Endodontics

Pulp and periodontal diseases – diagnosis, therapy, prevention

Aim of endodontic treatment

Healing of pulp diseases or removal bacteria from the root canal system and regeneration of damaged periodontal tissues. (Canal shaping, cleaning and filling)

„ *Endodontist helps nature only “*

W.D.Miller

Endodontics - terms

- Endodont (dentin + pulp)
- Pulp chamber
- Root canal
- Apical constriction
- Apical foramen
- Ramifications
- Radiographic apex
- Periodontal space

Morphology

- The root canal is not round it is usually oval (long axis mesiodistal direction)
- The root canal is not straight - it deflects distal
- Apical foramen is not on the top of the root but under it (distal or distooral side)

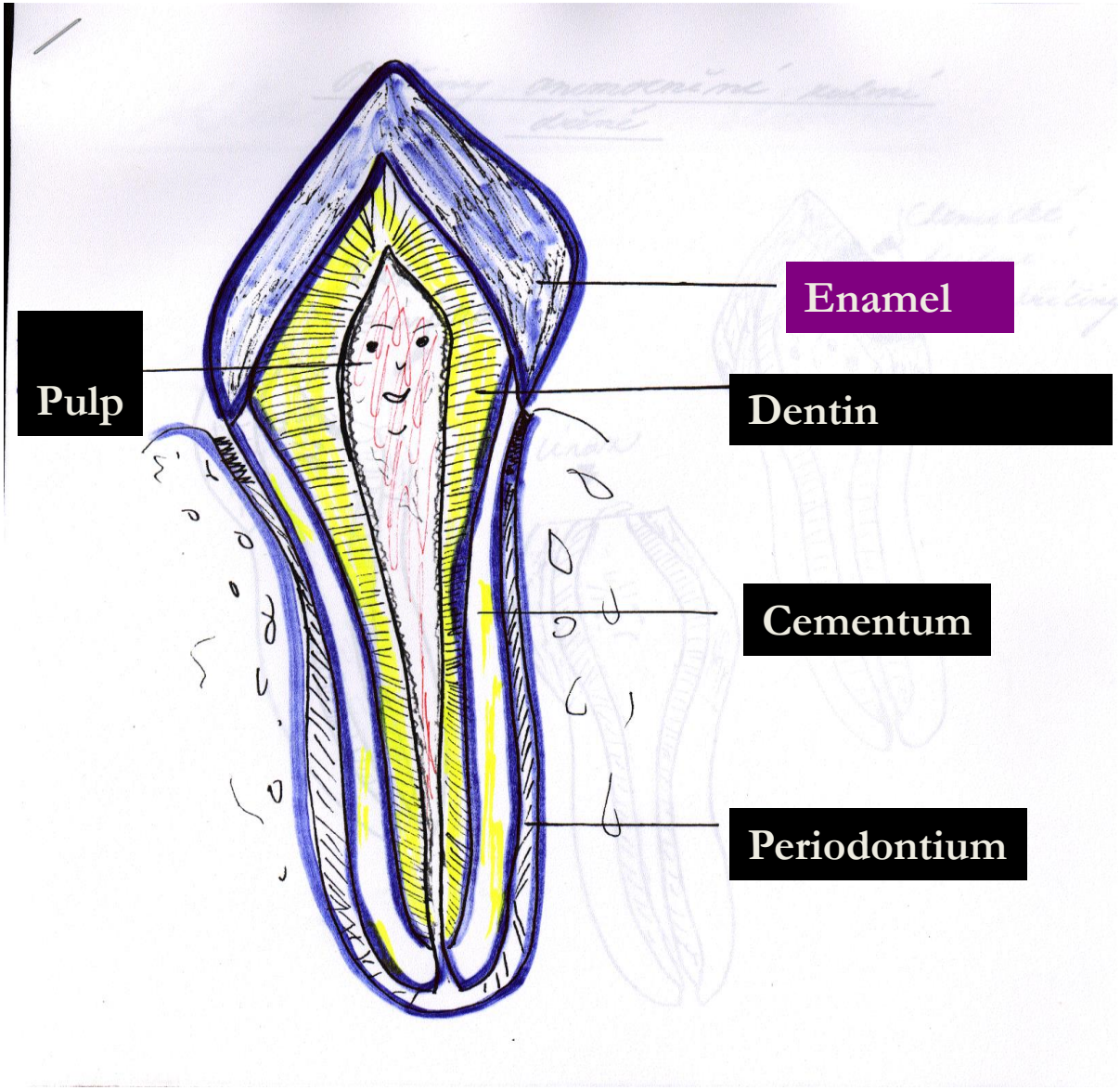
Morphology

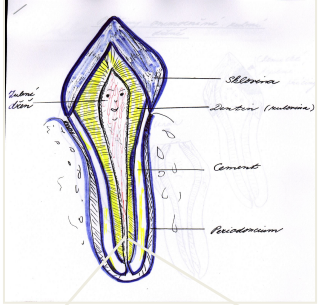
- Between apical constriction and apical foramen the wall of root canal are divergent towards periodontal space

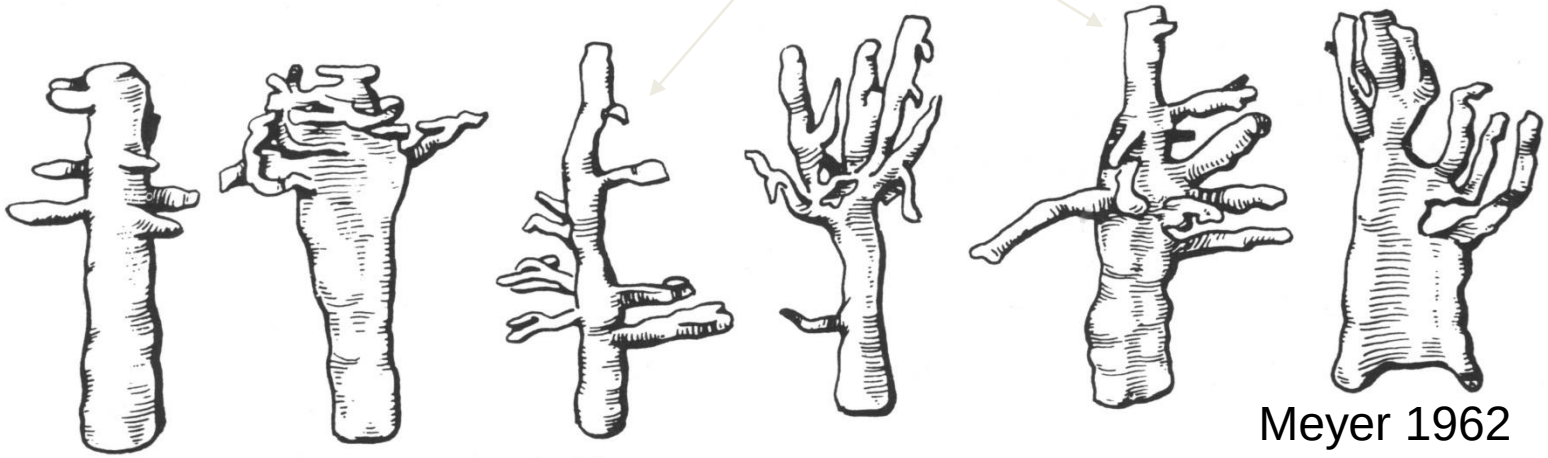
- The root canal system has usually more foramina (ramifications)

- The ramifications are situated mostly in apical area (first apical mm)
- All apical foramina are situated in cementum

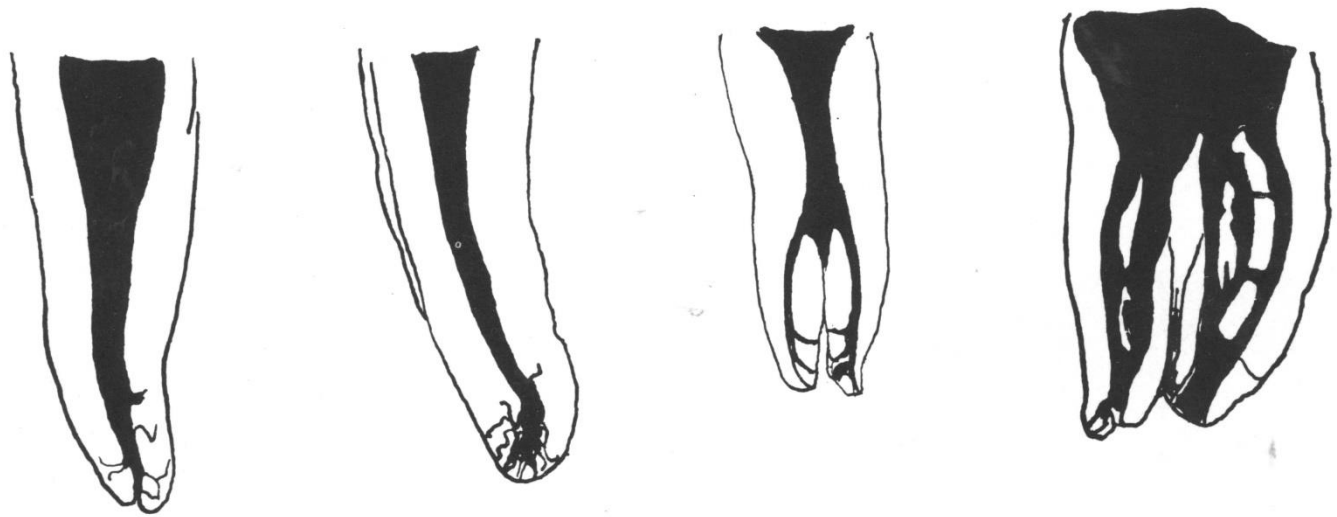
Morphology







Meyer 1962



3D

Meyers conclusions

- The root canal is not round but oval (long axis mesiodistal)
- The root canal does not go straight but it deflects distal
- The apical foramen is not on the top of the root but below (distal or distooral)

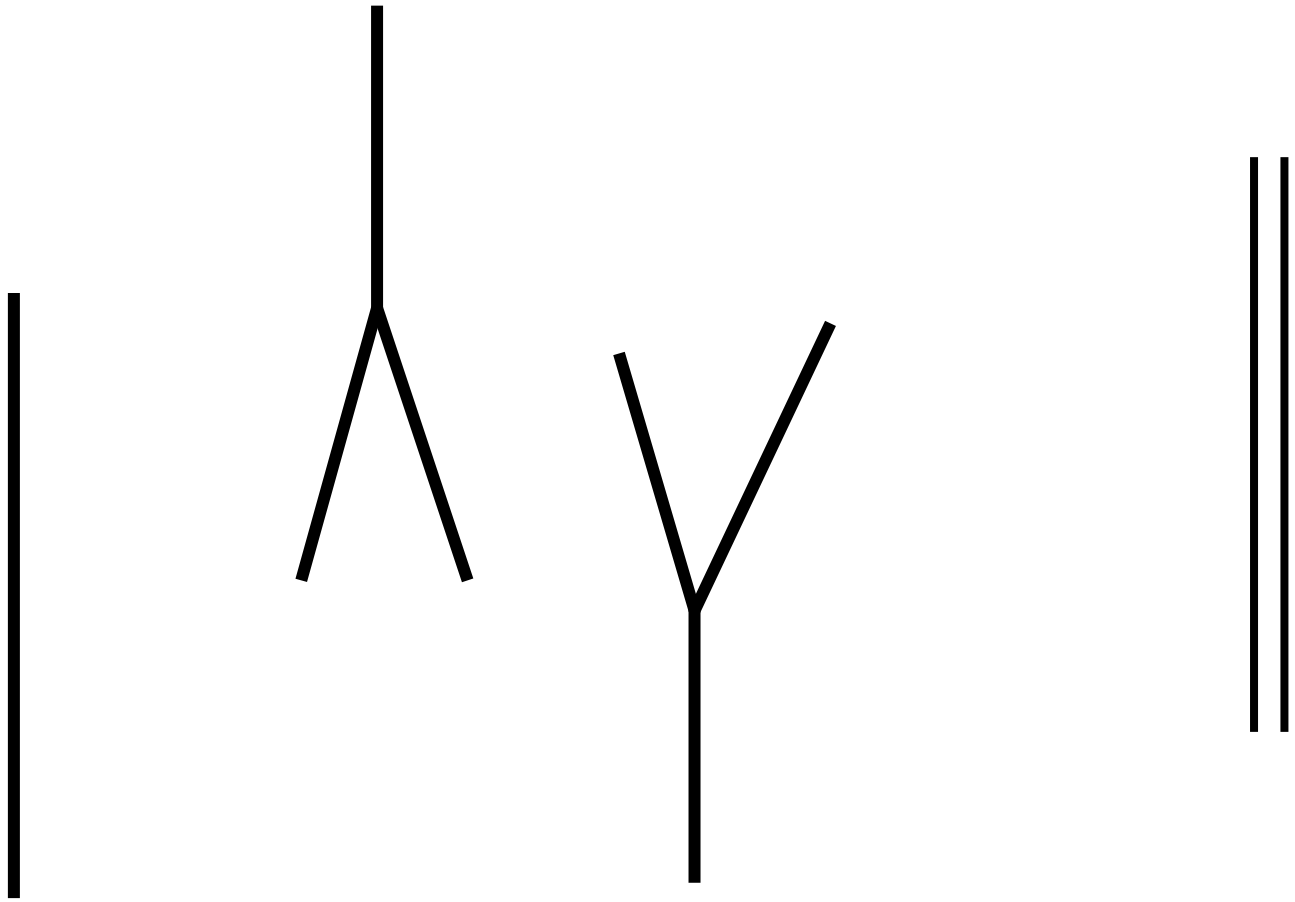
Meyer´s conclusions

- The walls of the root canal between apical constriction to apical foramen are divergent

- The root canal system has usually more apical foramina (side branches – ramifications)
- The ramifications are situated mostly in apical area (first apical mm)

- All foramina are situated in cementum

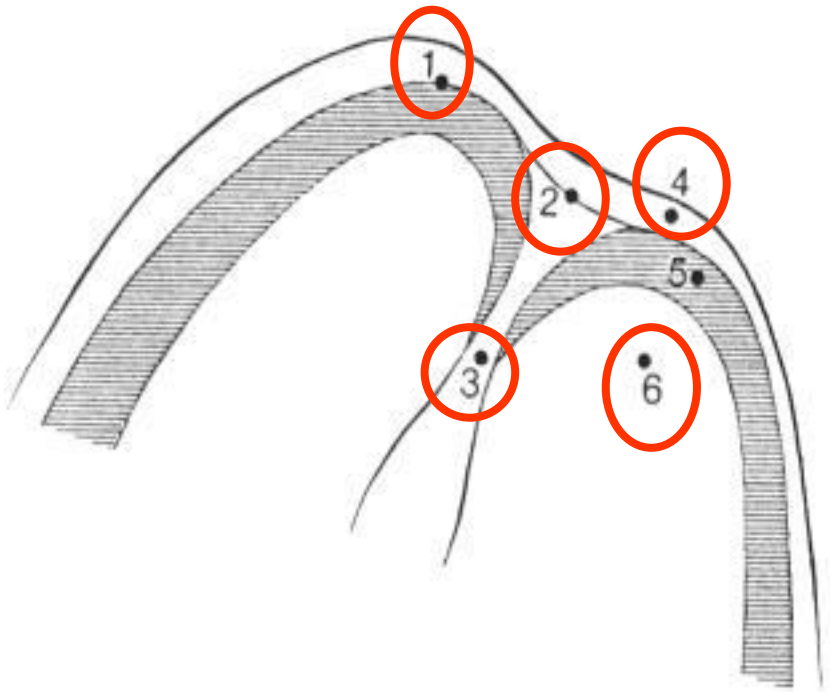
Basic forms of the root canal systém (Weine)



Vertucci
Gulabivala
Kartal a Yanikoglu….

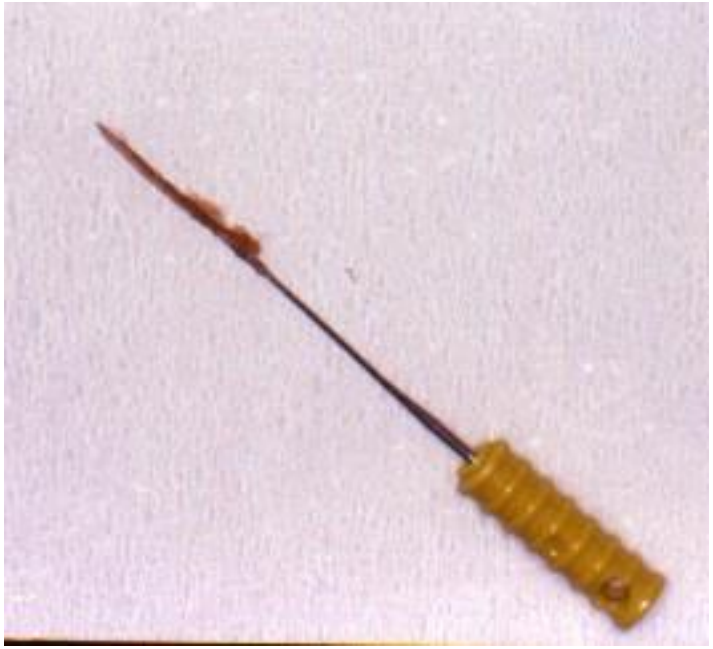
lenka.roubalikova@tiscali.cz

Apical morphology

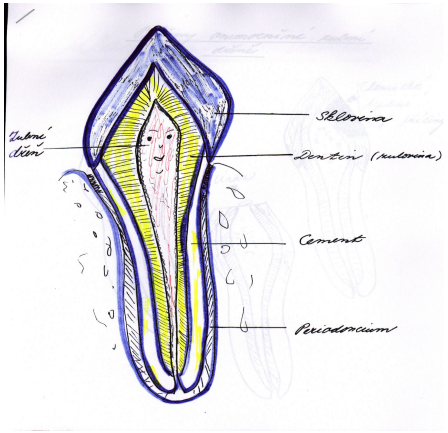


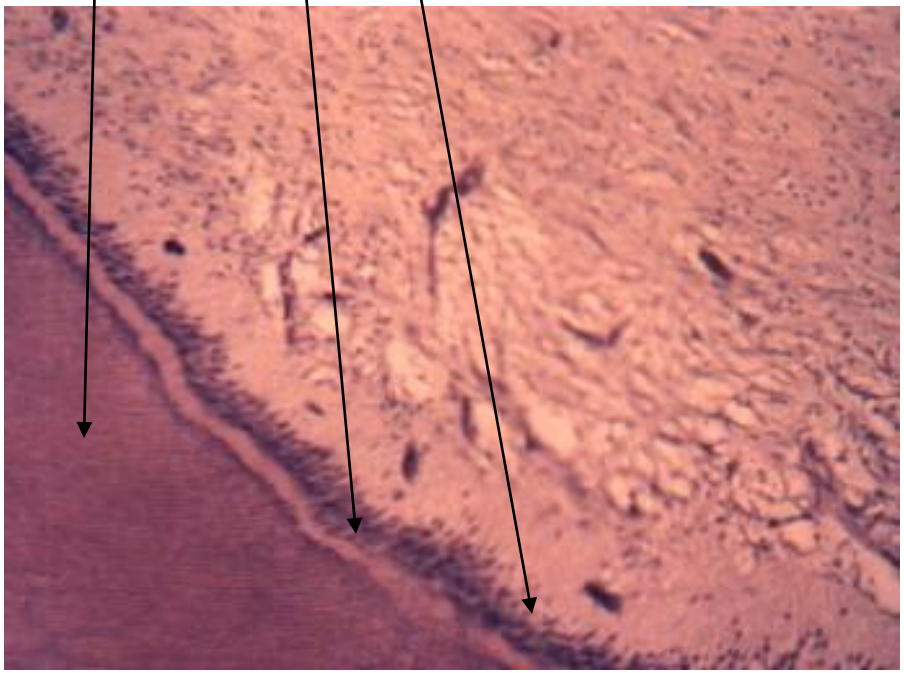
1. X – ray apex
2. Foramen apicale
3. Apical constrictionA
4. Periodontal ligament
5. Root cementum
6. Dentin

Acc. to Guldener a Langeland



Odontoblasts
Predentin
Dentin





Dental pulp
is in close connexion with dentin
pulp – dentinal complex - endodont

Dental pulp is a tissue of mesenchymal origin

- Compositin of the dental pulp
- connective tissue
  collagen fibres
- ground substance
  interfibrillar substance
- connective tissue cells (other celle- histiocytes, macrophages, dendritic celle, stem cells)
- blood vessels
- nerve fibres
- odontoblasts - dentine forming cells

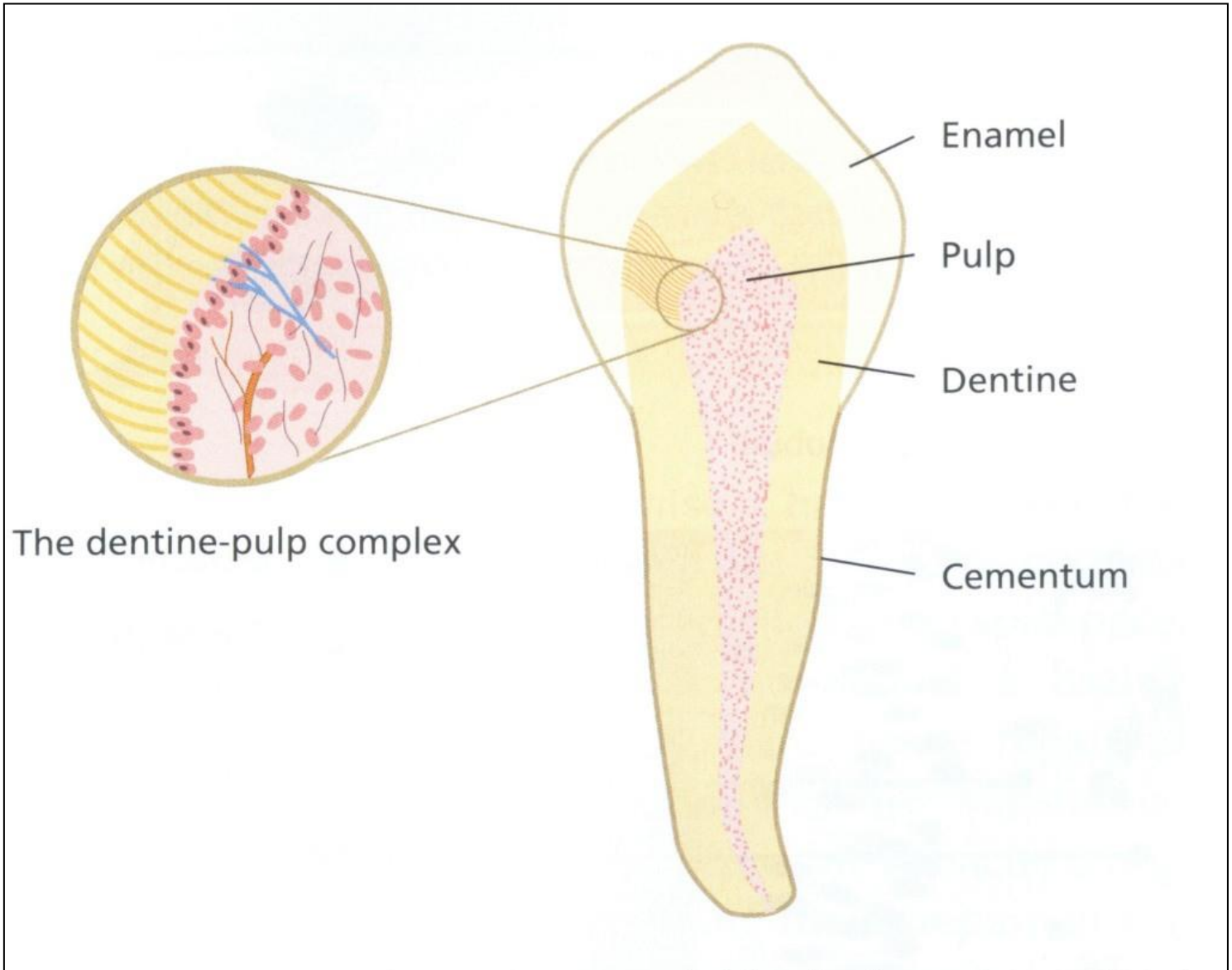


Fig. 3.1 Soft tissue of the pulp surrounded by dentine and enamel and cementum. Inset depicts the interface between dentine and pulp.

4 zones

1. central zone - larger nerves and blood vessels
2. cell rich zone - reserve cells (undifferentiated mesenchymal cells), fibroblasts
3. cell free zone (zone of Weil) - terminals of naked nerve fibres
4. odontoblastic zone

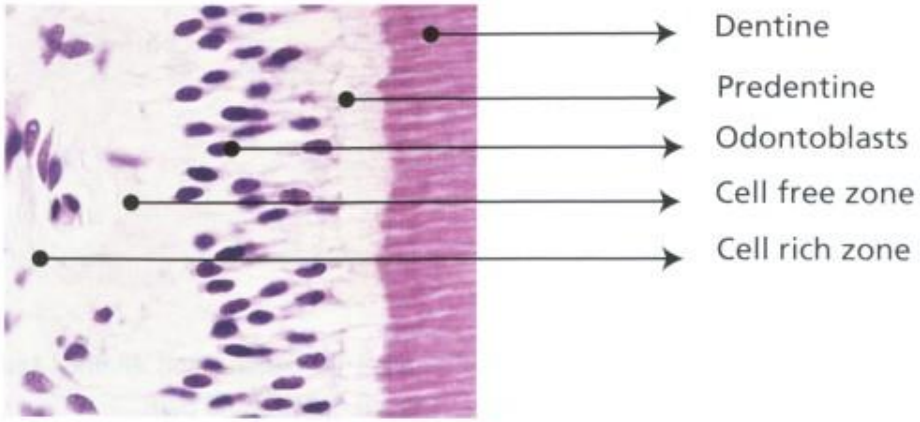


Fig. 3.4 Tissue section stained with hematoxylin and eosin showing dentine, predentine and pulp tissue proper with odontoblasts lining the periphery.

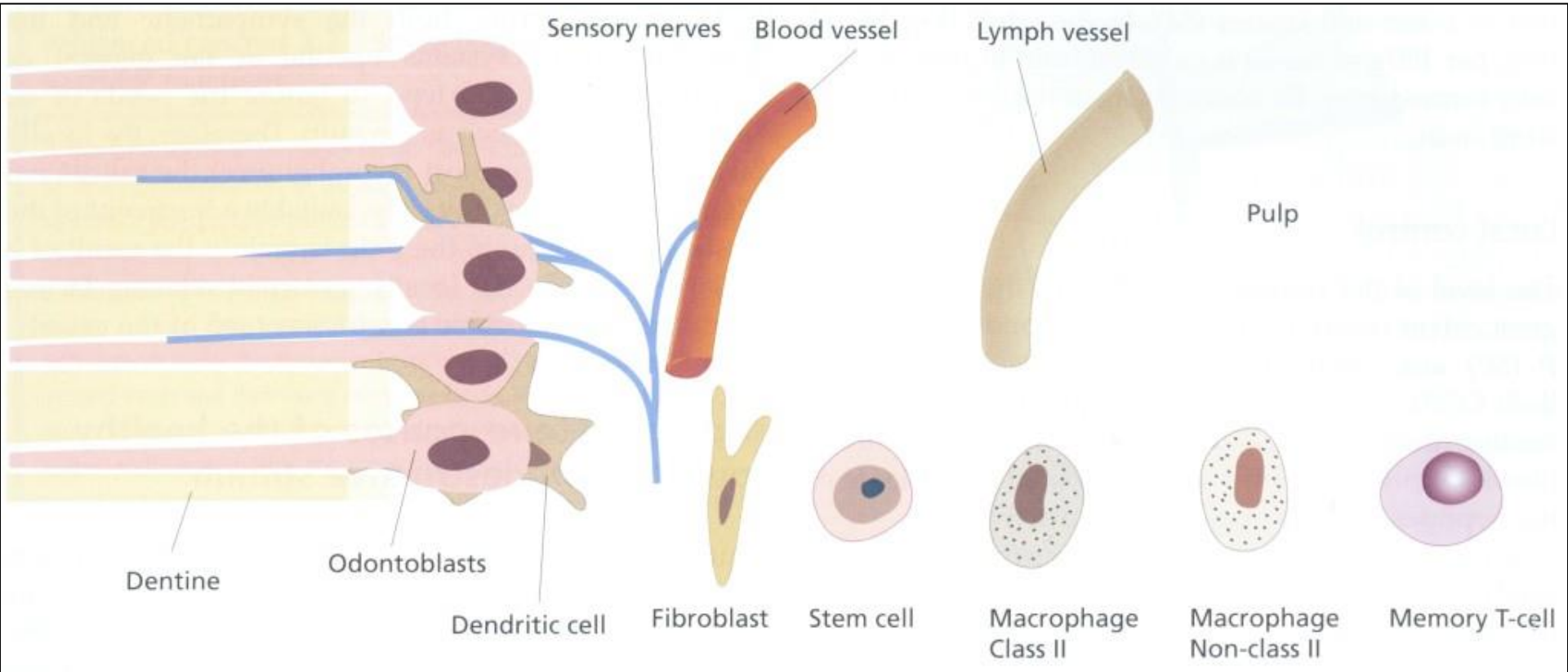


Fig. 3.11 Constituents of primary significance in the defense of the pulp against foreign substances, including bacterial elements, make up the innate 'first line of defense'.

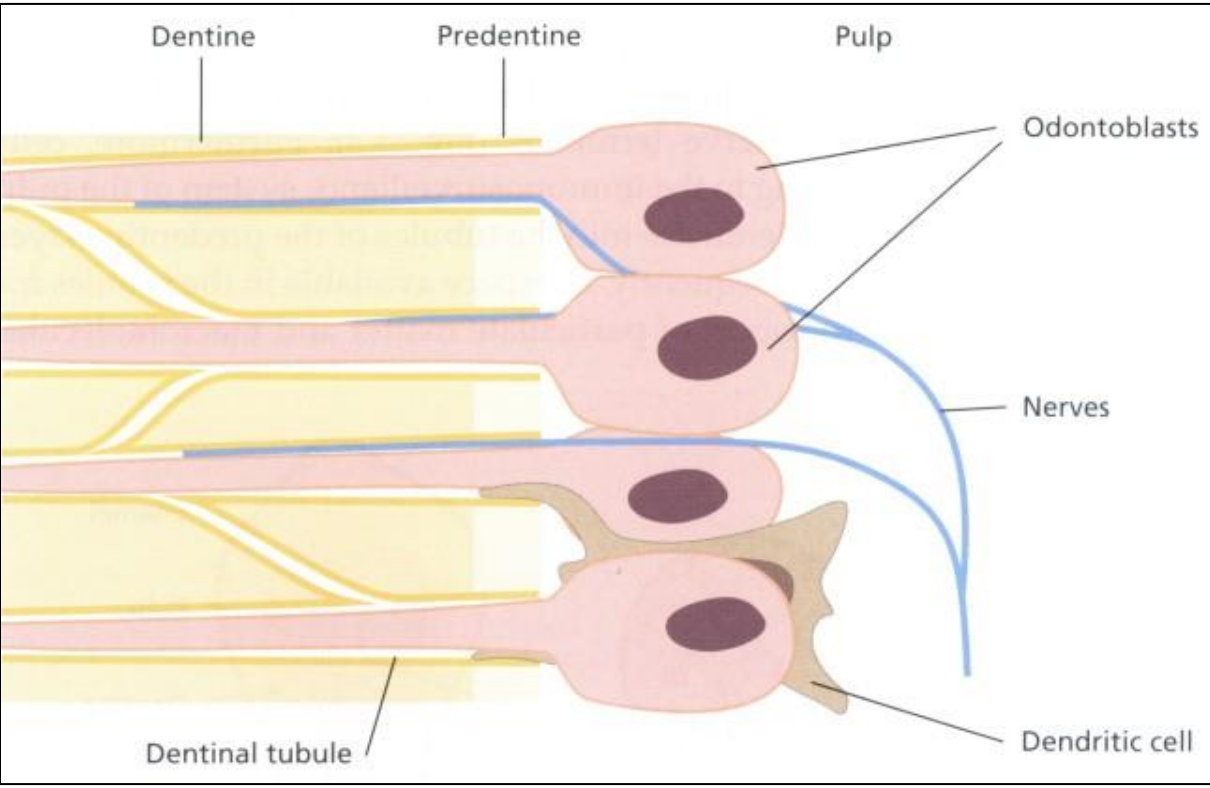


Fig. 3.3 Cellular extensions of odontoblasts, nerves and cells of the immune system (dendritic cells) that occupy the pulpal ends of the dentinal tubules.

Function of the dental pulp

- Formative - dentine formation through the life
- Nutritive - dental pulp
  maintains the vitality of dentine
- Nervous function
  - afferent
  - efferent
- Defensive function

Formative function

Formation of dentine through the life

- primary dentine
- secondary dentine
- tertiary dentine

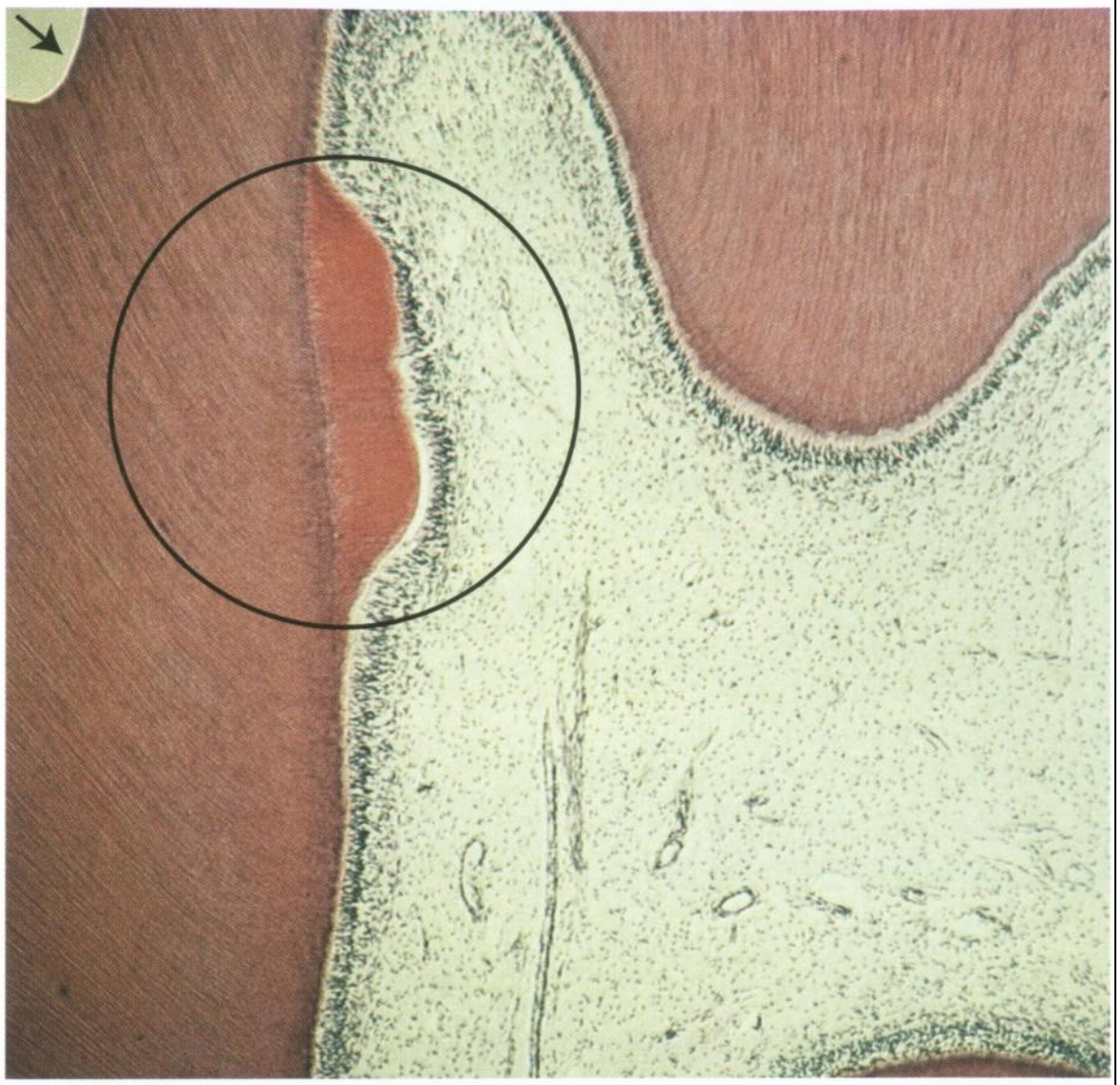


Fig. 3.5 Microphotograph shows hard tissue repair following a cavity preparation (arrow). The circle indicates the bulk of new dentine being formed.

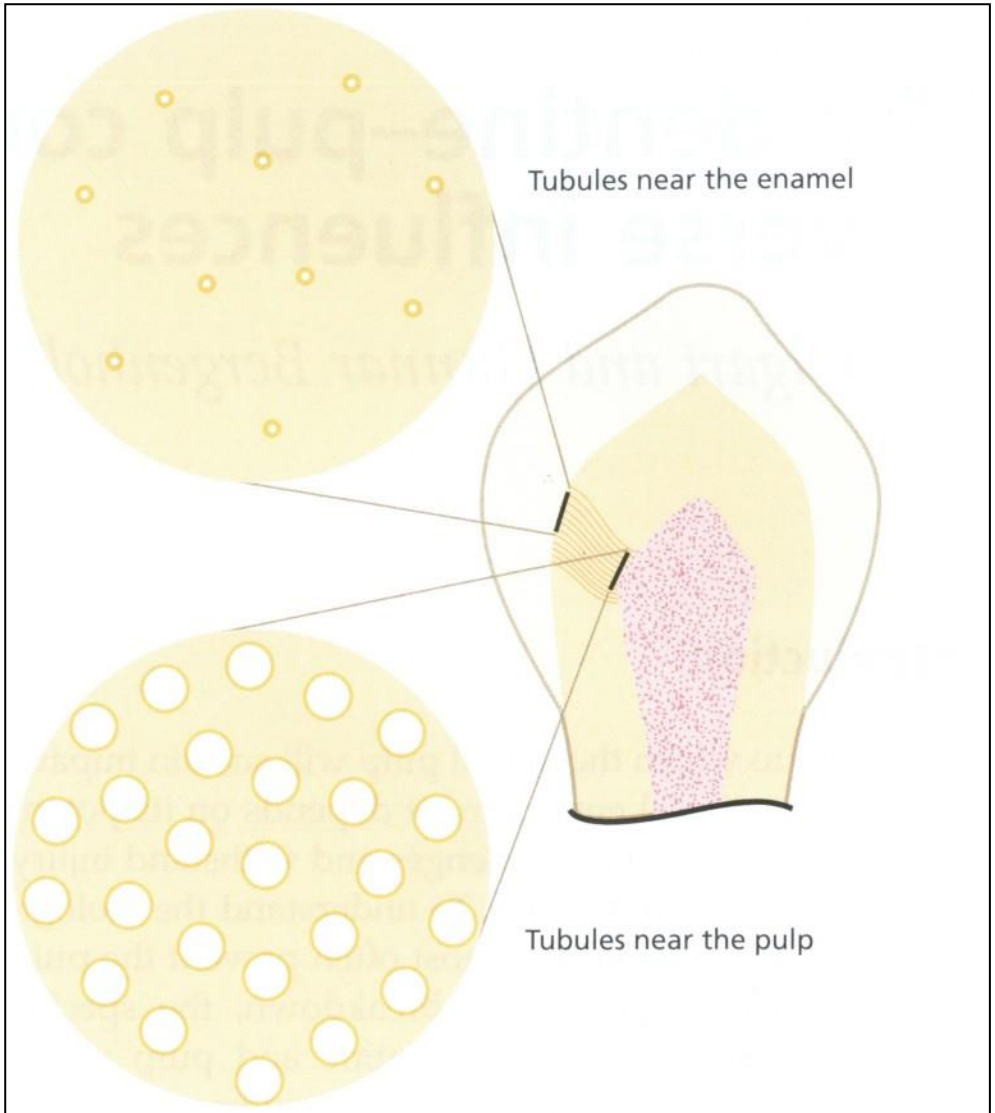


Fig. 3.2 Density of dentinal tubules in various portions of the crown region in teeth. It has been estimated that the surface area taken by cross-cut tubules is ca. 2–3% in the periphery but near the pulp the dentinal tubules assume ca. 25% of the surface area (67).

Nutritive function

- arterioles branching into terminal arterioles
- terminal capillary network - peripherally
- post capillary venules
- collective venules
- main venules
- anastomoses
- lymphatic vessels

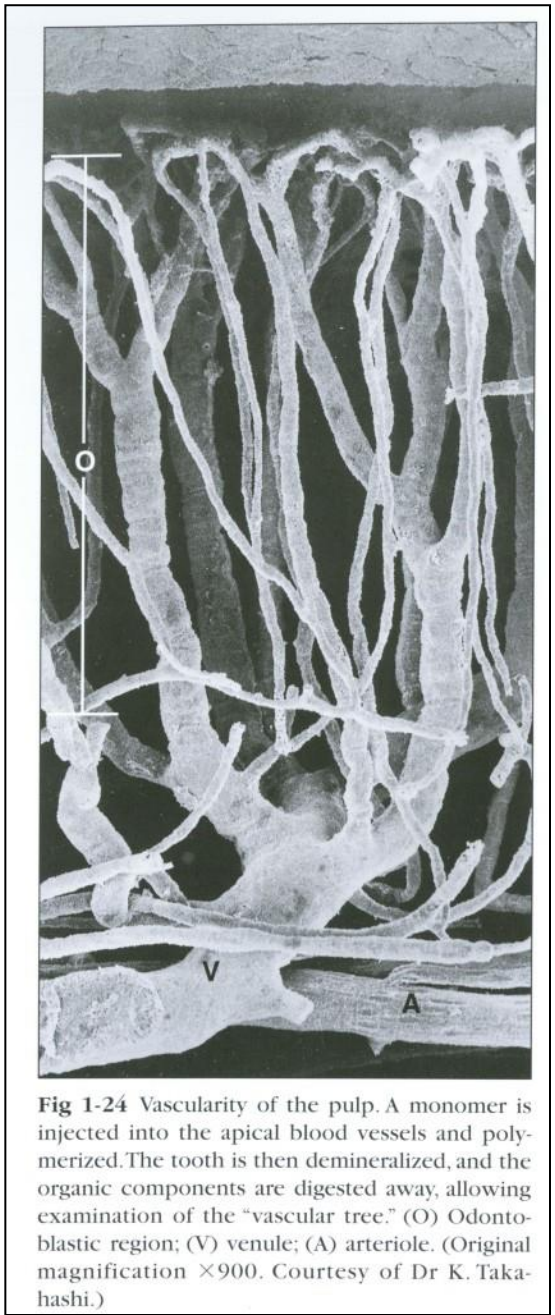


Fig 1-24 Vascularity of the pulp. A monomer is injected into the apical blood vessels and polymerized. The tooth is then demineralized, and the organic components are digested away, allowing examination of the "vascular tree." (O) Odontoblastic region; (V) venule; (A) arteriole. (Original magnification ×900. Courtesy of Dr K. Takahashi.)

Nervous function

- Dental pulp - both vasomotor and sensory nerves (vasomotoric and defense functions)
- **vasomotor nerves** - sympathetic division of the autonomic system (postganglion)
- accompany arterioles

Theories of pain transmission

- dentin innervation Nerve fibrs in dentine tubules)
- hydrodynamic mechanism
- odontoblasic deformation

Defense function

- dentinal pain
- smear layer
- tubular sclerosis
- irritation (tertiary) dentine formation
- inflammation of the connective tissue

- Smear layer - scaling, abrasion, attrition, caries, cavity preparation
- microcrystalline debris (smear layer)
- extends into the dentinal tubules - covers the dentinal surface (several µm thick)
- reduction od dentine sensitivity and permeability (plugging of the tubules).

- Tubular sclerosis - by milder or moderately irritating agents (slowly progressing caries, cavity preparation, abrasion, attrition, age changes)
- peritubular dentine formation

  and
- intratubular calcification
- the tubules become narrower and are closed

- Tertiary (irritative, irregular) dentine formation
- defensive barrier against caries progression

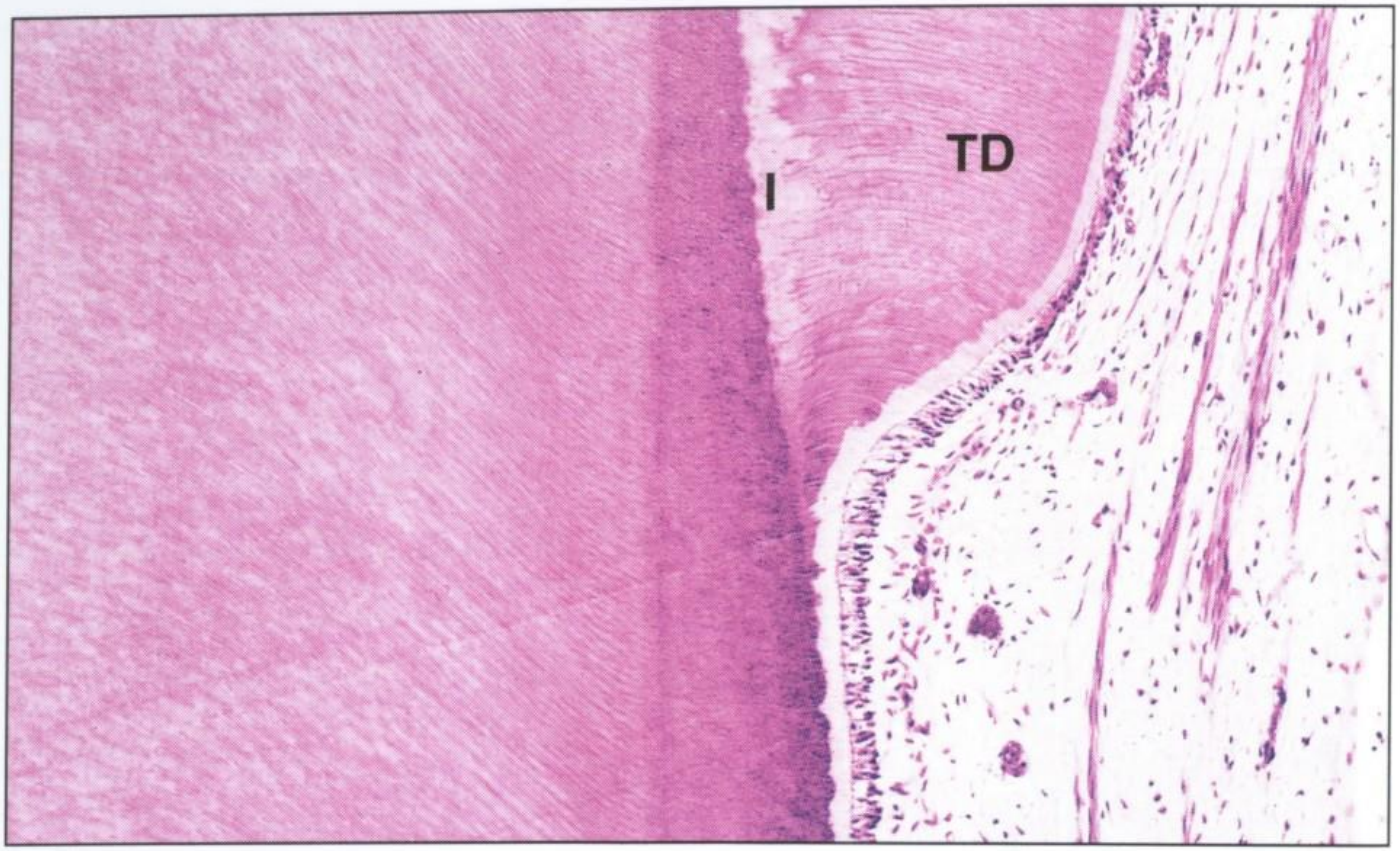


Fig 6-7 Tertiary dentin (TD) formed as a response to the healing of a lesion similar to that shown in Fig 6-5. Note the lightly stained, atubular interface dentin (I) and the dentinal tubules in the tertiary dentin. The odontoblasts lining the pulpal aspect of the tertiary dentin are short, and the cell-free zone is lacking in this area. (Hematoxylin-eosin stain; original magnification ×65.)

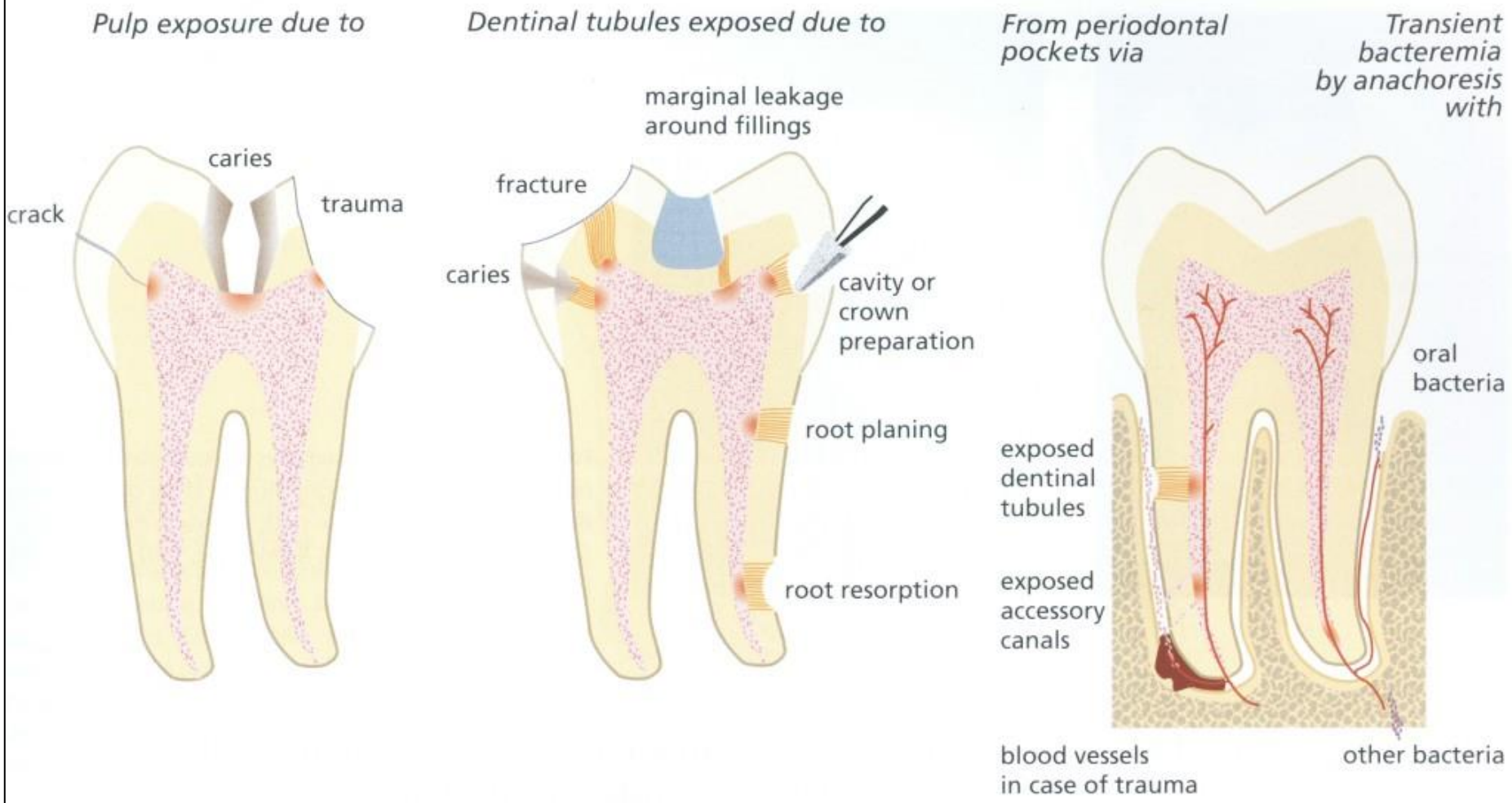


Fig. 8.1 Drawing illustrating the pathways of entry for micro-organisms into the root canal. Obvious ways of entry are pulp exposures due to caries or trauma. Potential pathways are cracks in enamel and dentine due to trauma, and dentinal tubules exposed by caries, fracture, cavity or crown preparation, marginal leakage around fillings, root resorption or root planing. From periodontal pockets, potential pathways are via exposed accessory canals, via exposed dentinal tubules or via blood vessels in the case of trauma. During bacteremia, blood-borne bacteria may colonize an inflamed or necrotic pulp (anachoresis). (See text for details.)

Most common factors leading to pulpal diseases

- Infection (caries, periodontal pocket, traumatic injury, cracs, abrasion,blood circulation)
- Trauma (interruption of blood vessels)
- Traumatization (ruxismus, badly made fillings)
- Chemical factors (filling materials, disinfectants
- Physical factors – increasing of temperature (preparation withour water cooling)


Ramification

Two ways of endodontic teratment

- Vital pulp therapy

Dental pulp remain in the pulp chambre and root canals completely or partly

- Root canal treatment

Dental pulp is removed from the root canal completely, root canal is shaped, cleaned, filled

Vital pulp therapy

- Indirect pulp capping
- Intermittent excavation
- Direct pulp capping
- Pulpotomy
  - Coronal: partly or completely
  - Deep pulpotomy

Diagnosis

- **History**

Presenting complaint

Medical history

Dental history

Pain history

Location

Type and intensity of pain

Duration

Stimulus

Relief (analgetics, antibiotics, sipping cold drinks)

Diagnosis

Clinical examination

Extraoral (swelling, redness, extraoral sinuses, lymph nodes, degree of mouth opening)

Intraoral examination

Swelling, redness,palpation, percussion, sinus tract examination, teeth mobility,pockets

Diagnosis

Clinical examination

Pulp sensitivity tests, radiographic examination, transillumination.

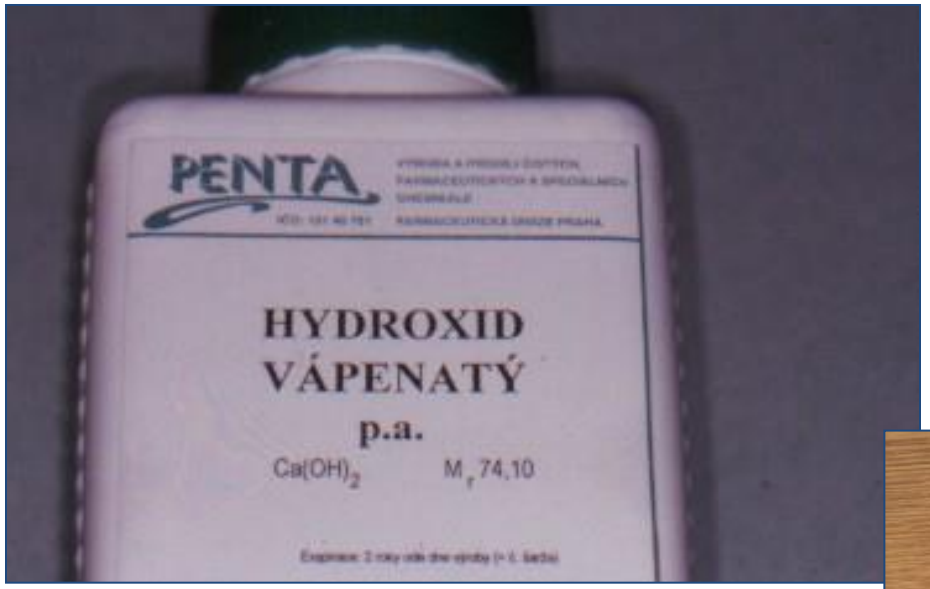
Consideration

- If the disease of dental pulp is reversible:

Vital pulp therapy

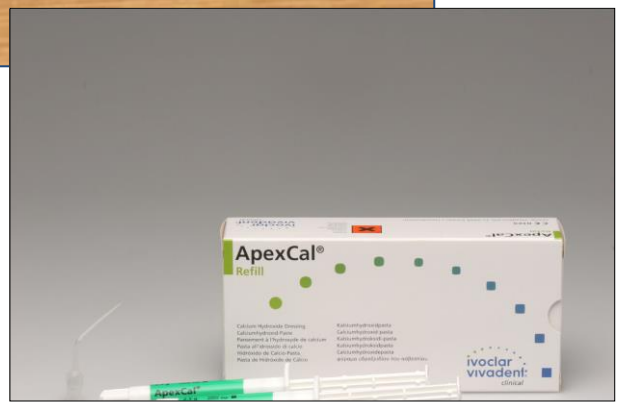
- If the disease of dental pulp is ireversible

Root canal treatment



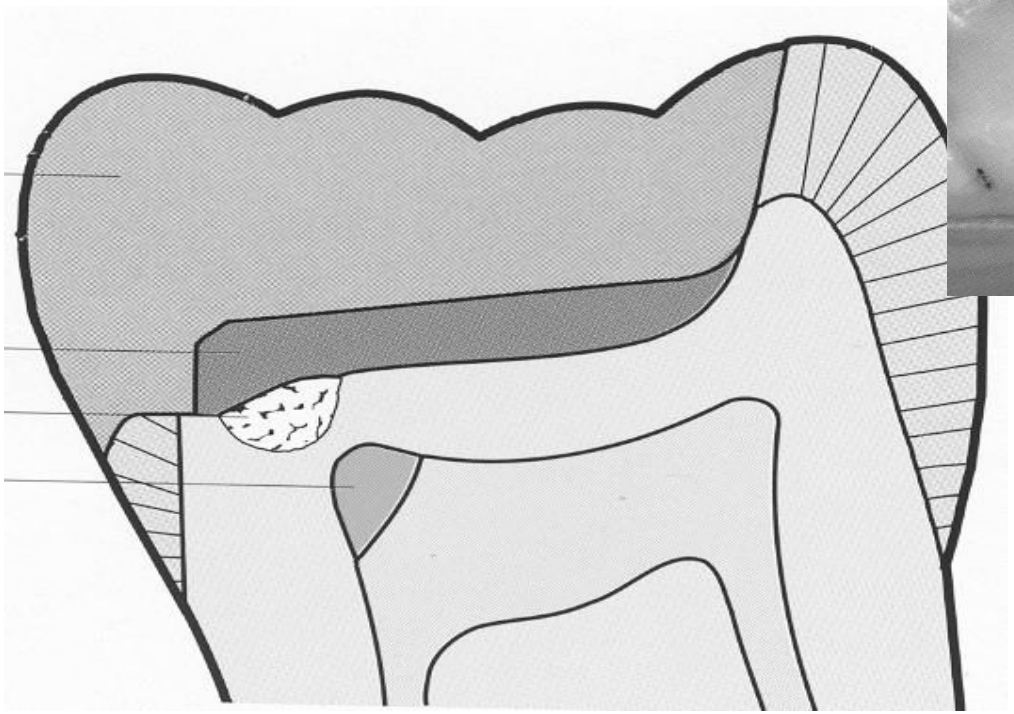
$Ca(OH)_2$

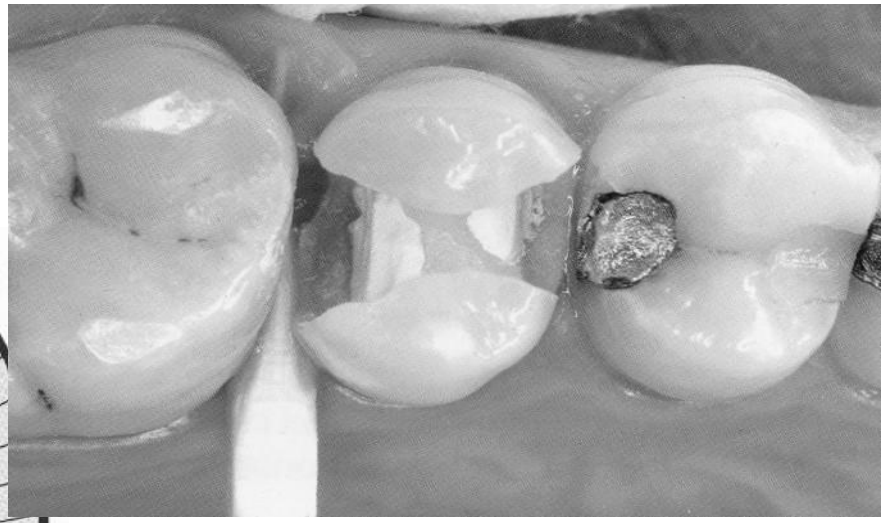
pH 12,5



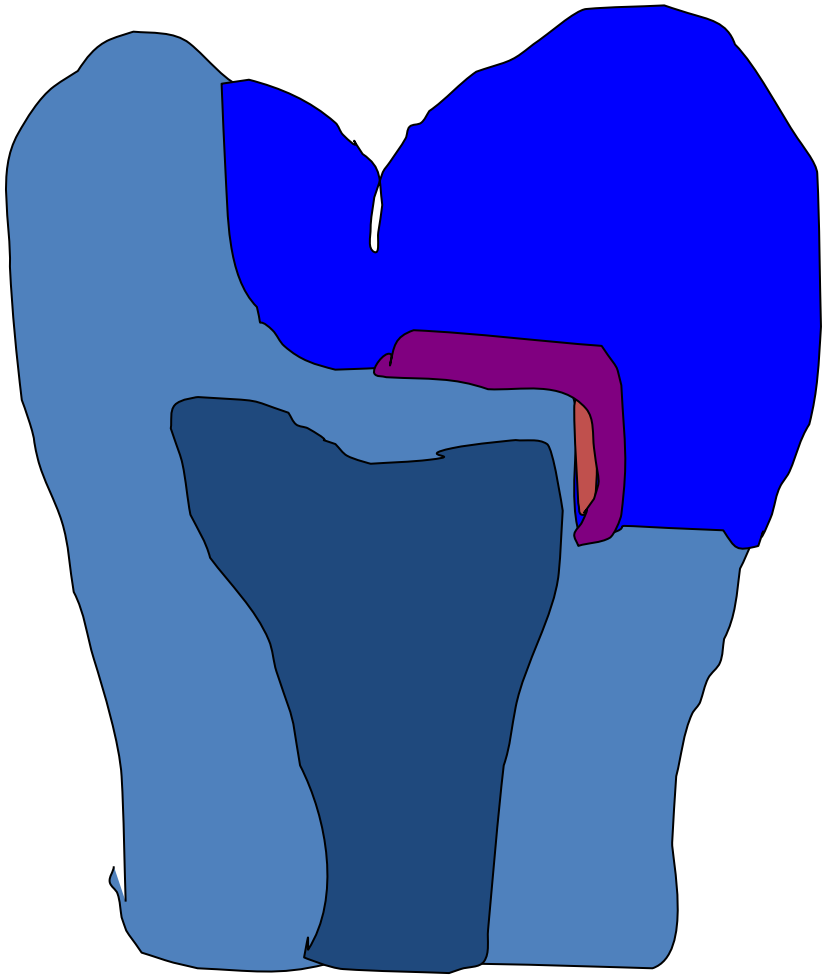
See text medicaments in endodontics

Indirect pulp capping



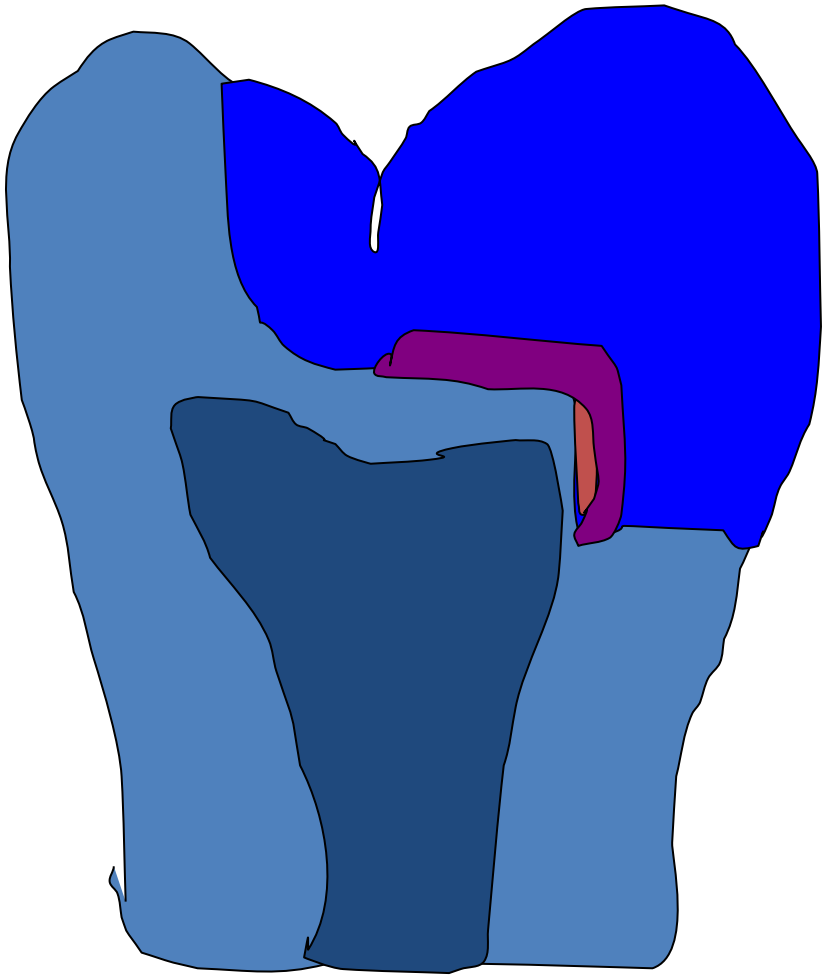


Indirect pulp capping



Only small amount of carious dentine left
Calciumhydroxide cement
Permanent filling

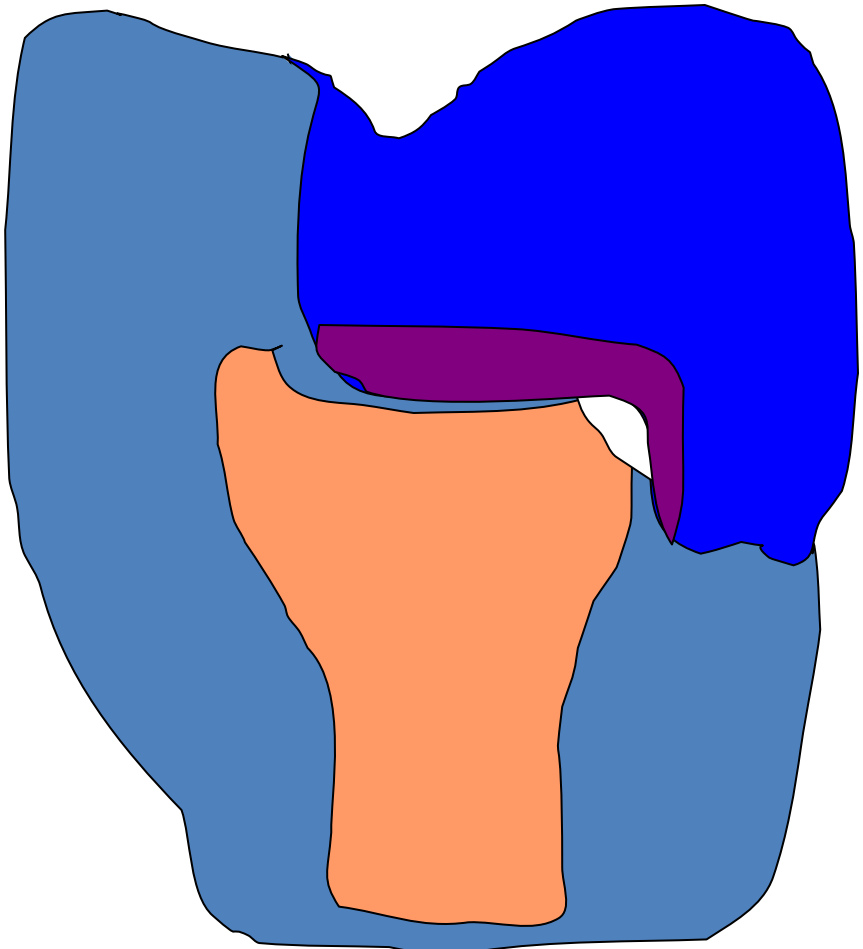
Intermittent excavation



Larger amount of
carious dentine left
Calcium hydroxide suspension
Temporary filling
6 weeks
Final excavation afterwards
Permanent filling

We expect improvement of
tertiary dentin formation,
dessication of carious dentine

Direct pulp capping

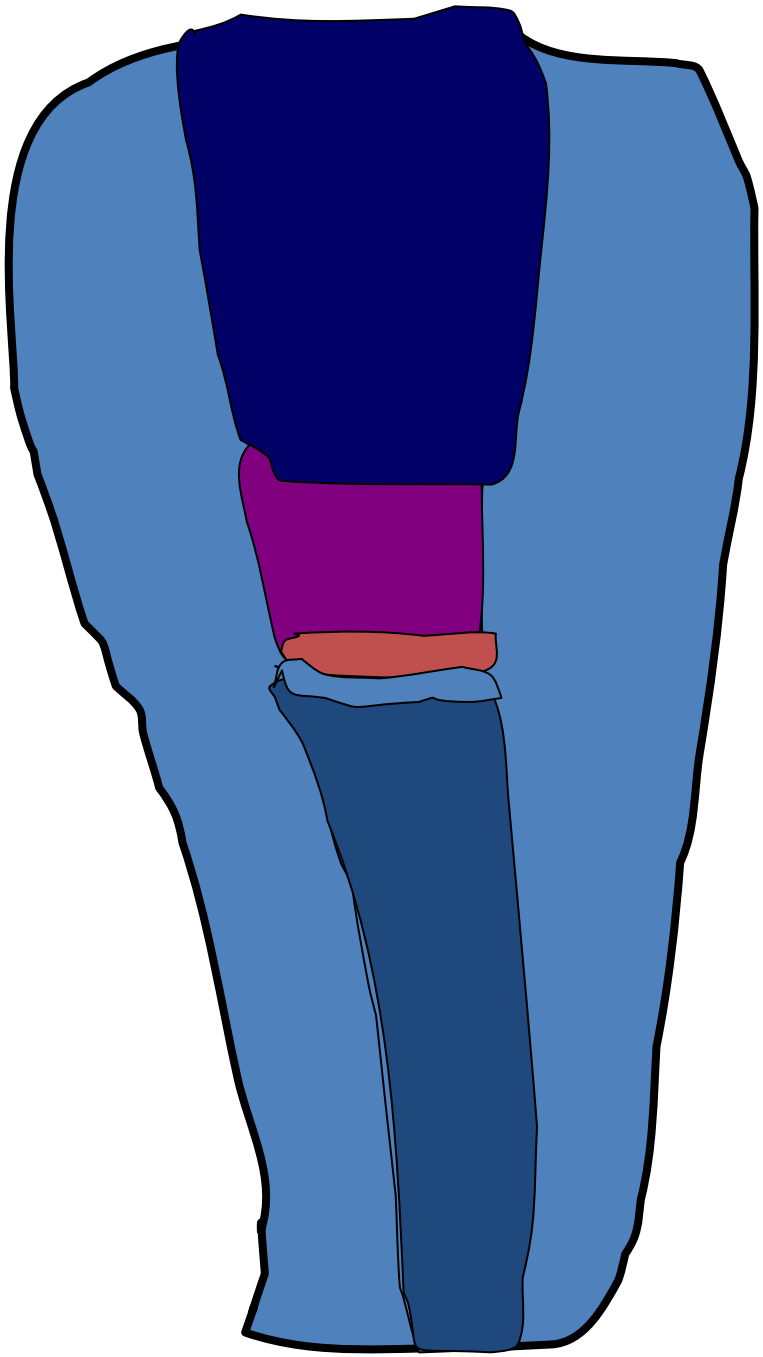


Directly on dental pulp
Very small perforation surrounded with non carious dentine
Calcium hydroxide Base filling

Dentim brosge is formed

Dentin bridge

- Rests of calcium hydroxide
- Connective tissue
- Calcified connective tissue
- Dentin
- Predentin
- Odontoblasts



Pulpotomy -
Coronal
- **partial**
- **Total**

Deep – inside root canal

Calcium hydroxide, Base,
Permanent filling

Dentin bridge is formed

Phases of the endodontic treatment

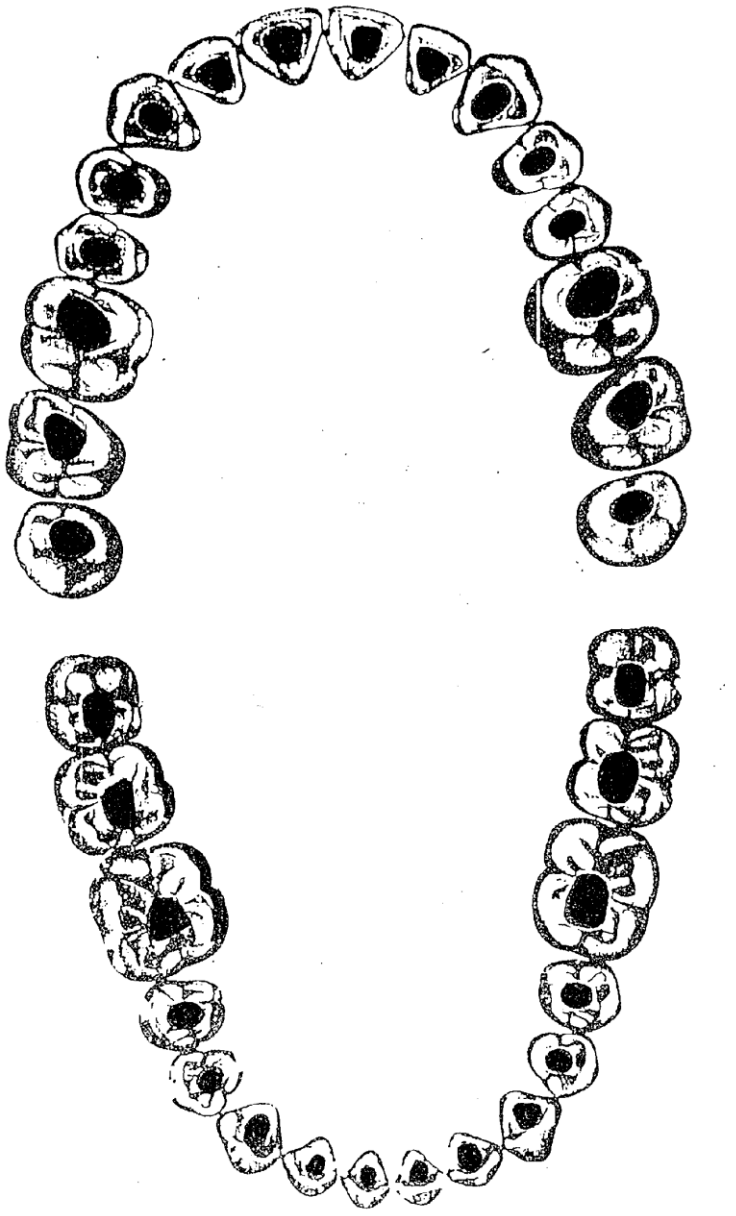
- **Investigation, diagnostic radiogram, consideration (local, regional, systemic factors)**
- **Preendo: Removal of old fillings, carious dentin, temporary restoration – sontour of the tooth.**
- **Dry operating field**
- **Preparation of the access (endodontic cavity)**

Phases of the endodontic treatment

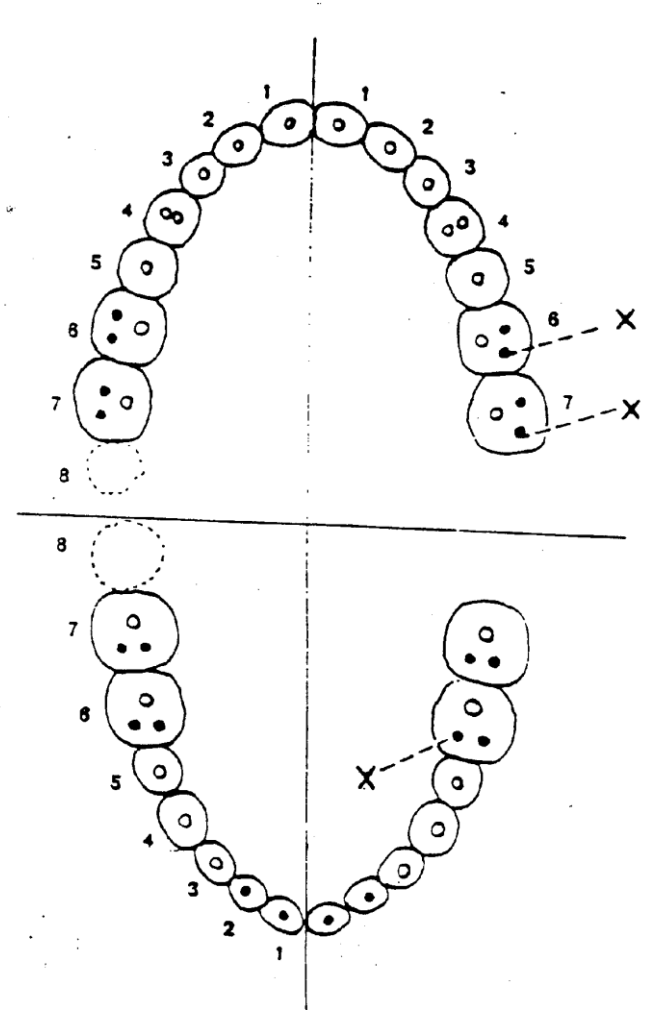
- Opening of root canals
- Initial flaring and removal of content of root canal
- WL (working length)
- Root canal shaping and cleaning (irrigation)
- Recapitulation, final irrigation
- Drying
- Filling
- Radiogram
- Postendodontic treatment

Access opening

Shapes of endo cavities



Number of root canals



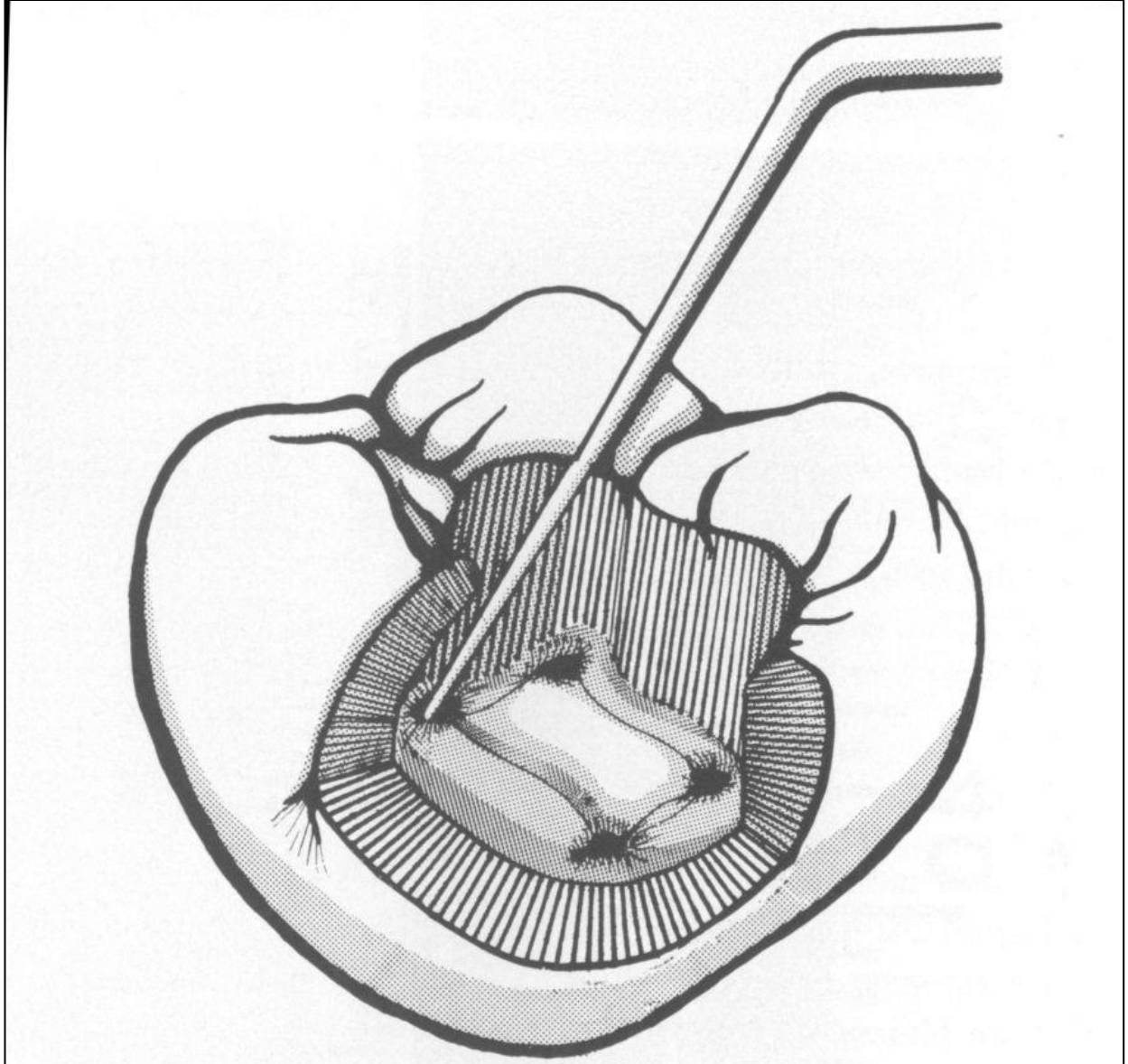


FIG. 7-5 Indispensable in endodontic treatment, the endodontic pathfinder serves as an explorer to locate orifices, as an indicator of canal angulation, and often as a chipping tool to remove calcification.

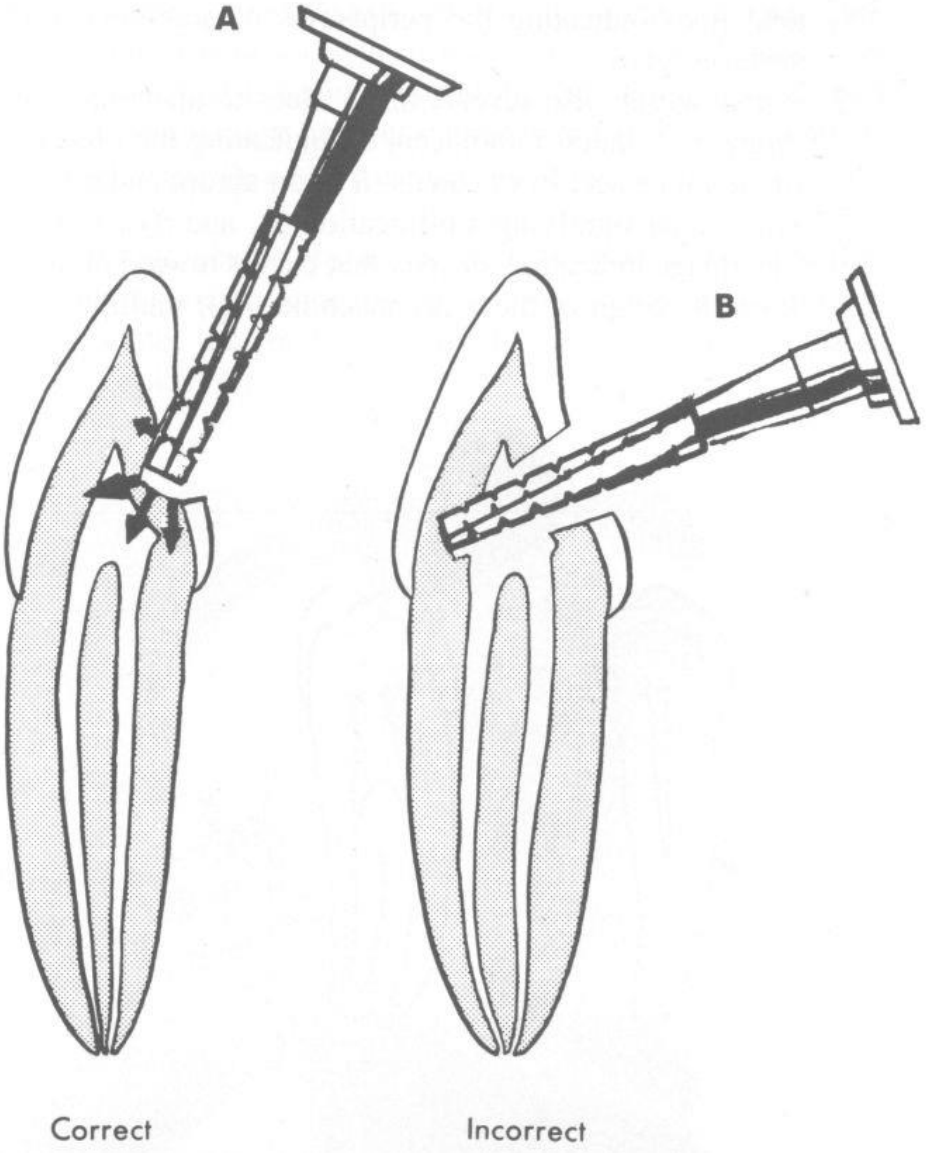


FIG. 7-6 A, Sweeping motion in a slightly downward lingual-to-labial direction *(arrows),* until the chamber is engaged, to obtain the best access to the lingual canal. **B,** Incorrect approach: directing the end-cutting bur in a straight lingual-to-labial direction. Mutilation of tooth structure and perforation will be the result in this small and narrow incisor.

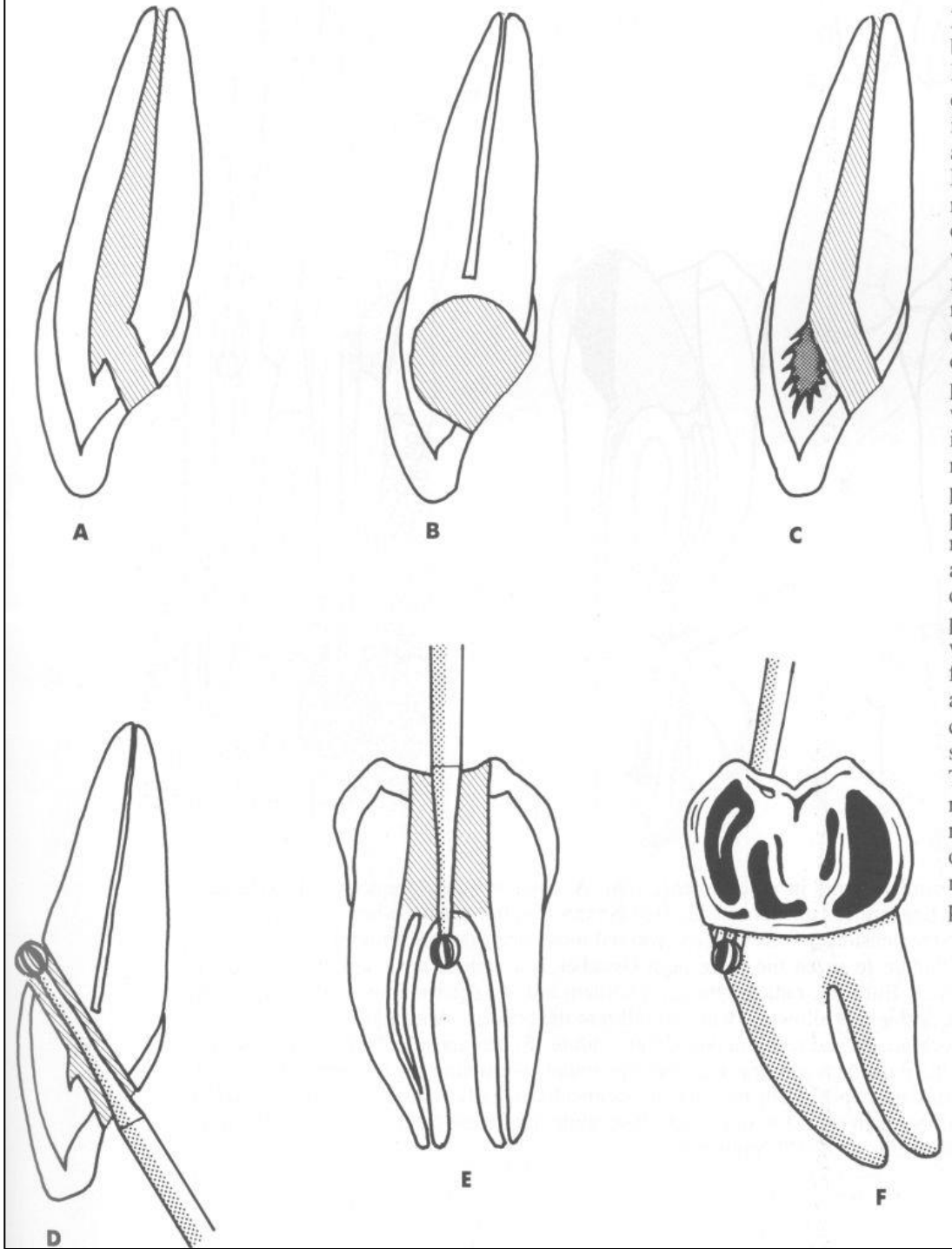


FIG. 7-30 Difficulties created by poor access preparation. **A,** Inadequate opening, which compromises instrumentation, invites coronal discoloration, and prevents good obturation. **B,** Overzealous tooth removal, resulting in mutilation of coronal tooth structure and weakening leading to coronal fracture. **C,** Inadequate caries removal, resulting in future carious destruction and discoloration. **D,** Labial perforation (lingual perforation with intact crowns is all but impossible in incisors). Surgical repair is possible, but permanent disfigurement and periodontal destruction will result. **E,** Furcal perforation of any magnitude, which (1) is difficult to repair, (2) causes periodontal destruction, and (3) weakens tooth structure, invites fracture. **F,** Misinterpretation of angulation (particularly common with full crowns) and subsequent root perforation. This is extremely difficult to repair; and even when it is repaired correctly, because it occurred in a difficult maintenance area the result is a permanent periodontal problem.

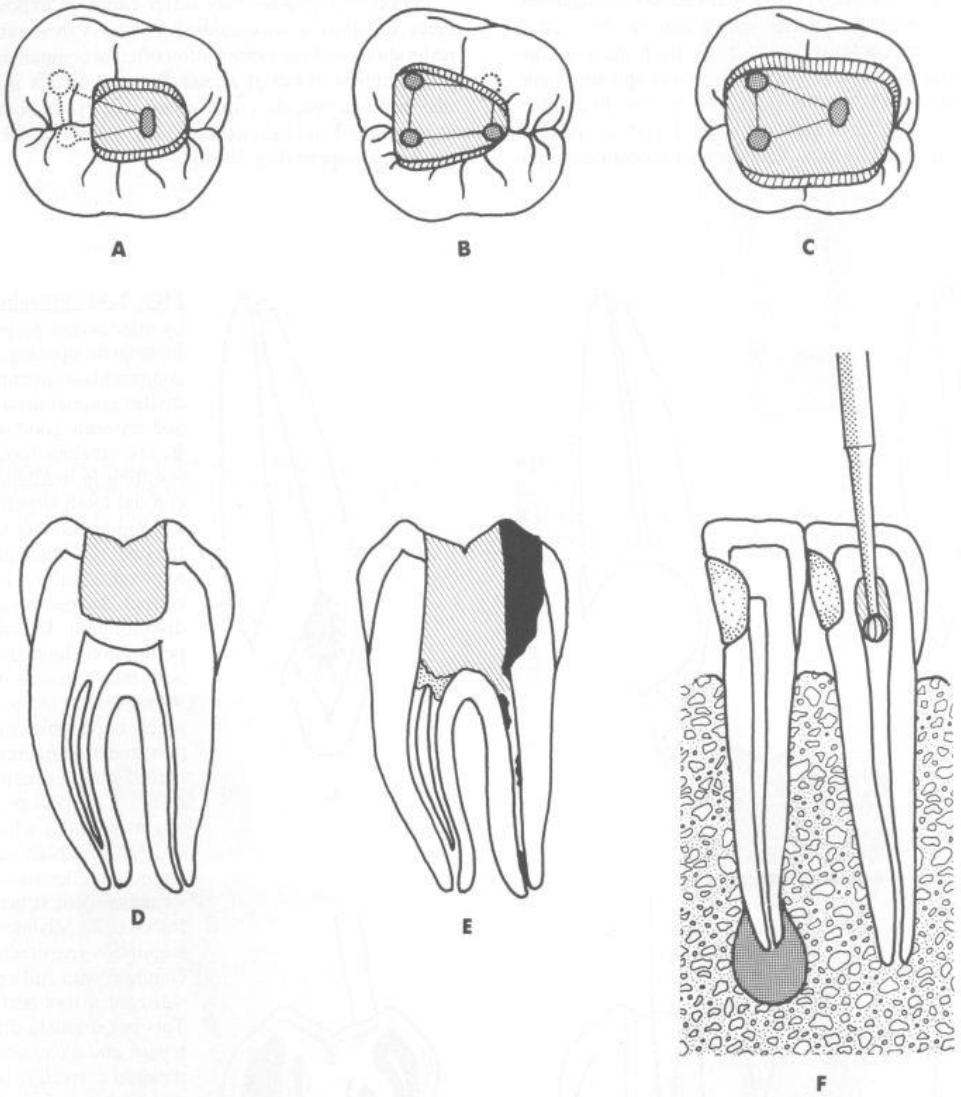
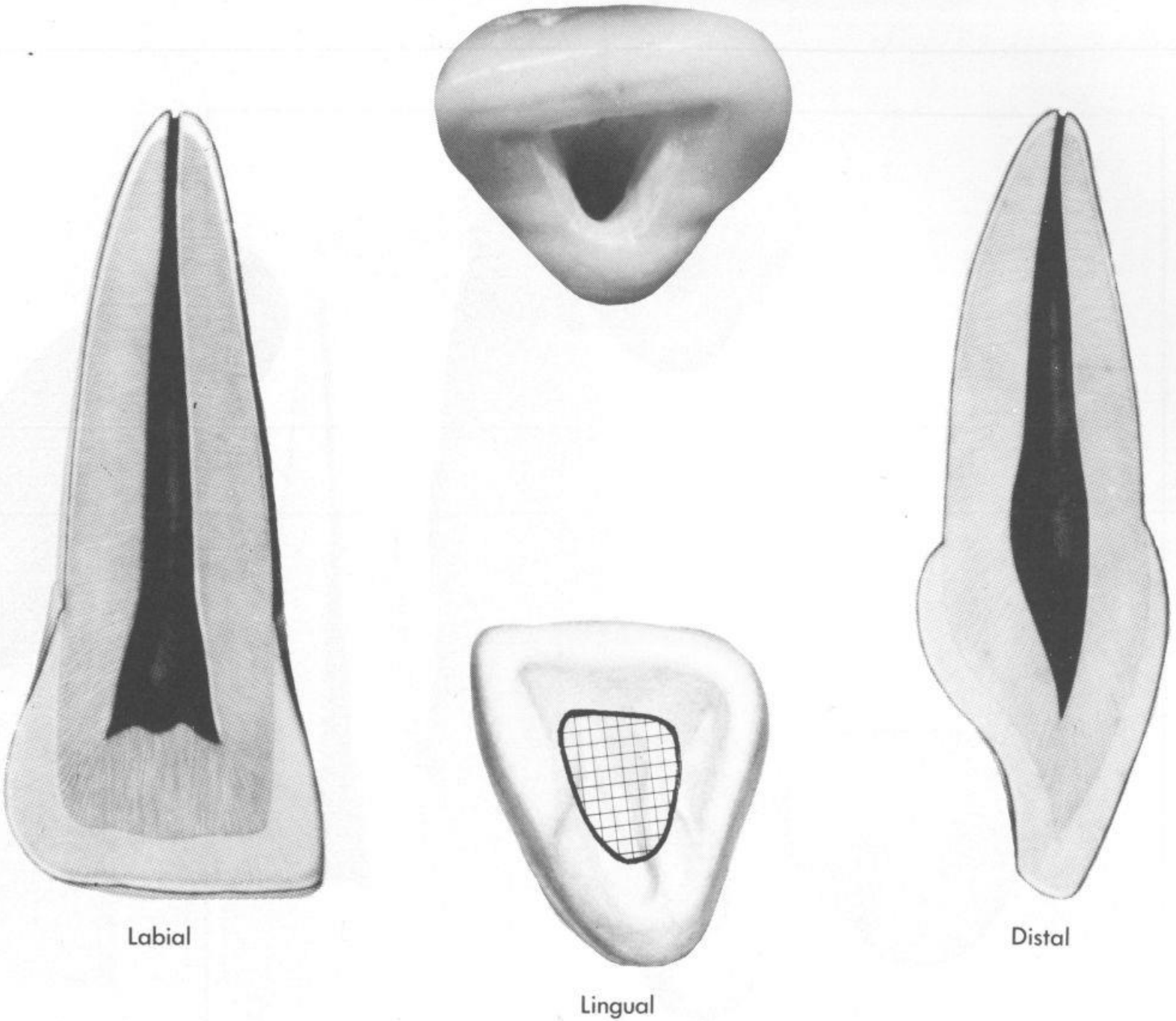
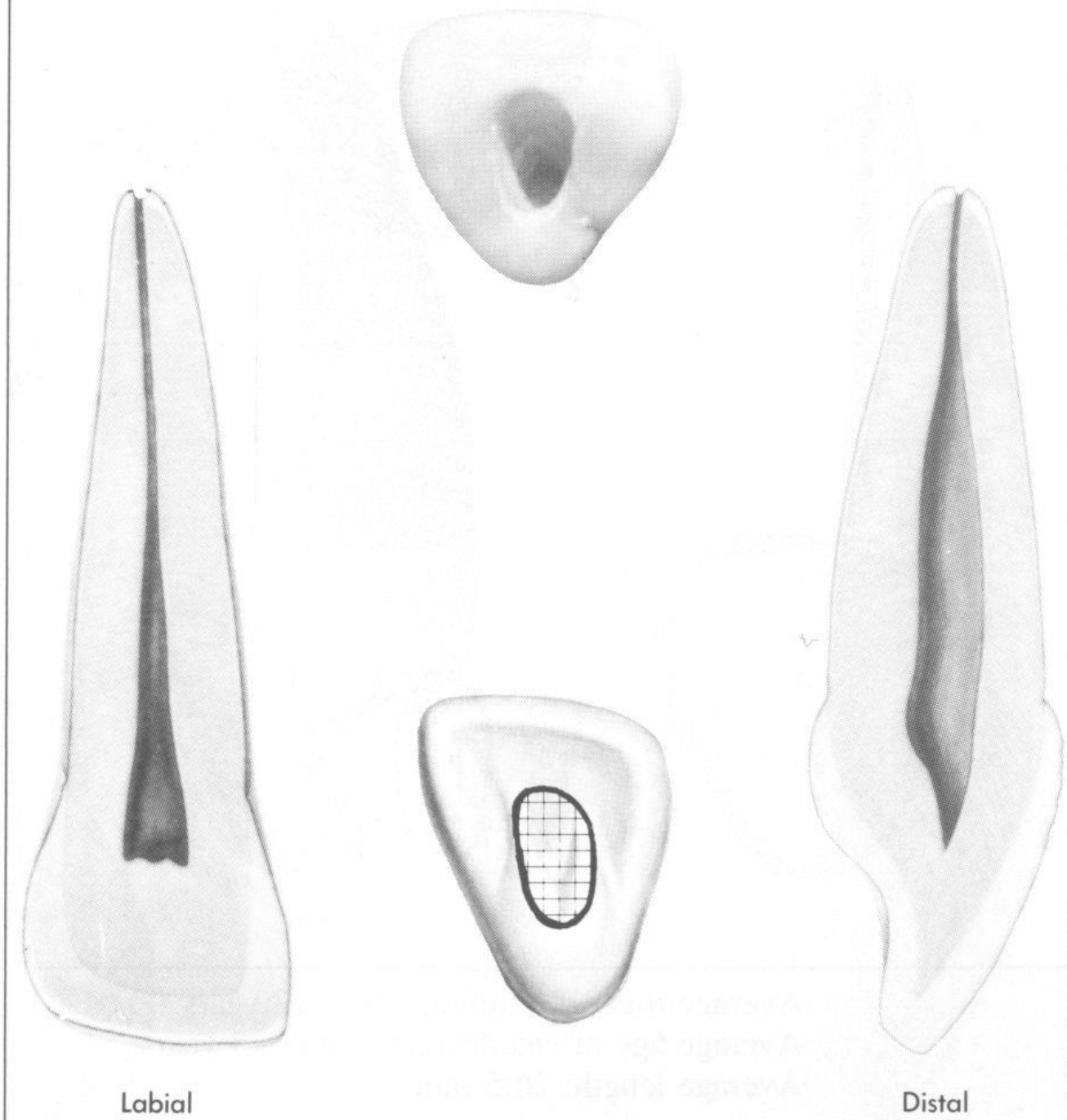
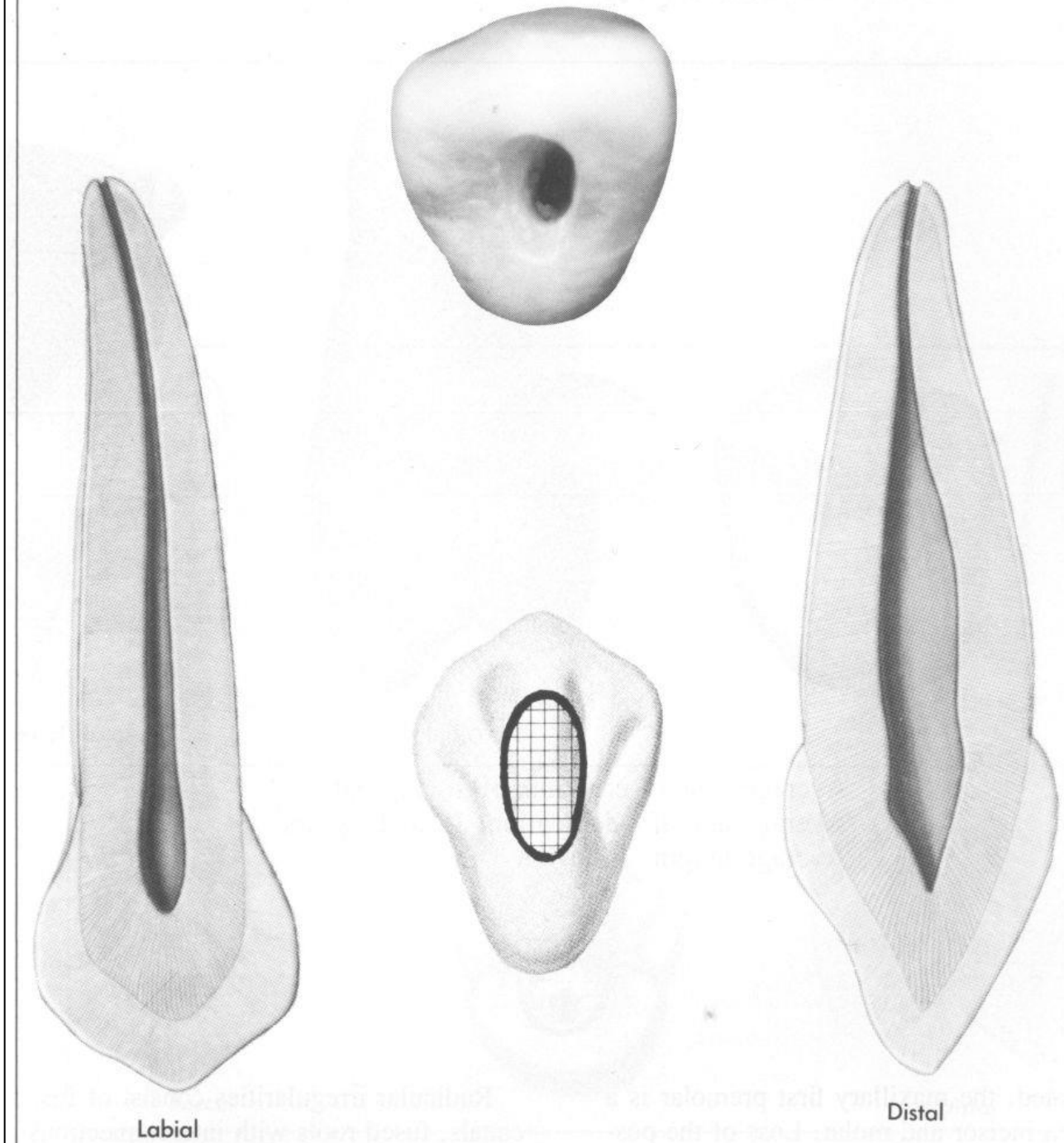
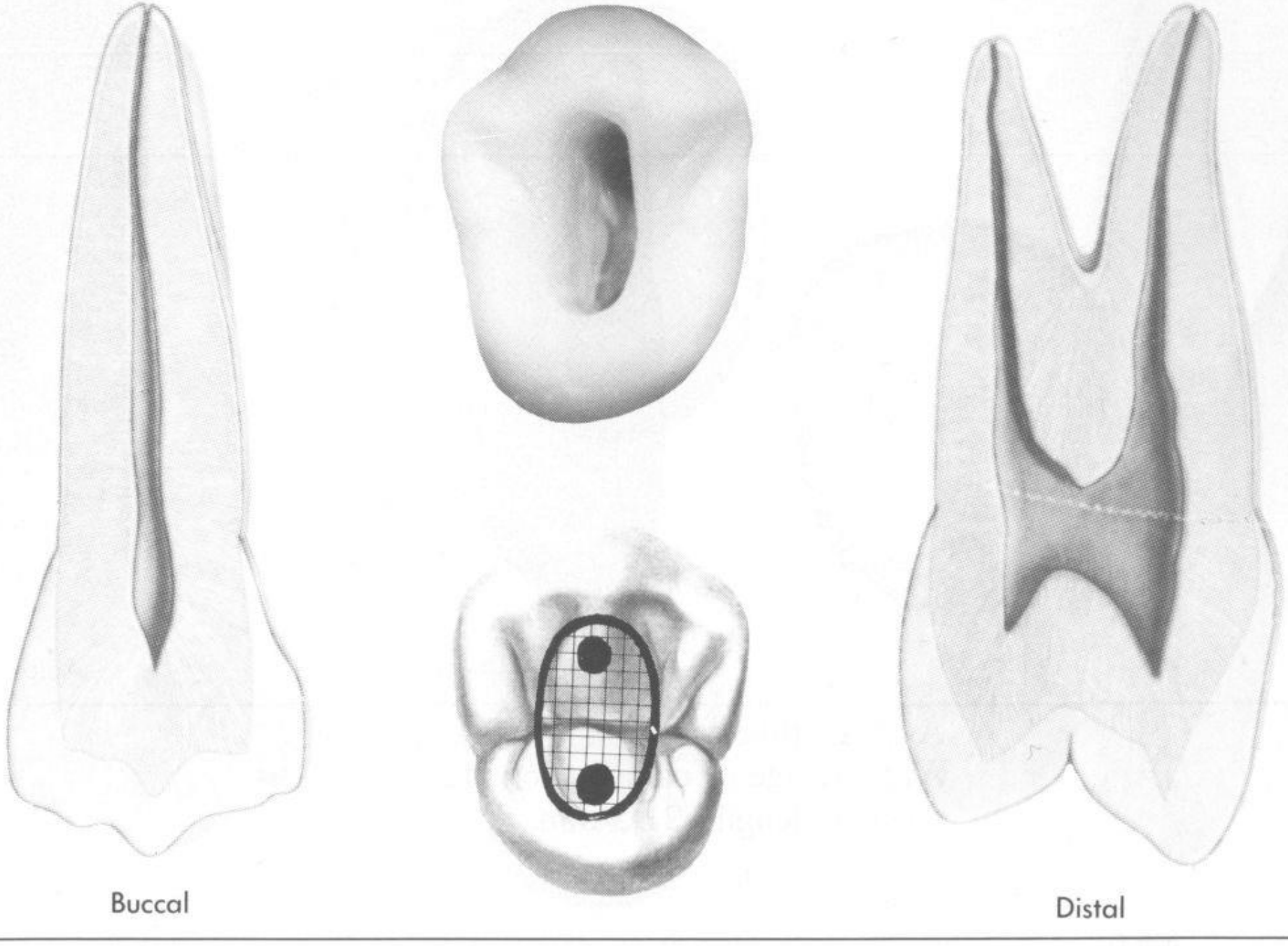


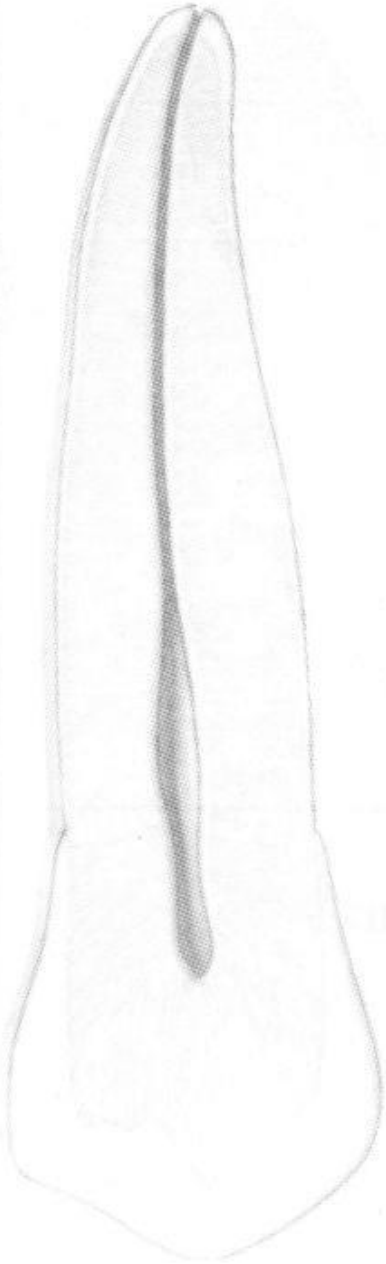
FIG. 7-31 Common errors in access preparation. **A,** Poor access placement and inadequate extension, leaving orifices unexposed. **B,** Better extension but not including the fourth canal orifice. **C,** Overextension, which weakens coronal tooth structure and compromises final restoration. **D,** Failure to reach the main pulp chamber is a serious error unless the space is heavily calcified. Bitewing radiographs are excellent aids in determining vertical depth. **E,** An iatrogenic problem is allowing debris to fall into the orifices. Amalgam filings and dentin debris can block access and result in endodontic failure. **F,** The most embarrassing error, and the one with the most damaging medical-legal potential, is entering the wrong tooth. A common site of this mishap is teeth that appear identical coronally, and the simple mistake is placing the rubber dam on the wrong tooth. Beginning the access cavity *before* placement of the rubber dam helps avoid this problem.

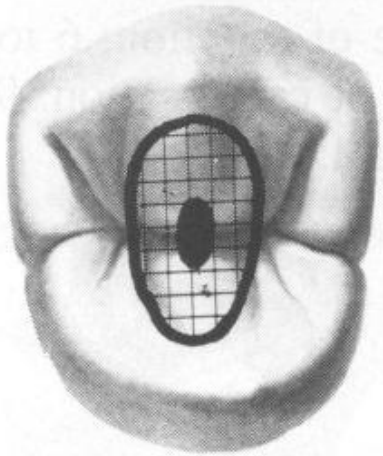

Labial
Lingual
Distal

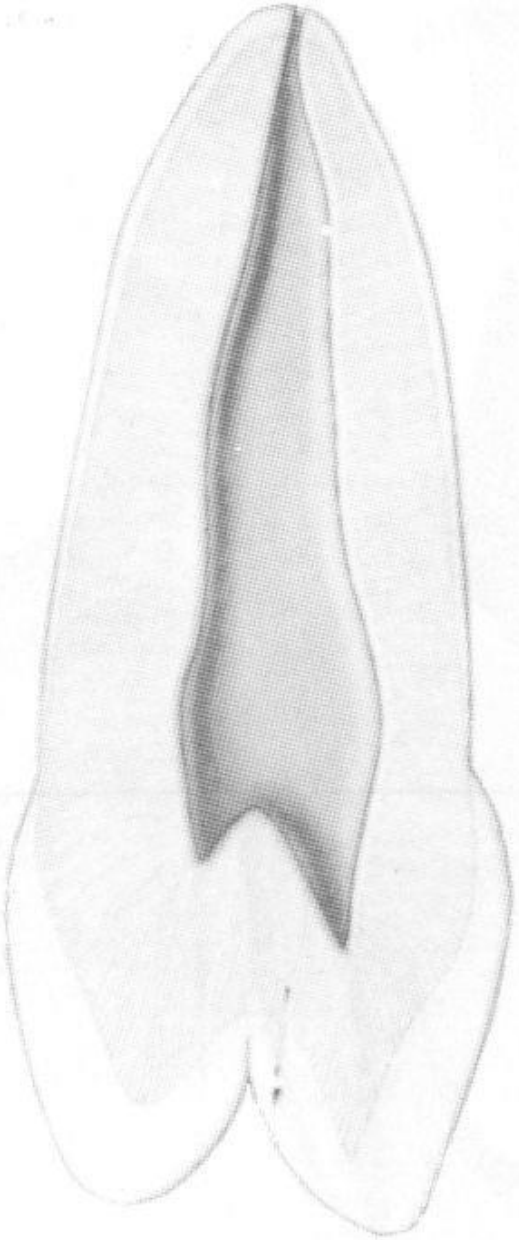

Labial
Distal


Labial
Distal


Buccal
Distal

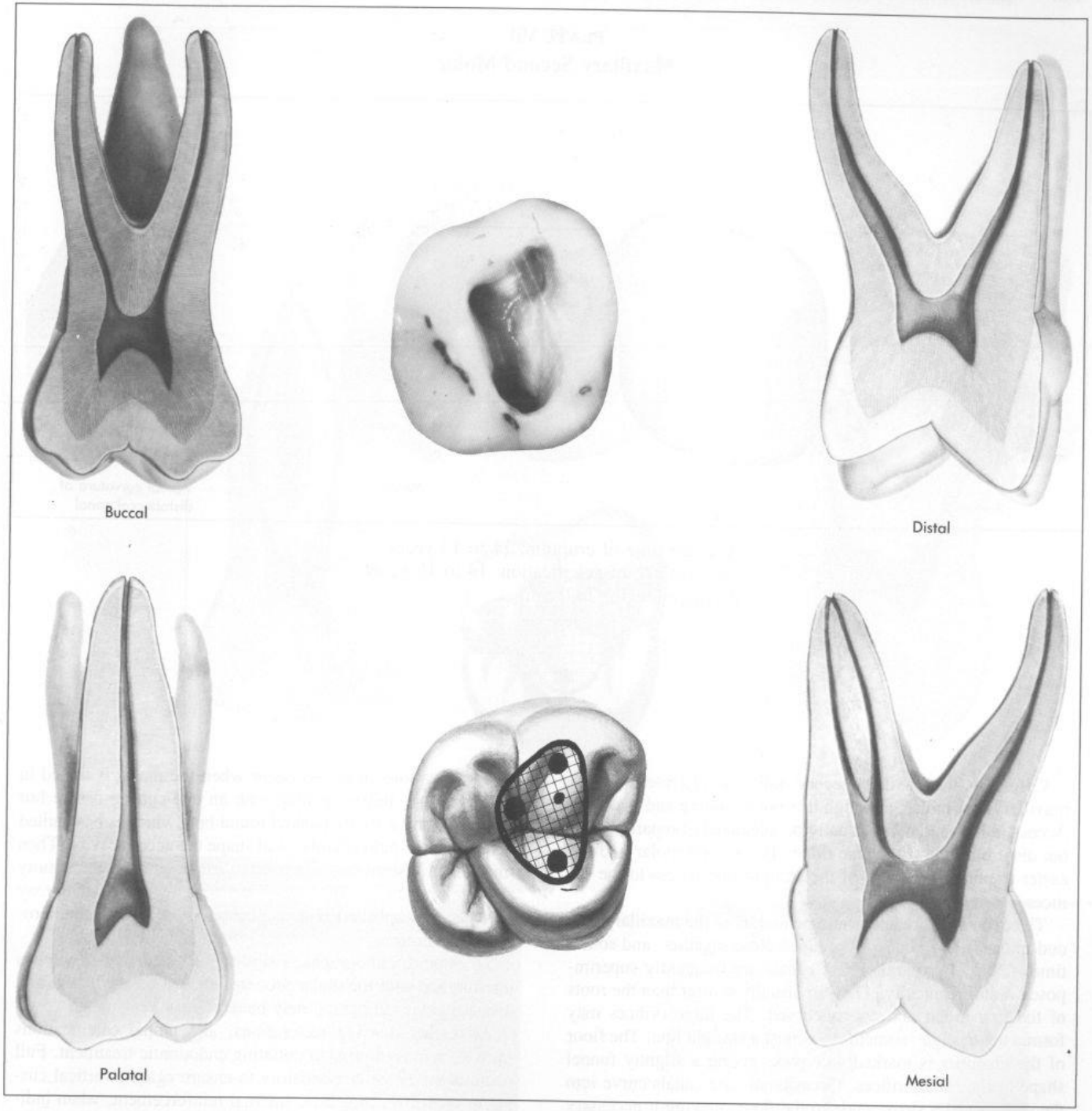


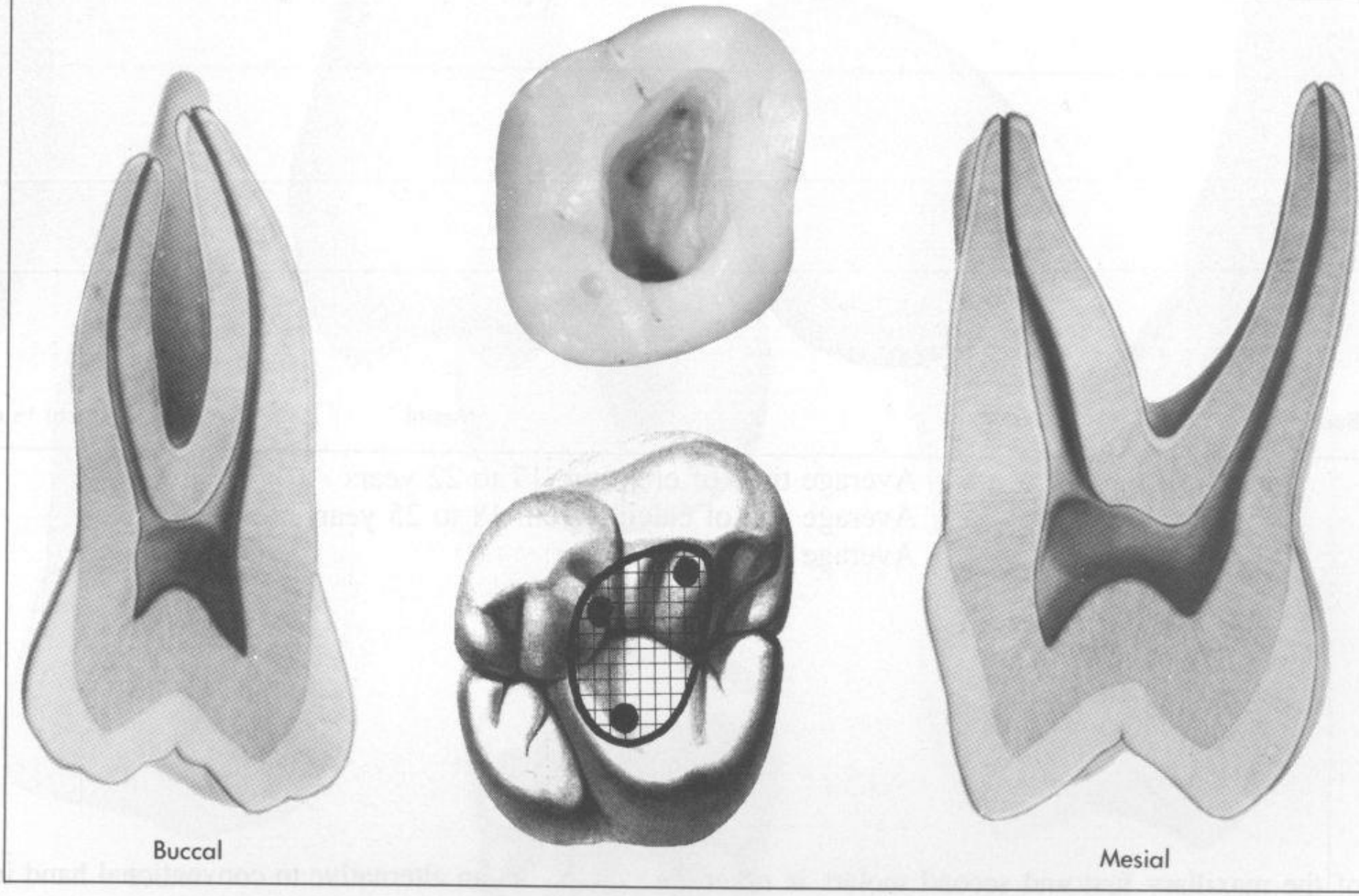




Buccal

Distal


Buccal
Distal
Palatal
Mesial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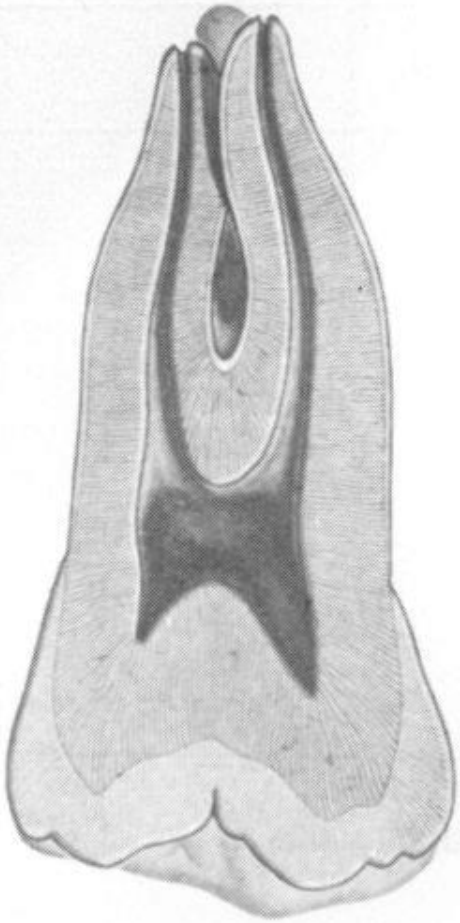
Mesial



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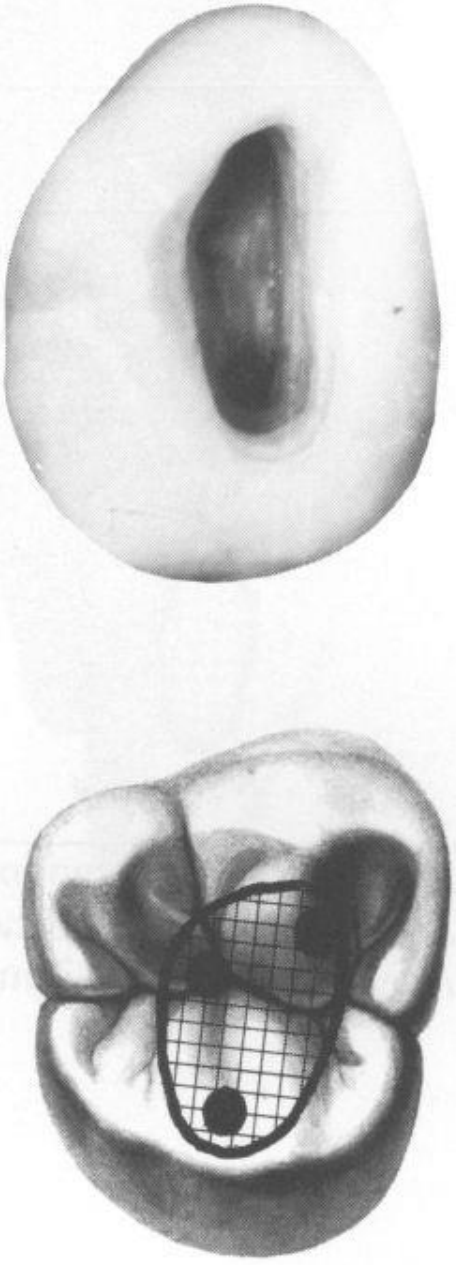
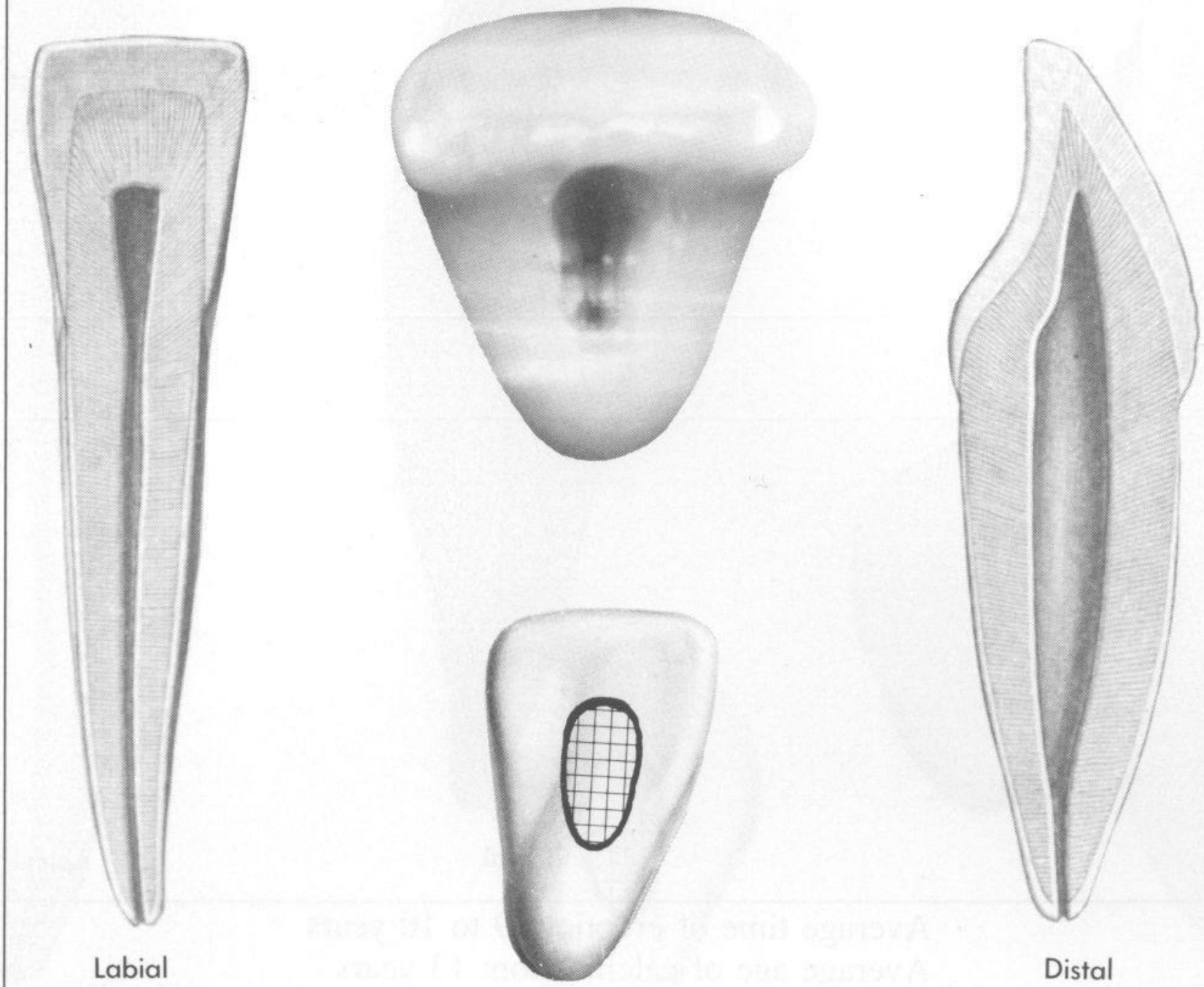
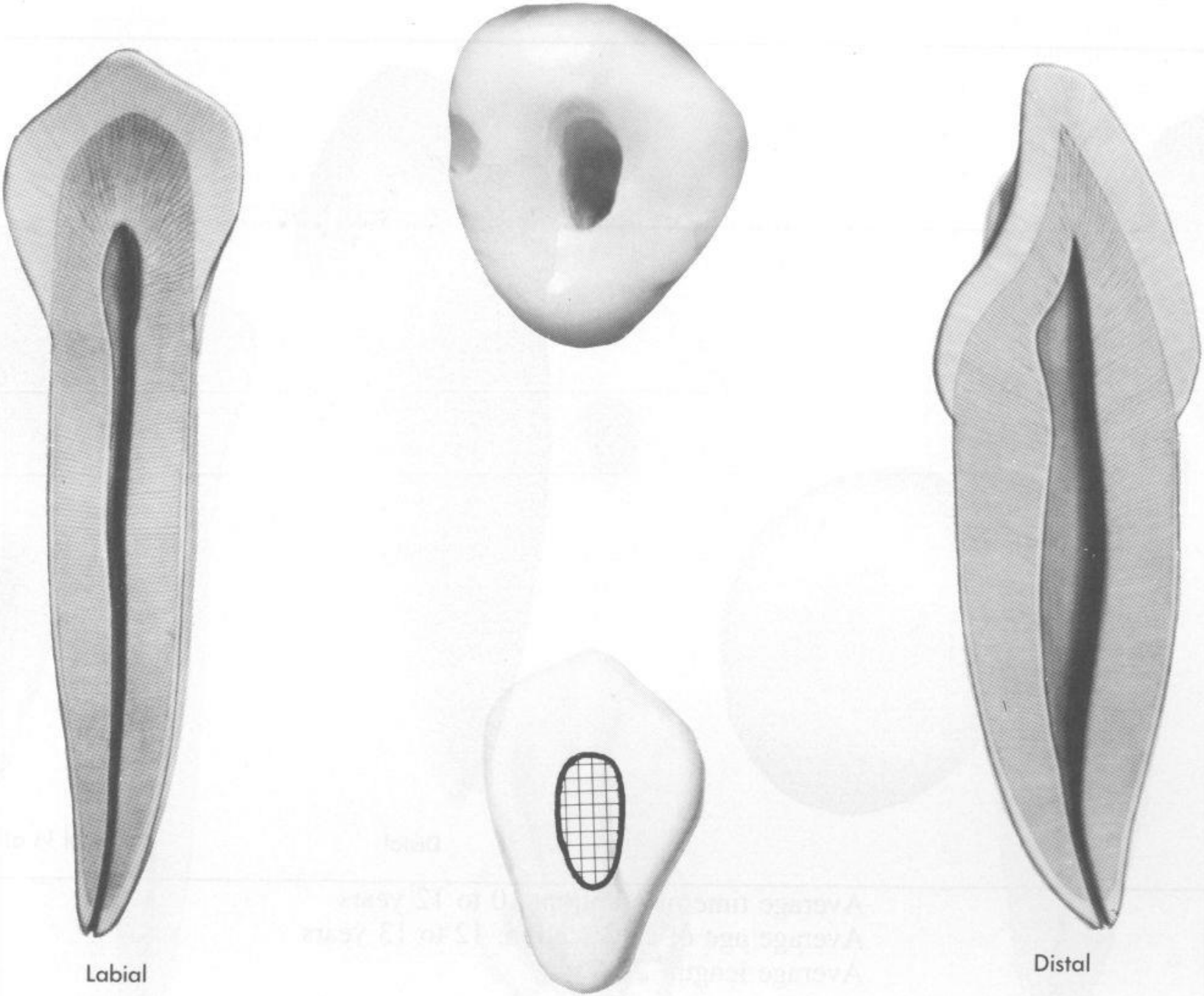
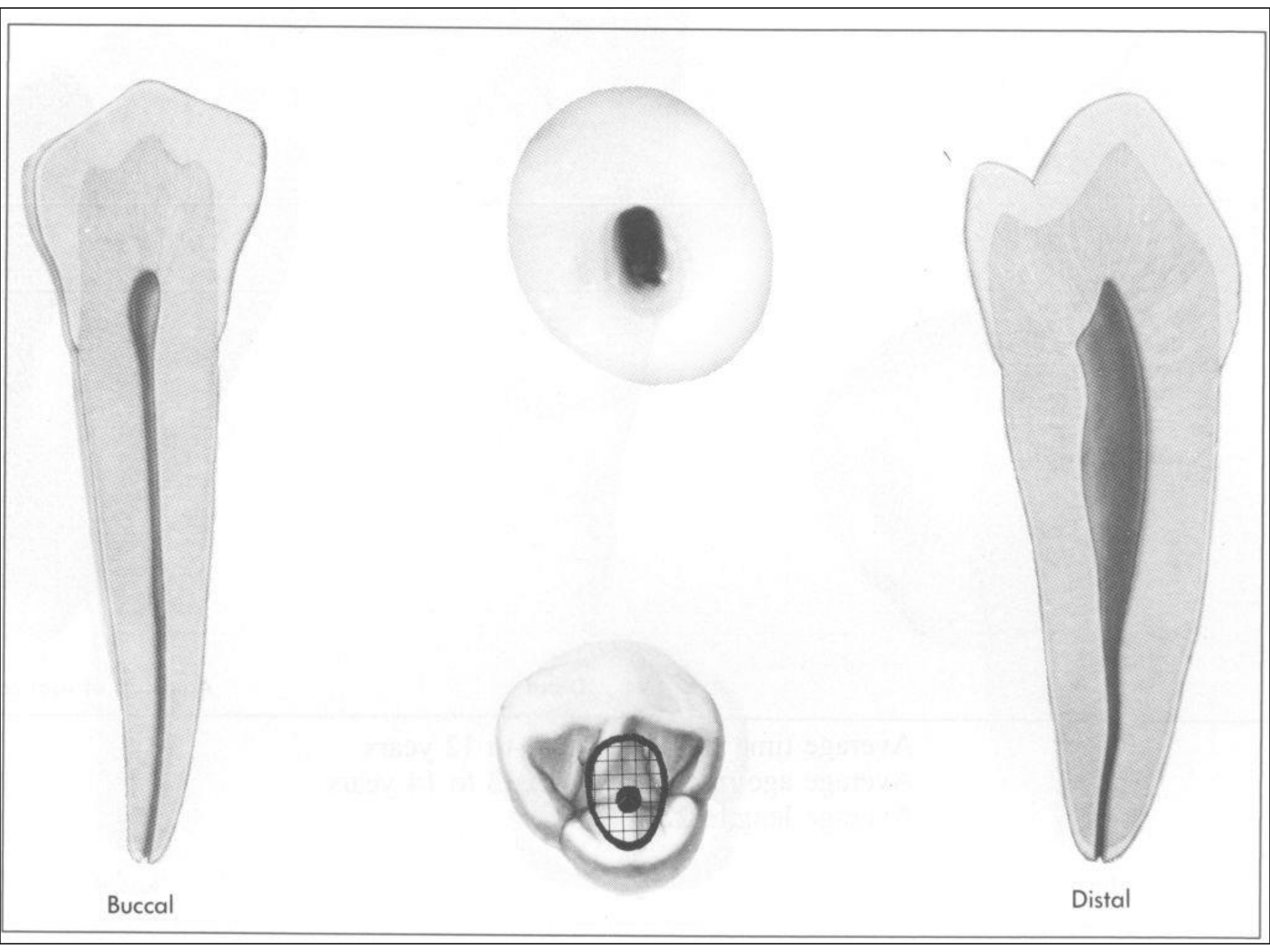
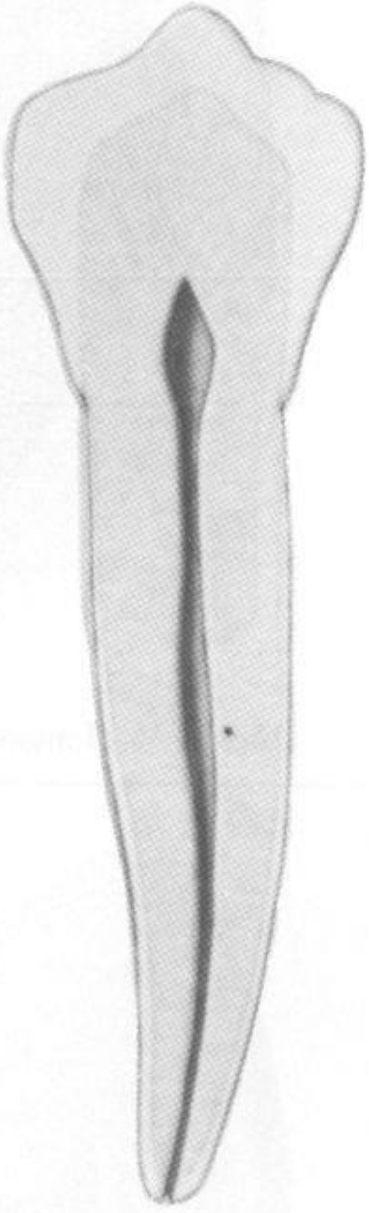


Distal


Labial
Distal


Labial
Distal


Buccal
Distal



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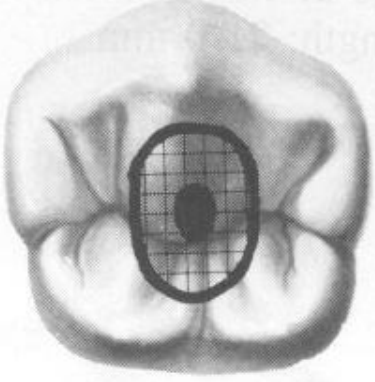
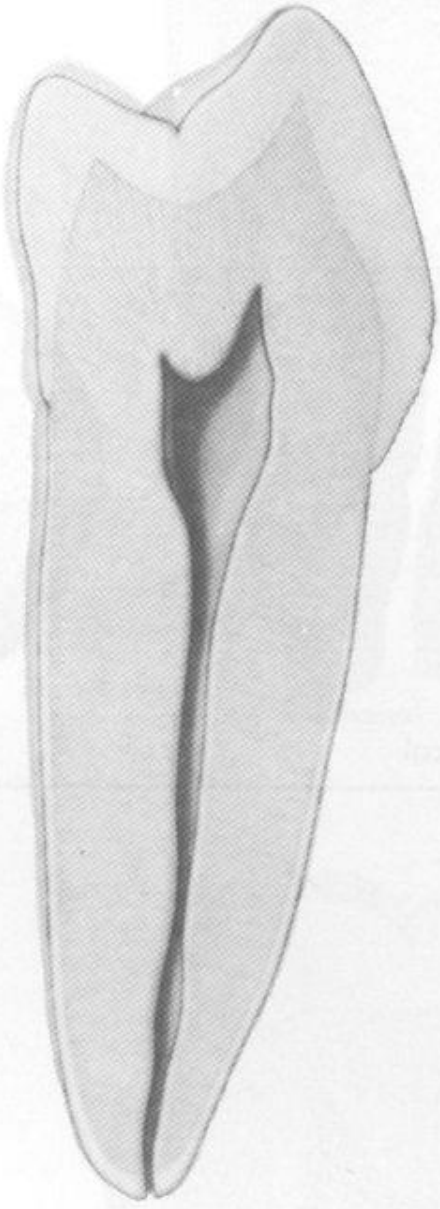
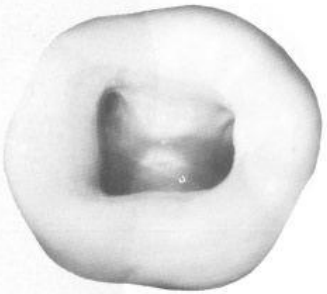
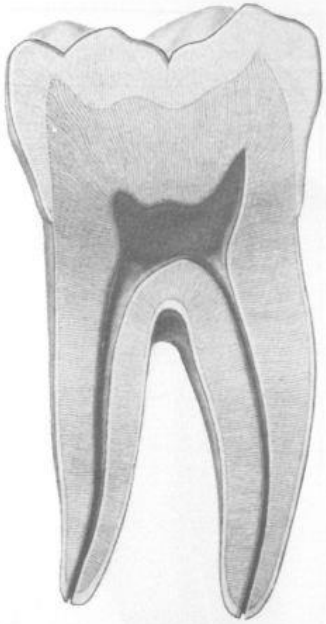




Distal

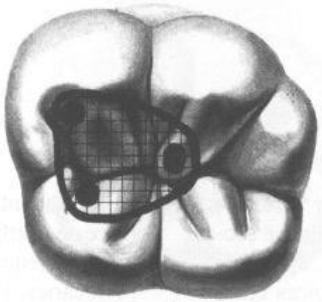
Buccal

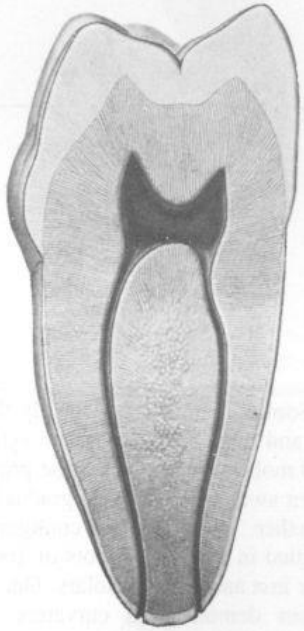




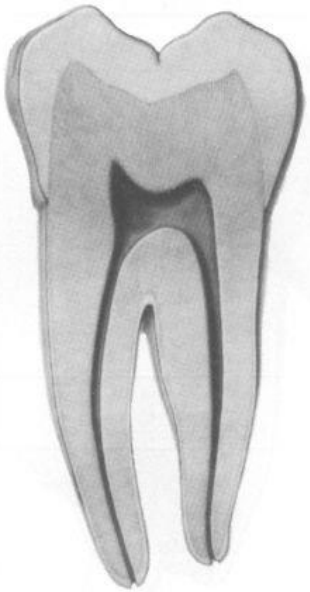
Lingual

Distal

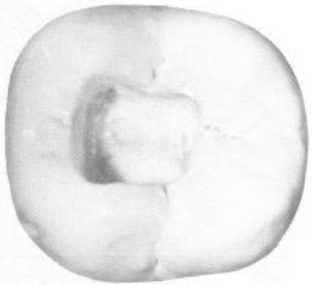


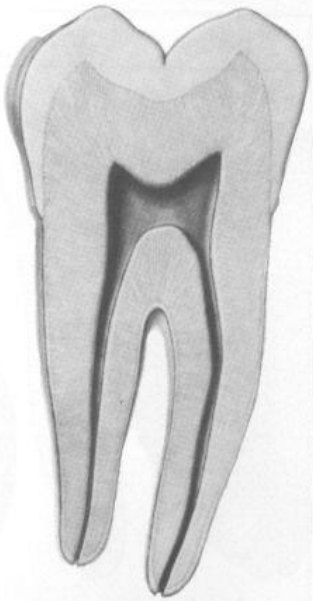


Mesial

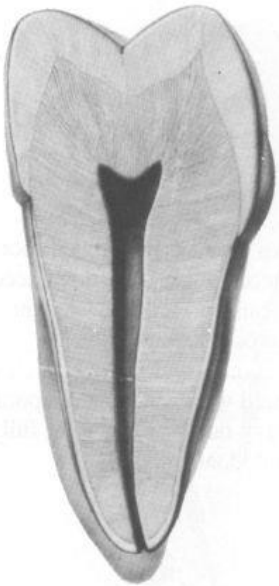


Buccal

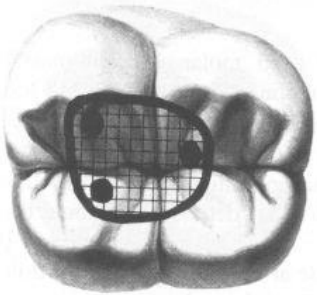


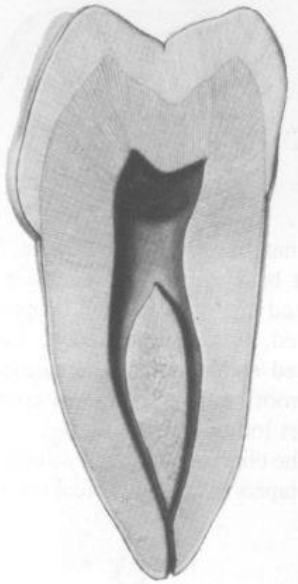


Lingual

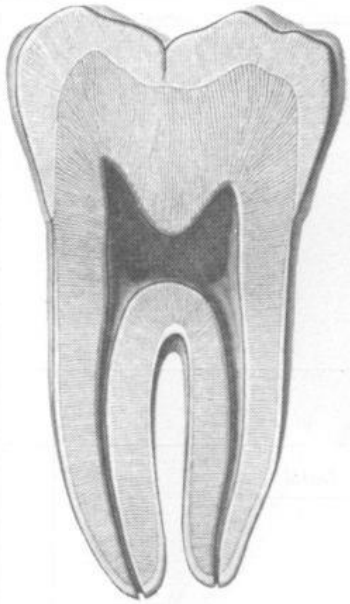


Distal

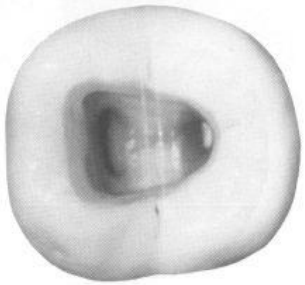


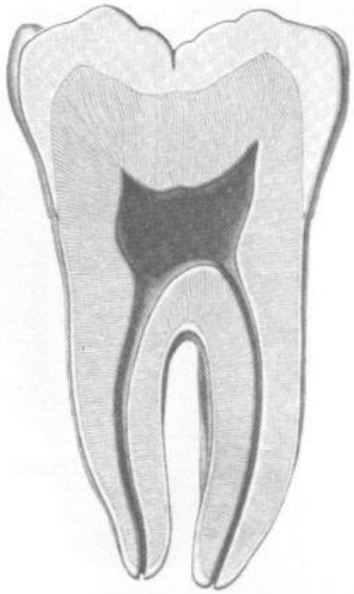


Mesial

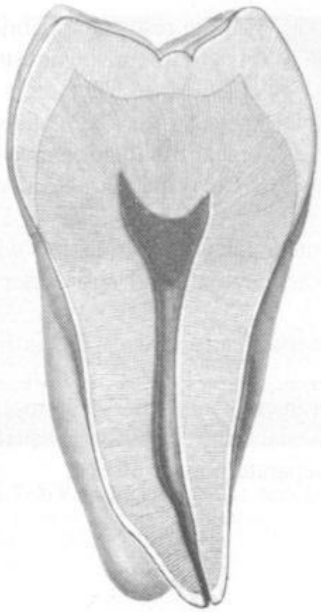


Buccal

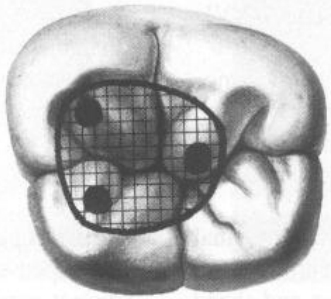


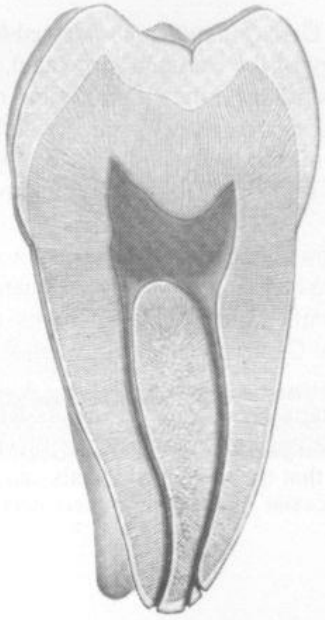


Mesial

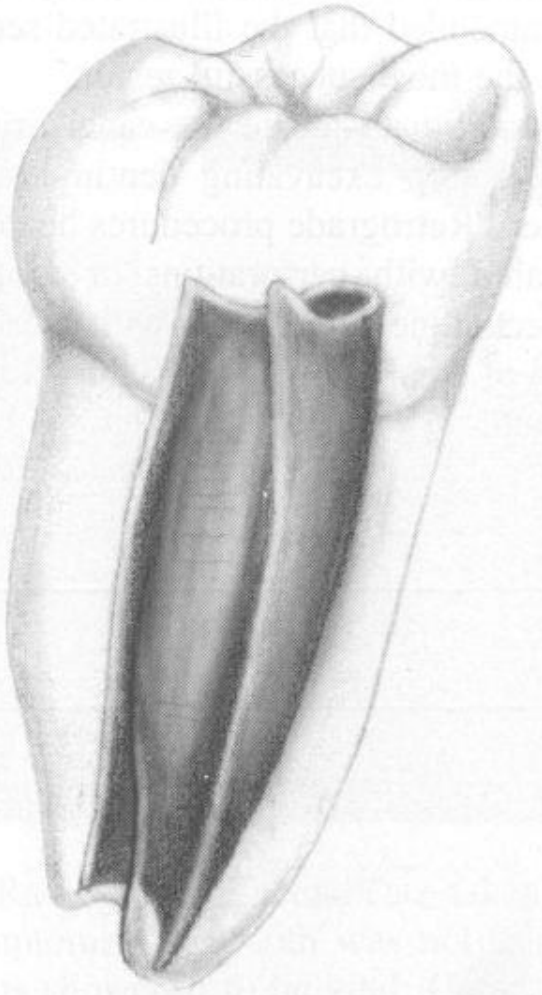


Distal

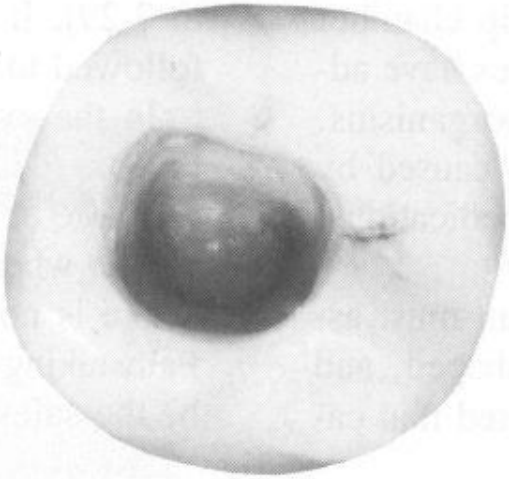


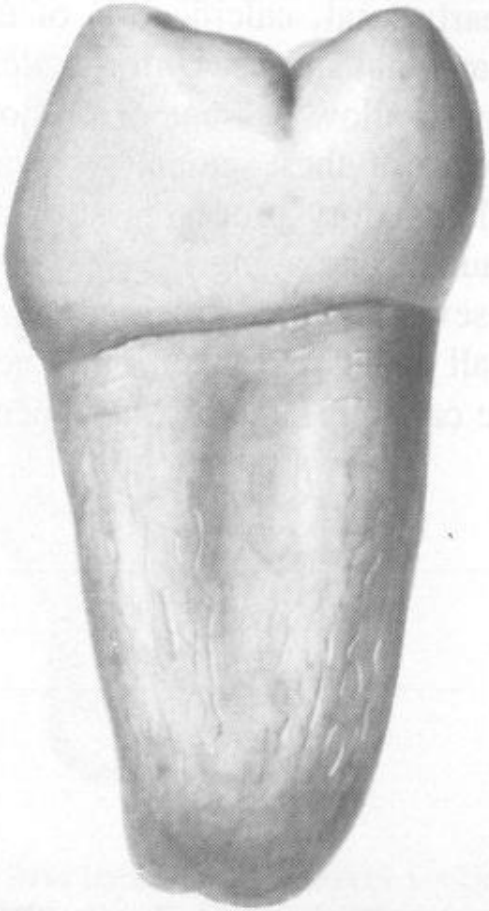


Lingual



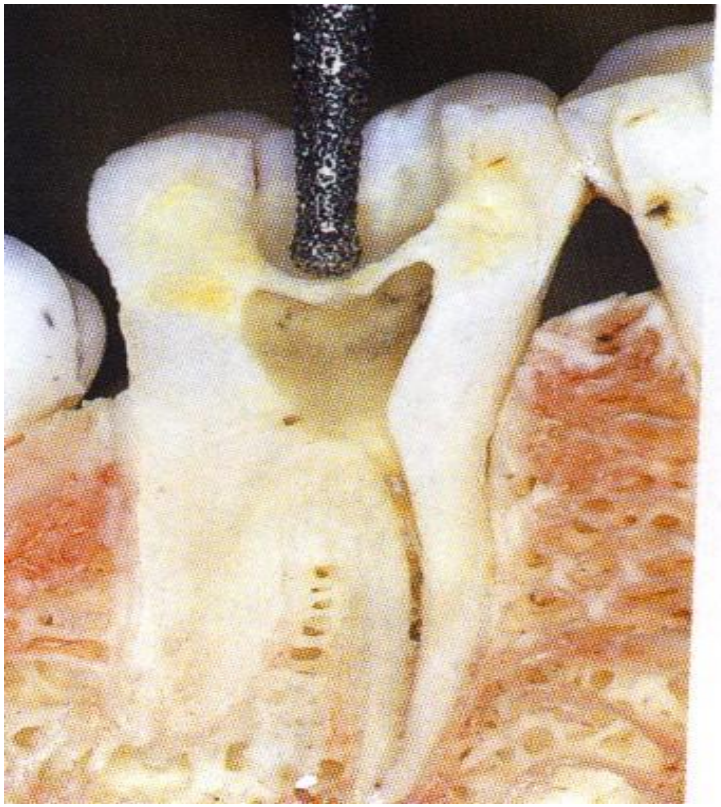
Mesiolingual





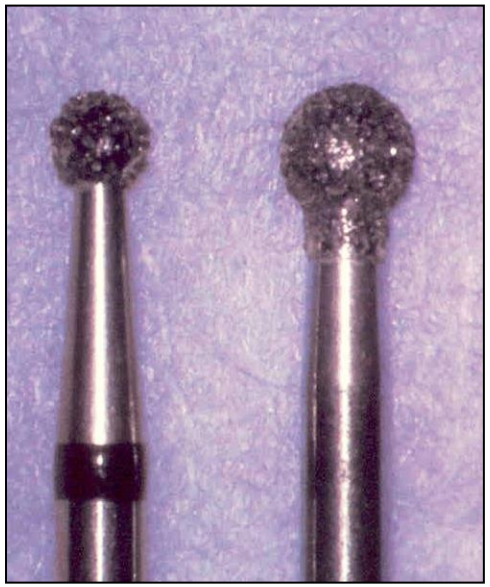
Distal

Access



Instruments

Dia trepan



Dia balls

Ball burs

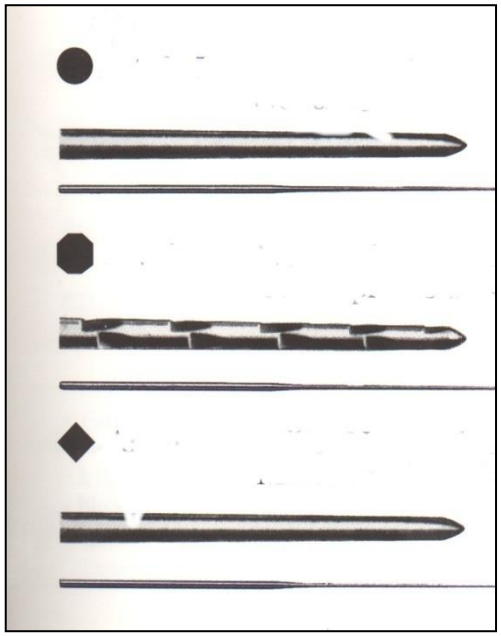
Preparation of the endodontic cavity

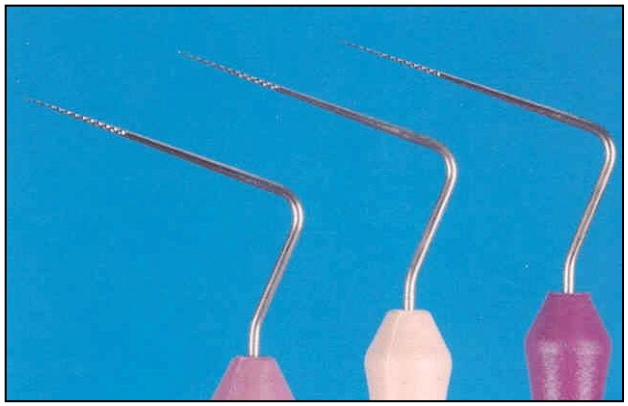
Dia trepan

Safe ended tips
Batt´s instruments

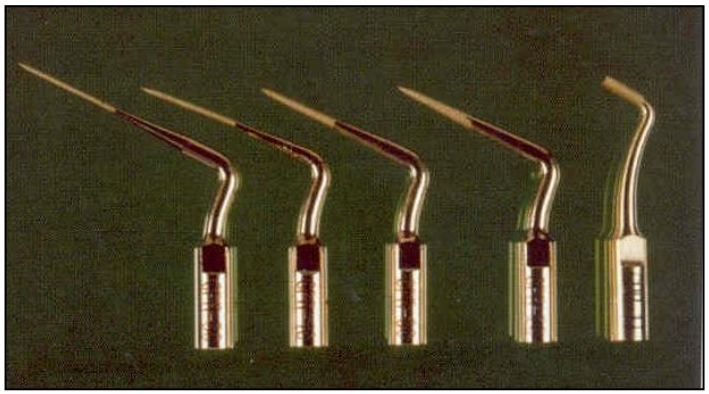
Fissur bur

Endodontic probes





Endodontic probes, microopeners

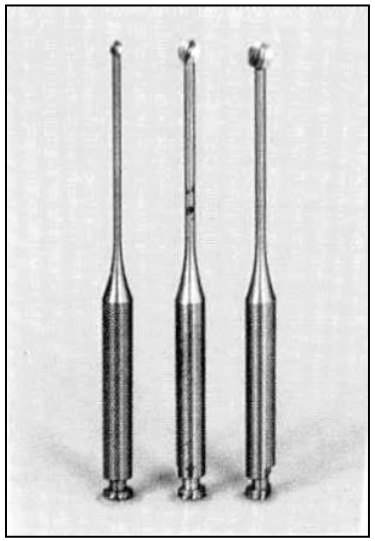


Ultrasound tips

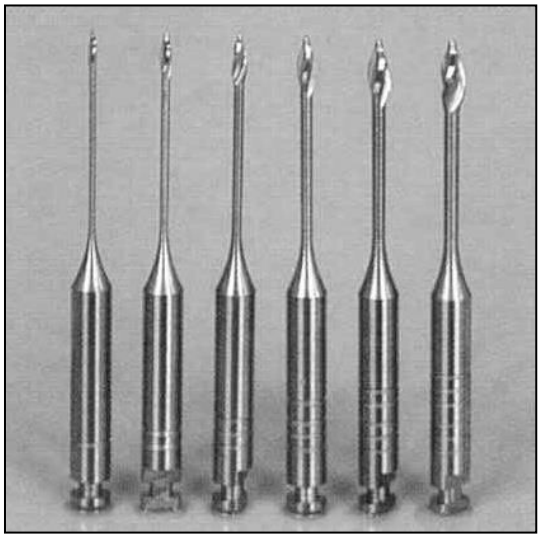
Dye

Opening of root canals

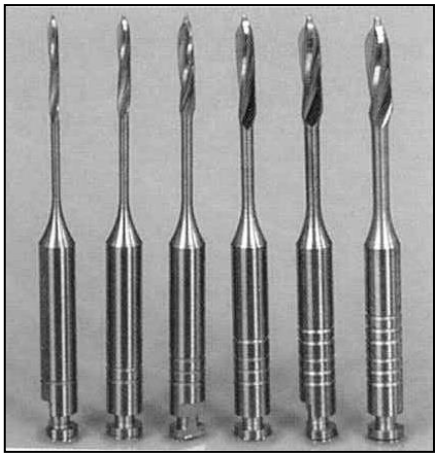
Ball burs



Miller‘s burs

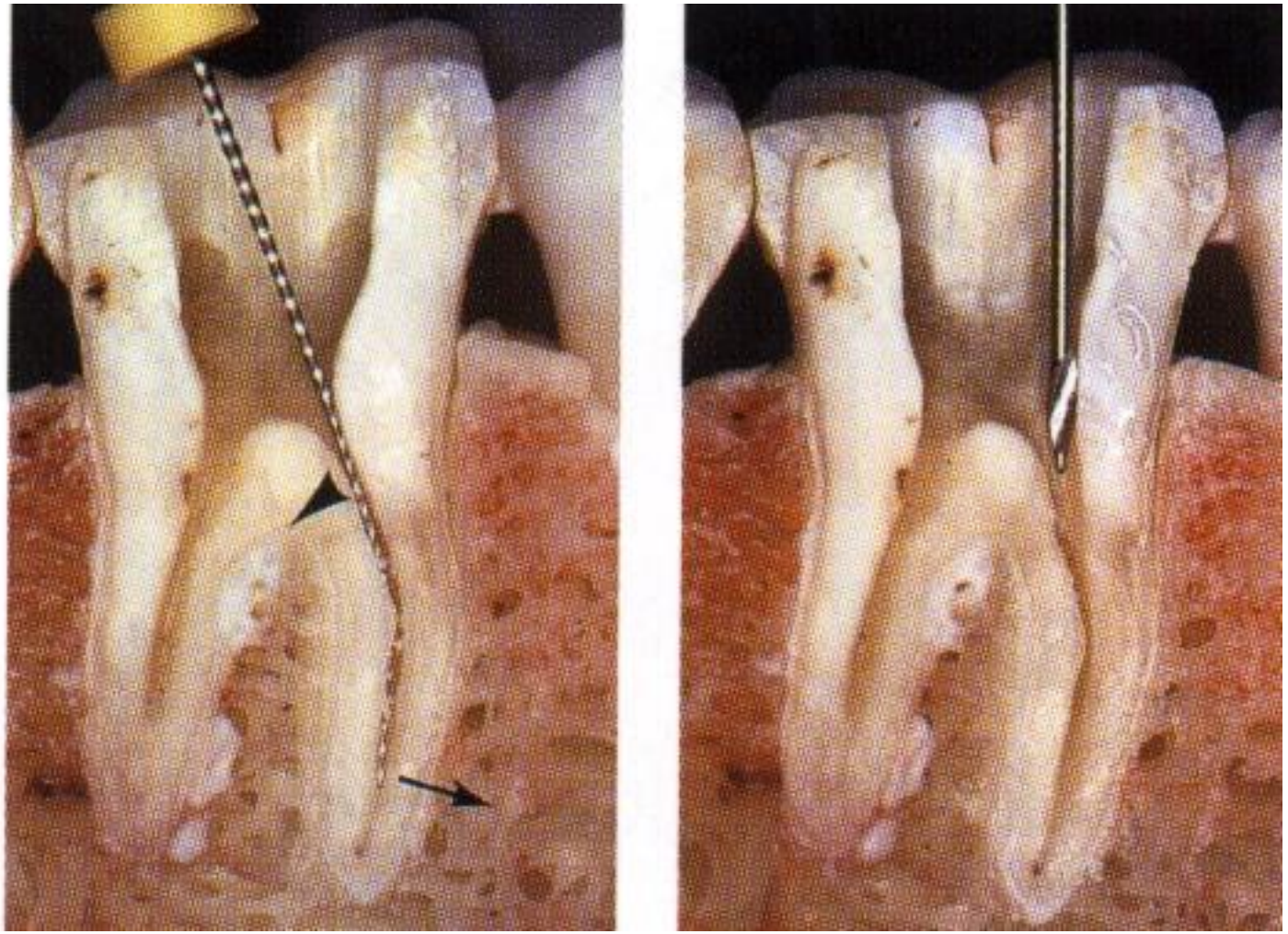


Gates Glidden‘s burs

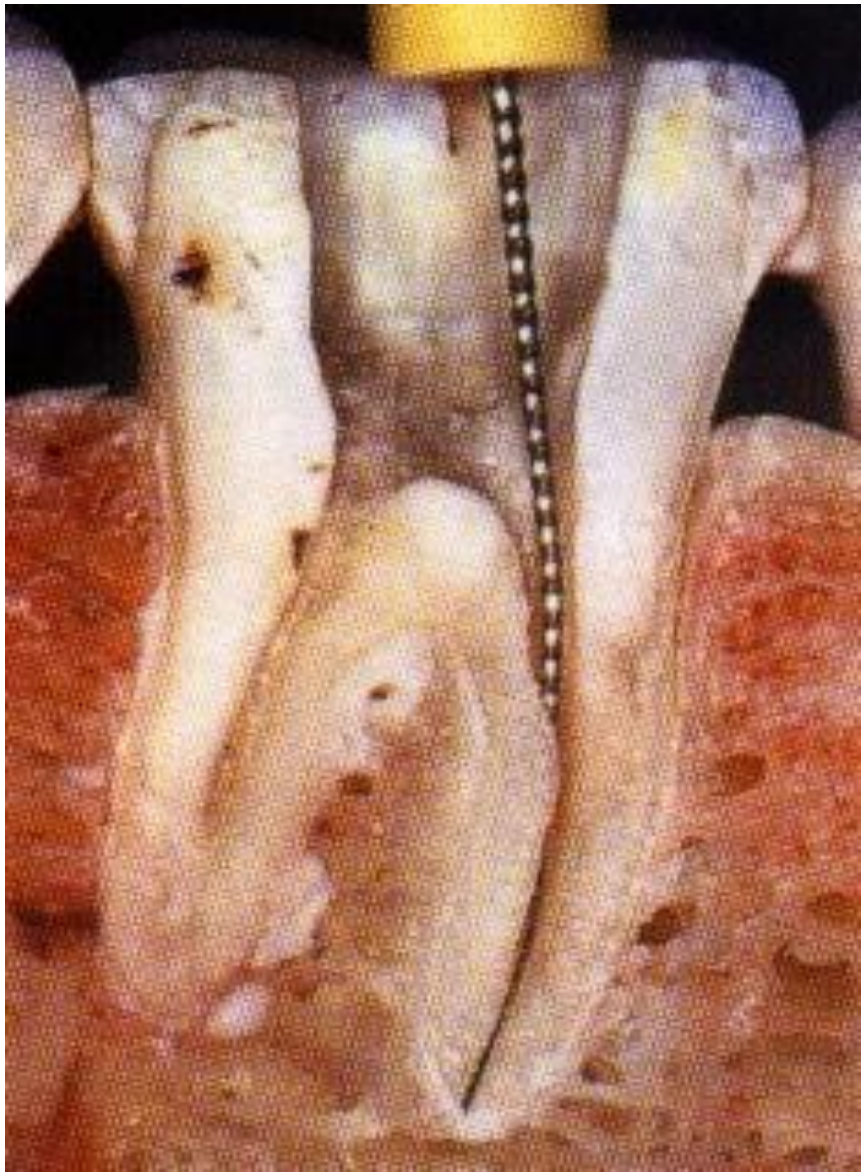


Peeso – Largo burs

Opening of the root canal



Insertion of root canal instrument after opening the pulp chamber and root canal orifice



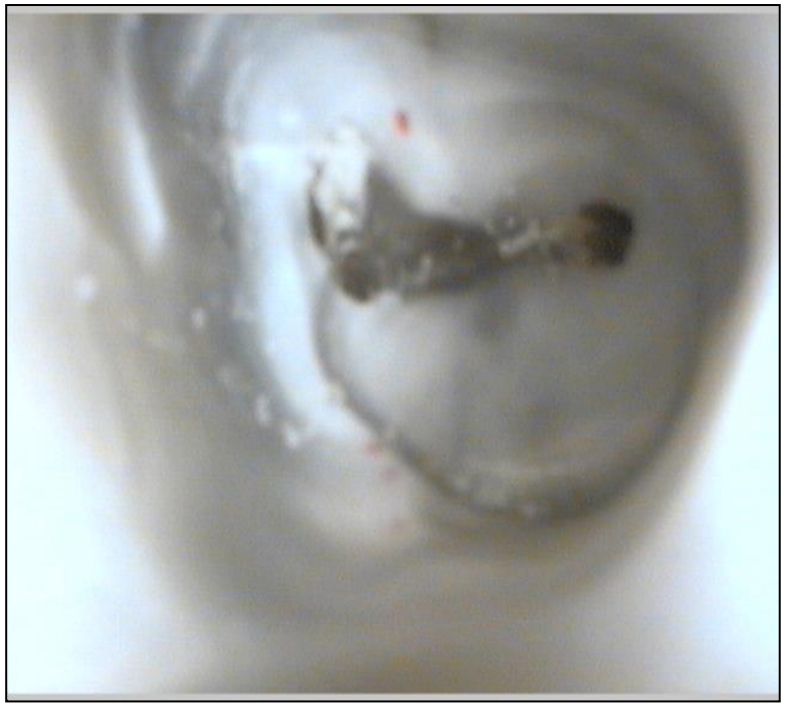

DENTSPLY
MAILLEFER
F 0001 016
E 0153 012
E 0123 010
E 0123 014
F 0199 016
X-Gates

Access kits

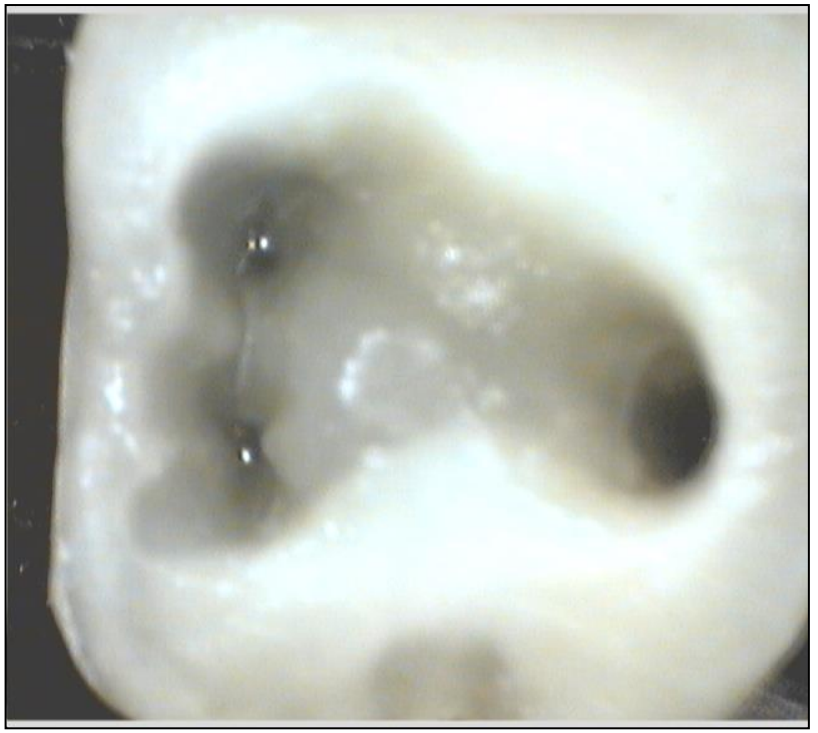

DENTSPLY
MAILLEFER
F 0001 016
E 0153 012
E 0123 010
E 0123 014
Endo Z
X-Gates

Access cavity

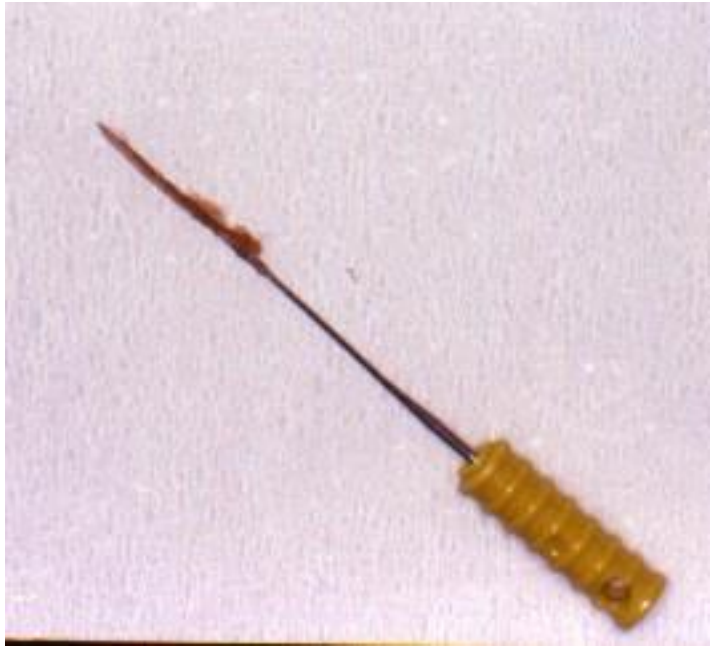
Incorrect



Correct



Pulpextractor



Soft wire
Prickles like harpune
Insertion
Contact with root canal wall – pull 1 mm
Rotation
Exstirpation during pull motion

Canal shaping

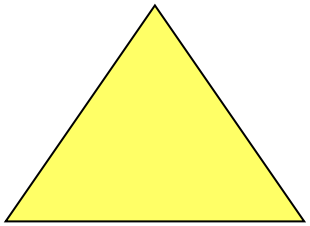
- Reamers (penetration)
- Files (shaping)

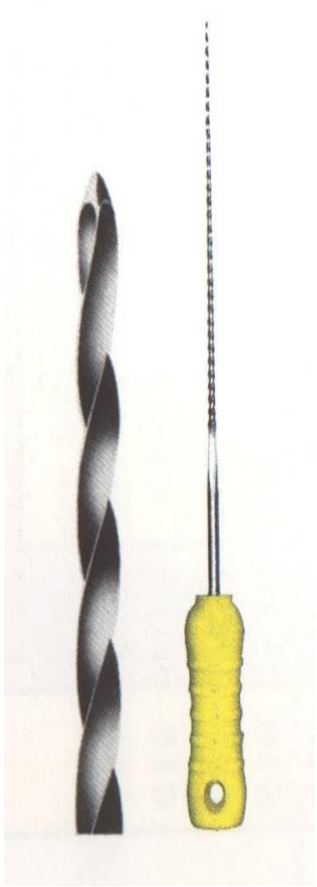
Reamer

K -reamer

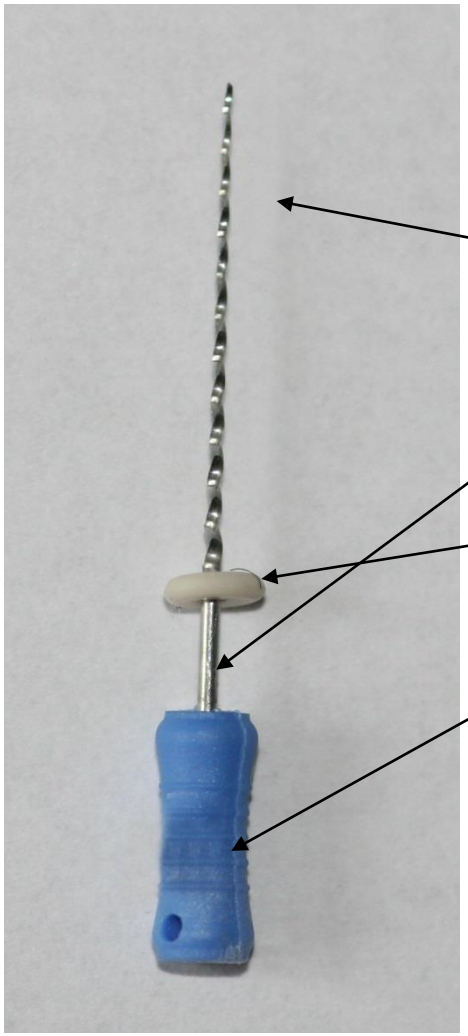
Triangl or square wire spun

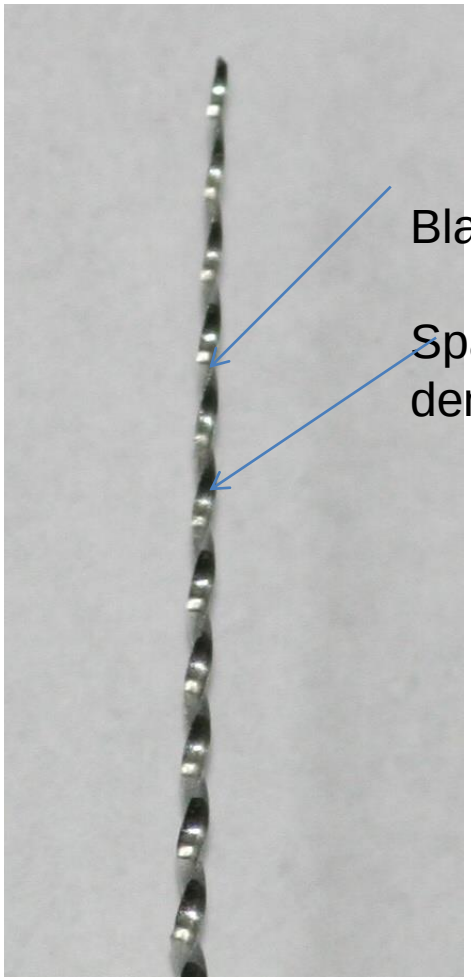
Symbol





Parts of root canal instruments



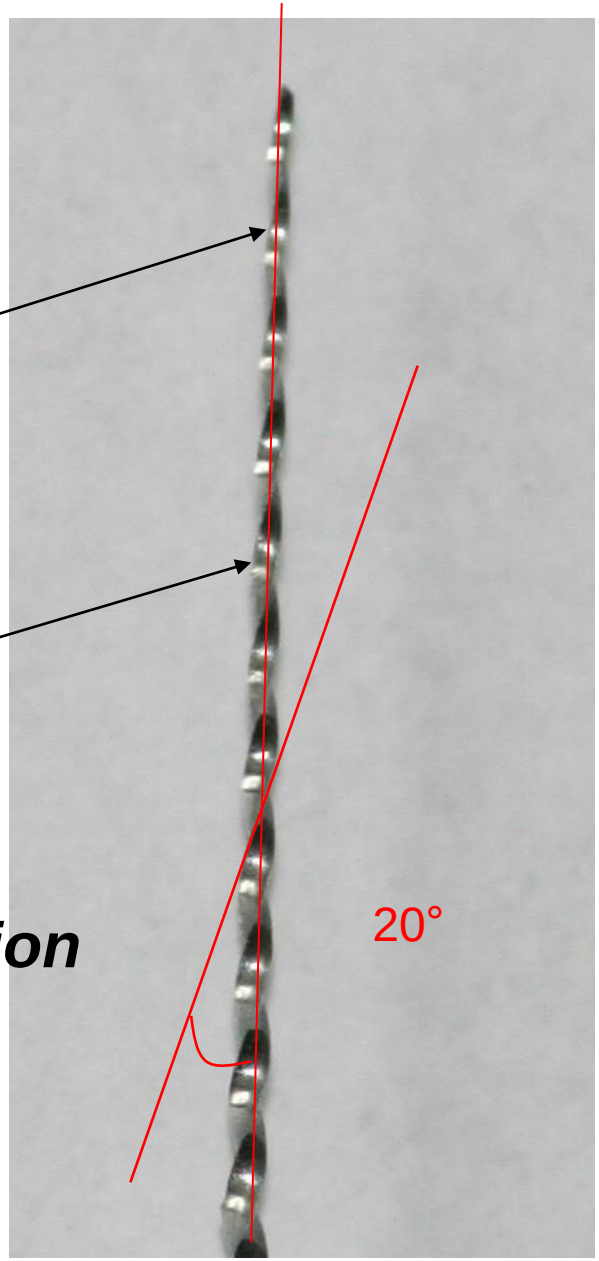


Reamer

Blades

Space for dentin chips

Rotation – reaming achtion - panetration



Reamer

Rotation (clockwise) – penetration

Application of plastic material (contraclockwise)

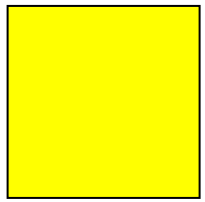
Files

1. **K-file**
2. **K-flexofile, flexicut, flex-R file**
3. **K-flex**
4. **H-file, S-file**

K file

Wire triangl or square

Symbol is always square

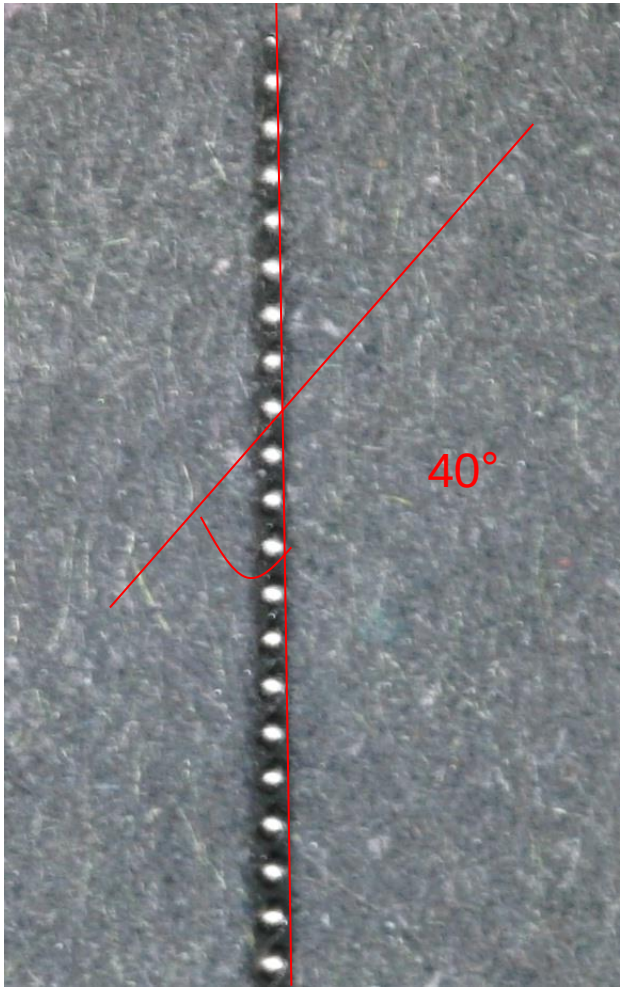


K-file

Filing

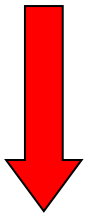
Also rotation

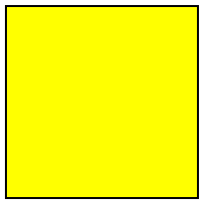
45° – 90°



K-flexofile, flexicut, flex-R

- Triangle wire always



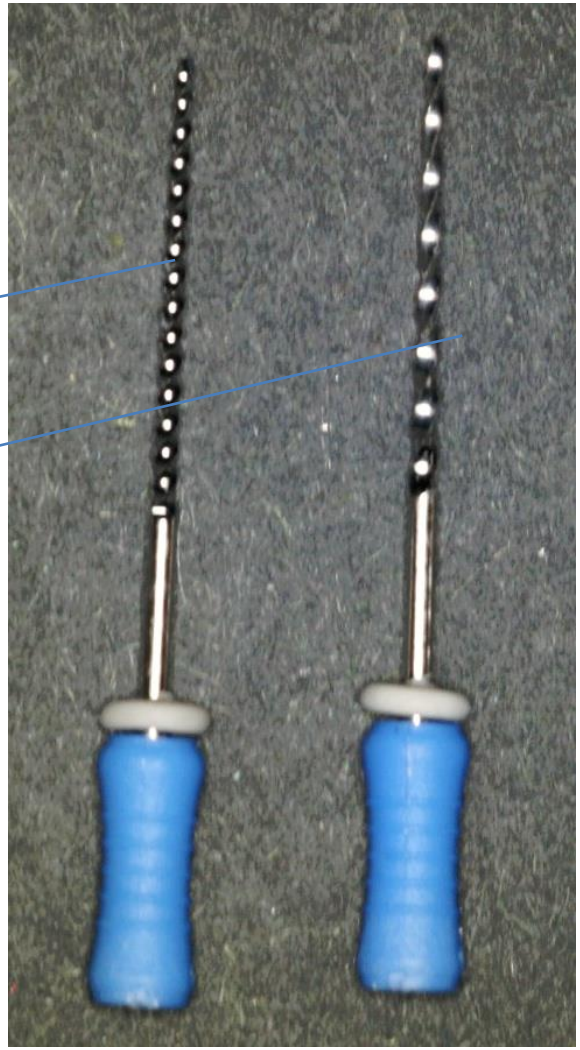


Flexibility

K- flexofile a flex – R file: non cutting tip and first blades are blunt

Like K-file

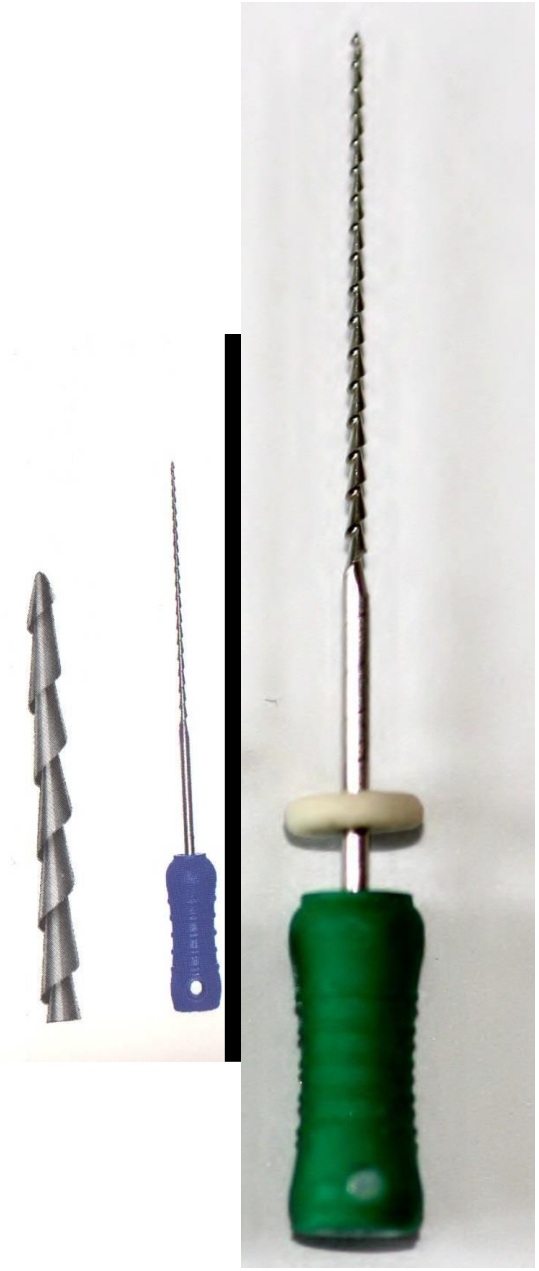
K-file and reamer



H-file

= Hedstroem file

Ring

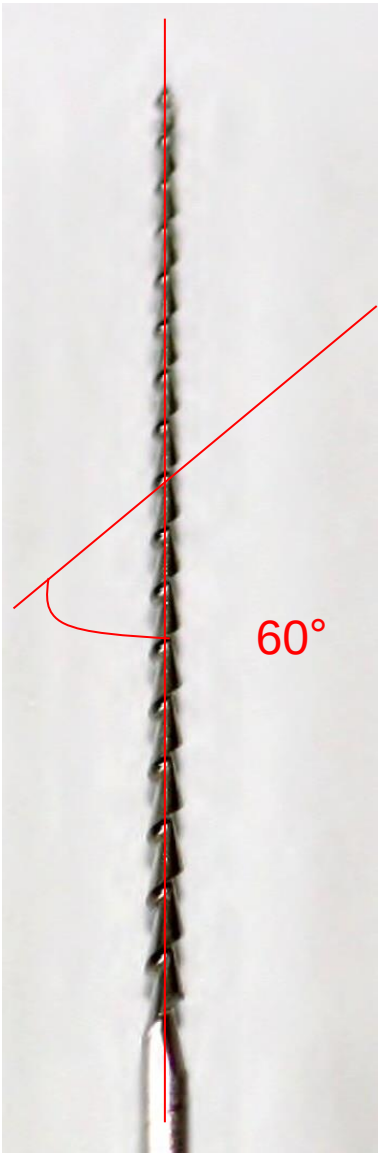


H- file

No rotation!!

Pull motion only!!

Risk of breakage in small sizes



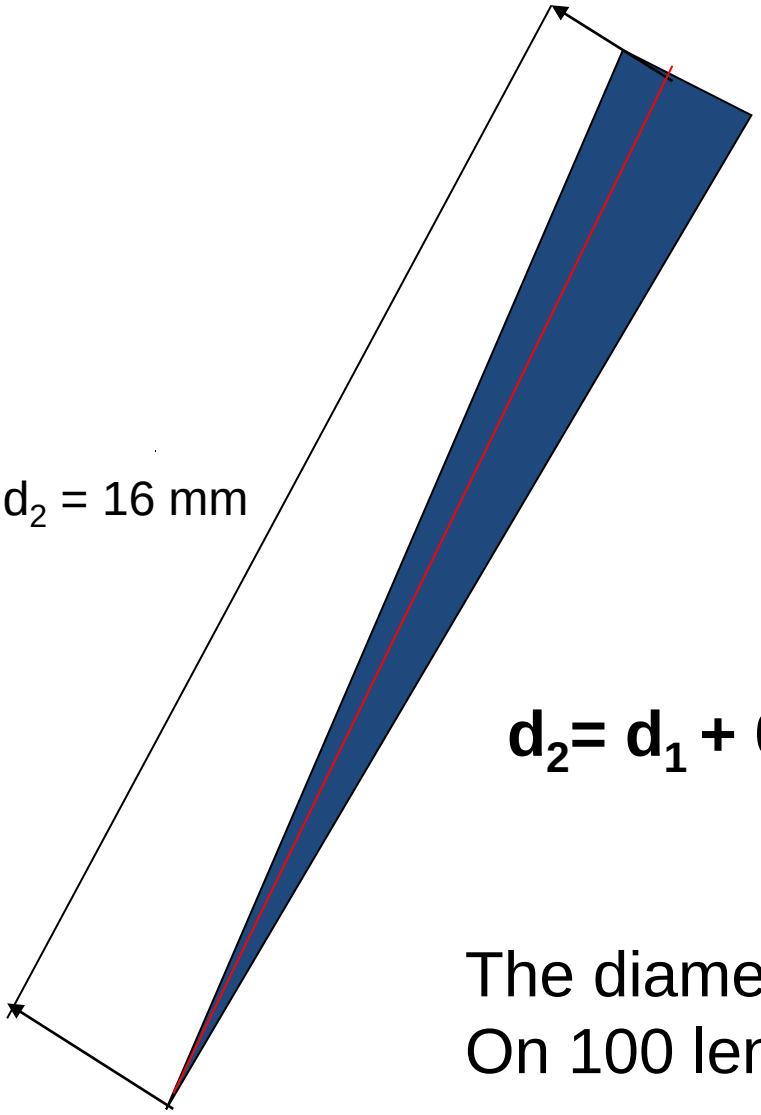
ISO

- Diameter of the tip
- Length of the cutting part
- Taper

ISO standard

06	
08	
10	
15	45
20	50
25	55
30	60
35	70
40	80

Size – diameter at the tip in mm/100

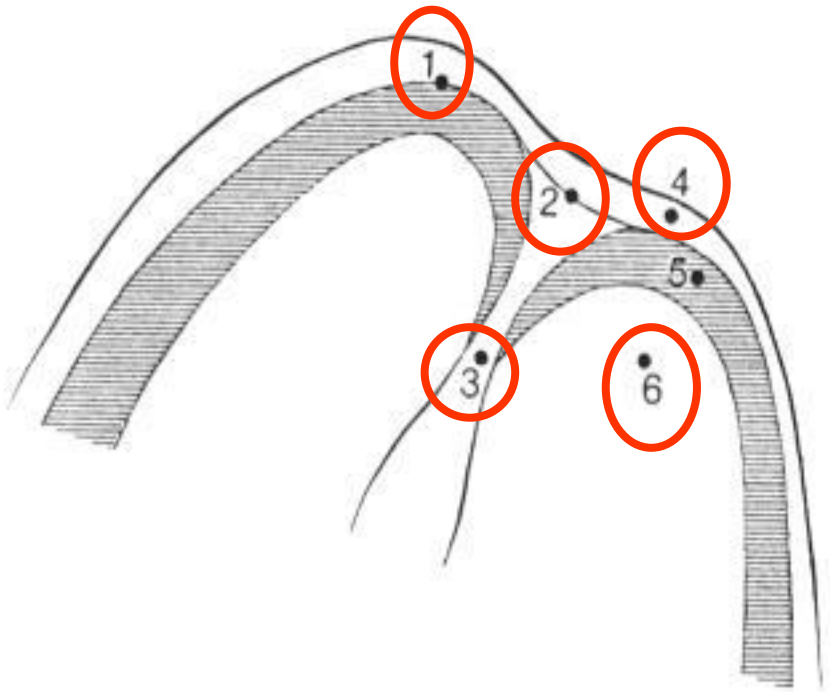


Taper 2%

$d_2 = d_1 + 0{,}32$

The diameter increases for 0,02 mm
On 100 length

Apical morphology



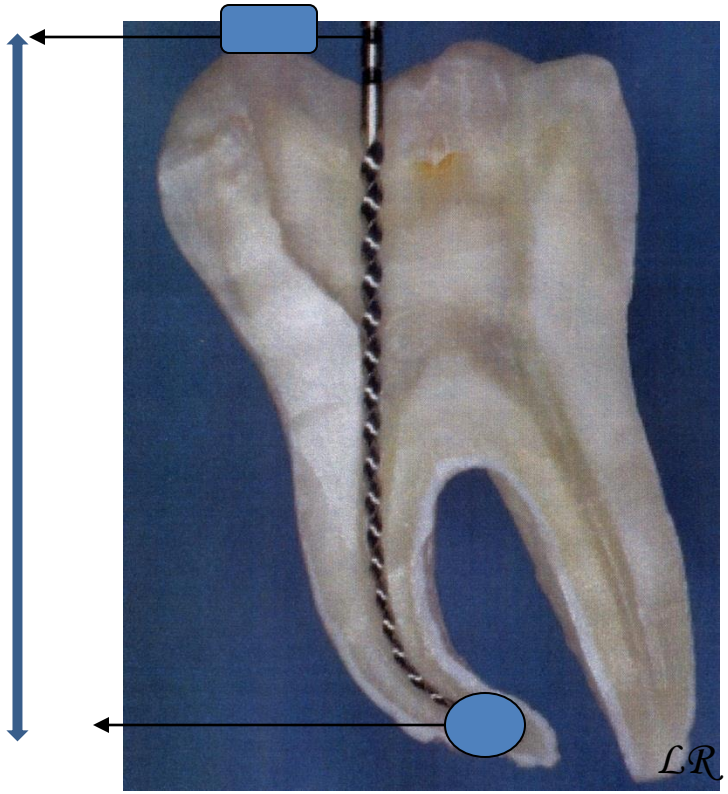
1. X – ray apex
2. Foramen apicale
3. Apical constrictionA
4. Periodontal ligament
5. Root cementum
6. Dentin

Acc. to Guldener a Langeland

Working length

- Distance between the referential point and apical constriction

- Radiographically
- Apexlocators
- Combination



Estimation

- Distance between apical constriction and apical foramen is appr. 0,5-0,75 mm
- Distance between apical foramen and x-ray apex is appr. 0,5 – 0,75 mm.
- Distance between apical constriction and x-apex is appr. 1,5 – 2mm

Why apical constriction

- Small apical communication
- Minimal risk of damage of periodontium
- Prevention of overfilling (extrusion of filling material)
- Prevention of extrusion of infection
- Good decontamination
- Godd condition for root canal filling

Radiogram

X-ray with inserted root canal instrument

Safe length: average length of teeth reduced for 2 – 3mm

Tooth with clinical crown

Procedure

- Instrument ISO 15 introduced into the root canal, stop at the referential point
- Estimation of location of apical constriction (1 – 1,5 mm distance from x-ray apex.

If there is diference in the radiogram more than 2 mm - repeat

If 2 mm or less – add to the safe length

= working length

Safe length

- Maxilla:

I1 20

I2 18

C22-24

P20

M 18 mkk,20 P

Safe length

- Mandible

I 18

C20 -22

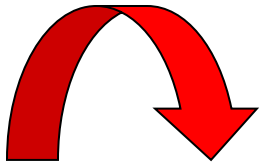
P18

M18

Remember- the length is for teeth with complete crown !!!

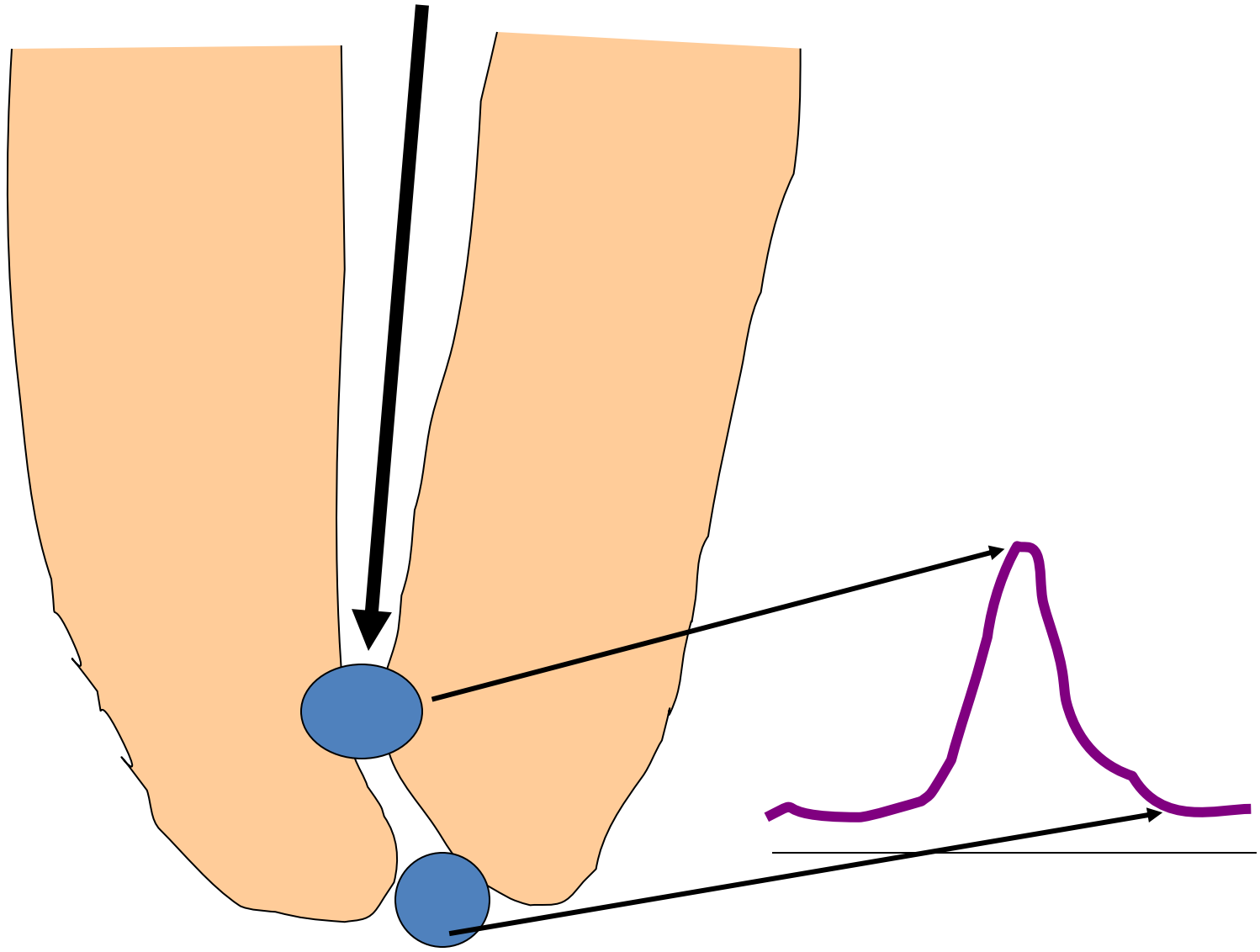
Endometry, odontometry

- Endometry



devices based on measurement of electrical resistance

$\mathcal{LR}$

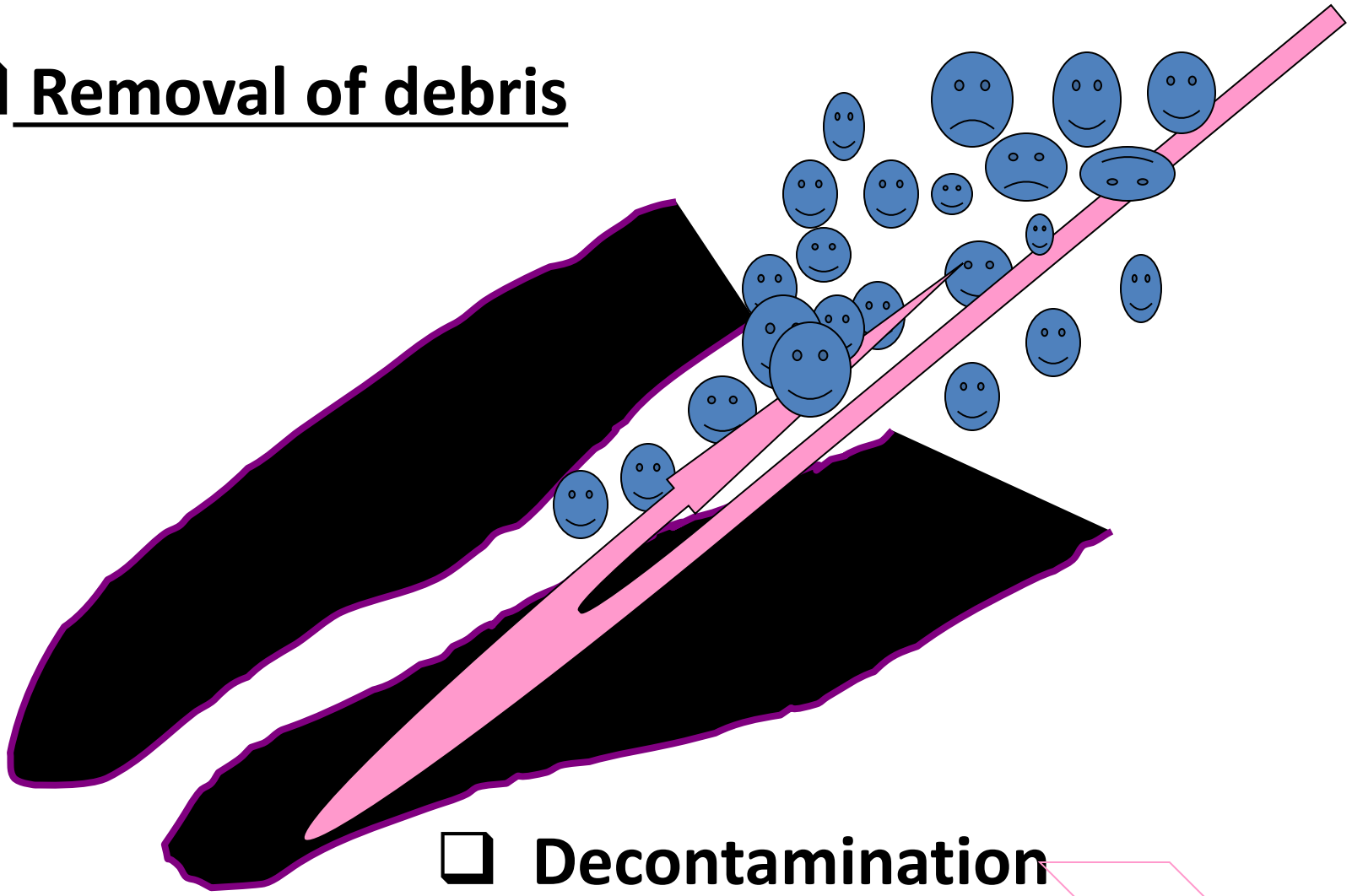


$\mathcal{LR}$

Apexlocator:

Irrigation

- **Removal of debris**



- **Decontamination**

Irrigants

- **Sodium hypochlorite (1,5 – 5,5%)**
- **Chlorhexidin (0,12% - 0,2%)**
- **EDTA – etyléndiaminotetraacetic acid 17%**

Irrigants

- Sodiumhypochlorite

  2 – 6%

- Oxidation a chloration
- Dissolving efect

- Bad smell, irritant.

Syringe and cannula

- B
- N

Activation of irrigation

- Increased effectivity

Vibration

Increasing of temperature

Decomposition of irrigants - dissociation

Syringe and cannula

- B
- N

Activation of irrigation

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Increasing of temperature

Decomposition of irrigants - dissociation