for 3-4 weeks.**

ANDRAESON STUDY STATED THAT "RIGID FIXATION PRODUCES A GREATER DEGREE OF REPLACEMENT RESORPTION." Minimal splinting that allows physiologic movement results in low incidence of replacement resorption.

Nasjleti study states that "Replanted teeth splinted for seven days recovered uneventfully, whereas replanted teeth splinted for 30 days showed increased root resorption and ankylosis."

CONCUSSION- Tooth is tender to touch, no mobility no displacement-
FLEXIBLE SPLINT 7-10 DAYS. SUBLUXATION-tender to touch and mobile,
not displaced, hemorrhage from sulcus possible-FLEXIBLE SPLINT 7-10
DAYS.

LATERAL LUXATION - displaced laterally and locked in bone, not tender, not
mobile. HIGH metallic sound=ANKYLOTIC SOUND-SPLINT FOR 3 WEEKS.
INTRUSION-displaced deeper into the socket, not tender to touch, not mobile,
again HIGH ANKYLOTIC sound-extirpate pulp in 1-3 weeks. An intruded adult
tooth will not re-erupt, use forceps and gently reposition tooth-you may hear the
osseous snap back into place.

EXTRUSION- elongated mobile tooth-SPLINT UP TO 3 WEEKS.

ROOT FRACTURE- SPLINT 2-3 WEEKS. ALVEOLAR FRACTURE-SPLINT
3-4 WEEKS.

A severe blow to the face with a chipped tooth-feel better to see the chip, if no
chip, the tooth may have suffered a more direct blow-possible pulpal damage, root
fracture/alveolar fracture. 95% of intrusion injuries will need NSRCT.
Splint with monofilament.

ANSWER: 1-F , 2- T, 3- F, 4- T, 5-T , 6-F , 7-T .

From Guidelines for the Evaluation and Management of Traumatic Dental Injuries,
Dental Traumatology, 2001: 17:1-4, 49-52, 97-102, 145-8, 193-6. Class handout.

6. Which of the following statements about the smear layer are true?

- 1. The smear layer is produced mainly by end cutting files.**
- 2. The smear layer is a superficial layer composed of organic and inorganic debris that forms on the walls of the canal and does not penetrate the dentinal tubules.**
- 3. The smear layer can be removed with 10% citric acid or ethylenediaminetetraacetic acid (EDTA).**
- 4. The failure to remove the smear layer prior to obturation can have significantly more microleakage than an obturated canal with the smear layer removed.**

Answers:

- a. 1,3**
- b. 2,3,4**
- c. 3,4**
- d. 1,4**
- e. 1,3,4**

Statement 1 is false it has been shown that all cutting instruments in the canal form a smear layer and not mainly by end cutting files.

Statement 2 is false because the smear layer does penetrate slightly into the tubules. The smear layer contains dentin debris, bacteria, pulpal remnants, endotoxins and sometimes restorative material. It is several microns in thickness and plugs the tubules.

Statement 3 is true. The smear layer can be removed by 10% citric acid and ethylenediaminetetraacetic acid (EDTA). The use of chelating agents, weak acids followed by rinsing with sodium hypochlorite can remove the smear layer. Ultrasonic streaming also may be used in the canal for smear layer removal.

Statement 4 is true. Research has shown that the failure to remove the smear layer prior to obturation does cause increased microleakage. The smear layer may interfere with the penetration of the gutta percha or sealer into the dentin tubules. Removal of the smear layer helps create a tight interface between the gutta percha and the dentin walls. The smear layer is a potential pathway for bacteria to enter the canal. The smear layer might also harbor bacteria that could repopulate the obturated canal.

ANSWER: C

Calt, S. and A. Serper (2002). "Time-dependent effects of EDTA on dentin structures." J Endodon 28(1): 17-9.

Cohen S. and Burns RC. Pathways of the Pulp. Eight Edition, 2002, Mosby Inc., St. Louis, Missouri. 286-287, 305-306

Gencoglu, N., S. Samani, et al. (1993). "Evaluation of sealing properties of Thermafil and Ultrafil techniques in the absence or presence of smear layer." J Endod 19(12): 599-603.

Weine FS. Endodontic Therapy. Mosby Inc, St Louis, 1996;5:127-129

7. Which of the following statements are true regarding nickel titanium endodontic files?

- 1. They have a high elastic modulus, which provides flexibility.**
- 2. Nitinol cannot be strained to the same level as stainless steel without permanent deformation.**
- 3. They are easier to prebend than stainless steel do to nickel titanium's poor "memory".**
- 4. When stressed they exhibit transformation from an austenitic crystalline phase to a martensitic structure.**

Answer

- a. 2,3**
- b. 4**
- c. 2,3,4**
- d. 1,4**

Statement 1 is false. Nitinol has a low elastic modulus making it very flexible. The metal expensive and is difficult to instrument and mill. The flexibility aids in instrumentation of curved canals.

Statement 2 is false. Nitinol is able to recover from plastic strain when unloaded.

Statement 3 is false. NiTi is an alloy in a class called "shape memory alloys". The memory can be hazardous at the apex. The constant tendency to straighten may lead to zipping or transportation or over instrumentation of the apex.

Statement 4 is accurate. Nitinol will change form a austenitic crystalline phase to a martensitic phase. While in the martensitic phase little force is needed to bend the metal. The little force needed to bend makes it helpful in the instrumentation of curved canals. This also causes little filling to be done for the same time period as a stainless steel file. When the stress of the martensitic phase is reached deformation and fracture can occur.

Correct answer b. 4

Cohen S. and Burns RC. Pathways of the Pulp. Mosby Inc., St Louis, 2002;8:526-527,539, 912-914,

Wein, FS. Endodontic Therapy. Mosby Inc., St Louis, 1996;5:352-352

8. Which statement best describes Root ZX apex locators?

- 1. The apex locator measures the impedance between the file and the mucosa.**
- 2. Root ZX measures the resistance of electricity to the PDL.**
- 3. The Root ZX uses different frequencies to determine to foramen location.**
- 4. The Root ZX must have a dry environment to effectively operate.**

Answer

- a. 2,3**
- b. 4**
- c. 2,3,4**
- d. 1,3**

Statement 1 and 3 are correct. The Root ZX is the latest generation of apex locators. It operates by measuring the impedance difference between high (8 kHz) and low (400 kHz) frequencies. The difference is greatest at the CDJ. Impedance is based on the theory that the long hollow tube of the canal develops electrical impedance by the transparent dentin that drops sharply at the CDJ. This drop can be measured electrically. They have been shown to be accurate to 0.5mm of the apex. This electrical instrument should not be used on patients with pacemakers.

Statement 2 is false. The first generation of apex locators developed were resistance types.

Statement 4 is false. The canal can be wet with blood or other fluids which is usually necessary to achieve an accurate measurement with impedance - frequency type devices.

Correct answer d. 1,3

Cohen S. and Burns RC. Pathways of the Pulp. Mosby Inc. St Louis, 2002;8: 542
Wein, FS. Endodontic Therapy. Mosby Inc., St Louis, 1996;5:408-416

9. Which of the following are true statements concerning tooth reimplantation?

- 1. The apical diameter (1.5 mm or greater) had an increased pulpal survival rate after reimplantation.**
- 2. Inflammatory resorption is usually detected radiographically within two weeks of injury.**
- 3. Replacement resorption (ankylosis) is caused by extensive PDL necrosis with bone formation onto the denuded root surface.**
- 4. Storage and transport should be done in Hank's balanced salt solution, milk, saline, hydrogen peroxide, saliva, or water.**

Answer

- a. 1,2,3**
- b. 3,4**
- c. 2,3,4**
- d. 1,2,3,4**

Statement 1 is correct. A large apex opening allows for adequate blood supply to be reestablished for the repair and survivability of the pulpal tissue.

Statement 2 is correct. The types of healing responses are

1. Normal PDL repair
2. Surface resorption (transient)- usually repairs in two three weeks
3. inflammatory response- occurs due to PDL damage, inflammatory response in the PDL with inflammatory resorption of root surface

Statement 3 is correct. ankylosis- often occurs after long extra-alveolar times, if less than 20% is involved reversal may occur, the resorbing cells are osteoclasts. Radiographic moth eaten root and there is no treatment.

Statement 4 is false. All of these are acceptable except hydrogen peroxide. Milk is superior to saliva. The storage medium is more important than the extroral time. Short periods of dry storage results in resorption. Best to maintain viability of PDL cells. Replant as soon as possible. Rinse off debris but do not scrub.

Correct answer a. 1,2,3

(Blomlof L, Lindskog S, Hammarstrom L. Periodontal healing of exarticulated monkey teeth stored in milk or saliva. Scan Dent Res 1981;89:251-9.

Andreason JO, Hjortting-Hansen E. Replantation of teeth. Part 1. Radiographic and clinical study of 110 teeth replanted after accidental loss. Acta Odontol Scand 1966;24:263-286

Andreason JO Effect of extra-alveolar period and storage media upon periodontal and pulpal healing after replantation of mature permanent incisors in monkeys. Int J Oral Surg 1981, 10:43-7)

Anderson FM, Zhijie Y, Thomsen BL. Relationship between pulp dimension and development of pulp necrosis after luxation injuries in the permanent dentition. Endod Detn Traumatol 1986;2:90-8)

10. Which of the following is not an ISO sized instrument?

- a. Stainless Steel hand files**
- b. Hedstroems files**
- c. NiTi files**
- d. Greater Taper files**

Answer is d. Greater taper files come in a set of four and have increasing tapers of 0.06, 0.08, 0.10, and 0.12 mm that correspond to fine, fine-medium, medium, and medium-large gutta percha. Additionally they have variably pitched flutes that act as reamers and remove more dentin at the shank and function as a file at the tip. (*Pathways of the Pulp 8th, p251*)

ISO files follow a universal nomenclature according to taper diameter that allows machinists and dentists to specifically fabricate and utilize endodontic files. All of these files have 16mm length of cutting flutes and taper at 0.02mm per 1mm of length giving the overall standard taper of 0.32mm for the cutting surface. (*Pathways of the Pulp 8th, p250*)

Most all rotary instruments have manufacturer specific tapers, flute pitch, cutting length and depth etc, therefore are not ISO standardized. These include; GG Drills, NiTi Rotary Shaping Instruments, ProFile Rotary Instruments, GT rotary files, Accessory GT files, ProTaper Instruments, and Quantec Files. (*Pathways of the Pulp 8th, p251-7*)

11. ISO file diameters progressively increase by 0.050 from size No.8 to 90. Regardless of file length ISO 21mm, 25mm, or 31mm, they all have a 16mm fluted cutting surface.

- a. Both statements are true**
- b. First statement is true, second statement is false**
- c. First statement is false, second statement is true**
- d. Both statements are false**

Answer is c. The file number represents the size at D_0 which is the tip of the file. The number 10 file is 0.10mm in diameter at D_0 , and tapers at 0.020mm for 16mm and terminates at a diameter of 0.42mm at D_{16} which is the end of the flutes at the shank. ISO file sizes 10 through 60 have diameters at D_0 that increase by 0.05mm. From No. 60 onward to 140 D_0 increases by 0.10mm. How about the No. 6 and 8 file you ask, well just think of them as in hundredths of a millimeter in that a No. 6 file is 0.06mm and No. 8 file is 0.08mm at D_0 . (*Pathways of the Pulp 8th, p250*)

12. Files are used in endodontic preparation to:

- 1. Clean the canal system**
- 2. Shape the canal system**
- 3. Improve access to canal system**

4. Facilitate obturation

- a. All of the above
- b. 1, 2, 3
- c. 1, 2, 4
- d. 2, 3, 4

Answer is c. Goal #1 of shaping is to facilitate cleaning by removing restrictive dentin that allows and effective volume of irrigant to work deeper and circulate in all aspects of the root canal system. Additionally it serves to eliminate the pulp, bacteria and their toxins.

Goal #2 of shaping is to facilitate obturation compactly in three dimensions. It removes canal contents and creates a smooth tapered opening to the terminus which allows the unimpeded insertion of an obturating material, by the removal of restrictive dentin and allowing instruments to work deeply in the canal preparation.

Cleaning of the canal is done by irrigants that either dissolve, dissolve, lubricate and rinse debris from the canal while the canal is being shaped. It is the files that produce shape and the irrigants that clean the canal system.

The final shape is specific for the anatomy of each root.

(Pathways of the Pulp 8th, p235)

13. For which of the following scenarios is thermoplastic gutta percha technique potentially beneficial over standard lateral compaction?

- a. When the canals are curved.
- b. When there are irregularities in the canal system.
- c. When there is an open apex.
- d. When the canal system is perfectly prepared .

Answer is b. Irregularities such as internal resorption or “C” shaped canals are best filled using thermally manipulated obturating material due to the nature that walls may not be completely instrumented and compaction pressure may not be applied directly.

There are several types of warm techniques. Some are done with standard gutta percha master cones utilizing Enhanced Heated Systems for softening of intracanal gutta percha as is the case with System B. The Core Carries Technique where a firm plastic core coated with gutta percha is placed in an oven, heated then inserted into a sealer-lined canal. Most noted of this type is ThermoFil. And finally the Injectable Technique in which a continuously tapered funnel canal prep allows the flow of heat softened (in the neighborhood of 365° to 392°F) gutta percha material from the 20 gauge applicator of an injection gun. A definite apical matrix is essential for these techniques to prevent over extrusion of the material.

(Pathways of the Pulp 8th, p342-53)

14. A patient arrives at your office in severe pain on mandibular right with cellulitis of the buccal mucosa and trismus limited to an opening of 5mm. Intraorally you visualize swelling buccal to #30, which when tested is extremely percussion and palpation sensitive with an EPT of no response at 80/80. With much skill you negotiate radiographic file into position and identify a large periradicular radiolucency associated with #30. What is your anesthetic technique of choice?

- a. Inferior alveolar nerve block**
- b. Auricular-temporal extra oral injection technique**
- c. Akinosi technique**
- d. Gow-Gates technique**
- e. Rx of felxaril to relax muscular complex then attempt anesthesia**

Answer is c. The Akinosi-san technique is often referred to as the “closed-mouth” technique, but you won’t here be calling it that. I met the guy and he deserves his name on something if not this perhaps a puff pastry, he likes sweets. Indicated in time of limited openings owing to infection, trauma and trismus, the following steps are followed in order to administer this injection. A 27-gauge long needle is held in the maxillary buccal fold at the height of the mucogingival junction of the most posterior tooth. The needle is inserted into soft tissue to the lingual surface of the ramus immediately adjacent to the maxillary tuberosity and advanced to a depth of 25mm at which point 1.8ml of anesthetic is deposited. Thus gaining anesthesia of the inferior alveolar nerve with an 80 to 85% success rate. The disadvantage of this technique is the absence of bony contact
(Pathways of the Pulp 8th, p736)

The Gow-Gates technique is a mandibular nerve V₃ block injection that is targeted higher and deeper than the IANB. The aim is at the neck of the condyle below the insertion of the lateral pterygoid. Success rates are reported as high as 97.25%
(PotP 8th, p735)

The barrel of an aspirating syringe is larger in diameter than 5mm.

The auricular-temporal injection will not get near the mandibular nerve branch.

Rx of flexaril could work, but this patient is swelling and needs to be treated pronto.

15. The incidence of external root resorption is increased when heat is applied to the Superoxyl while in the chamber. The incidence of external resorption is increased when Superoxyl placed apical to the level of the CEJ.

- a. Both statements are true**
- b. First statement is true, second statement is false**
- c. First statement is false, second statement is true**
- d. Both statements are false**

Answer a: A 30% solution of Superoxyl and sodium perborate are common materials used in the non-vital chair-side and walking bleach techniques. Heating the bleaching solution in the chamber can double the incidence of resorption.

(Pathways of the Pulp 8th, p755)

The majority of cases of external root resorption appear in patients under the age of 25. It is speculated that this is due to larger pulp canal systems the greater number of patient tubules. Evidence usually does not manifest for 6 months therefore recall are essential. Their repair can sometimes be initialized by calcium hydroxide to arrest the lesion, then flap for access surgery, orthodontic extrusion, or crown lengthening surgery. Therefore it is recommended that after removal of the gutta percha from the chamber and pulp horns, a barrier of a GI or RMGI be placed 2mm thick at a level 1mm incisal to the CEJ.

(Pathways of the Pulp 8th, p756)

16. Which of the following are true regarding host defense response to the threat of microbial invasion from the root canal?

- 1. The plasma cells are the front line fighting force against bacteria.**
 - 2. The T-lymphocytes, B-lymphocytes and natural killer cells are primary cells of importance in chronic inflammation and immunity**
 - 3. Plasma cells are the only cells that can manufacture and secrete antibodies**
 - 4. PMNs have a life of 8-10 days and die in great numbers at acute inflammatory sites**
 - 5. The accumulation and local death of neutrophils is a major cause for tissue breakdown in chronic phases of apical periodontitis**
- a. 1 only is correct**
 - b. 2 only is correct**
 - c. 3 only is correct**
 - d. 2, 4, and 5 are correct**
 - e. All of the above are correct**

The cells present during inflammation (such as apical periodontitis) are as follows: Neutrophils, macrophages, lymphocytes, plasma cells and epithelial cells. In general, the acute phase reveals high concentrations of neutrophils and some macrophages and chronic phase reveals accumulation of lymphocytes, macrophages, and plasma cells.

PMNs-polymorphonuclear leukocytes or neutrophils are the front line fighting force against microbes and are the hallmark of acute inflammation.

They locate and destroy microbes as nonspecific phagocytes and are well equipped to attack enemies with weapons already stored within them, classified into primary, secondary, and tertiary groups. Primary contain lysosomes, myeloperoxidase, cationic proteins, and neutral proteases. Secondary granules are marked by lactoferrin and vitamin B12 binding protein. Tertiary granules are released in response to specific stimuli.

Lymphocytes-three major classes: T-lymph's, B-lymph's and natural killer (NK) cells.

Plasma cells-the only cells that can manufacture antibodies.

Macrophages-the primary cells of chronic inflammation and immunity; a large mononuclear phagocyte.

Epithelial cells-about 30-52% all apical periodontitis lesions contain proliferating epithelium; during periapical inflammation the cells rests of Malassez are stimulated by

cytokines and growth factors to undergo division and proliferation called inflammatory hyperplasia.

1. is wrong-PMNs are the front line fighting force against microbes.
2. is wrong-macrophages are the “prima donna” of chronic inflammation and immunity.
3. is correct
4. is wrong-PMNs are short lived (2-3 days)
5. this describes acute phases of apical periodontitis

Answer is c. 3 only

Reference: Pathways of the Pulp, 8th Ed. Cohen and Burns 2002

17. Which of the following are true regarding microorganisms associated with endodontic disease?

- 1. The vast majority of endodontic infections contain anaerobic bacteria**
 - 2. Kobayashi found similar bacteria from caries infections as were found in root canals**
 - 3. Tissue fluid, necrotic pulp tissue, low-oxygen tension, and bacterial by-products determine which bacteria will predominate**
 - 4. Teeth requiring endodontic retreatment have shown a prevalence of Streptococcus faecalis.**
 - 5. Facultative bacteria are predominant in the initial infections of root canals.**
-
- a. 1 and 3 only**
 - b. 1, 3, and 5**
 - c. 1, 2 and 4**
 - d. 2 and 4**
 - e. 1, 3 and 4**

1. is correct. Many repeated studies continue to show that there are primary anaerobic bacteria cultivated from root canal spaces

2. is wrong. The study showed a similarity in bacteria isolated from root canals to those isolated from the sulcus of a periodontal pocket. It is believed from this study that the sulcus is the source of bacteria in root canal infections

3. is correct

4. is correct

6. is wrong. Strict anaerobes are predominant in the initial infections of root canals.

Chart 1 Demonstrates bacteria from the Root Canals of teeth with apical lesions:

Bacteria	Percentage of Incidence
<i>Fusobacterium nucleatum</i>	48
<i>Streptococcus</i> sp.	40
<i>Bacteroides</i> sp.*	35
<i>Prevotella intermedia</i>	34
<i>Peptostreptococcus micros</i>	34
<i>Eubacterium alactolyticum</i>	34
<i>Peptostreptococcus anaerobius</i>	31
<i>Lactobacillus</i> sp.	32
<i>Eubacterium lentum</i>	31
<i>Fusobacterium</i> sp.	29
<i>Campylobacter</i> sp.	25
<i>Peptostreptococcus</i> sp.	15
<i>Actinomyces</i> sp.	15
<i>Eubacterium timidum</i>	11
<i>Capnocytophaga ochracea</i>	11
<i>Eubacterium brachy</i>	9
<i>Selenomonas sputigena</i>	9
<i>Veillonella parvula</i>	9
<i>Porphyromonas endodontalis</i>	9
<i>Prevotella buccae</i>	9
<i>Prevotella oralis</i>	8
<i>Propionibacterium propionicum</i>	8
<i>Prevotella denticola</i>	6
<i>Prevotella loescheii</i>	6
<i>Eubacterium nodatum</i>	6

Chart 1.

Chart 2 Demonstrates taxonomic changes for previous *Bacteroides* species:

Porphyromonas: Black-pigmented (asaccharolytic *Bacteroides* species)

- *Porphyromonas asaccharolyticus* (usually nonoral)
- *Porphyromonas gingivalis**
- *Porphyromonas endodontalis**

Prevotella: Black-pigmented (saccharolytic *Bacteroides* species)

- *Prevotella melaninogenica*
- *Prevotella denticola*
- *Prevotella loescheii*
- *Prevotella intermedia**
- *Prevotella nigrescens*†
- *Prevotella corporis*
- *Prevotella tanneriae*

Prevotella: Nonpigmented (saccharolytic *Bacteroides* species)

- *Prevotella buccae**
- *Prevotella bivia*
- *Prevotella oralis*
- *Prevotella oris*
- *Prevotella oulorum*
- *Prevotella ruminicola*

Chart 2.

The correct answer is e.

18. Which of the following are true of the crown-down technique?

1. To enlarge the coronal 1/3 of the canal preparation.
2. To enlarge the apical 1/3 of the canal to properly fit the master cone of gutta percha.
3. To use a sequential series of instruments, starting with the smaller sizes and progressing toward the larger sizes, irrespective of the instruments series used.
4. To use a series of instruments whereby one begins with larger sizes and progresses towards the smaller sizes.
5. NiTi rotary-shaping files are best.
6. ISO hand files and GGs are best.

Answers:

- a. 1, 3, 5
- b. 1, 3, 6
- c. 2 and 5
- d. 3 and 6
- e. 4 and 5

The Crown-down manner is one technique of coronal two-thirds preenlargement of a canal, involving the serial use of instruments, starting with the larger sizes and

progressing toward the smaller sizes. The other type is called Step-back. Step back involves sequentially using instruments, starting with the smaller sizes and progressing toward the larger sizes, regardless of the instrument series.

- 1 and 2 are both wrong because the technique involves two-thirds preenlargement of the coronal canal preparation
3. is wrong because this describes the Step-back technique
4. is one of the correct responses as noted in the above
5. is correct; this is the virtual consensus on the preferred instrument type for crown-down
6. is incorrect; ISO hand files and GGs are best used in a step-back technique

Taken from:

Cohen S, Burns RC. Pathways of the Pulp. 8th Ed. (2002). CV Mosby, St. Louis, MO. Pp 265-266.

Correct Answer is e. 4 and 5

19. Which are of the following are true of the balanced-force technique?

- 1. Balanced force uses three distinct phases that comprise the instrument cycle.**
- 2. Phase I involves the use of ultrasonic pre-debridement of the coronal 1/3.**
- 3. Phase III involves flute loading.**
- 4. The file is withdrawn after two to three dozen rapid rotations of the file.**
- 5. The balanced force involves file cutting at the apical extent of the file and not along its length**
 - a. 1 only**
 - b. 1, 2, 3**
 - c. 1, 3, 4, 5**
 - d. 2, 3, 4, 5**
 - e. 1, 3, 5**

The balanced force technique uses instruments in a step-back manner to initiate preenlargement of the canal and gain access to the apical third rapidly. This involves three distinct phases as follows:

Phase I-file insertion. As advocated by Roane, the balanced force utilizes the newer K-file design called the Flex-R-File (Rhomboid). Recently, NiTi files have been recommended for use as well. The file is inserted and reciprocated by the handle in a back and forth motion until it feels snug. The handle of the file is then turned 45-90 degrees, CW rotation is used to draw the instrument down, which moves the cutting blades deeper into the canal, and engage dentin.

Phase II-file cutting. Two forces are applied simultaneously on the file handle. The file is rotated CCW while pushing apically. When rotated CCW, the tendency of the file backing out of the canal is “balanced” by the force of the file being pushed into the canal. One will often hear a clicking sound as the dentin is cut or sheared off of the canal walls.

After the first cutting cycle, the file is extended slightly deeper into the canal as in Phase I. Phases I and II can be repeated up to 2-4 times.

Phase III-flute loading. The dentin cut in the Phase II lies in the interblade spaces of the file and also in the canal spaces apical to the file. The debris is removed by rotating the file CW and pulling coronally. Flute loading never causes the file tip to advance apically because of the balanced force of the file being lifted out of the canal. Two or three rotations are all that are required to fill the apical flutes with dentin mud. Hence, the file should be withdrawn.

Three advantages of balanced force using NiTi are as follows:

1. File cutting occurs at the apical extent of the file and not along its length. This increases the control of the file.
2. The safe-ended file tip stays centered in the root when activated in the Phase II file cutting.
3. It is not necessary to pre-curve the files to simulate canal anatomy, but, rather used straight as they were manufactured. The metallurgy and method of use cause the file to stay centered in the canal and guides the files into most curvatures.

The correct answer is e. 1, 3, 5 as can be determined from reading of the above phases I-III of the balanced force technique.

Cohen S, Burns RC. Pathways of the Pulp. 8th Ed. (2002). CV Mosby, St. Louis, MO. p. 268.

20. 23 year-old healthy male patient's maxillary central incisor was avulsed less than one hour ago. The avulsed tooth was stored in milk since the incident. The radiograph and clinical exam showed no sign of fracture of alveolar socket. Treatment of choice is Doxycycline 100mg BID for 7 days, Chlorhexidine mouthrinse (0.1%) BID for 1 week and:

- a. Reimplant after rinsing with saline, flexible splint for 7 days, followed by RCT in 7-10 days with Ca(OH)₂ as an intra-canal medicament.
- b. Soak the avulsed tooth in pH5.5, 2.4% Sodium Fluoride for minimum of 5 minutes, flexible splint for 7 days, followed by NSRCT in 7-10 days with Ca(OH)₂ as an intra-canal medicament.
- c. Complete NSRCT extra-orally, reimplant and stabilize for 3 weeks.
- d. Reimplantation is not indicated.

Answer: a

Is the recommended treatment for avulsed permanent tooth with closed apex, extra-oral dry time is less than 60 minutes, according to IADT guidelines (Dental Traumatology, 2001: 17: 193-196) .

B is not correct for this situation. This treatment is the recommended treatment for extra-oral dry time is greater than 60 minutes.

C is not correct. If extra-oral dry time is greater than 3 hours, the endodontic treatment may be completed extra-orally since time is of no consequence. Tooth may be stabilized for 3 weeks when the tooth was luxated or extruded.

D is not correct. When the tooth has open apex and extra-oral dry time is greater than 60 minutes, reimplantation is not indicated.

REF: Dental Traumatology 2001; 17: 145-148, 193-196

21. Followings are the indications for SBE Prophylaxis on high and moderate-risk patients (prosthetic valves, previous bacterial endocarditic, congenital cardiac malformations, hypertrophic cardiomyopathy, rheumatic heart disease, and MVP with regurgitation) EXCEPT:

- a. Dental extractions
- b. Periodontal procedures including scaling and root planning, probing and recall maintenance
- c. Dental implant placement and reimplantation of avulsed teeth
- d. Endo treatment or surgery only beyond the apex
- e. Local anesthetic injections (nonintraaligamentary)

Answer: e

On high and moderate-risk patients, invasive dental procedures where bleeding is likely are recommended to have antibiotic coverage.

REF: Dajani AS, Taubert KA, Wilson W, et al "Prevention of bacterial Endocarditis. Recommendations by the AHA," JAMA, 1997, 277(22): 1794-801

22. When the patient is taking Amoxicillin for some other reason, prophylaxis is not necessary.

- f. True.
- g. False.

Answer: b

If a patient is already taking antibiotics for another condition, prophylaxis is accomplished with a drug from another class. If the patient is taking Amoxicillin, Azithromycin or Clarithromycin (500mg PO 1 hr before procedure) is the drug of choice for antibiotic prophylaxis.

REF: Dajani AS, Taubert KA, Wilson W, et al "Prevention of bacterial Endocarditis. Recommendations by the AHA," JAMA, 1997, 277(22): 1794-801

23. EDTA is a chelating agent that:

- a. Lubricates**
- b. Emulsifies**
- c. Holds debris in suspension**
- d. Removes smear layer**
- e. All of the above**

Answer: e

REF: Pathways of the Pulp, Eighth Edition p. 259

24. Danger zone is defined by Abou-Rass, Frank and Glick as the thin area in the root canal wall that is vulnerable to stripping by injudicious filling. Danger zone is located at mandibular first molar mesial root, 1.5mm below the furcation about 1.3mm thick on the distal surface.

- a. Both statements are true.**
- b. Both statements are false.**
- c. The first statement is true, second statement is false.**
- d. The first statement is false, second statement is true.**

Answer: a

REF: Abou-Rass, Frank and Glick, Anticurvature filing method to prepare the curved root canal, JADA, 101 Nov 1980.

25. What is the goal of root end surgery?

- a. Provide an apical seal**
- b. Prevent leakage of potential irritants from the root canal into the periradicular tissues**
- c. Remove the necrotic apical 3mm of tooth structure.**
- d. Curettage of the periapical osseous necrotic tissue**

A: a&b

When the pathway between the canal and the periradicular tissues has been effectively sealed, resolution of inflammation is rapid.

26. Which of the following statements regarding flap reflection is correct?

- a. The horizontal incision for the mucogingival flap is made perpendicular to the cortical bone.**
- b. The rectangular flap design is most appropriate in the posterior areas.**

- c. **The mucogingival flap with an anterior-releasing incision is preferred in posterior areas.**
- d. **The type of vertical-releasing incision distinguishes the mucogingival flap from the Luebke-Oschsenbein flap.**
- e. **The semilunar flap has the advantage of providing an esthetic result without scar formation.**

A: c&d

- a. 45° is better to allow the widest cut surface permitting better adaptation once the flap is repositioned.
 - b. The rectangular flap may be better for anterior teeth because it provides better access to the root apex, especially when the root is long. Triangular design is better for posterior teeth due to suturing problems from limited space
 - c. Yes, because distal vertical releasing incisions make for difficult access during suturing.
 - d. Yes : Mucogingival = vertical releasing incisions or PARALELL
L-O = wider at the base.
 - e. Rarely used, limited access, prone to scarring
- Pathways of the Pulp

27. Which of the following statements are true regarding access preparation?

- 1. The objective of entry is to give direct access to the pulp chamber, not merely the canal orifices.**
 - 2. Access cavity preparations are similar to operative occlusal preparations**
 - 3. The likely interior anatomy of a tooth under treatment need not be determined before entry since unroofing will reveal canal orifice locations.**
 - 4. The rubber dam should always be placed before initial access preparation.**
- a. **All of the above**
 - b. **None of the above**
 - c. **1 and 4**
 - d. **1 and 3**

A: None of the above

The objective of entry is to gain direct access to the apical foramina, not merely to the canal orifices. Remember straight-line access.

Access cavity preparations are different from typical operative occlusal preparations since operative preparations are based on the topography of occlusal grooves, pits and fissures, and the avoidance of the underlying pulp.

The likely interior anatomy of a tooth under treatment must be determined. Each tooth has a typical length, number, and configuration of canals. Radiographs taken from two different angles must be studied. The information gained before initiation of penetration will greatly facilitate the entry as well as subsequent treatment.

When canals are difficult to find, the rubber dam should not be placed until correct location has been confirmed. Determination of the angle of malposed or extensively restored teeth can sometimes be easier with the dam off.

References:

1. Weine, FS. Endodontic Therapy, 5th edition, Mosby 1996

28. What is the success rate of endodontic treatment?

- a. 50%
- b. 40%
- c. 53-94%
- d. 40-95%

A: C. 53-90%

There are a great number of articles reporting the success rate of endodontic treatment, ranging between 53 and 94%. However, even if 90% of all endodontic treatment is successful over time, the reciprocal failure rate is still 10%. In the United States alone where the number of teeth treated per year now exceeds 50 million, a 10% failure rate would represent 5 million treatment failures per year. Extrapolating these numbers over the past 3 to 4 decades reveals that the number of failing endodontically treated teeth is massive and could approach tens of millions!

Bonus question: The *major* reason for failure, requiring retreatment, is which of the following?

- a. Persistent pain
- b. Draining sinus tract
- c. Restorative indications
- d. Microleakage

A: d. Microleakage

Endodontic failures can be attributable to inadequacies in cleaning, shaping, and obturation, iatrogenic events, or reinfection of the root canal system when the coronal seal is lost after completion of root canal treatment. Regardless of the initial cause, the sum of all causes is microleakage.

References

1. Ruddle, C. Pathways of the Pulp, 8th edition, Mosby, 2002P

29. The posterior tooth with the highest endodontic failure rate is the:

- a. Mandibular 1st molar
- b. Mandibular 2nd molar
- c. Maxillary 2nd molar
- d. Maxillary 1st molar

A: D (maxillary 1st molar)

The largest tooth in volume and the most complex in root and canal anatomy, the “six year molar” is possibly the most treated and least understood posterior tooth. Studies vary in the number of canals present however, *the clinician should always assume there are two canals in the mesiobuccal root until it is proven that there is only one.* In addition, the palatal often curves toward the buccal at the apical 1/3 that may not be obvious on a radiograph.

In contrast, according to a study by Skidmore and Bjorndal, 1/3 of mandibular first molars had four root canals.

References

1. Cohen S et al. Pathways of the Pulp, 8th edition, Mosby, 2002.

30. Which of the following statements regarding the use of intra-osseous anesthesia are accurate:

- a. Epinephrine concentration of anesthetic agent should not exceed 1:200,000
- b. Mandibular injections should be preceded by conventional block anesthesia
- c. X-tip injections at the angle of the mandible area should be avoided
- d. Total volume of anesthetic should not exceed 1 carpule

A: a,c,d

- a. The highly vascular cancellous bone can deliver dramatic vasopressor response when concentrations higher than 1:100,00 of vasoconstrictor are used.
- b. All intraosseous injections should be preceded by delivery of anesthetic agent

in the mucco-buccal fold to prevent discomfort during penetration of the cortical plate. Block anesthesia is not required. (this is the point)

- c. The bone at the angle of the mandible is thick and penetration can be difficult, therefore it should be avoided
- d. One carpule of anesthetic agent maximum is adequate for profound anesthesia.

31. Incision and Drainage is indicated under the following conditions:

- a. When facial swelling is present**
- b. When cellulitis is present**
- c. involvement of facial spaces**
- d. when a traceable fistula is present**

A: a,b,c

Any facial swelling due to infection is a potential life-threatening condition, which can spread to other areas via fascial planes and terminate with airway compromise. The infection is no longer limited to the periradicular region and conventional nsrct will not suffice. In addition, if the practitioner does not have adequate support staff, facilities and skill to perform the procedure, referral is recommended. A traceable fistula can usually be treated successfully with nsrct.

32. Which would not be a hallmark of a Phoenix Abscess?

- a. Pain with slight to large swelling.**
- b. Radiographic lucency.**
- c. Negative EPT.**
- d. Exquisitely percussion sensitive.**
- e. Intact lamina dura.**

Hallmarks of Recrudescence of Chronic Periradicular Periodontitis - Phoenix Abscess

- 1) Chief Complaint: pain with slight to large swelling
- 2) History: coronal microleakage?
- 3) Radiograph: radiolucency
- 4) EPT: -
- 5) Thermal Tests: -
- 6) Percussion: exquisitely sensitive
- 7) Palpation: sensitive
- 8) Mobility: + / -

9) Other: necrotic pulp or pulpless tooth

Answer e. Intact lamina dura

Pathways of the Pulp 2002, Page 29

33. Which percentage most correct for the amount of gutta percha in dental gutta percha?

- a. 19-22%**
- b. 56-75%**
- c. 2-17%**
- d. 1-4%**

Dental gutta percha consists of the following ranges of materials:

Gutta Percha 19-22%, Zinc Oxide 56-75%, Heavy metal sulfates 2-17%, Waxes and Resins 1-4%.

Dental gutta percha comes in two forms, alpha phase, which is brittle, and beta phase, which is pliant. Alpha phase GP can be rejuvenated back to beta by heating under hot tap water at >55 degrees C, then immediately tempering vertically with cold (<20' C) water.

Answer a.

Pathways of the Pulp 2002, Page 299

34. Which antibiotic is indicated for management of Penicillin allergic patients with a serious anaerobic bacterial infection?

- a) Augmentin**
- b) Erythromycin**
- c) Clindamycin with Flagyl**
- d) Keflex**

1929 Pen G (IV), V, narrow spectrum, mainly for G+ aerobic and facultatives. And a few anaerobes. (Streptococci, Pneumococci, Bacillus, Clostridium, Neisseria). Antibiotic of choice for endodontic infections due to efficacy and low toxicity.

Extended spectrum PCN's, Ampicillin (IM/IV), Amoxicillin.

Amoxicillin - (combined with Clavulanic Acid, a beta-lactamase inhibitor, to form Augmentin). Enhanced activity vs. G- species. Broader spectrum and faster absorption than Pen VK

Cephalosporins

Bind to enzymes involved in cross linking of peptidoglycan strands of bacterial cell wall (Like PCN's). Expensive.

1. First gen. Cephlexin (Keflex), vs. G+ Cocci, G- bacilli (E.Coli, Klebsiella)
2. 2nd gen. Vs. Providencia, Proteus Cefaclor.

3. 3rd gen. Most effective vs. G- species, H.Influenzae, enterococci, Neisseria, Serratia, Pseudomonas, and anaerobes like B. fragilis.

Erythromycin 1952, macrolide, inhibits bacterial protein synthesis Narrow spectrum like Pen G. Less effective vs. anaerobic species found in endodontic infections.

Clindamycin 1970- spectrum like e-mycin, more effective vs. most G+ and G- anaerobes. Not effective vs. most G- aerobes. Concentrates in bone. Pseudomembranous colitis risk only present in doses greater than that needed for endodontic infections.

Metronidazole- 1959 drug of choice for protozoal infections. Works vs. strict aerobic bacterial infection. ANUG application. Given with PCN to cover G+ and G- bacteria.

Quinolones - 1962, Ciprofloxacin, Broad spectrum, Highly active vs. G- enteric bacteria. Expensive.

Answer c. Clindamycin with Flagyl(Metronidazole)

Pathways of the Pulp, 8th Ed, Cohen and Burns 2002
Endodontic Therapy 5th Ed, Weine 1996

35. A patient presents with a radiolucency on a non-angulated periapical film of tooth #5 that appears to be superimposed over both roots. A second film is taken but horizontally angulated more from the distal of #5. One of the roots appears to have moved mesially, while the radiolucency and one root stayed in place. Which root is most likely affected?

- a) Buccal
- b) Lingual
- c) Both B and L
- d) Neither

SLOB Rule.

Same Lingual, Opposite Buccal. Also known as BOR, Buccal Object Rule, or Clark's Rule.

Helps clinician radiographically determine B-L position of fractures, perforations, foreign bodies, and anatomic landmarks in relation to root apices or other bony landmarks.

*Object closest to the buccal surface appears to move in the direction opposite the movement the movement of the cone or tube head when compared with a second film.

This also applies to vertical tube head angulations.

Answer b) lingual

Pathways of the Pulp, 8th Ed, Cohen and Burns 2002, 120-123

**36. Ultrasonic instruments allow better access during apical root preparations.
Use of burs in the apical root end surgery yields more conservative preparations.**

- a) The first statement is TRUE, the second statement is FALSE.**
- b) The first statement is FALSE, the second statement is TRUE.**
- c) Both statements are TRUE.**
- d) Both statements are FALSE.**

Ultrasonic instruments are Piezo electrical units that create an oscillating sinusoidal wave in a file or accessory tip.. They operate at a frequency of 25-30 kHz.
(Sonic devices operate at 2-3 kHz)

Applications for ultrasonics are:

1. Root apical preparation.

Advantages over bur preparations are:

- a) Better access in difficult to reach areas with small tips.
- b) More thorough debridement of tissue and debris.
- c) More conservative preparations, follows the canal.
- d) Precise isthmus preparations with parallel walls allow better retention of filling materials.

2. Endodontic paste (resin based) removal.

3. Indirect silver point removal.

During silver point removal, direct contact with the point is avoided since the ultrasonic action will erode the silver. The objective is to create a trough around the point to facilitate mechanical instrumentation or use of removal pliers. The ultrasonic unit is used indirectly by contacting the pliers grasping the point.

4. Post removal.

Direct contact with the post loosens the cement that holds it in place.

5. Enhance irrigant effect.

Acoustic streaming and cavitation allows for better clearing of debris.

Used with 17% EDTA, can help eliminate smear layer.

6. Identifying constricted canal orifi.

7. During retreatment, can aid in softening gutta percha.

Prolonged use of ultrasonic files may result in file breakage. Files must be changed out frequently.

In many cases, the ultrasonic is used as an adjunct and not the primary instrument.

Answer a

Pathways of the Pulp, 8th Ed, Cohen and Burns 2002

