7. ENDODONTICS

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DIAGNOSIS

1. What is the proper role of the pulp tester in clinical diagnosis?

The pulp tester excites the nervous system of the pulp through electrical stimulation. However, the pulp tester suggests only whether the tooth is vital or r the crucial factor is the vascularity of the tooth. The pulp test alone is not sufficient to allow a diagnosis and must be combined with other tests.

2. What is the importance of percussion sensitivity in endodontic diagnosis?

Percussion sensitivity is a valuable diagnostic tool. Once the infection or inflammatory process has extended through the apical foremen into the periodontal ligament (PDL) space and apical tissues, pain is localizable with a percussion test. The PDL space is richly innervated by proprioceptive fibers, which make the percussion test a valuable tool.

3. Listening to a patient's complaint of pain is a valuable diagnostic aid. What differenti ates reversible from irreversible pulpitis?

In general, with reversible pulpitis pain is elicited only on application of a stimulus (i.e., cold, sweets). The pain is sharp and quick but disappears on removal of the stimulus. Spontaneous pain is absent. The pulp is generally noninflamed. Treatment usually is a sedative dressing or a new restoration with a base. Irreversible pulpitis is generally characterized by pain that is spontaneous and lingers for some time after stimulus removal. There are various forms of irreversible pulpitis, but all require endodontic intervention.

4. What are the clinical and radiographic signs of an acute apical abscess?

Clinically an acute apical abscess is characterized by acute pain of rapid onset. The affected tooth is exquisitely sensitive to percussion and may feel "elevated" because of apical suppuration. Radiographic examination may show a totally normal periapical complex or a slightly widened PDL space, because the infection has not had enough time to demineralize the cortical bone and reveal a radiolucency. Electric and thermal tests are negative.

5. Discuss the importance of inflammatory resorption.

Resorption after avulsion injuries depends on the thickness of cementum. When the PDL does not repair and the cementum is shallow, resorption penetrates to the dentinal tubules. If the tubules contain infected tissue, the toxic products pass into the surrounding alveolus to cause severe inflammatory resorption and potential loss of the tooth.

6. A patient presents with a "gumboil" or fistula. What steps do you take to diagnose the cause or to determine which tooth is involved?

All fistulas should be traced with a gutta percha cone, because the originating tooth may not be directly next to the fistula. Fistulas positioned high on the marginal gingiva, with concomitant deep probing and normal response of teeth to vitality testing, may have a periodontal etiology.

7. Why is it often quite difficult to find the source of pain in endodontic diagnosis when a patient complains of radiating pain without sensitivity to percussion or palpation?

Teeth are quite often the source of referred pain. Percussion or palpation pain may be lacking in a tooth in which the inflammatory process has not reached the proprioceptive fibers of the

periodontal ligament. The pulp contains no proprioceptive fibers.

8. What is the anatomic reason that pain from pulpitis can be referred to all parts of the head and neck?

In brief, nerve endings of cranial nerves VII (facial), IX (glossopharyngeal), and X (vagus) are profusely and diffusely distributed within the subnucleus caudalis of the trigeminal cranial nerve (V). A profuse intermingling of nerve fibers creates the potential for referral of dental pain to many sites.

9. Is there any correlation between the presence of symptoms and the histologic condition of the pulp?

No. Several studies have shown that the pulp may actually degenerate and necrose over a period of time without symptoms. Microabscess formation in the pulp may be totally asymptomatic.

10. Describe the process of internal resorption and the necessary treatment.

Internal resorption begins on the internal dentin surface and spreads laterally. It may or may not reach the external tooth surface. The process is often asymptomatic and becomes identifiable only after it has progressed enough to be seen radiographically. The etiology is unknown. Trauma is often but not always implicated. Resorption that occurs in inflamed pulps is characterized histologically by dentinoclasts, which are specialized, multinucleated giant cells similar to osteoclasts. Treatment is prompt endodontic therapy. However, once external perforation has caused a periodontal defect, the tooth is often lost.

11. How can one deduce a clinical impression of pulpal health by examining canal width on a radiograph?

Although not a definitive diagnostic tool, pulp chamber and root canal width on a radiograph may give a suggestion of pulp health. When compared with adjacent teeth, very narrowed root canals usually indicate pulpal pathology, such as degeneration due to prior trauma, capping, or pulpotomy or periodontal disease. Conversely, root canals that are very wide in comparison to adjacent teeth often indicate prior pulp damage that has led to pulpal necrosis.

12. What is the significance of the intact lamina aura in radiographic diagnosis?

The lamina aura is the cribiform plate or alveolar bone proper, a layer of compact bone lining the socket. Because of its thickness, an x-ray beam passing through it produces a white line around the root on the radiograph. Byproducts of pupal disease, passing from the apex or lateral canals, may degenerate the compact bone; its loss can be seen on a radiograph. However, this finding is not always diagnostic, because teeth with normal pulps may have no lamina aura.

13. Which radiographic technique produces the most accurate radiograph of the root and surrounding tissues?

The paralleling or right-angle technique is best for endodontics. The film is placed parallel to the long axis of the tooth and the beam at a right angle to the film. The technique allows the most accurate representation of tooth size.

14. What is the definition of a true combined lesion?

A true combined lesion is due to both endodontic and periodontal disorders that progress independently. The lesions may join as the periodontal lesion progresses apically. Such lesions, if any chance of healing is to occur, require both endodontic therapy and aggressive periodontal therapy. Usually, the prognosis is determined more by the extent of the periodontal lesion.

15. What is the reason that radiographic examination does not show periapical radiolucencies in certain teeth with acute abscesses?

One study showed that 30—50% of bone calcium must be altered before radiographic evidence of periapical breakdown appears. Therefore, in acute infection apical radiolucencies may not appear until later, as treatment progresses.

16. Why do pulpal-periapical infections of mandibular second and third molars often involve the submandibular space?

Extension of any infection is closely tied to bone density, the proximity of root apices to cortical bone, and muscle attachments. The apices of the mandibular second and third molars are usually below the mylohyoid attachment; therefore infection usually spreads to the lingual and submandibular spaces; often the masticator space is also involved.

17. A patient presents with a large swelling involving her chin. Diagnostic tests reveal that the culprit is the lower right lateral incisor. What factor determines whether the swelling extends into the buccal fold or points facially?

A major determining factor in the spread of an apical abscess is the position of the root apex in relation to local muscle attachments. In this particular case, the apex of the lateral incisor is below the level of the attachment of the mentalis muscle; therefore, the abscess extends into the soft tissues of the chin.

18. A middle-aged woman has been referred for diagnosis of multiple radiolucent lesions around the apices of her mandibular incisors. The patient is asymptomatic, the teeth are normal on vitality tests, no cortical expansion is noted, and the periodontium is normal. Medical history and blood tests are normal. What is your diagnosis?

The most likely diagnosis is periradicular cemental dysplasia or cementoma. This benign condition of unknown etiology is characterized by an initial osteolytic phase in which fibroblasts and collagen proliferate in the apical region of the mandibular incisors, replacing medullary bone. The teeth remain normal to all testing. Eventually, cementoblasts differentiate to cause reossification of the area. Treatment is to monitor over time.

Torabinejad M, Walton R: Periradicular lesions. In Ingle JI (ed): Endodontics, 4th ed. Baltimore, Williams & Wilkins, 1994, pp 434—457.

CLINICAL ENDODONTICS (TREATMENT)

19. What is the current thinking on use of the rubber dam?

The dam is an absolute necessity for treatment. It ensures a surgically clean operating field that reduces chance of cross-contamination of the root canal, retracts tissues, improves visibility, and improves efficiency. It protects the patient from aspiration of files, debris, irrigating solutions, and medicaments. From a medicolegal standpoint, use of the dam is considered the standard of care.

20. What basic principles should be kept in mind for proper access opening?

Proper access is a crucial and overlooked aspect of endodontic practice. The root canal system is usually a multicanaled configuration with fins, loops, and accessory foramina. When possible, the opening must be of sufficient size, position, and shape to allow straight-line access into the canals. Access of inadequate size and position invites inadequate removal of caries, com promises proper instrumentation, and inhibits proper obturation. However, overzealous access leads to perforation, weakening of tooth structure, and potential fracture.

21. What are the current concepts on irrigating solutions in endodontics?

The type of irrigant is of minor importance in relation to the volume and frequency. The crucial factor is constant irrigation to remove dentinal debris, to prevent blockage, and to lessen the chance of apical introduction of debris. Several studies have shown the efficacy of saline, distilled water, sodium hypochlorite, hydrogen peroxide, combinations of the above, and many other agents. The results show no advantage to chemomechanical preparation of the root canal system.

22. Of what material are endodontic files currently made?

Hand-operated instruments, including broaches, H-files, K-files, reamers, K-flex files, and S-files, are made of stainless steel as opposed to carbon steel, which was used in the past. Stainless steel bends more easily, is not as brittle, is less likely to break compared with carbon steel, and can be autoclaved without dulling. In addition, hand and rotary files are now being made of nickel-titanium.

23. What are the characteristics of a K-file?

The K-file is made by machine grinding of stainless steel wire into a square shape (some companies produce a triangular shape). The square wire is then twisted by machines in a counterclockwise direction to produce a tightly spiraled file.

24. What are the characteristics of a reamer?

The reamer is made by machine twisting of a triangular stainless steel stock wire in a counterclockwise direction but into a less tightly spiraled instrument than the K-file.

25. How does the K-flex file differ?

The K-flex file is produced from a rhomboid or a diamond-shaped stainless steel stock wire twisted to produce a file. However, the two acute angles of the rhombus produce a cutting edge of increased sharpness and cutting efficiency. The low flutes made from the obtuse angles form an area for debris removal.

26. How does filing differ from reaming?

Filing establishes its cutting action upon withdrawal of the instrument. The instrument is re moved from the canal without turning. Thus it uses basically a push-pull motion. Reaming is done by placing the instrument in the canal, rotating, and withdrawing.

27. What is the recommended use for Gates-Glidden and Reeso drills?

These two types of engine-driven instruments, especially the Gates-Glidden drills, are useful in the new recommended instrumentation technique of step-down preparation. They are efficient in initial coronal preparation of the canal, thereby allowing easier, more efficient, and less traumatic apical preparation.

28. What is RC-prep? How is it used?

RC-prep is composed of ethylene diamine tetraacetic acid (EDTA) and urea peroxide in a carbwax base. Its use as a canal lubricant is also enhanced by combination with sodium hypochlorite, which produces much bubbling action, allowing enhanced removal of dentinal debris and permeability into the tubules.

29. Why is nickel-titanium becoming a material of choice for endodontic hand and rotary instruments?

The newer hand and rotaiy instruments made from nickel-titanium have excellent flexibility and strength after repeated sterilization, are quite anticorrosive, and resist fracture quite well.

30. What types of hand-operated implements for root canal instrumentation are currently available?

A detailed discussion of the various properties and differences in file-reamer types is beyond the scope of this chapter. K-type files and reamers are still widely used because of their strength and flexibility. H-type Hedstrom files are quite popular because of their aggressive ability to cut dentin. S-files are highly efficient for cutting dentin on the withdrawal stroke and for filing and reaming. Flex-it files are a new modification with a noncutting tip design. This design allows guidance of the tip through curvatures and reduces the risk of ledging, perforation, and transportation of the apex. For an excellent discussion of instrumentation devices and techniques, the reader is referred to Cohen 5, Burns RC (eds): Pathways of the Pulp, 6th ed. St. Louis, Mosby, 1994.

31. What is the current status on acceptability of root canal obturation materials?

Gutta percha remains the most popular and accepted filling material for root canals. Numerous studies have demonstrated that it is the least tissue-irritating and most biocompatible material available. Although differences occur among manufacturers, gutta percha contains transpolyisoprene, barium sulfate, and zinc oxide, which provide an inert, compactible, dimensionally stable material that can adapt to the root canal walls.

N-2 pastes and other paraformaldehyde-containing pastes are not approved by the Food and Drug Administration (FDA). Several studies have shown conclusively that such root-filling pastes are highly cytotoxic in tissue culture; reactions to bone include chronic inflammation, necrosis, and bone sequestration. Compared with gutta percha, the pastes are highly antigenic and perpetuate inflammatory lesions. For these reasons they are not considered the standard of endodontic care.

32. What is the proper apical extension of a root canal filling?

The proper apical extension of a root canal filling has been discussed extensively for years, and the debate continues. In the past recommendations

were made to fill a root canal to the radiographic apex in teeth that exhibited necrosis or areas of periapical breakdown and to stop slightly short of this point in vital teeth. Currently, however, it is generally recommended that a root canal be filled to the dentinocementum junction, which is 0.5-2 mm from the radiographic apex. Filling to the radiographic apex is usually overfilling or overextending and increases the chance of chronic irritation of periapical tissues.

33. Describe the walking bleach technique.

The walking bleach technique is used to bleach nonvital teeth with roots that have been obturated. The technique involves the placement of a thick white paste composed of sodium perborate and Superoxol in the tooth chamber with a temporaly restoration. Several repetitions of this procedure, along with the in-office application of heat to Superoxol-saturated cotton pellets in the tooth chamber, work quite well.

34. Several authors report extensive cervical resorption after bleaching of pulpless teeth with the walking bleach technique using Superoxol, sodium perborate, and heat. What is the cause?

In approximately 10% of all teeth, defects at the cementoenamel junction allow dentinal tubules to communicate from the root canal system to the PDL. These tubules remain open, without sclerosis, if the tooth becomes puipless at a young age. It is thought that the bleaching agents may leach through the open tubules to cause the resorption. Therefore, a barrier of some type is recommended, such as zinc, phosphate cement, or some type of light canal bonding agent.

Rothstein CD: Bleaching and vital discolored teeth. In Cohen S. Bums RC (eds): Pathways of the Pulp, 7th ed. St. Louis, Mosby, 1998, pp 674—691.

35. List four useful tools in the diagnosis of a vertical crown-root fracture.

1. Transillumination with fiberoptic light
2. Persistent periodontal defects in otherwise healthy teeth
3. Wedging and staining of defects
4. Radiographs rarely show vertical fractures but do show a radiolucent defect laterally from sulcus to apex (which can be probed).

36. Describe the crown-down pressureless technique of root canal instrumentation.

With the crown-down pressureless technique the canal is prepared in a coronal toapical direction by initially instrumenting the coronal two-thirds of the canal before any apical preparation. This technique, popularized by Marshall-Pappin, minimizes apically extruded debris and eliminates binding of instruments coronally, thereby making apical preparation more difficult.

37. What is the balanced-force concept of root canal instrumentation and preparation?

The balanced-force concept, proposed by Roane and Sabala, is based on the idea of balancing the cutting forces over a greater area of the canal and focusing less force on the area where the file tip engages the dentin. The technique is done with the Flex-it file with a noncutting tip and a triangular cross-section. By using this type of file in a counterclockwise reaming motion, ledging is minimized, more inner canal curvature is accomplished, and less zipping of the apex occurs.

Roane JB, Sabala C, Duncanson M: The "balanced force" concept for instrumentation of curved canals. JEndod 11:203, 1985.

38. What is the frequency of fourth canals in mesial roots of maxillary first molars?

In an extensive study of maxillary first molars, 51% of the mesiobuccal roots contained either a larger buccal and smaller lingual canal or two separate canals and foramina. This finding shows the importance of searching for a fourth canal to ensure clinical success.

39. What is the current thinking about the manner of storage of an avulsed permanent tooth and its relationship to postreplantation success?

After 15—12 minutes of extraoral exposure, the cell metabolites in the periodontal ligament have been depleted and need to be reconstituted before replantation. Research by Cvek has shown that soaking the tooth in a physiologic solution for 30 minutes before replanting reduces the chance of postreplant resorption. The media of choice are Hank's balanced salt solution (found in Save-A-Tooth) and Viaspan (used for storage of transplant organs). If neither is available, milk or saline may be used, but not as successfully.

40. What is the current guideline for the length of time to splint an avulsed tooth, with and without alveolar fracture?

The current recommendation is to splint an avulsed tooth for 7—14 days (3—5 weeks with alveolar fracture). If an avulsed tooth is replanted fairly quickly (within 1 hour) and some of the fibroblasts of the periodontal ligament (PDL) and cementoblasts of the root surface remain viable, initial PDL repair may occur in 7—14 days.

41. When an avulsed tooth is replanted, what are the current recommendations concerning rigid or functional splinting?

Recent studies show that early functional stimulus may improve the healing of luxated teeth. It is advantageous to reduce the time of fixation to the rime necessary for clinical healing of the periodontium, which may take place in a few weeks. Andreasen has shown that prolonged rigid immobilization increases the

risk of ankylosis; thus the splint should allow some vertical movement of the involved teeth.

Andreasen J: Effect of masticatory stimulation on dentoalveolar ankylosis after experimental tooth replantation. Endod Dent Traumatol 1:13—16, 1985.

Andreasen J: Periodontal healing after replantation of traumatically avulsed human teeth: Assessment by mobility testing and radiography. Acta Odontol Scand 33:325—335, 1975.

42. What is the physiologic basis for the use of calcium hydroxide pastes for resorptive de fects or avulsed teeth?

The theory behind the use of calcium hydroxide pastes is that areas of resorption have an acidic pH of approximately 4.5—5. Such areas are more acidic than normal tissue because of the effects of inflammatory mediators and tissue breakdown products. The basic pH of calcium hydroxide neutralizes the acidic pH, thereby inhibiting the resorptive process of osteoclastic hydrolases.

Tronstad L, et al: pH changes in dental tissues after root canal with calcium hydroxide. J Endod 7:17,1981.

43. What is the current thinking on the use of medicaments in endodontic practice?

Formerly, medicaments were in wide use in endodontics to kill bacteria in the canal. However, current thinking stresses thorough debridement of canals and the use of irrigating solutions to clean canals. Medicaments are not stressed, because all have been shown to be cytotoxic in tissue culture. In addition, several medicaments have been shown to elicit immunologic reactions in animal studies. Mechanical canal cleaning sufficiently lowers microbial levels to allow the local defense mechanisms to heal endodontic periapical lesions.

44. Discuss the variations of postoperative pain in one-visit vs. two-visit endodontic procedures.

Several studies show no difference in postoperative pain in one-visit vs. two-visit endodontic procedures. In fact, one study found that single-visit therapy resulted in postoperative pain approximately one-half as often as multiple-visit therapy.

45. What is the treatment of choice for an intruded maxillary central incisor with a fully formed apex?

Repositioning or surgical extrusion should be done immediately with splinting for 7—10 days. Because pupal necrosis is the usual outcome, pulpectomy within 2 weeks and placement of calcium hydroxide are recommended. Close observation every few months is needed.

46. What is the desired shape of the endodontic cavity (root canal) for obturation in both lateral and vertical condensation techniques?

The canal should be instrumented and shaped so that it has a continuously tapering funnel shape. The narrowest diameter should be at the dentinocemental junction (0.5—1 mm from apex) and the widest diameter at the canal opening.

47. Are electronic measuring devices for root canal of any clinical value in everyday endodontic practice?

Yes. Electronic measuring devices have been shown by several investigators to be quite accurate. In general, they work by measuring gradients in electrical resistance when a file passes from dentin (insulator) to conductive apical tissues. They are quite useful when the apex is obscured on a radiograph by sinus superimposition, other roots, or osseous structures.

48. What is the accepted material of choice for pulp-capping procedures?

The literature has reports of many drugs, medicaments, and antiinflammatory agents used for pulp capping, but the material of choice remains calcium hydroxide. Calcium hydroxide, applied to the pulp tissue, seems to cause necrosis of the underlying tissue, but the continuous tissue often forms calcific bridges.

49. Describe the process of apexification.

Apexification involves the placement of agents in the pulpless permanent tooth, with an incompletely formed apex, to stimulate continued apical closure. Calcium hydroxide pastes are the accepted agents for use in the canals.

50. What is the accepted treatment for carious exposures in primary teeth?

For carious exposures in primary teeth in which the tissue appears vital and the inflammation is only in the coronal pulp, the formocresol pulpotomy is still widely accepted. When a carious exposure shows total pulpal degeneration (necrosis), full pulpectomy is indicated with placement of a resorbable zinc oxide-eugenol (ZOE) paste.

51. What is the role of sealer-cements in root canal obturation?

Sealer-cements are still widely recommended for use with a semisolid 6bIurating material (gutta percha). The sealers fill discrepancies between the root filling and canal wall, act as a lubricant, help to seat cones of gutta percha, and fill accessory canals and/or foramina apically.

52. What biologic property is shared by all sealer-cements used in endodontics?

Studies of biocompatability have shown that all sealer-cements are highly toxic when freshly mixed, but the toxicity is reduced on setting. Chronic inflammatory responses, which usually persist for several days, are often cited as

a reason not to avoid apical overextension of the sealer. Several studies have recommended the use of sealers that are more biocompatible, such as AH-26 and the newer calcium hydroxide-based sealers (Sealapex and CRCS).

53. In using Cavit as an interappointment temporary seal, what precautions must be taken?

Cavit, which is a hygroscopic single paste containing zinc oxide, calcium and zinc phosphate, polyvinyl and chloride acetate, and triethanolamine, requires placement of at least 3 mm of material to ensure a proper seal and fracture resistance.

54. What materials or devices are of use in removing gutta percha for retreatment?

Initial removal should be done with endodontic drills (Gates-Glidden or Peezo) or by using a heated plugger to remove the coronal portion of the gutta percha. This procedure allows space in the canal for placement of solvents to dissolve remaining material. Solvents include chloroform, xylene, methyl chloroform, and eucalyptol. Chloroform is the most effective, although it has been used less because of reported carcinogenic potential. Xylene and eucalyptol are the least effective. Once the remaining gutta percha has been softened, it often can be removed by files or reamers.

Wennberg A, Orstavik D: Evaluation of alternatives to chloroform in endodontic practice. Endod Dent Traumatol 5:234,1989.

55. What are the cause, histologic characteristics, and treatment for internal resorption?

The exact cause is unknown, but internal resorption is often seen after trauma that results in hemorrhage of vessels in the pulp and infiltration of chronic inflammatory cells. Macrophages have been shown to differentiate into dentinoclastic-type cells. With this proliferation of granulation tissue, resorption can occur. Treatment is to remove the pulpal tissues as soon as possible so that tooth structure is not perforated.

56. Does preparation of the post immediately on obturation have a different effect on the apical seal of a root canal filling from delayed preparation?

Dye leakage studies have shown no difference and no effect on the apical seal whether post preparation is immediate or delayed.

Madison S, Zakariasen K: Linear and volumetric analysis of apical leakage in teeth prepared for posts. J Endod 10:422-427,1984.

57. What temperature and immersion time are needed to sterilize endodontic files in a bead sterilizer?

At the proper temperature of 220°C (428°F) in the bead sterilizer, an endodontic file should be immersed for 15 seconds. However, because of the

potential for a wide variation of temperatures in the transfer medium (beads or salt), this technique should be secondary to other, more reliable techniques of sterilization.

58. What is the best and easiest technique for sterilization of gutta percha cones?

Immersion of the cone in a 5.25% solution of sodium hypochlorite for 1 minute is quite effective in killing spores and vegetative organisms.

Senia SE, et al: Rapid sterilization of gutta percha cones with 5.25% sodium hypochlorite. J Endod 1:136, 1975.

59. What simple techniques should be used to avoid apical ledging and perforation?

Overly aggressive force should not be used in the apical area. A light touch with a precurved file to negotiate apical curvature is necessary to maintain proper canal curvature.

60. Which type of file is the strongest and cuts least aggressively?

K-files are the strongest of all files. Because they cut the least aggressively, they can be used with quarter-turn pulling motion, rasping, or clockwise-counterclockwise motions.

61. List four criteria that must be met before obturation of a canal.

1. The patient must be asymptomatic; the tooth in question must not be sensitive to percussion or palpation.
2. No foul odor should emanate from the tooth.
3. The canal should not produce exudate.
4. The temporary restoration should be intact, i.e., no leakage has contaminated the canal.

62. How does preparation of the canal for filling techniques that use injection of gutta percha differ from that for conventional techniques?

All injection techniques require a more flared canal body and a definite apical constriction to prevent flow of softened gutta percha into periapical tissues.

63. What is the treatment of choice for a primary endodontic lesion in a mandibular molar with secondary periodontal involvement (includii furcation lucency) in a periodontally healthy mouth?

Treatment generally consists solely of endodontic therapy. Necrotic pulpal tissue that causes furcation and lateral root or apical breakdown also may cause periodontal pockets through the sulcus, but these are actually fistulas rather than true pockets. Endodontic therapy alone often heals this secondary periodontal involvement.

64. What is the current thinking on the prognosis of pulp capping and partial pulpectomy procedures on traumatically exposed pulps?

In a study of traumatically exposed pulps, including both mature teeth and teeth with immature apices, Cvek found that pulp capping or partial pulpectomy procedures were successful in 96% of cases. In all teeth the superficial pulp in the traumatized area was carefully excised. Cvek and others agree that such procedures are generally more successful in vital teeth with immature root formation.

Cvek M, Lundberg M: et al: Histological appearance of puips after exposure by a crown fracture: Partial pulpotomy and clinical diagnosis of healing. J Endod 9:8—11, 1983.

65. What is the current thinking on ideal treatment for carious exposure of a mature permanent tooth?

There is general agreement that carious exposure of a mature permanent tooth generally requires endodontic therapy. Carious exposure generally implies bacterial invasion of the pulp, with toxic products involving much of the pulp. However, partial pulpotomy and pulp capping of a carious exposure in a tooth with an immature apex have a higher chance of working.

66. You have elected to perform partial pulpotomy and to place a calcium hydroxide cap on a maxillary permanentcentral incisor with blunderbuss apex in a young boy. What follow-up is necessary?

Close monitoring of the tooth is necessary. First, it is important to see whether any pathology develops. If necrosis occurs with apical pathology, extirpation with apexification is needed. On the other hand, if vitality is maintained in such teeth, root formation continues, along with dystrophic calcification.

67. What is the recommended technique for the access opening in endodontic therapy for maxillary primary incisors?

A facial approach is generally recommended for such teeth, which need pulpectomy with a filling of zinc oxide-eugenol paste. Because of esthetic problems and the difficulty in bleaching, endodontic therapy is followed by composite facial restoration.

68. Can infections of deciduous teeth cause odontogenesis of the permanent teeth?

In one study, local infections of deciduous teeth for up to 6 weeks did not influence odontogenesis of the permanent central incisors. However, longstanding infections may have a profound effect on permanent teeth buds because of direct communication between the pulpal and periodontal vasculature of the deciduous tooth and the plexus surrounding the developing permanent tooth.

69. Describe the characteristics of the Profile Rotary Instrumentation Series.

This series of nickel-titanium rotary files has a rounded, guided tip and a U-shaped flute for collecting debris. It is available in a .04 and .06 taper series; the .06 taper is used in a sequential series, allowing for a crown-down preparation.

70. Thermafil endodontic obturators are now widely used. What is the basic methodology?

Prenotched stainless steel files coated with alpha-phase gutta percha are used to obturate the canal. Selection of the Thermafil device depends on the last carrier and condenser for the thermally plasticized alpha-phase gutta percha. Alpha-phase rather than the more common betaphase gutta percha is used because, when heated, it has superior flow properties and adheres well to the metal barrier.

71. What is the major difference between the two main thermoplasticized gutta percha techniques on the market?

In the Obtara II system, gutta percha heated to 160°C is injected through a silver needle tip at a temperature of about 65°C. The Ultrafil system is a low-temperature technique that heats the gutta percha to 70°C for injection. Both techniques stress the importance of maintaining constriction at the cementodentinal junction to prevent flow of gutta percha beyond the apex.

72. What is the "dentin-chips apical-plug filling technique"?

This technique consists of filling the last 1—2 mm of the apex of the canal with dentin chips to seal the apical foremen. Above this is placed a seal of gutta percha. This so-called biologic seal of dentin chips should be made only after proper debridement of the canal to avoid apical placement of infected chips. The efficacy of this technique is controversial.

73. In treating a maxillary lateral incisor, what particular care must be taken in instrumenting the apical portion?

The apical root portion usually curves toward the distal palatal space; this configuration must be negotiated carefully.

74. Should the smeared layer of dentinal debris be removed from canal walls?

Yes. Removal of the smeared layer is recommended because of the possibility that it harbors bacteria.

75. What is considered the most reliable technique to remove the smeared layer of organic and inorganic dentinal debris from canal walls?

The recommended technique is the use of a chelating agent, such as EDTA with sodium hypochlorite, during instrumentation.

76. What is the single most important factor in determining the degree and severity of the pulpal response to a tooth preparation (cutting) procedure?

Research has shown that the remaining dentin thickness between the floor of the cavity preparation and the pulp chamber is the most crucial determinant of the pulpal response. In general, a 2-mm thickness of dentin provides a sufficient degree of protection from the trauma of high-speed drills and restorative materials. With a thickness less than 2 mm, the inflammatory response in the pulp seems to increase dramatically. Neither age nor tooth size has as significant an effect.

Swerdlow H, Stanley HR: Reaction of human dental pulp to cavity preparation. J Prosthet Dent 9:121, 1959.

77. In restoring a tooth with a deep carious lesion, clinicians often excavate the caries and place a temporary sedative restoration to allow symptoms to subside. What is the rationale behind this procedure in relation to pulpal physiology?

A deep carious lesion produces an inflammatory response in the pulp tissue adjacent to the dentinal tubules in the area of the caries. Removal of the irritation to the pulp and placement of a sedative filling allow new odontoblasts to differentiate and to produce a reparative dentin in the involved area. This process usually requires approximately 20 days for odontoplastic regeneration and 80 days for reparative dentin formation.

Stanley HR: The rate of tertiary dentin formation in the human tooth. Oral Surg 21: 100, 1966.

78. What is the most common reason for failure of root canals?

Although an endodontically treated tooth may fail for various reasons, including fracture, periodontal disease, or prosthetic complication leading to one of the above, the most common cause of failure is incompletely and inadequately debrided and disinfected root canals. The timehonored saying that what you take out of the canal is not as important as what you put in has much merit. The chemomechanical debridemdnt of the root canal system, which is necessary to remove all irritants to the surrounding apical and periodontal tissues, is still the crucial aspect of root canal treatment.

PULP AND PERIAPICAL BIOLOGY

79. What is the dental pulp? Describe in a brief paragraph the ultrastructural characteristics of this remarkable tissue.

The dental pulp is a matrix composed of ground substance, connective cells and fibers, nerves, a microcirculatory system, and a highly specialized and differentiated cell called the odontoblast. The dental pulp is similar to other connective tissues in the body, but its ability to deal with injury and inflammatory

reactions is severely limited by the mineralized walls that surround it. Therefore, its ability to increase blood supply during vasodilation is impaired.

80. The odontoblast is a remarkable and unique cell. Briefly describe its major characteristics.

The odontoblast is a highly differentiated cell that forms a pseudostratified layer of cells along the periphery of the pulp chamber. It is a highly polarized cell with synthesizing activity in its cell body and secretory activity in the odontoblastic process, which forms the predentin matrix. Because it is the main cell for dentin formation, injury by caries or restorative procedures may affect this activity.

81. Give a brief description of the most accepted theory about the mechanism of dentin sensitivity.

The most plausible theories are based on the fact that the dentinal tubule acts as a capillary tube. The tubule contains fluid, or a pulpal transudate, that is displaced easily by air, heat, cold, and explorer tips. This rapid inward or outward movement of fluid in tubules may excite odontoblastic processes, which have been shown to travel within the tubules, or sensory receptors in the underlying pulp.

Brannstrom M, Astrom A: The hydrodynamics of the dentine: Its possible relationship to dentinal pain. mt Dent J 22:219—227, 1972.

82. A 45-year-old woman presents for consultation. She is asymptomatic. Radiographs reveal a radiolucent lesion apical to teeth 24 and 25 with no swelling or buccal plate expansion. The dentist diagnosed periapical cemental dysplasia. How is this diagnosis confirmed?

Periapical cemental dysplasia or cementoma presents as a radiolucent lesion in its early stages. It is a fibroosseous lesion developing from cells in the periodontal ligament space. The teeth involved respond normally to vitality testing.

83. What is the effect of orthodontic tooth movement on the pulp?

In progressive, slow orthodontic movement, the minor circulatory changes and inflammatory reactions are reversible. However, with excessively severe orthodontic forces, disruption of pulpal vascularity may be irreversible, leading to disruption of odontoblasts and fibroblasts and possible pulpal necrosis. Rupture of blood vessels in the periodontal ligament also may affect pulpal vascularity. In addition, orthodontic tooth movement is associated with excessive root resorption and blunted roots, both of which may occur with continued vitality.

84. Inflammatory mediators cause vasodilation of blood vessels. How does vasodilation in the pulp differ from that in other tissues?

Vasodilation in all tissues is a defense mechanism, controlled by various inflammatory mediators, to allow tissue survival during inflammation. The pulp

responds differently, with an increase in blood flow followed by a sustained decrease. This secondary vasoconstriction often leads to the demise of the pulp.

Kim S: Regulatio of blood flow of the dental pulp. J Endod 15(9): 1989.

85. Is it possible to differentiate a periapical cyst from a periapical granuloma on the basis of radiographic appearance alone?

No. Radiographic appearance is not diagnostic. Often a sclerotic border may be present, but its absence does not preclude cystic formation. An exhaustive study indicates that lesions greater than 200 mm are usually cystic in nature.

Natkin B, Oswald RJ, Carnes LI: The relationship of lesion size to diagnosis, incidence and treatment of periapical cysts and granulomas. Oral Surg Oral Med Oral Pathol 57:82-94, 1984.

86. A patient presents with a maxillary central incisor that has a history of trauma. The patient is asymptomatic, and the radiograph is normal. Because the tooth gives no response to an electric pulp tester, you elect to do endodontic therapy without anesthesia. However, with access and instrumentation the patient feels everything. Explain the inconsistency.

The electric pulp tester excites the A8 fibers in the tooth. The pulp contains A8 and C nociceptive fibers; the A8 fibers have a lower stimulation threshold than the C fibers. The C fibers are more resistant to hypoxia and can function long after the A8 fibers are inactivated by injury to pulp tissue. The electric pulp tester does not stimulate C fibers.

87. List six normal changes in pulp tissue due to age.

(1) Decrease in size and volume of pulp, (2) increase in number of collagen fibers, (3) decreased number of odontoblasts (4) decrease in number and quality of nerves, (5) decreased vascularity, and (6) overall increase in cellularity.

Bernick 5: Effect of aging on the nerve supply to human teeth. J Dent Res 46:694, 1967.

88. What is the meaning of the term *dentinal pain*?

Dentinal pain is due to the outflow of fluid in dentinal tubules that stimulates free nerve endings, most likely A8 fibers. Dentinal pain is usually associated with cracked teeth (into the dentin), defective fillings, or hypersensitive dentin. The pain produced by such stimulation does not usually signify that the pulp is inflamed or the tissue injured, whereas pulpal pain is due to true tissue injury associated with stimulation of C fibers.

89. Do the odontoblastic processes extend all the way through the dentin?

This controversial topic has been studied extensively by several investigators. The process is basically an extension of the cell body of the odontoblast. It is the secretory portion of the odontoblast and contains large amounts of microtubules and microfilaments. Light microscopic studies have generally shown odontoblastic processes only in the inner one-third of dentin; this finding agrees with scanning electron microscope studies and transmission

electron microscope studies, which showed processes mainly in the inner one-third of dentin. However, one series of studies suggested that processes go all the way through dentin. More elaborate techniques with immunofluorescent antibody labeling against microtubules also showed staining the entire length of the dentin, suggesting that the processes extend the entire length of the dentinal tubule.

Brannstrom M: The dentinal tubules and the odontoblast processes. Acta Odontol Scand 30:291, 1972.

Gunji T. et al: Distribution and organization of odontoblast processes in human dentin. Arch Histol Jpn 46:213, 1983.

Sigal MJ: The odontoblast process extends to the dentinoenamel junction: An immunocytochemical study of rat dentine. J Histochem Cytochem 32:872. 1984.

Thomas HF: The extent of the odontoblast process in human dentin. J Dent Res 58:2207, 1979.

90. Describe briefly the circulatory system of the dental pulp.

The pulp contains a true microcirculatory system. The major vessels are arterioles, venules, and capillaries. The capillary network in the pulp is extensive, especially in the subodontoblastic region, where the important functions of transporting nutrients and oxygen to pulpal cells occurs and waste products are removed. The pulpal microcirculation is under neural control and also under the influence of chemical agents, such as catecholamines, that exert their effects at the alpha and beta r found in pulpal arterioles.

Cohen S, Burns RC (eds): Pathways of the Pulp, 6th ed. St. Louis, Mosby, 1994.

91. Have immunoglobulins and immunocompetent cells been found in the dental pulp?

Yes. Numerous studies have demonstrated that the pulp and penapical tissues are able to mount an immune response against injury to the pulp and apical tissues. All classes of im munoglobulins have been identified in the dental pulp, and microscopic examination of damaged pulpal tissue reveals the presence of leukocytes, macrophages, plasma cells, lymphocytes, giant cells, and mast cells.

MICROBIOLOGY AND PHARMACOLOGY

92. What types of bacteria are the predominant pathogens in endodontic-periapical infections?

Many well-done studies have shown definitively the predominant role of gram-negative obligate anaerobic bacteria in endodontic-periapical infections. Earlier studies generally implicated facultative organisms (streptococci, enterococci, lactobacilli), but improved culturing techniques established the predominance of obligate anaerobes. A recent study further demonstrated the important role of *Porphyromonas endodontalis (formerly Bacteroides endodontalis)* in endodontic infections.

Van Winkelhoff, et al: Porphyromonas endodontalis: Its role in endodontic infections. J Endod 18:431, 1992.

93. What is considered the antibiotic of choice in treatment of orofacial infections of endodontic origin?

In light of all the new microbiologic research implicating the predominance of obligate anaerobes, drug sensitivity tests still show the penicillins to be the drugs of choice. Penicillin is highly effective against most of the obligate anaerobes in endodontic infections, and because the infections are of a mixed nature with strict substrate interrelationships among various bacteria, the death of several strains has a profound effect on the overall population of an endodontic-periapical infection.

94. What antibiotics are considered most effective in treatment of orofacial infections of endodontic origin that do not respond to the penicillins?

For infections not responding to the penicillins, clindamycin is often recoffiThènded. It produces high bone levels and is highly effective against anaerobic bacteria, but it must be used with caution because of the potential for pseudomembranous colitis. A second choice is metronidazole, which also is quite effective against gram-negative obligate anaerobes.

95. What is the current status of culturing and sensitivity testing for endodontic.periapical infections?

Culturing and sensitivity testing have been a controversial topic in endodontic practice for years. According to current thinking, if the proper clinical guidelines are followed, including use of rubber dam, proper chemomechanical cleaning of the root canal system, and proper use of correct antibiotics as indicated, culturing and sensitivity testing are not required. Proper culturing for both facultative and anaerobic bacteria is expensive, time-consuming, and not cost-effective, given the high success rate of properly done endodontic therapy.

96. The role of gram-negative anaerobic bacteria is an established fact in the pathogenesis of endodontic lesions. What role does the bacterial endotoxin play?

Endotoxins are highly potent lipopolysaccharides released from the cell walls of gram-negative bacteria. They are able to resorb bone via stimulation of osteoclastic activity, activation of complement cascades, and stimulation of lymphocytes and macrophages. Various studies have demonstrated their presence in pulpless teeth (with necrotic tissue) and apical lesions.

97. What roles do nonsteroidal antiinflammatory drugs (NSAIDs) have in endodontic practice?

NSAIDs have a significant role in endodontic practice. Many patients require postoperative medication to control pericementitis, which can be quite painful after pulpectomy and may persist for several days. The NSAIDs are quite effective; their mechanism of action is to inhibit synthesis of prostaglandins. One

study showed that ibuprofen, when given preoperatively to symptomatic and asymptomatic patients, significantly reduces postoperative pericementitis.

Dionne RA, et al: Suppression of postoperative pain by preoperative administration of ibuprofen in comparison to placebo, acetaminophen and acetaminophen plus codeine. J Clin Pharmacol 23:37—43, 1983.

98. What is the latest thinking on the role of black-pigmented anaerobic rods in the etiology of infected root canals and periapical infection?

Black-pigmented anaerobic rods have been shown to play an essential role in the etiology of endodontic infections when present in anaerobic mixed infections. The most strongly implicated organism is Porphyromonas endodontalis, which, because of its need for various growth factors, is directly related to the presence of acute periapical inflammation, pain, and exudation.

99. A patient presents with swelling, in obvious need of endodontic therapy. His medical history is significant for penicillin allergy and asthma, for which he is taking Theo-Dur. What precautions should you exercise?

By no means should erythromycin be used as an alternative to penicillin. Theo-Dur is a form of theophylline used for chronic reversible bronchospasm associated with bronchial asthma, and erythromycin has been shown to elevate significantly serum levels of theophylline.

100. For years it was taught that any bacteria left behind in an obturated canal would die and therefore cause no problems. What are the latest findings about this controversy?

The most recent electron micrograph studies have shown persistence of bacteria in the apical portion of roots in therapy-resistant lesions. The result is persistent periapical pathosis.

101. What efficacy do the cephalosporins have in treating acute pulpal-periapical infections?

Although the cephalosporins are broad-spectrum antibiotics, their activity is limited in pulpal-periapical infections, which are mixed infections predominantly due to obligate anaerobic bacteria. The cephalosporins are not highly effective against such bacteria and actually have less activity against many anaerobes than penicillin. For serious infections that are penicillin or erythromycin-resistant, clindamycin is much more effective because of its activity against the obligate and facultative organisms in pulpal-periapical infections.

102. What precautions should be taken in prescribing antibiotics to a female patient who takes birth control pills?

The dentist should warn the patient that oral antibiotics may decrease the effectiveness of birth control pills and that they may be ineffective during the course of antibiotic therapy. The most often implicated antibiotic is the penicillin class, although erythromycin, cephalosporin, tetracyclines, and metronidazole also have been implicated.

103. The quinolone class of antibiotics, which includes ciprofloxacin, are becoming quite popular. Do they have any role in treating alveolar infections?

Very little, if any. Most anaerobes implicated in endodontic-alveolar abscesses are resistant to the quinolones.

ANESTHESIA

104. What is the physiologic basis of the difficulty in achieving proper pulpal anesthesia in the presence of inflammation or infection?

Attaining effective pulpal anesthesia in the presence of pulpal-alveolar infection or inflammation is bften quite difficult because of changes in tissue pH. The normal tissue pH of 7.4 decreases to 4.5—5.5. This change in pH due to pulpal-periapical pathology favors a shift to a cationic form of the local anesthesia molecule, which cannot diffuse through the lipoprotein neural sheath. Therefore, anesthesia is ineffective.

105. What is the significance of the mylohyoid nerve in successful anesthesia of the mandibular first molar?

The mylohyoid nerve is often implicated in unsuccessful anesthesia of the first molar. This nerve branches off the inferior alveolar nerve above its entry into the mandibular foremen. The mylohyoid nerve then travels in the mylohyoid groove in the lingual border of the mandible to the digastric and mylohyoid muscles. However, because it often carries sensory fibers to the mesial root of the first molar, lingual anesthetic infiltration may be required to block it.

106. What is the method of action of injection into the periodontal ligament?

Injection into the periodontal ligament is not a pressure-dependent technique. The local anesthetic works by traveling down the periodontal ligament space and shutting off the pulpal microcirculation. To be effective, this technique requires the use of a local anesthetic with a vasoconstrictor.

107. The Gow-Gates block is an effective alternative to the inferior alveolar block. When is it indicated? Briefly describe how it works.

In patients in whom the traditional inferior alveolar block is ineffective or impossible to perform because of infection or inflammation, the Gow-Gates block has a high success rate. It is a true mandibular block that anesthetizes all of the

sensory portions of the mandibular nerve. The injection site is the lateral side of the neck of the mandibular condyle; thus, it is effective when intraoral swelling contraindicates the inferior alveolar block.

108. What is the reason for attempting to anesthetize the mylohyoid nerve for endodontic treatment of a symptomatic lower first molar?

The mylohyoid nerve has been shown to supply sensory innervation to mandibular molars, especially the mesial root of first molars. Infiltration of this nerve as it courses along the medial surface of the mandible is often helpful.

109. A drug salesman has convinced you to use propoxycaine hydrochloride as a local anesthetic. Is there any true or absolute contraindication to use of an esteriiiesthetic?

Yes. Patients who have a hereditary trait known as atypical pseudocholinesterase have an inability to hydrolyze ester-type local anesthetics. Therefore, toxic reactions may result. Only amide anesthetics should be used.

110. A patient presents with an extremely painful lower molar requiring endodontic therapy. You have already used six cartridges of lidocaine with epinephrine to achieve anesthesia. The patient begins to react differently. In brief, what are the signs of local anesthetic toxicity?

Local anesthetic toxicity depends on the blood level and the patients status. In general, a mild toxic reaction manifests as agitation, talkativeness, and increased vital parameters (blood pressure, heart rate, and respiration). A massive reaction manifests as seizures, generalized collapse of the central nervous system, and possible myocardial depression and vasodilation.

SURGICAL ENDODONTICS

111. What is the purpose of the apicoectomy procedure in surgical endodontics?

Perpetuation of apical inflanmrntion or infection often is due to poorly obturated canals, tissue left in the canal, or quite often an apical delta of accessory foramina containing remnants of necrotic tissue. The removal of this apical segment via apicoectomy usually removes the nidus of infection.

112. A patient presents for apicoectomy on a maxillary central incisor with failed endodontic therapy. A well-done porcelain-to-gold crown is present, with the gold margin placed in the gingival sulcus for esthetic purposes. What flap design is most appropriate?

A full mucoperiosteal flap involving the marginal and interdental gingival tissues may potentially cause loss of soft-tissue attachments and crestal bone height, thereby causing an esthetic problem with the gold margin of the crown.

Instead, a submarginal rectangular (Luebke-Ochsenbein) flap that preserves the marginal and interdental gingiva, is recommended.

113. What is the material of choice for root end fillings in surgical endodontics?

Histologic studies have compared several materials, including amalgam, EBA cement, resins, polycarboxylate cements, glass ionomers, and gold foils. Although no study has shown a definitive superiority of one over another, the most commonly used today are amalgam and EBA cements. The type of material is properly secondary in importance to the root resection technique, apical preparation, curettage of the lesion, and technique in placement.

114. What type of scalpel is best used for intraoral incision and drainage of an endodontic abscess?

A pointed no. 11 or no. 12 blade is preferred over a rounded no. 15 blade.

115. In performing apical surgery on the mesial root of maxillary molars, what mistake is commonly made?

It is important to look for unfilled mesiolingual canals in such roots. Therefore, a proper long bevel is necessary to expose this commonly unfilled fourth canal.

116. Numerous studies have addressed the success rates of endodontic surgery. Most agree, however, on certain basic conclusions. Can you name the most common conclusions?

All of the success studies share certain basic conclusions. First, the success of endodontic surgery is closely related to the standard of treatment of the root canal. Second, orthograde (conventional) root fills are preferred, if possible. Thirdly, the success rate is about 20% lower for retrograde fills than for properly done orthograde fills.

Andreasen JO, Rud J: A multivariate analysis of various factors upon healing after endodontic surgery. IntJ Oral Surg 1:258—271, 1972.

Rud J, Andreasen JO: Radiographic criteria for the assessment of healing after endodontic surgery. mt J Oral Surg 1:195—214, 1972.

117. What is the recommended surgical approach for apical surgery on palatal roots of maxillary molars?

The palatal approach is recommended; with proper flap design and size, proper reflection is not a difficult procedure. The buccal approach is potentially too damaging to supporting bone of the molar and may actually cause more risk of postoperative sinus problems.

118. Why is a "slot preparation" often recommended in preparation of root end filling for mesial roots of maxillary or mandibular roots?

The slot preparation is a trough-type preparation that extends from one canal orifice to another canal orifice in the same root. This procedure is accomplished with undercuts in the adjacent walls. The slot preparation allows not only sealing of the canal orifices but also small anastomoses between the main canals.

119. Has the ideal retrosurgical material been developed?

No. Many research studies have been published about a myriad of materials. However, the ideal is not yet determined. Most likely the material itself is not as important as the surgical preparation, the depth of the preparation, and how it is placed.

120. After root end resection during endodontic surgery, many practitioners apply citric acid to the exposed dentin surface. What is the rationale behind this practice?

A desired result of root end surgery (apicoectomy) is to achieve, if possible, a functional apical dentoalveolar apparatus with cementum deposition on the root end. However, the resected root end is covered with a smeared layer of dentin from the high-speed bur, which does not allow reattachment of newly deposited cementum. Applying citric acid for 2 or 3 minutes dissolves the smear layer and causes a small degree of demineralization of dentin. This, in turn, exposes collagen fibrils of the dentinal organic matrix and allows a proper area for attachment of collagen fibrils from newly formed cementum.

Polson AM, et al: The production of a root surface smear layer by instrumentation and its removal by citric acid. J Periodontol 55:443-446, 1984.

121. Several studies have shown that resected mandibular molars fail twice as often as resected maxillary molars. What are the major etiologic reasons for failure?

The most common cause of failure is root fracture, followed in order by cement washouts around restorations, undermining caries, and recurrent periodontal pathoses around remaining roots.

Langer B, Wagenberg B: An evaluation of root resections: A ten-year study. J Periodontol 52:719-722,
1981.
Erpensten H: A 3-year study of hemisectioned molars. J Clin Periodontol 10:1-10, 1983.

122. In performing apical surgery, what is the current thinking about the angle of the apical bevel during apicoectomy and how it relates to depth of retrograde fillings?

Recent studies have shown that increasing the angle of the apical bevel increases the potential for apical leaking due to exposure of more dentinal tubules. A bevel as close to zero degrees as possible is ideal. In addition, increasing the depth of retrograde preparation and filling decreases apical leaking by sealing more dentinal tubules.

123. Why, in the past, have the mesial roots of maxillary first molars and mandibular first molars failed so commonly after endodontic surgery?

Before the advent of enhanced illumination and magnification with surgical loupes and the operating microscope, the isthmus between the mesial canals was commonly not prepared. The isthmus may contain necrotic tissue that can perpetuate the apical lesion.

124. Why are ultrasonic techniques becoming the most popular instruments for retropreparation during apical surgery?

The ultrasonic systems available today are a huge improvement over techniques in the past. They allow retropreparations that align properly with the long axis of the tooth, d they can be sufficiently deep to conform to the true shape of the apical root canal system.

125. During apical surgery in the past, teeth with extensive periodontal defects were extracted because of the poor prognosis. Today, however, guided tissue regeneration can save many of these teeth. How does it work?

An inert barrier is placed over the periodontal defects. These membranes allow proliferation of undifferentiated cells of the PDL and surrounding bone to grow across the wound, potentially forming a new attachment, and prevent the downgrowth of epithelial cells to form a junctional epithelium.

126. What is the ultimate goal of apical surgery?

The goal is to eliminate the source of periapical irritation emanating from the root canal, which perpetuates apical infection. In addition, it is important to allow reformation of cementum around the apex, to reestablish a functioning PDL, and to allow alveolar bone repair. If these goals are not possible, we aim at least to allow repair scar tissue, which is less than ideal but still a form of repair.

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