



ZAHNHISTOLOGIE

Pulpa und Zementum

Dr. Andrea D. Székely

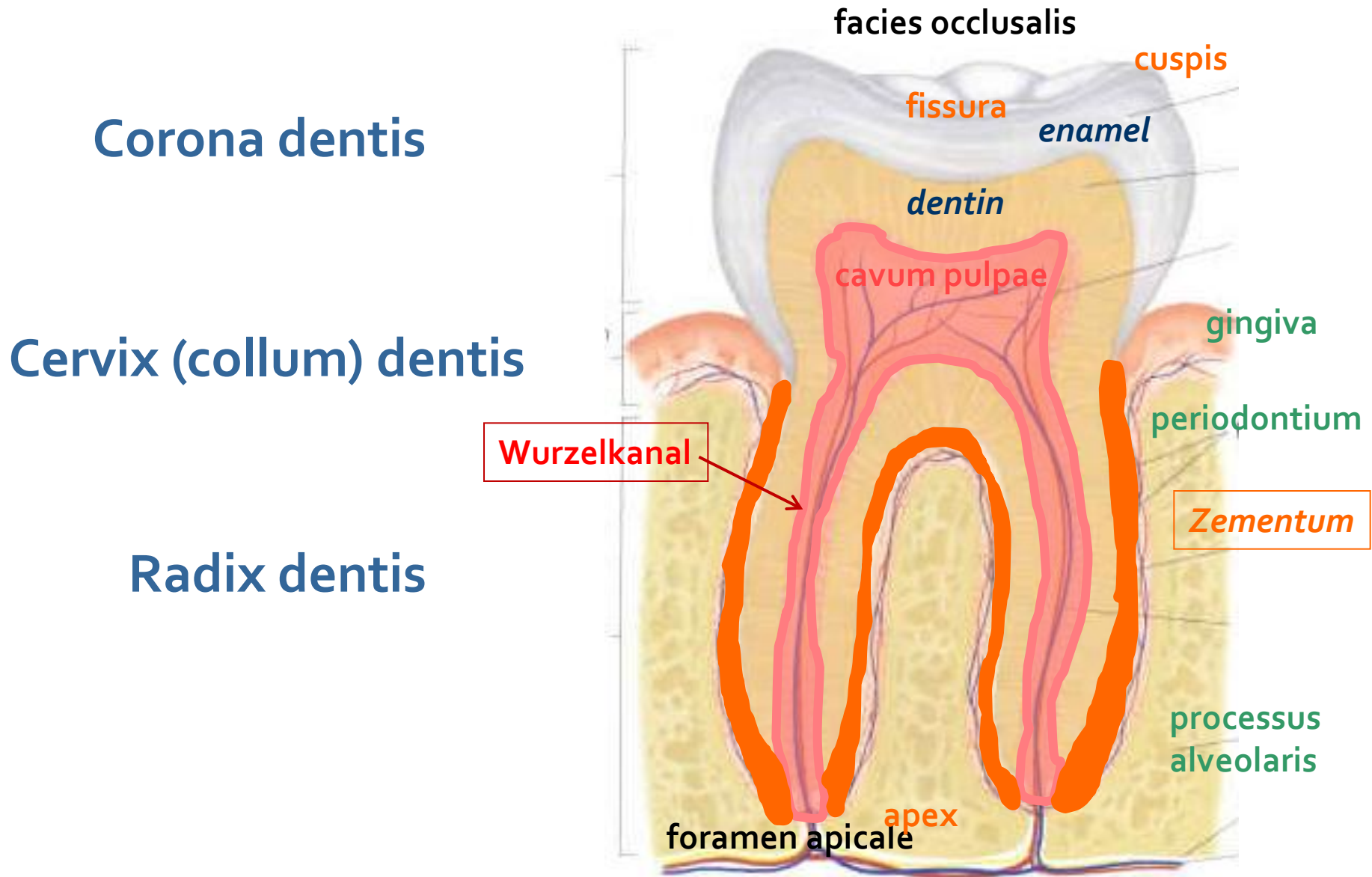
Semmelweis Universität

Institut für Anatomie, Histologie und Embryologie

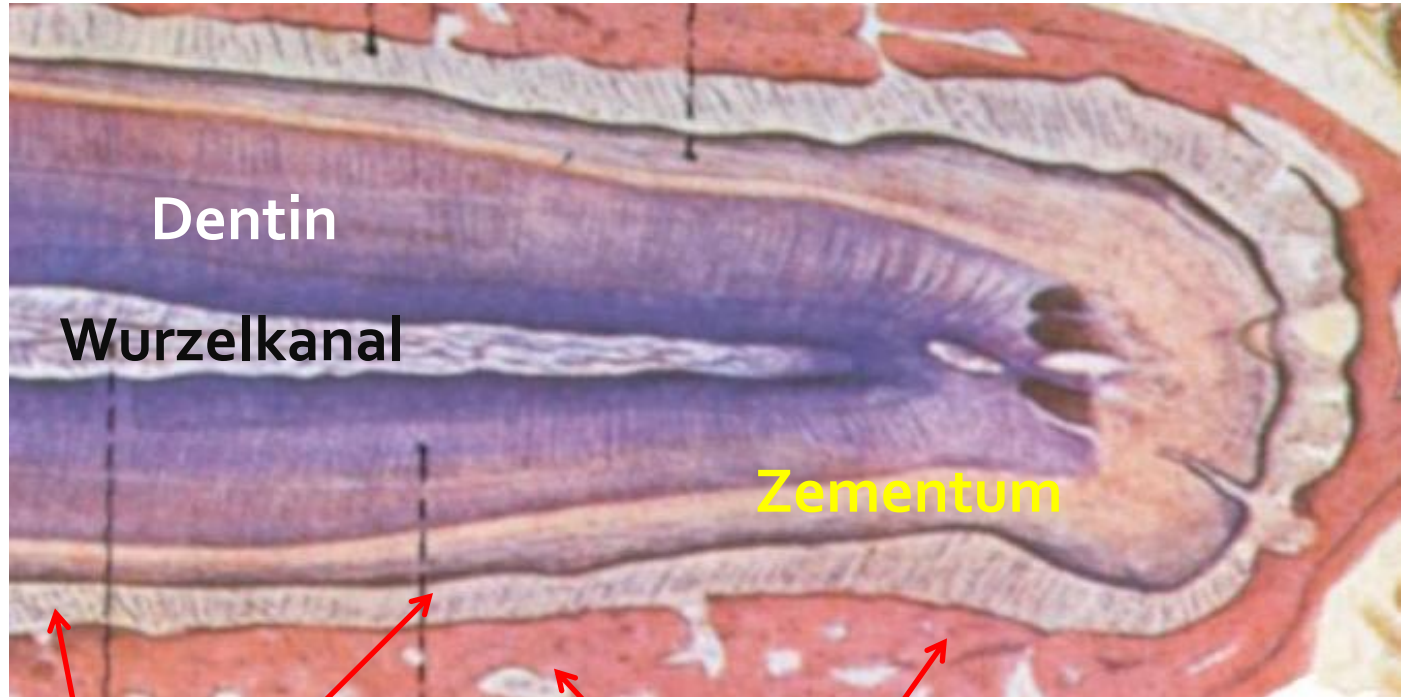
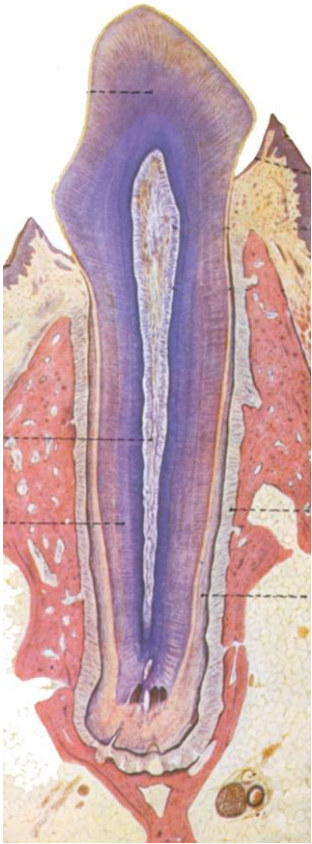
Budapest



ÜBERBLICK DER ZAHNSTRUKTUR



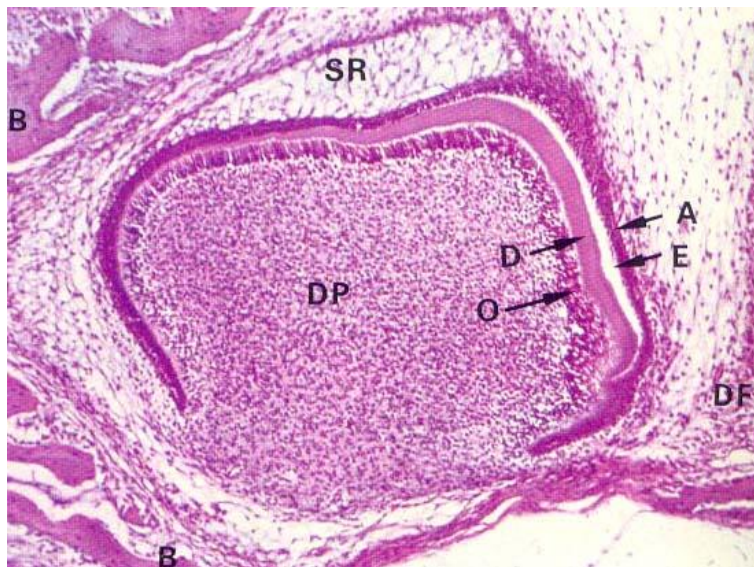
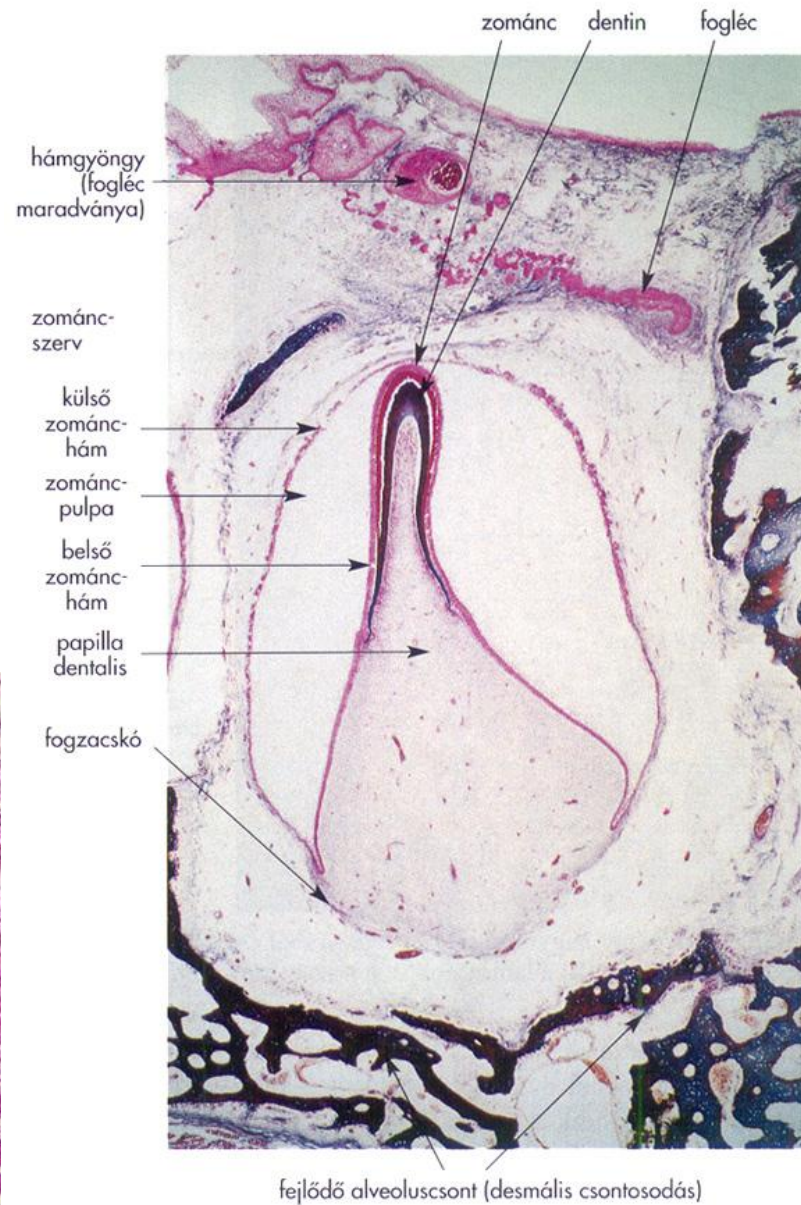
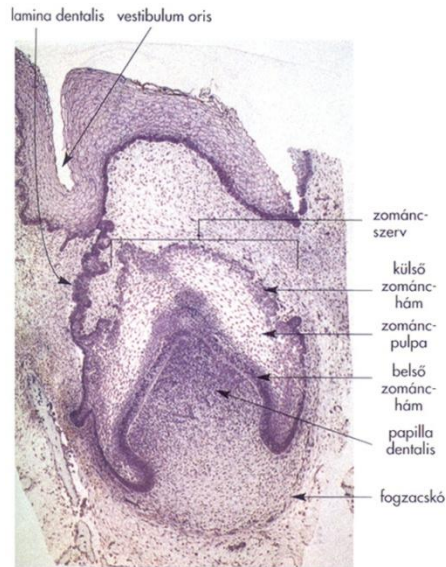
ZAHNGEWEBETYPEN



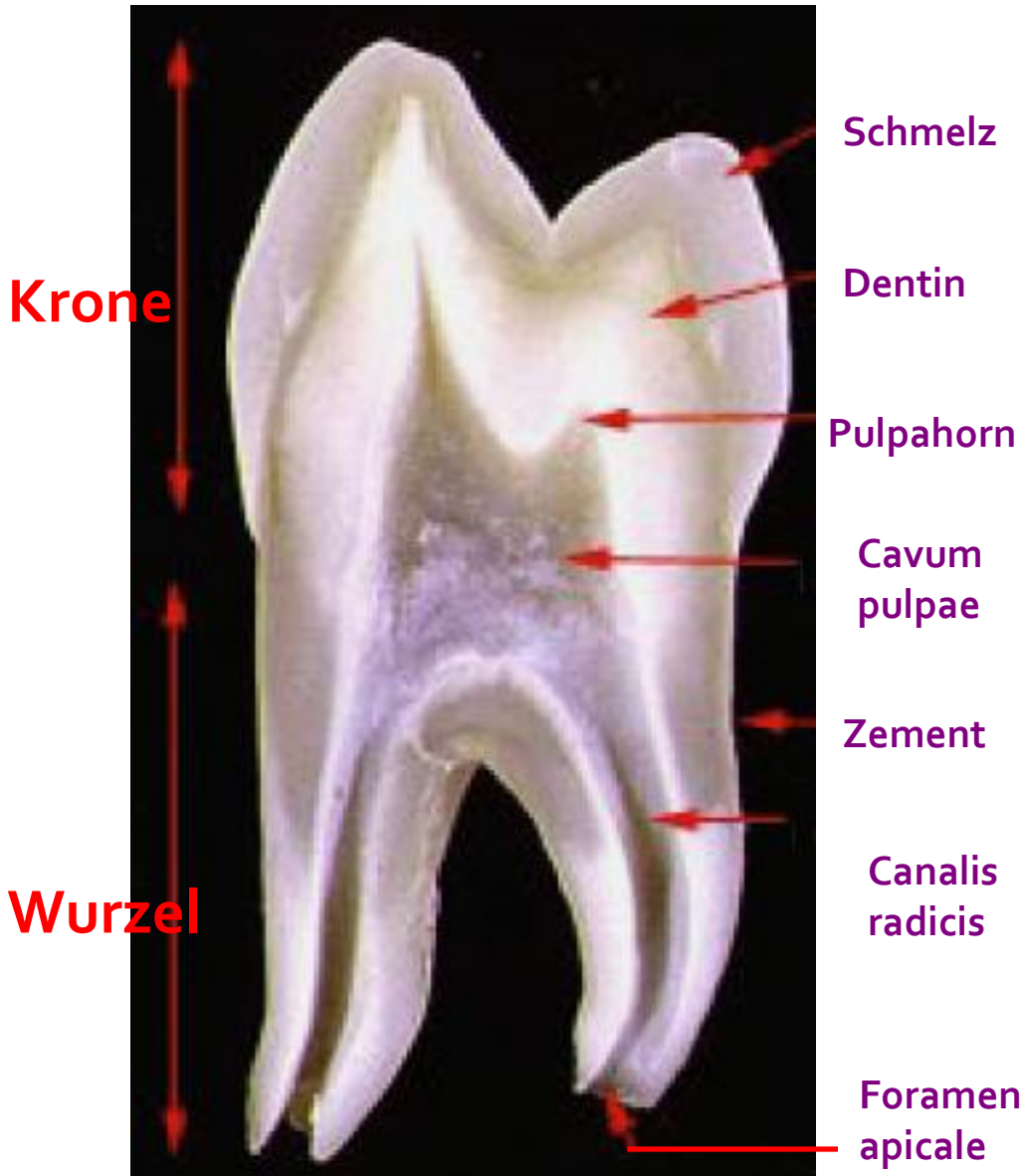
Periodontium

Alveolarknochen

EMBRYOLOGISCHÉ HERKUNFT

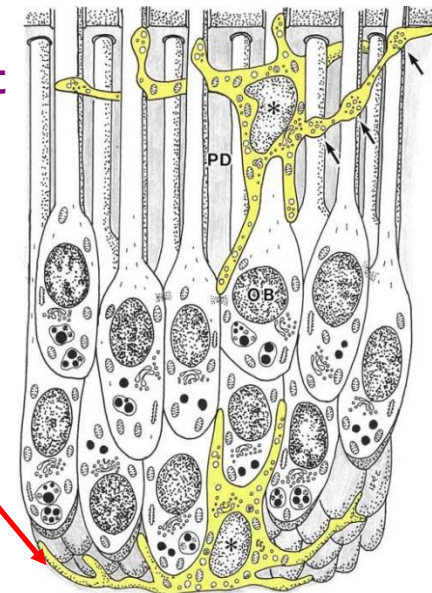


ZAHNPULPA



Herkunft: Mesenchym der Zahnpapille
Füllt die Pulpahöhle aus
Lockeres Bindegewebe:
Fibroblasten, Fibrozyten,
Macrophagen, Lymphozyten,
Plasmazellen
Nicht differenzierte Mesenchymzellen
(Odontoblasten)
Antigen presentierende Zellen
Typ I, Typ III Kollagen, keine elastische
Fasern
Hyaluronsäure,
Dermatansulphat
Leitungsbahnen

Dendritische
Zellen zw den
Odontoblasten



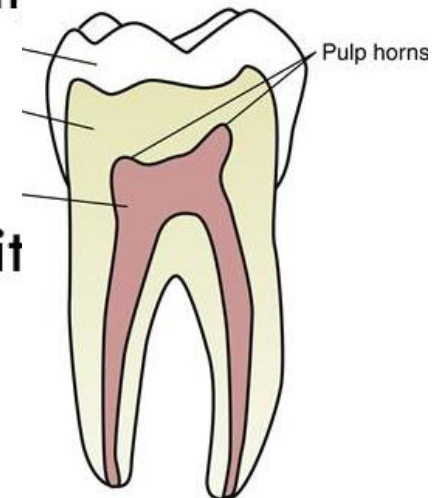
ZAHNPULPENMORPHOLOGIE

Die *cavitas pulpae* (Pulpenkammer) enthält die Zahnpulpe



Kronenpulpe + Pulpenhörner

- It is the pulp occupying the pulp chamber of the crown of the tooth
- In young teeth it resembles the shape of the outer dentin
- It has six surfaces : occlusal, mesial, distal, buccal lingual and floor.
- Pulp horns are projections into the cusp
- This pulp constricts at the cervical region where it continues as the radicular pulp



ZAHNPULPENMORPHOLOGIE

Der Pulpenkammer öffnet durch die Wurzelkanäle am Foramen apicale



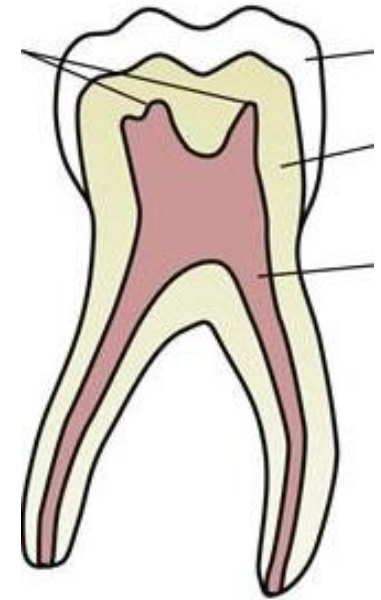
Wurzelpulpe

It is the pulp occupying the pulp canals of the root of the tooth

In the anterior tooth it is single and in the posterior teeth it is multiple

The radicular portions of the pulp is continuous with the periapical tissues through apical foramen

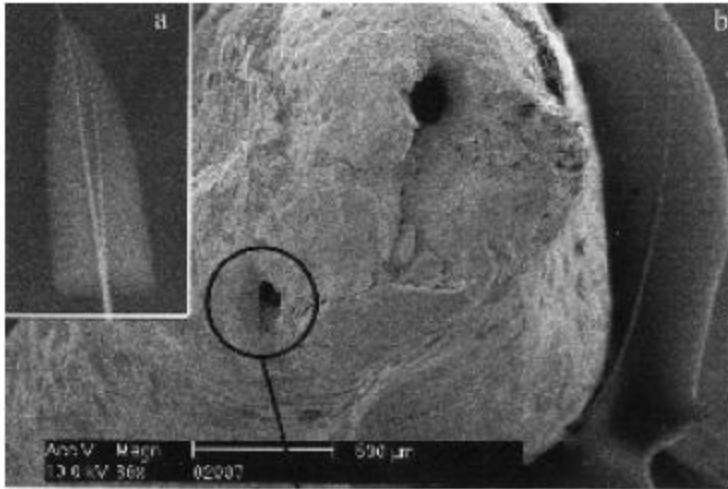
As age advances the width of the radicular pulp is reduced, and so is the apical foramen.



ZAHNPULPENMORPHOLOGIE

Canalis accessorius

- Leading laterally from the radicular pulp into the periodontal tissue.
- Present in the apical third of the root sheath cells
- Formed due to premature loss of HERS or when developing root encounters a blood vessel.
- Overall occurrence is 33%
- May also be present at the furcation region



ZAHNPULPENHISTOLOGIE

PULPA

Die Zahnpulpa beim Erwachsenen hat eine ähnliche Zusammensetzung wie das gallertige BG, besitzt aber eine Innervation und grössere Durchblutung

ZELLEN: Fibroblasten

Mobile Immunzellen

ODONTOBLASTEN!!

STAMMZELLEN

Dendritische Zellen

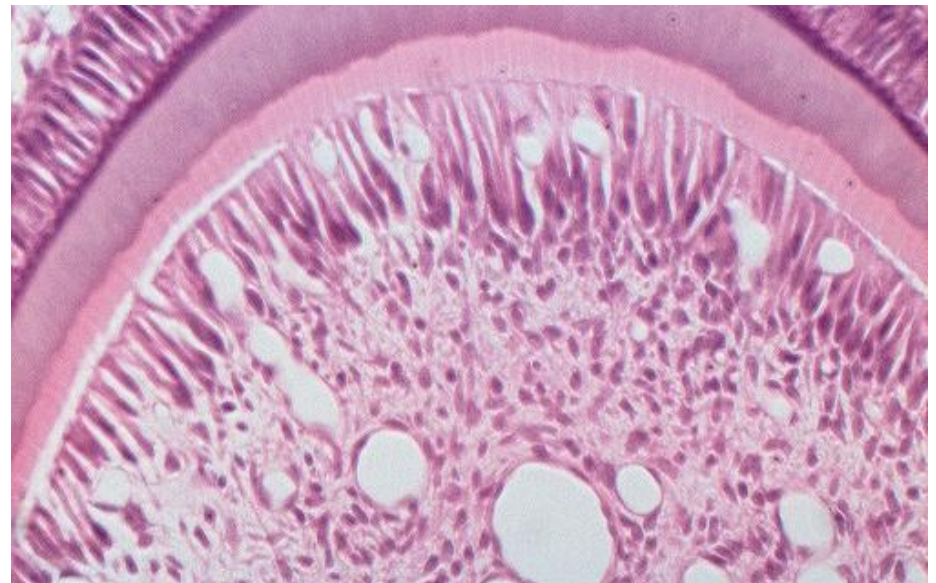
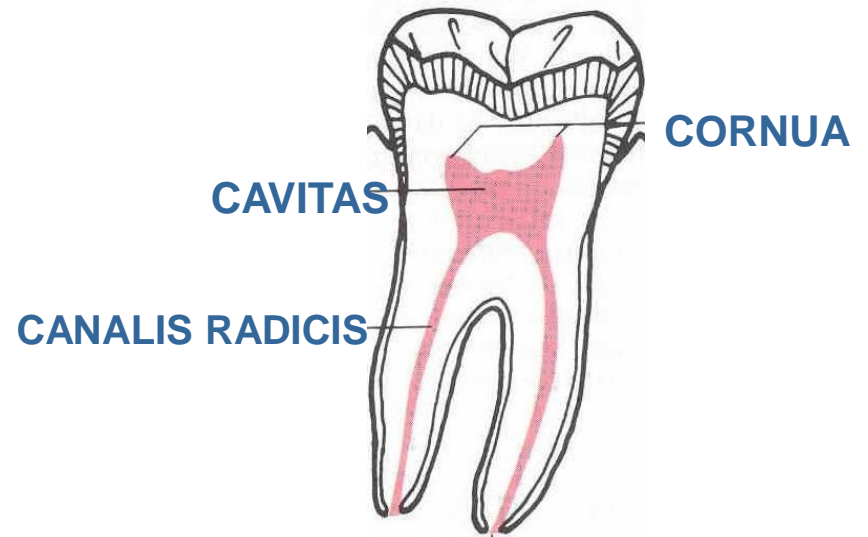
FASERN: reticulin

kollagen

(KEIN elastische Fasern)

PULPAREGRESSION

- mehrere Wurzelkanäle
- Pulpasteinen
- Pulpenpolip
- verengte Kammer und Kanäle



ZAHNPULPENHISTOLOGIE

ROLLE DES EC MATRIX

- *Maintain tissue's physical properties and integrity*
- *Control of growth and development and repairs*
- *Control of cell migration*
- *Control of diffusion of macromolecules*

- **FIBERS AND GLYCOPROTEIN** (collagen type I, III, no elastic fiber, fibronectin)
- **GROUND SUBSTANCES** (glycosaminoglycans, chondroitin sulfate proteoglycan)
- **BLOOD VESSELS, NERVES, LYMPH VESSELS**

Versican
Syndecan
Decorin
Biglycan
Integrins
Fibronectin
Tenascin
Osteoadherin

Form large hydrated aggregates creating a gel

Binds to type I collagen

May help regulate collagen fibrillogenesis

Cell surface adhesion receptors

Concentrated near the odontoblast layer. Binds cells to extracellular matrix

Associated with cell movement. Concentrated near the odontoblast layer

Associated with mineralization

ROLLEN DER ZAHNPULPA

- Dentinbildung (lebenslang)
- Dentinernährung
- Sinnesfunktionen
- Abwehr

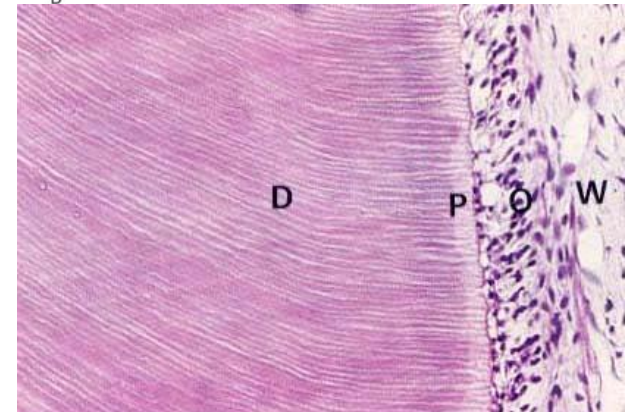
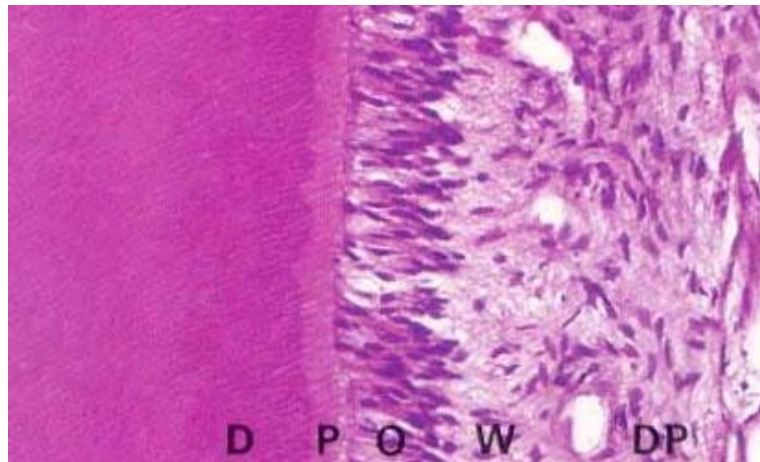
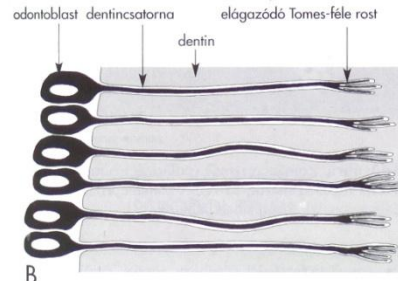
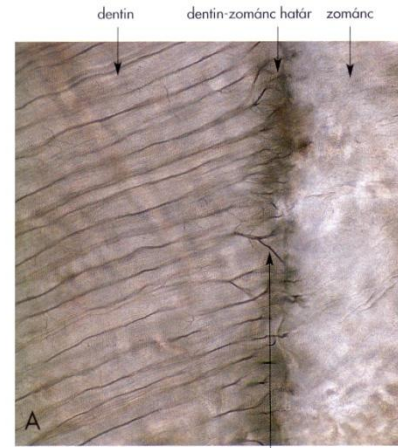
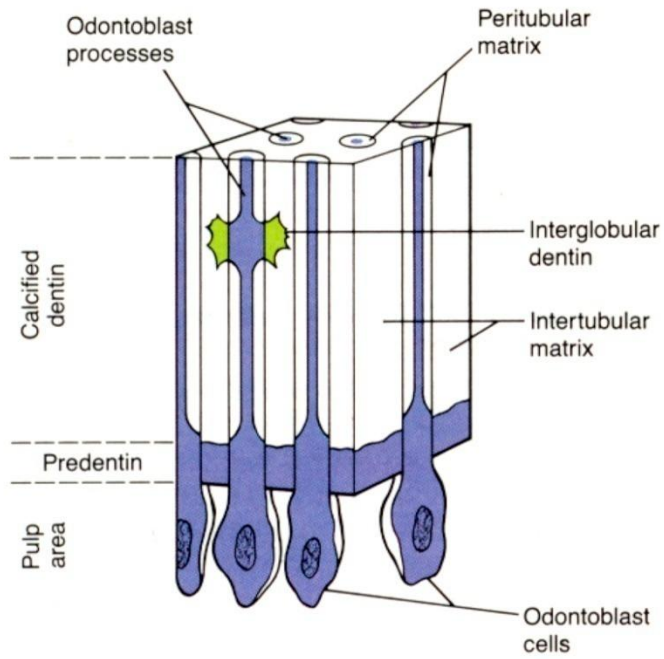
The Pulp is a soft mesenchymal connective tissue that occupies pulp cavity in the central part of the teeth.

It is a special organ because of the unique environment

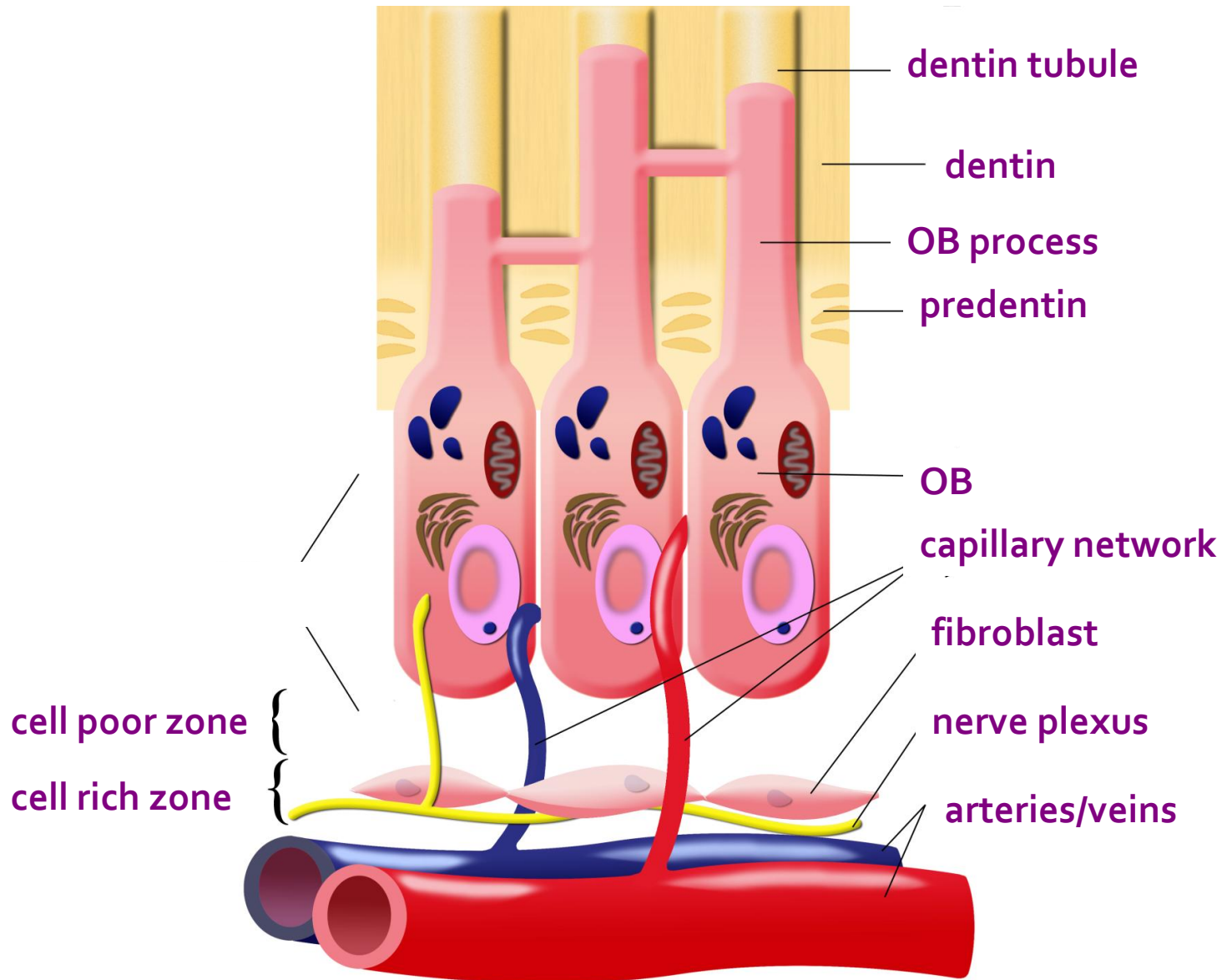
Each of these organs has a shape that conforms to that of the respective tooth.

Has ability to form dentin throughout life

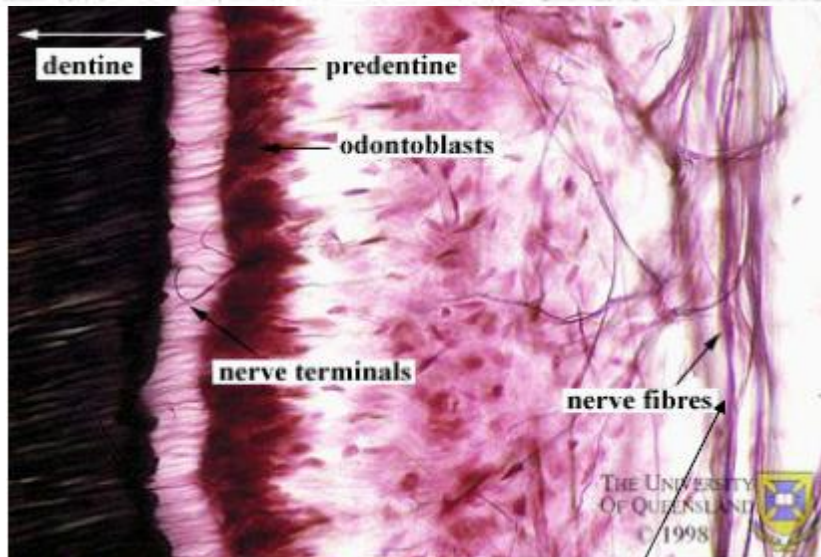
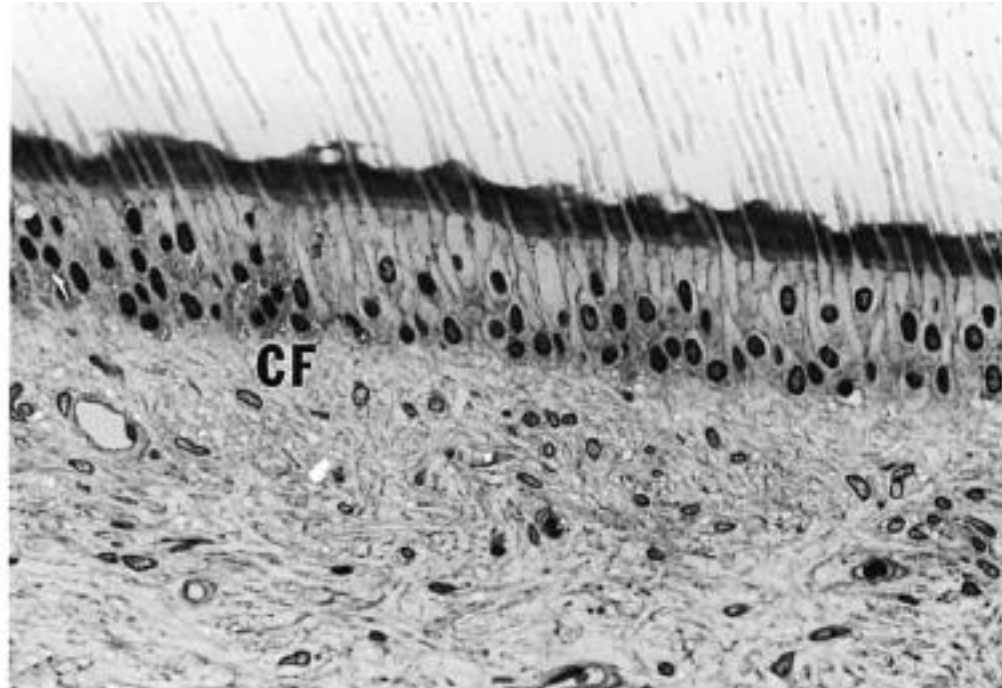
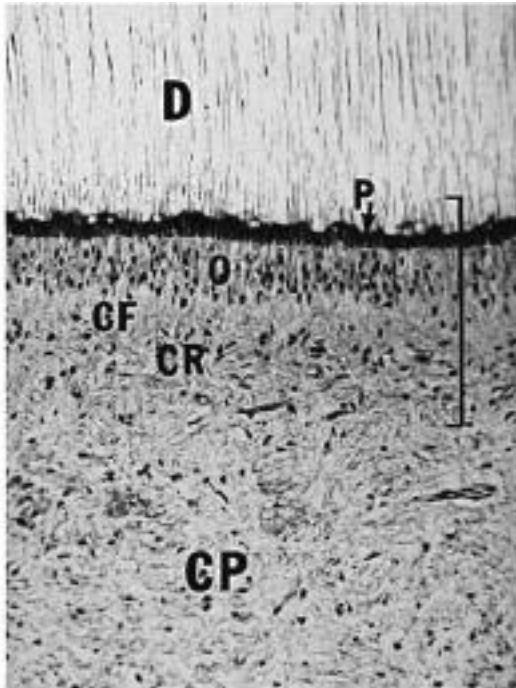
DENTIN – PULP INTERFACE



PULPAL DENTIN JUNCTION

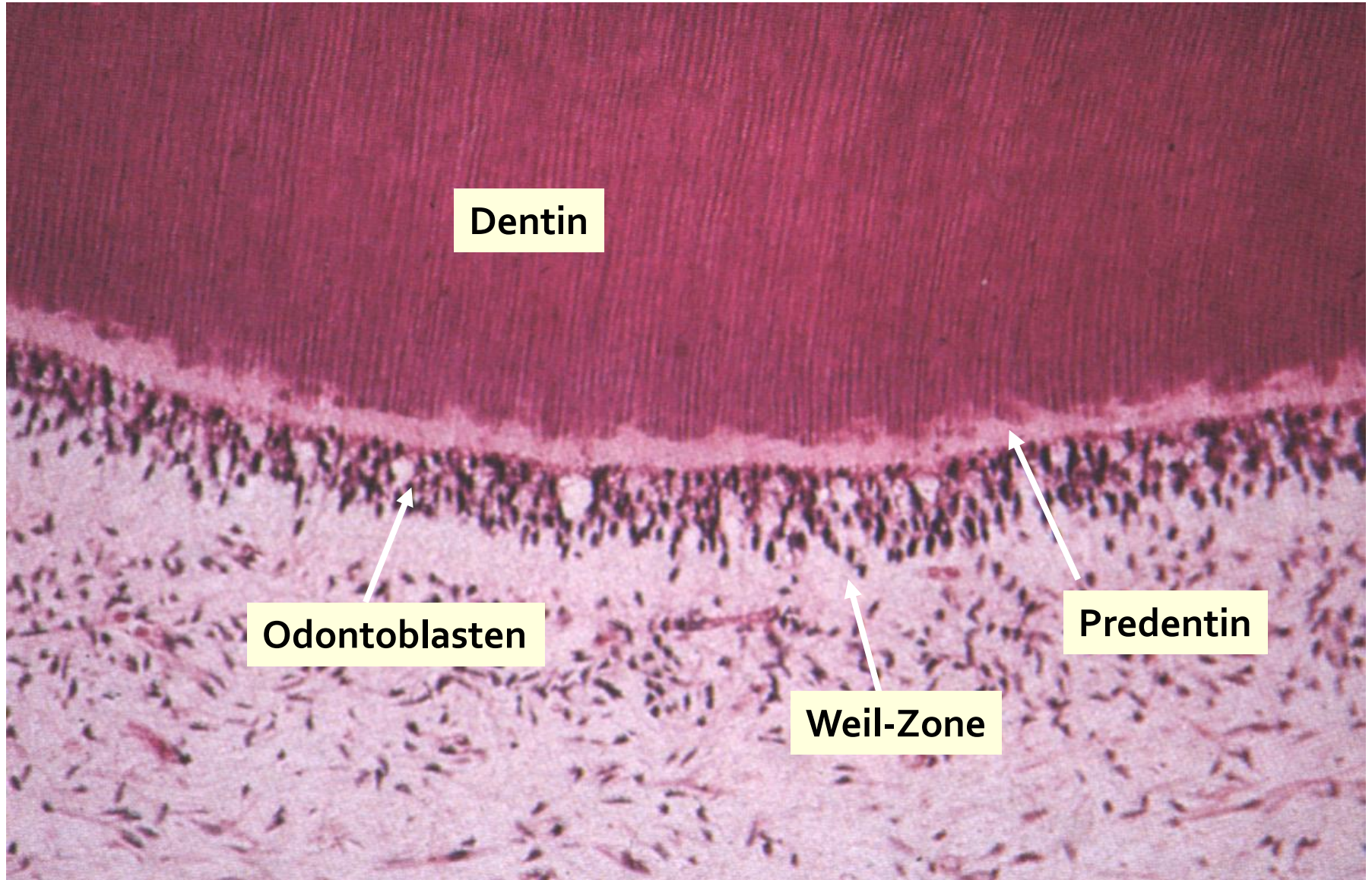


ZAHNPULPA



CF: zellfreie Zone (Weil-Zone),
Str. subodontoblasticum,
Plexus subodontoblasticus aus
nicht-myelinisierten
Nervenfasern
CR: zellreiche Zone
CP: zentrale Pulpa (locker)

ZAHNPULPENHISTOLOGIE



ZAHNPULPA

SCHICHTEN

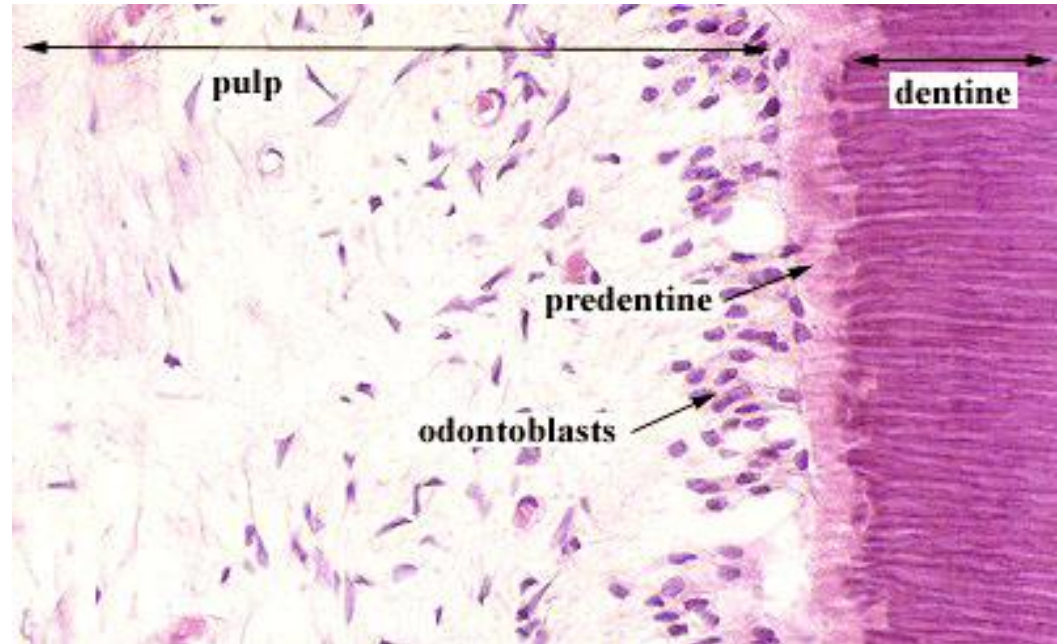
stratum odontoblasticum

acellular zone of Weil

stratum subodontoblasticum

cell rich zone

central pulp



ZELLTYPEN

Fibroblasten/fibrozyten

(alte vs junge Pulpa)

Odontoblasten

Stammzellen

Schutzzellen

macrophagen

dendritische AG presentierende zellen

mastzellen

plasmazellen

lymphozyten

eosinophilen

basophilen

neutrophilen

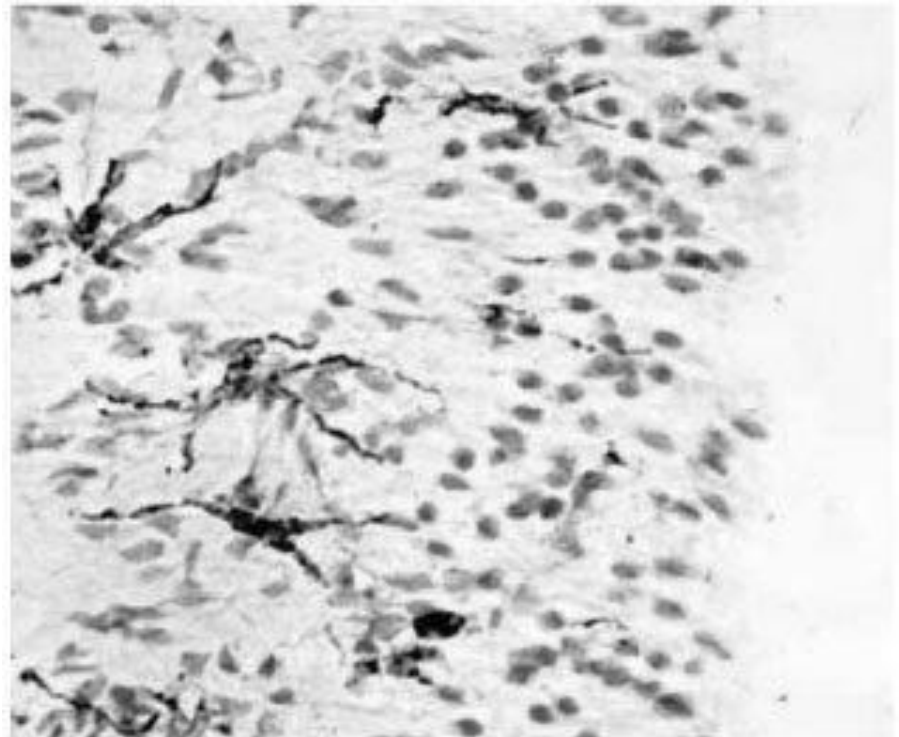
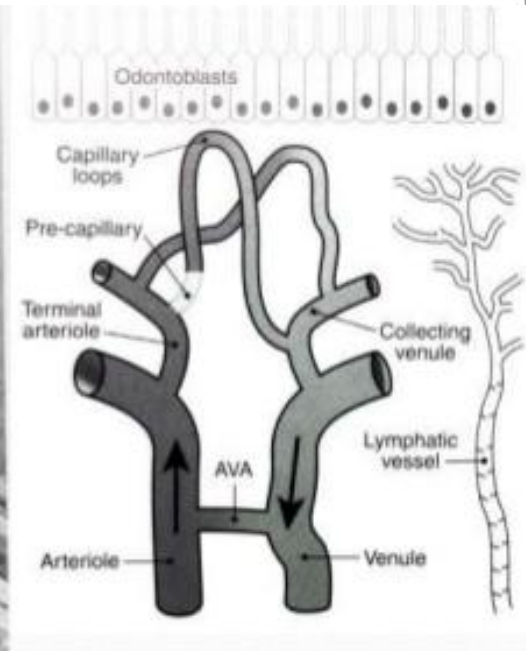
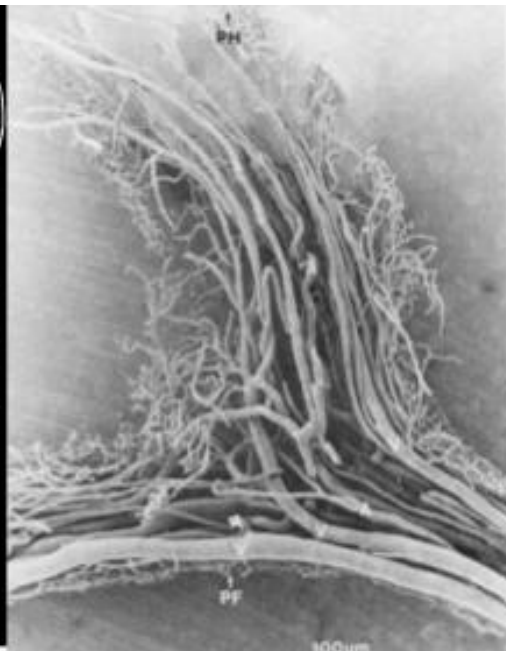
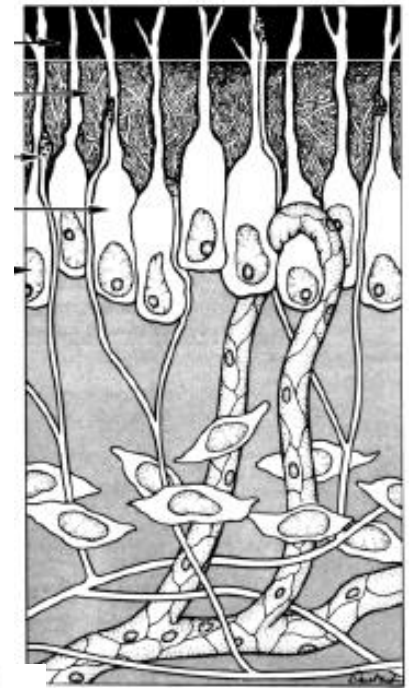


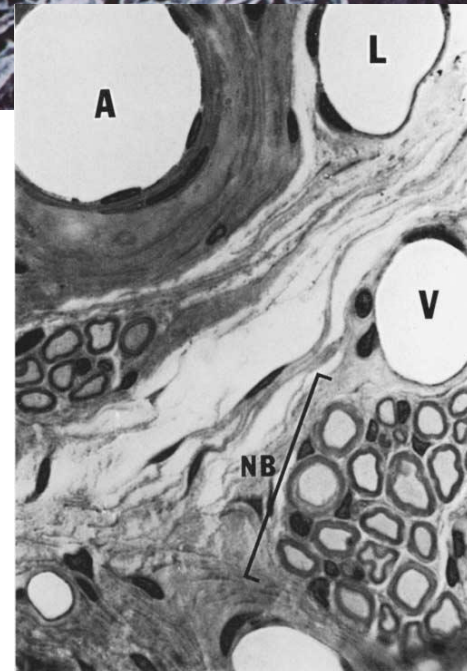
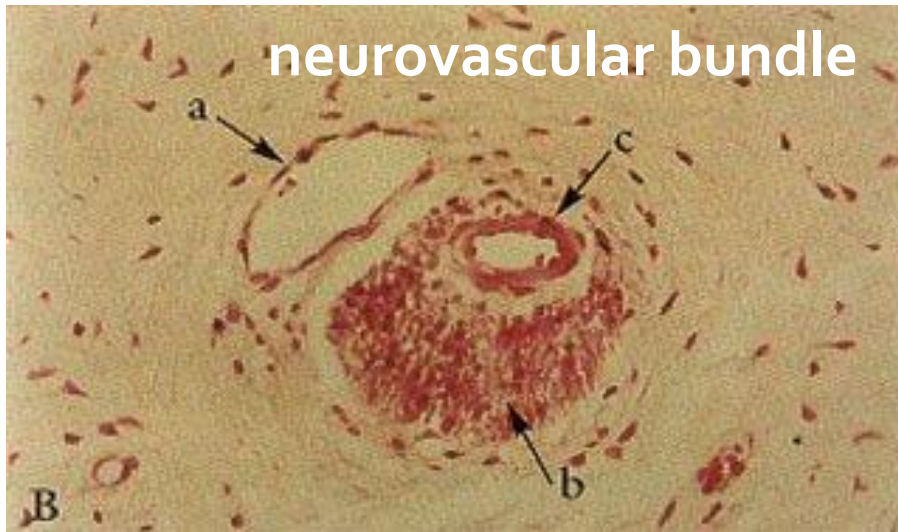
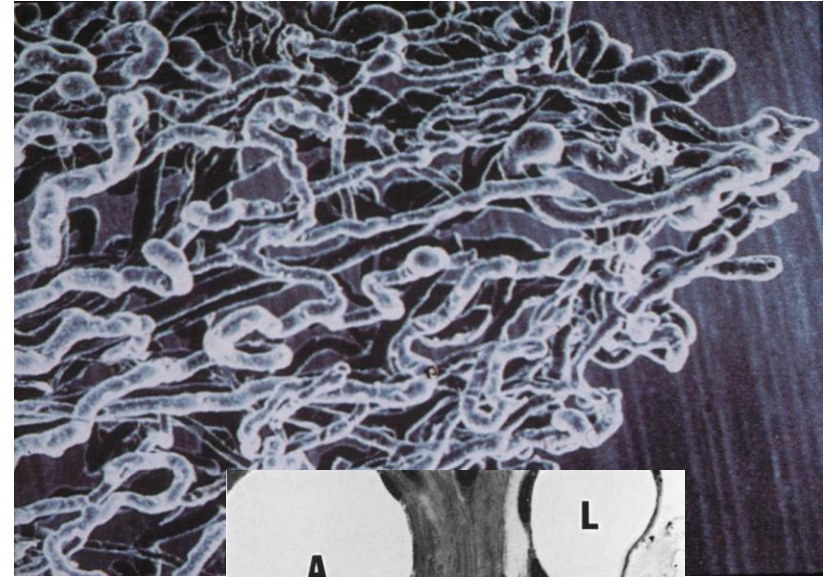
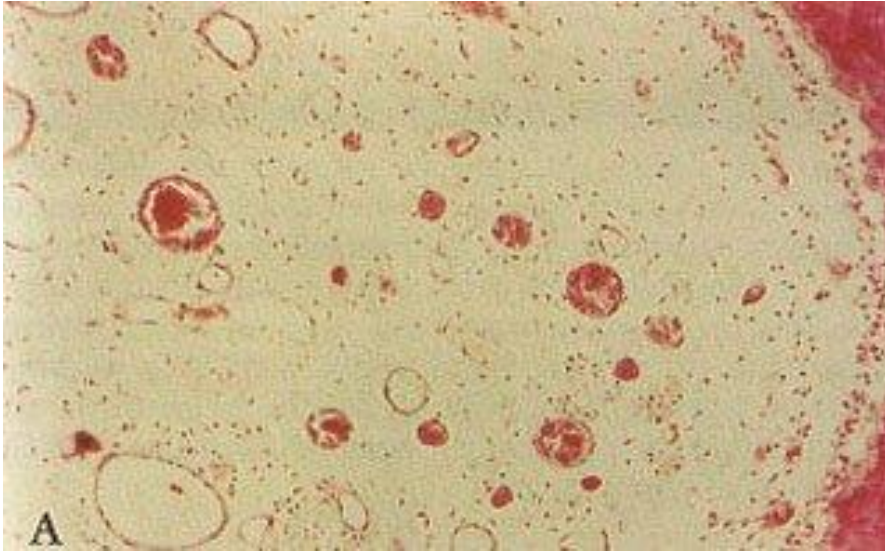
Fig. 2.13 Tissue section showing dendritic cells (stained brown) within the odontoblastic and subodontoblastic layer. Immunohistochemical staining was carried out with OX6-antibody, which is a marker for class II MHC molecules.

PULPA GEFÄßE

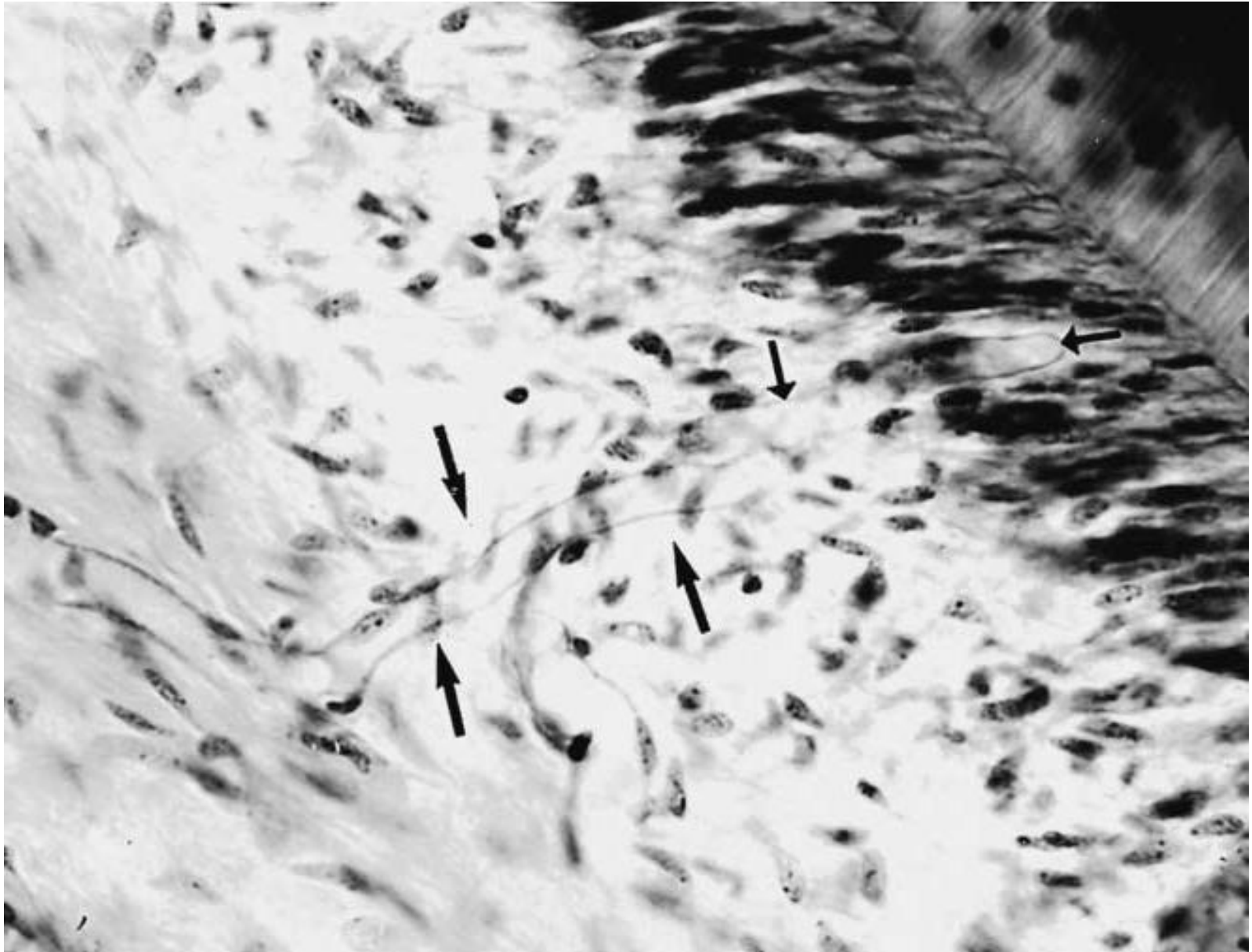
Rr. dentales → Foramen apicale
Dichtes Plexus subodontoblasticus
Mit fenestriertem und kontinuierlichem
Endothel



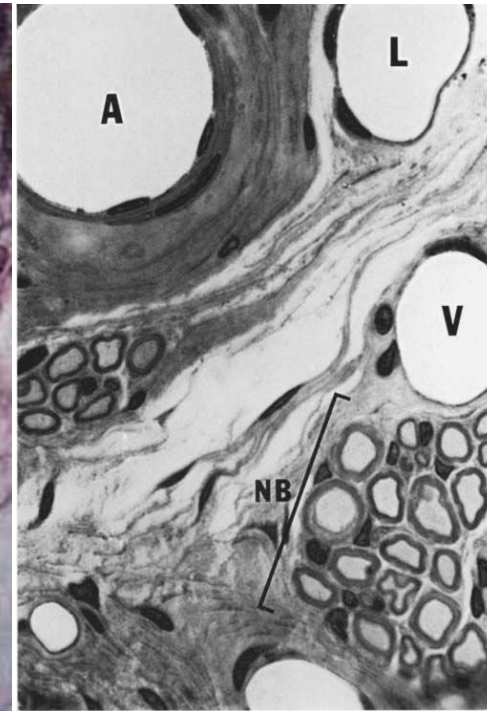
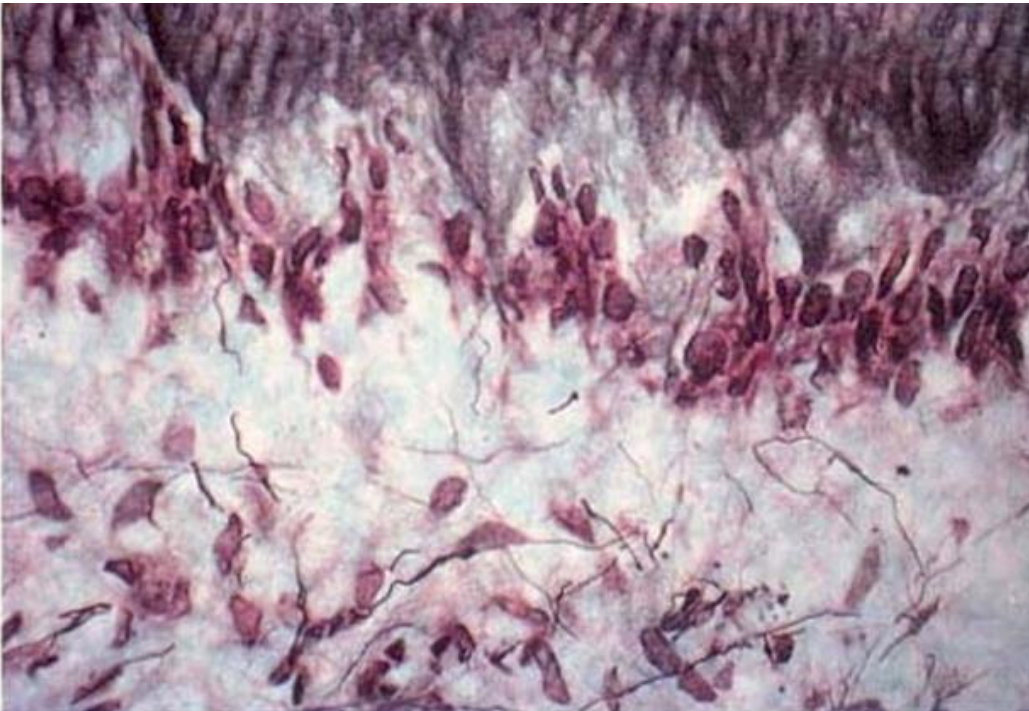
PULPA GEFÄSSE



LYMPH GEFÄSSE



PULPA - LEITUNGSBAHNEN



Neurovaskuläres Bündel:

- Arterie
- Vene
- Lymphkapillare
- Bündel von Nervenfasern

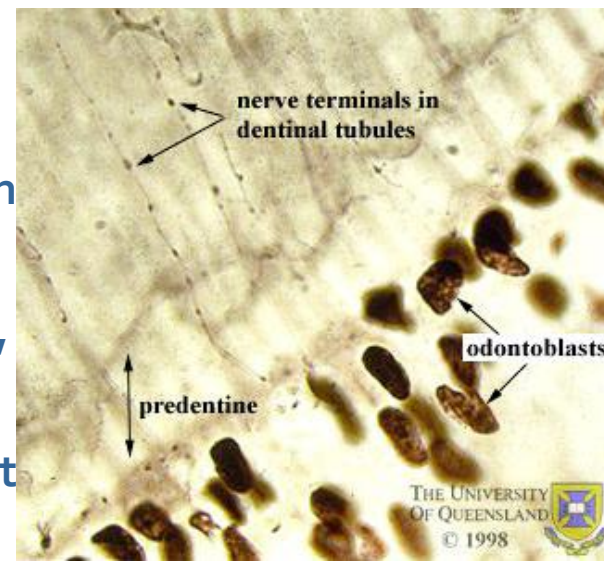
Rr. alveolares → Wurzelkanal

Premolar:

300 myelinisierte Nervenfasern (90%: A δ , C), sensorisch, auch in den Dentinkanälchen (hier ohne Myelinscheide)

2000 nichtmyelinisierte Nervenfasern: sensorisch, postggl. sympathisch, SGRP, SP

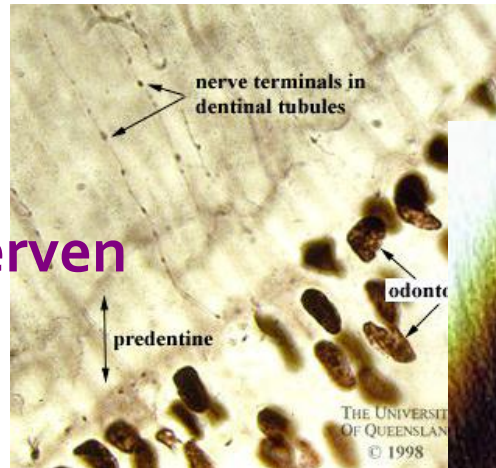
Regeneration: NGF aus Odontoblasten, Fibroblasten



NERVEN DER PULPA

Myelinisierte Nerven

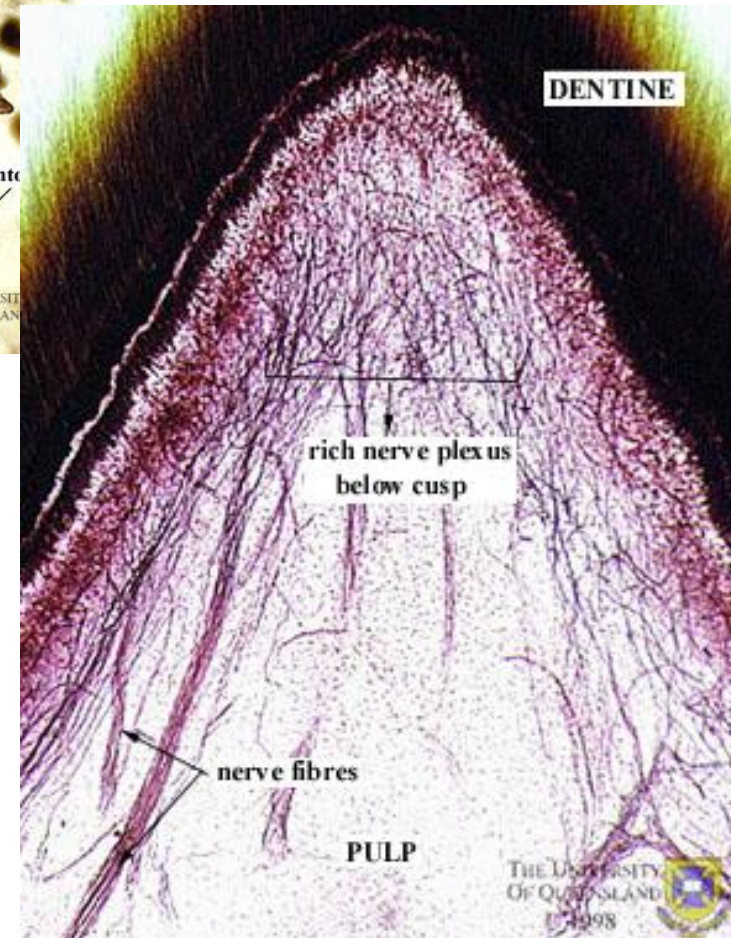
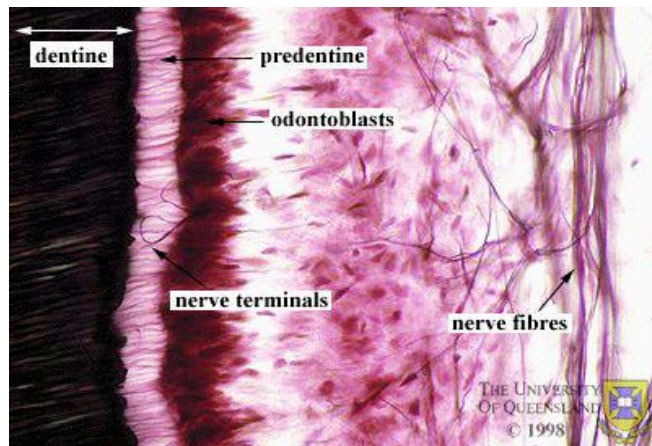
n. trigeminalis
(A beta Fasern)



Non-myelinisierten Nerven

C Fasern

*Meistens gehören auch zum Trigeminalsystem,
Einige Fasern gehören zum Sympatisches system
Versorgen die arteriolen*



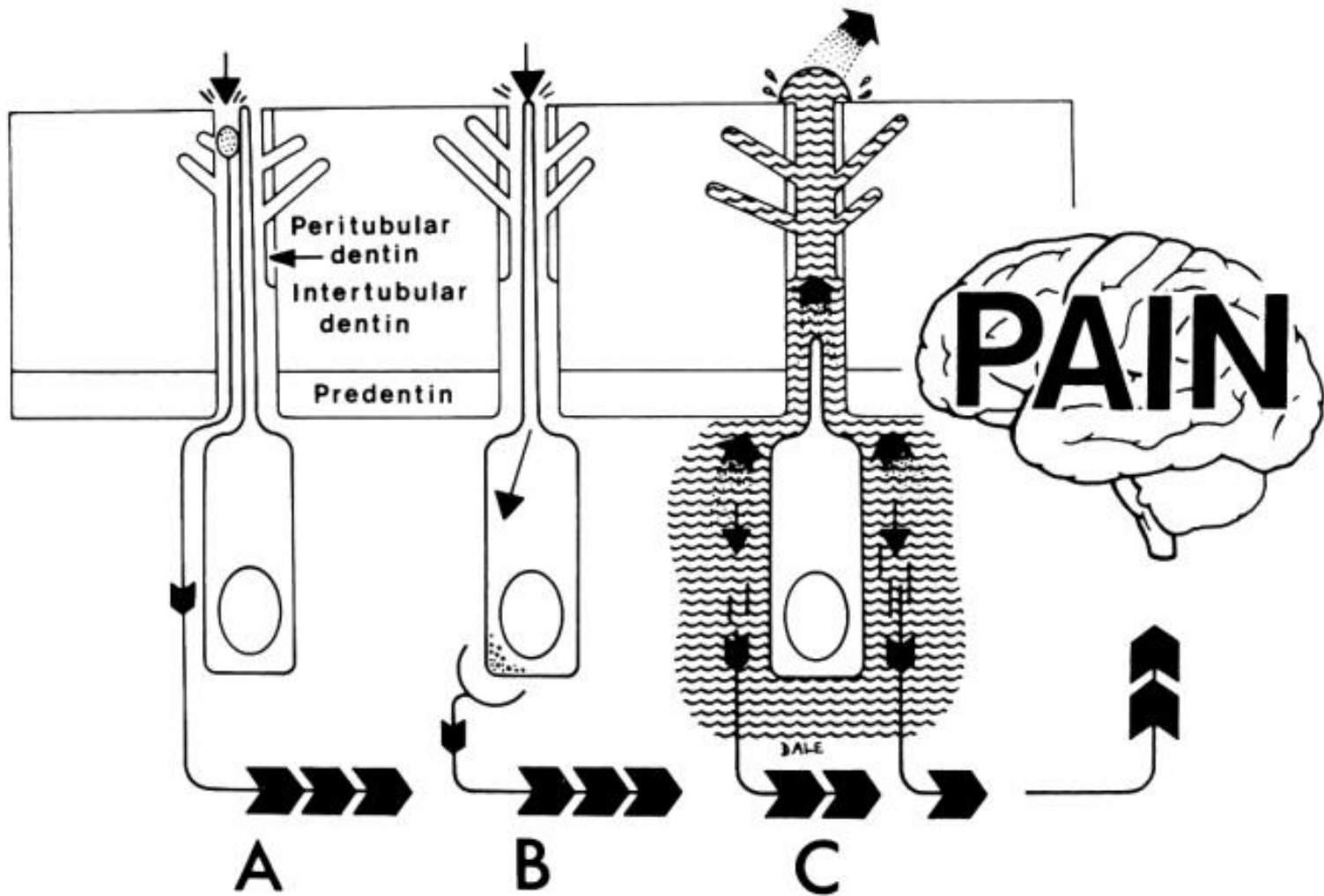
NERVEN DER PULPA



Raschkow plexus

Figure 9.14

Nerve fibers in the subodontoblastic area. Fibers can be traced to the odontoblastic cell layer.

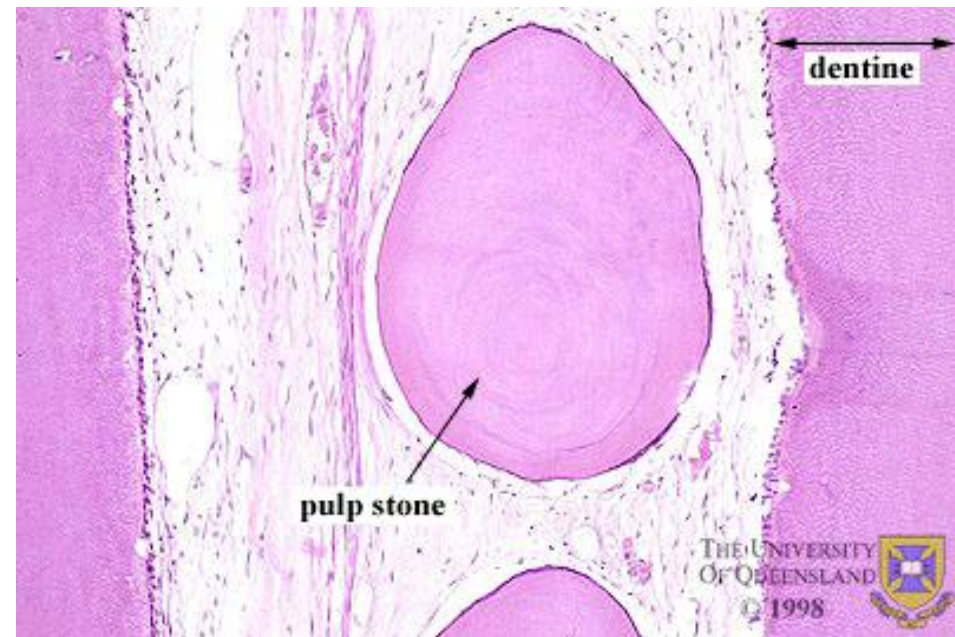
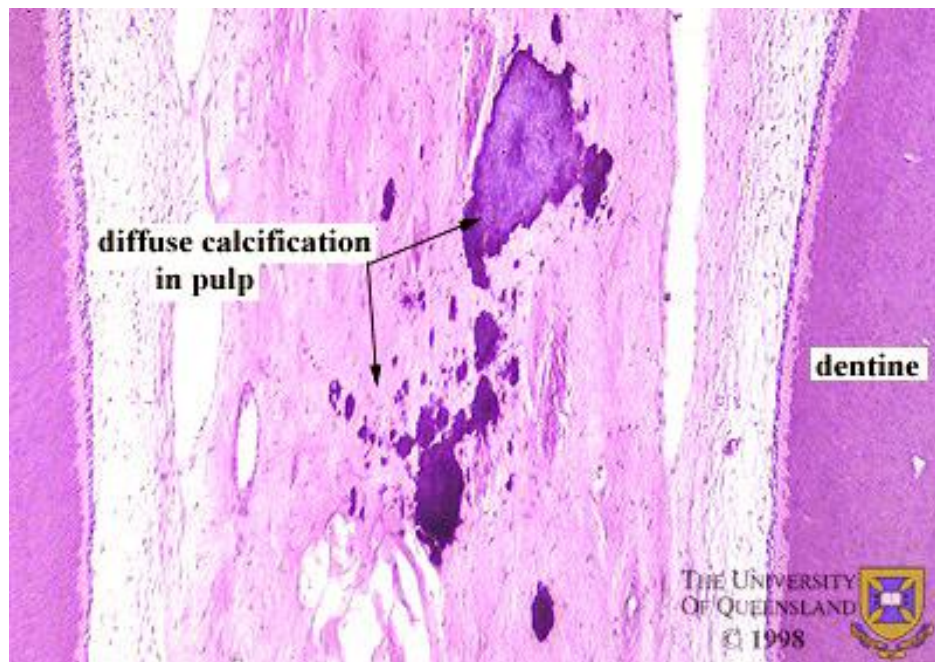


(from ART Cate: Oral Histology - Development, Structure, and Function; Mosby Year Book)

KLINISCHE RELEVANZEN



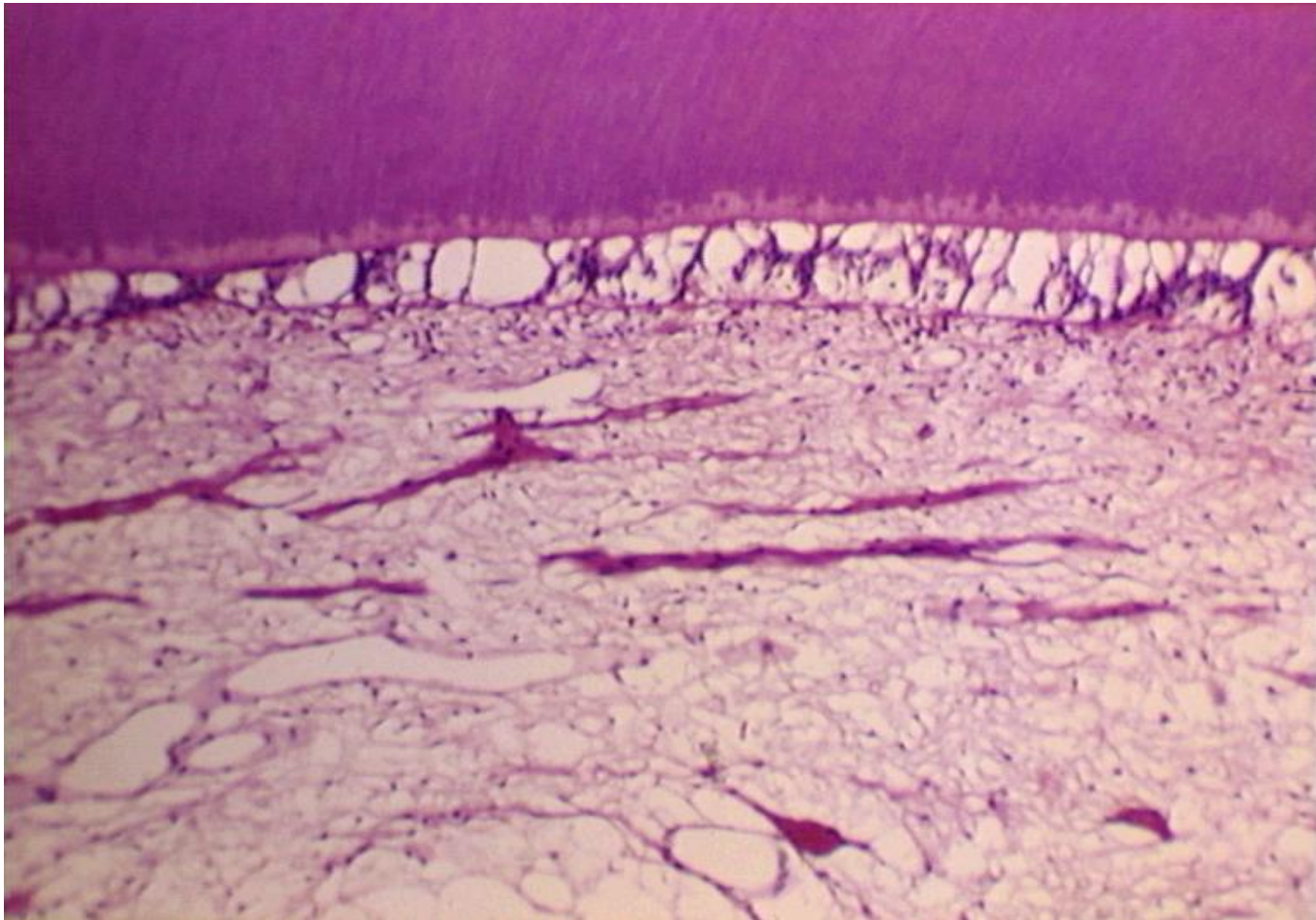
PULP STONES



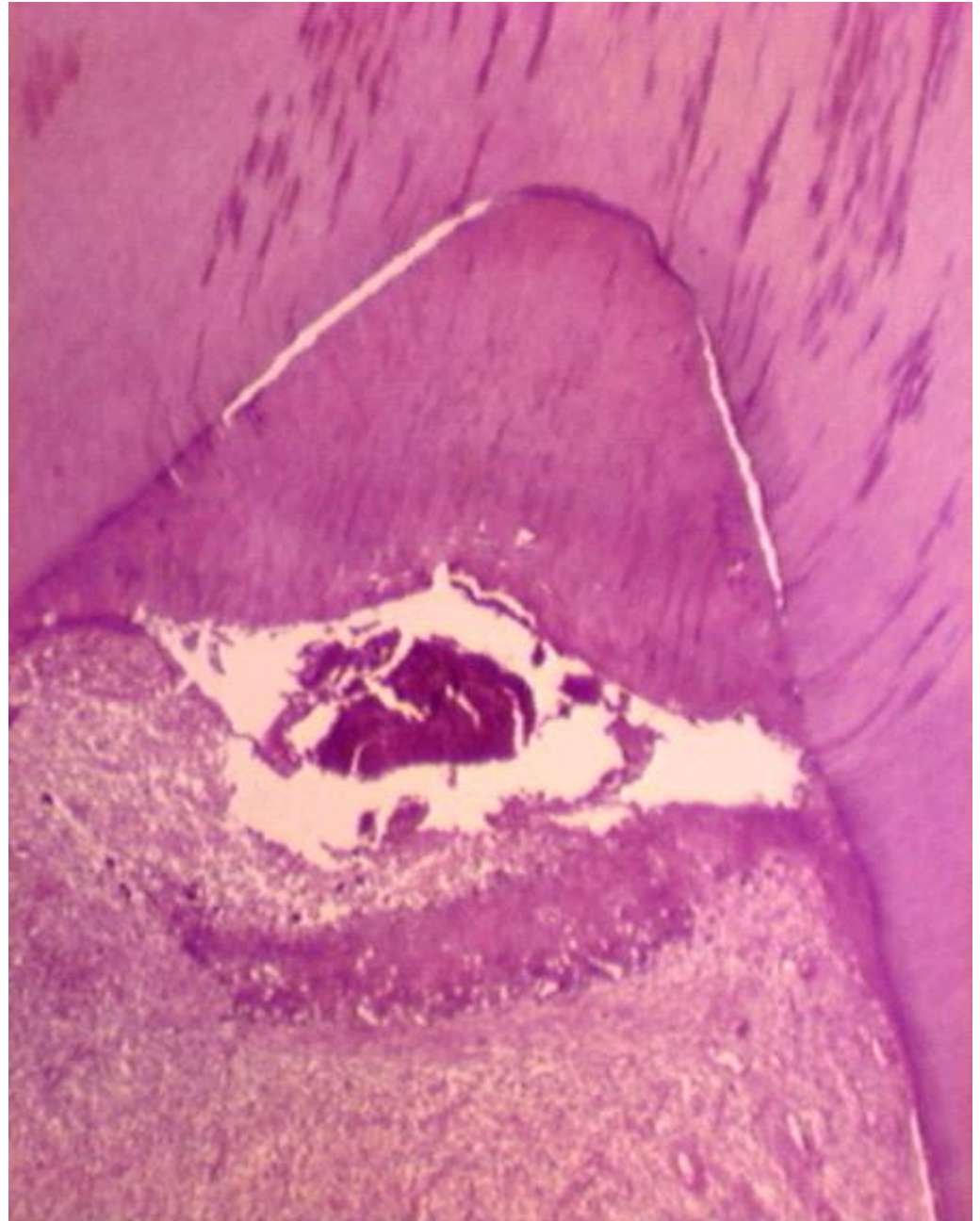
PULPAL INFECTION



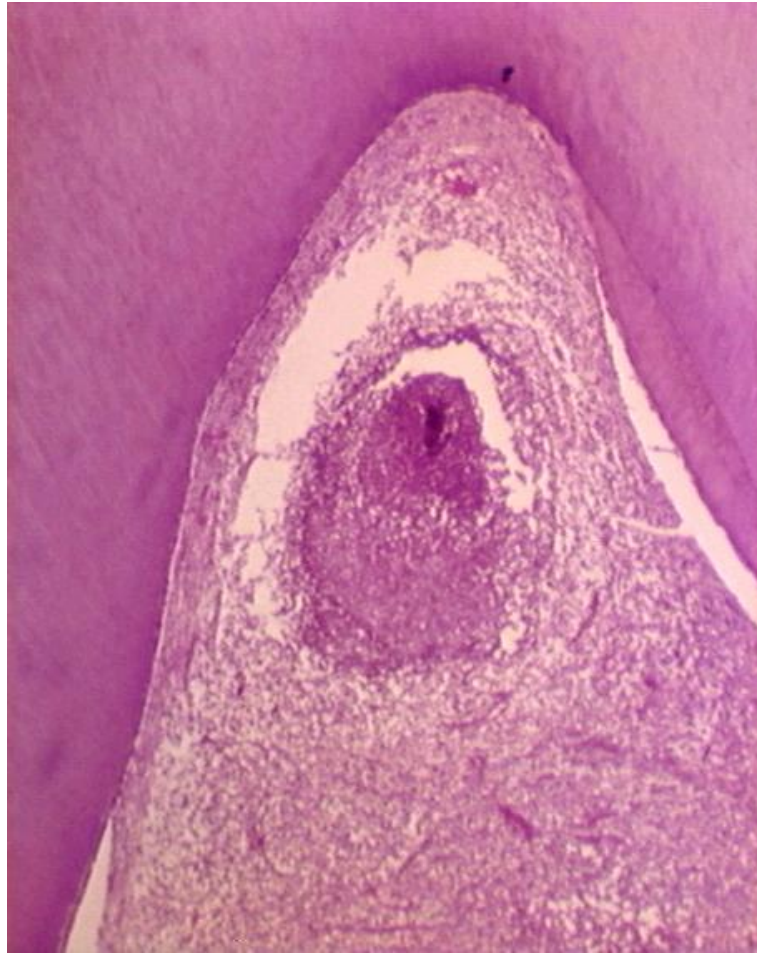
PULPAL EDEMA



**PULPAL
ABSCESS
AND
REPARATIVE
DENTIN**



DECAY AND PULPITIS



OPEN PULPITIS

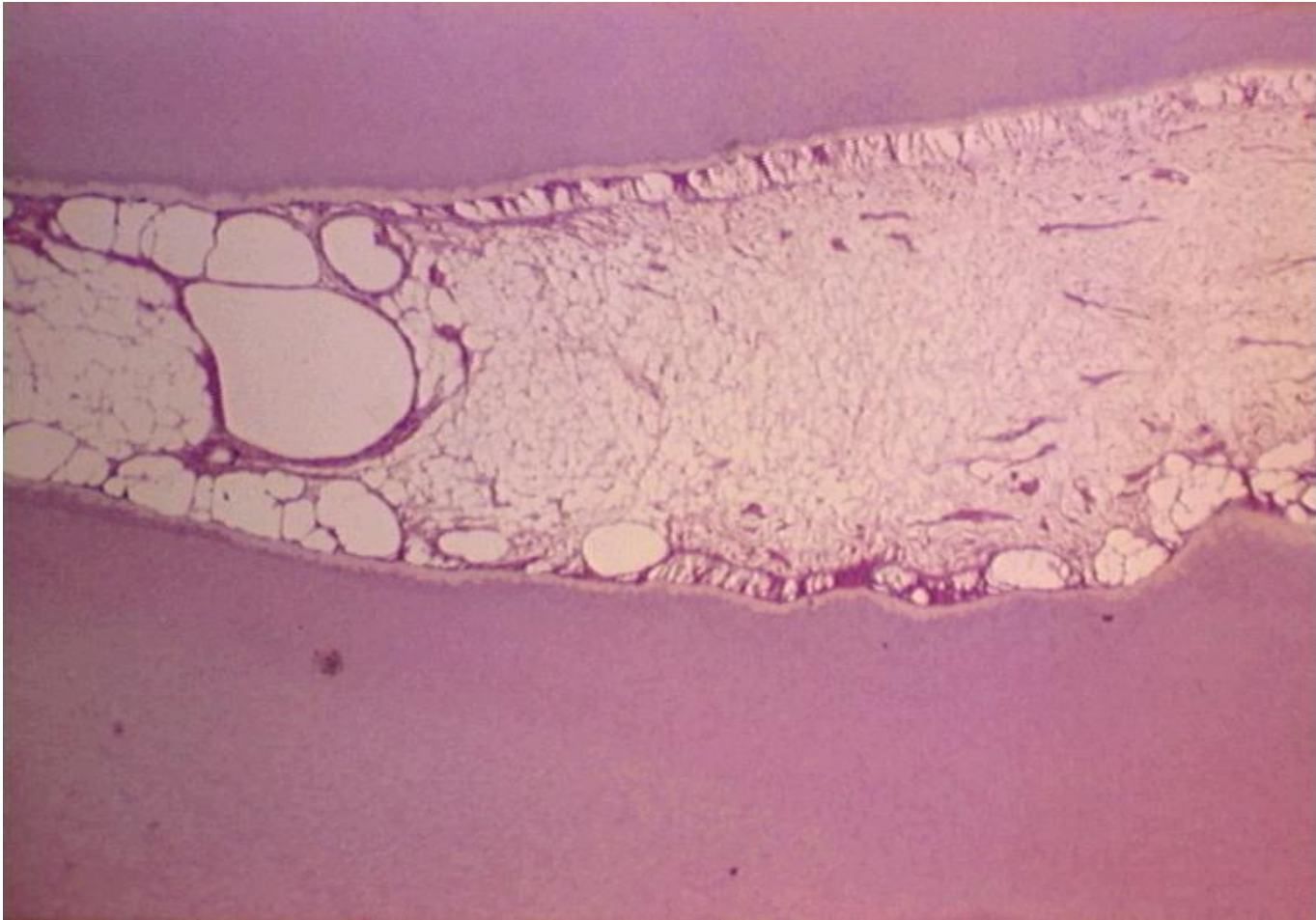


PULPAL POLYPUS

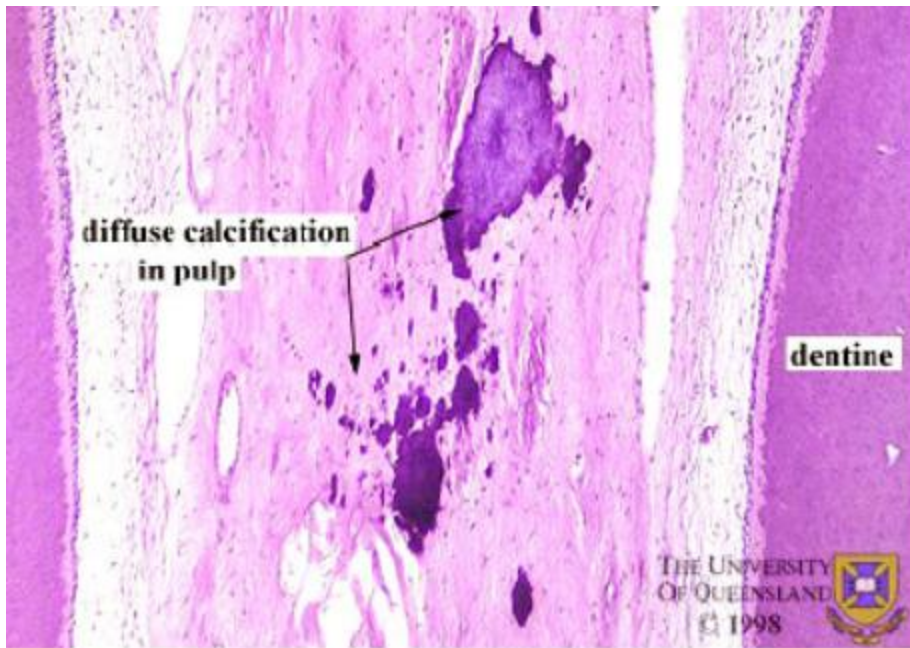




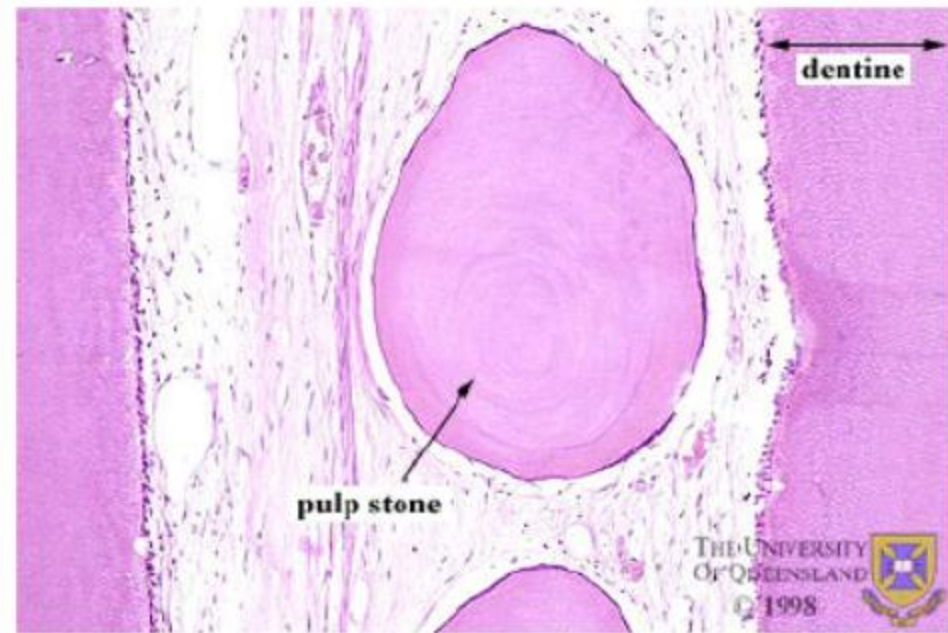
RETICULAR PULPAL DEGENERATION



Pulpa - Altersveränderungen

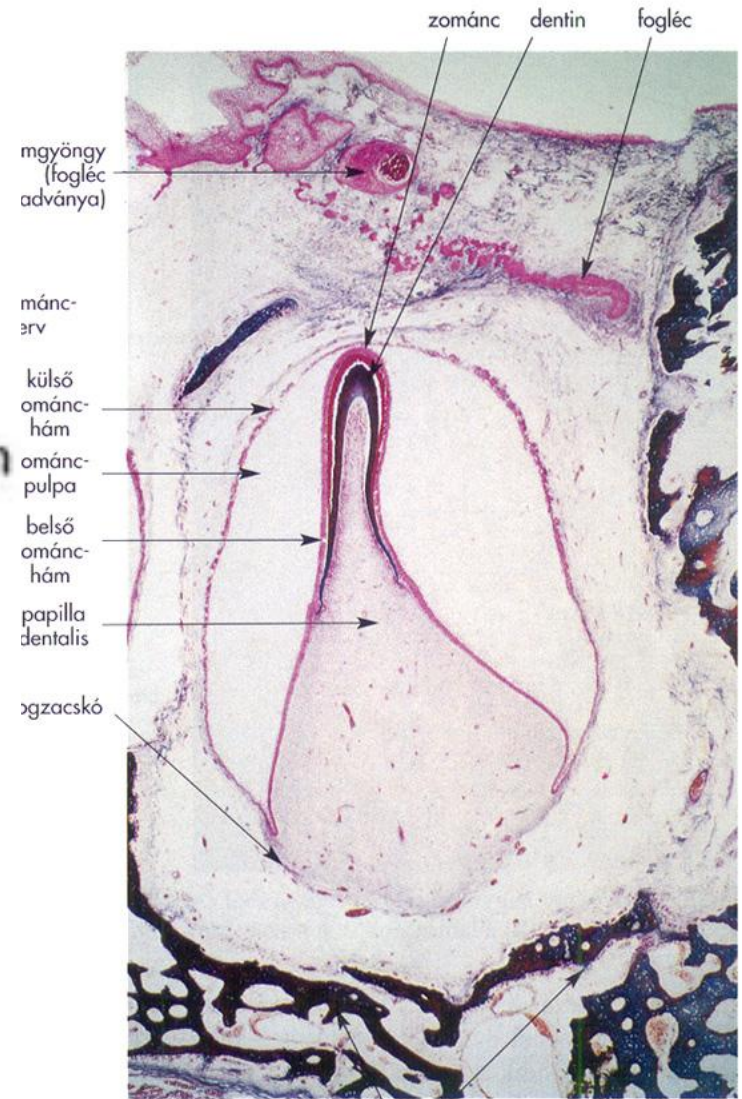
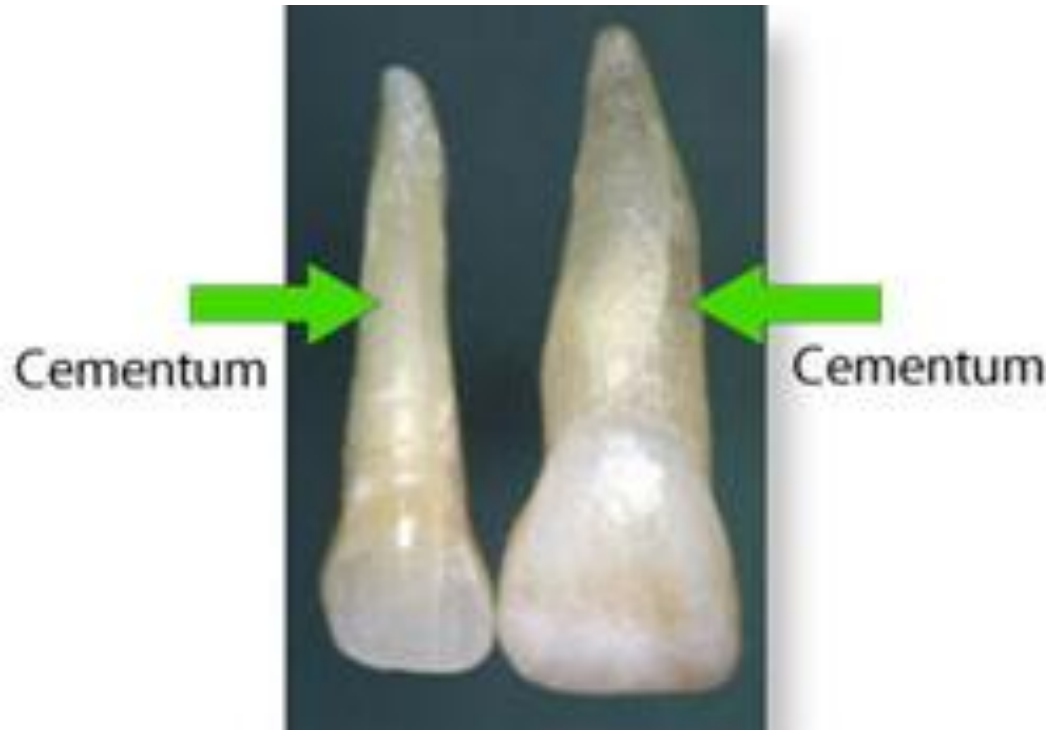


Diffuse oder umschriebene Verkalkungen



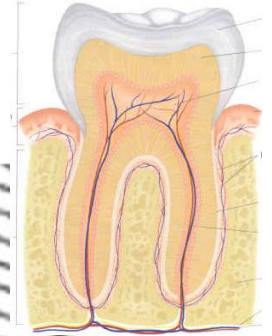
Denticulus: Pulpastein

ZEMENTUM



fejlődő alveoluscsont (desmális csontosodás)

SCHMELZ - ZEMENT GRENZE



60%:
überlappend



30%:
aufeinander
treffend



10%:
lückenhaft

ZAHNHISTOLOGIE

ZEMENTUM

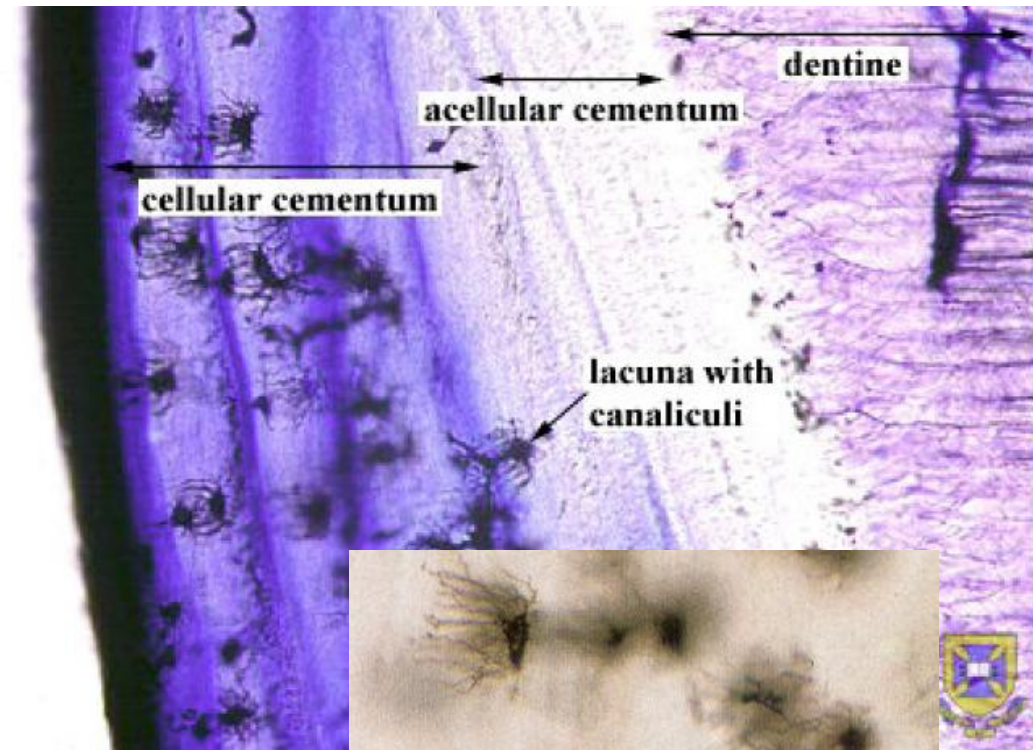
Bedeckt den Wurzel

Herkunft: Zahnsack

0,1-0,5 mm dick, kann in den Wurzelkanal reichen

Knochenähnlich, aber avaskulär

Gute Druckfestigkeit
Zementozyten



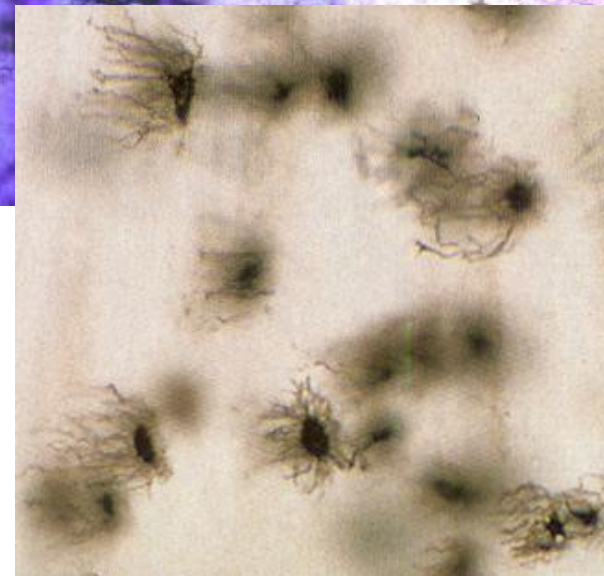
TYPEN

Azelluläres Zement

obere 2/3 der Wurzel, Zementozyten auf der Oberfläche; Verankerung der Sharpey-Fasern

Zelluläres Zement

untere 1/3 der Wurzel



ZAHNHISTOLOGIE

ZEMENTUM

Zement ist eine dem Geflechtknochen ähnliche Substanz. Er umgibt als 0,1 - 0,5 mm dicke Schicht die Dentinoberfläche im Hals- und Wurzelbereich.

45-50% anorganische Substanz
50-55% organische Substanz
+ Wasser

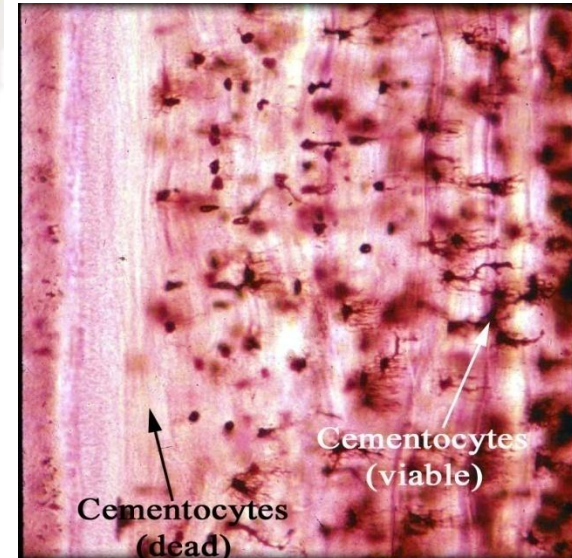
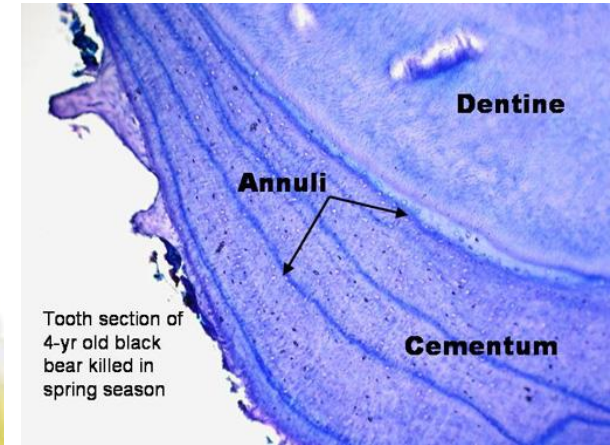
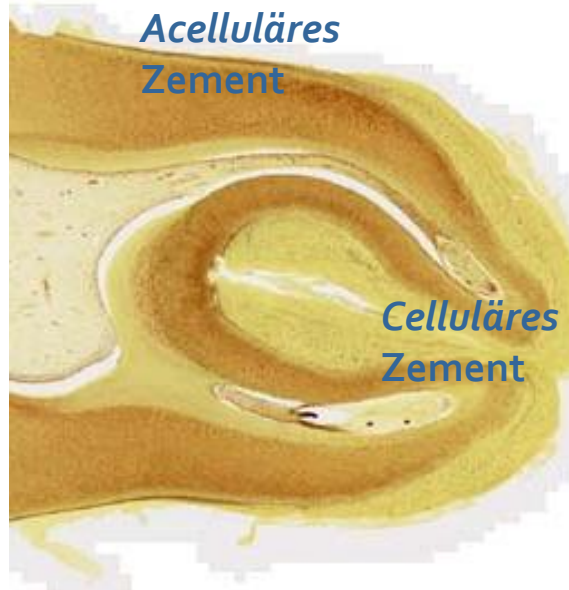
ZELLEN:

Zementoblast, Zementocyt
Nur im unteren 1/3! *zelluläres*
Zement
Obere 2/3 Azelluläres Zement

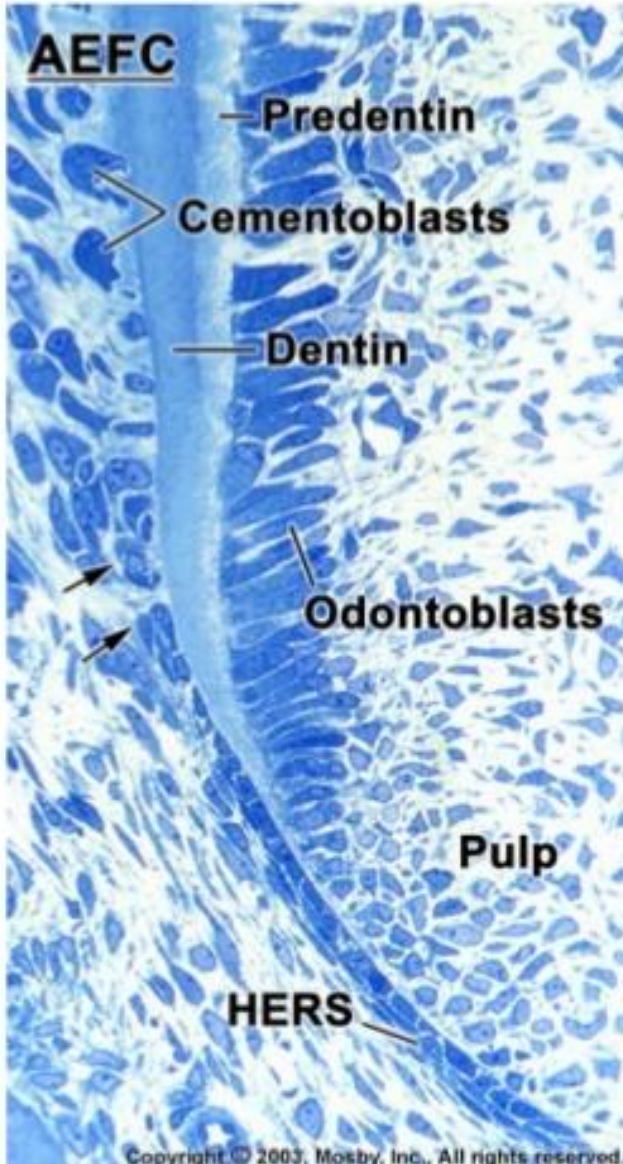
Fremdfaserzement (beim Periodont)
Eigenfaserzement

Avaskuläres Gewebe

Hohe Widerstandsfähigkeit gegen
Resorption (wichtig bei Orthodontie)



ZEMENTBILDUNG



Cementum formation occurs along the entire tooth

Hertwig's epithelial root sheath (HERS) – Extension of the inner and outer dental epithelium

HERS sends inductive signal to ectomesenchymal pulp cells to secrete predentin by differentiating into odontoblasts

HERS becomes interrupted

Ectomesenchymal cells from the inner portion of the dental follicle come in with predentin by differentiating into cementoblasts

Cementoblasts lay down cementum

STADIEN DER ZEMENTBILDUNG

- Phase I : Laying down of cementoid tissue
(matrix formation)

- Phase II : Mineralization

Apatite crystals are deposited along the fibrils.

Cementum formation takes place rhythmically.

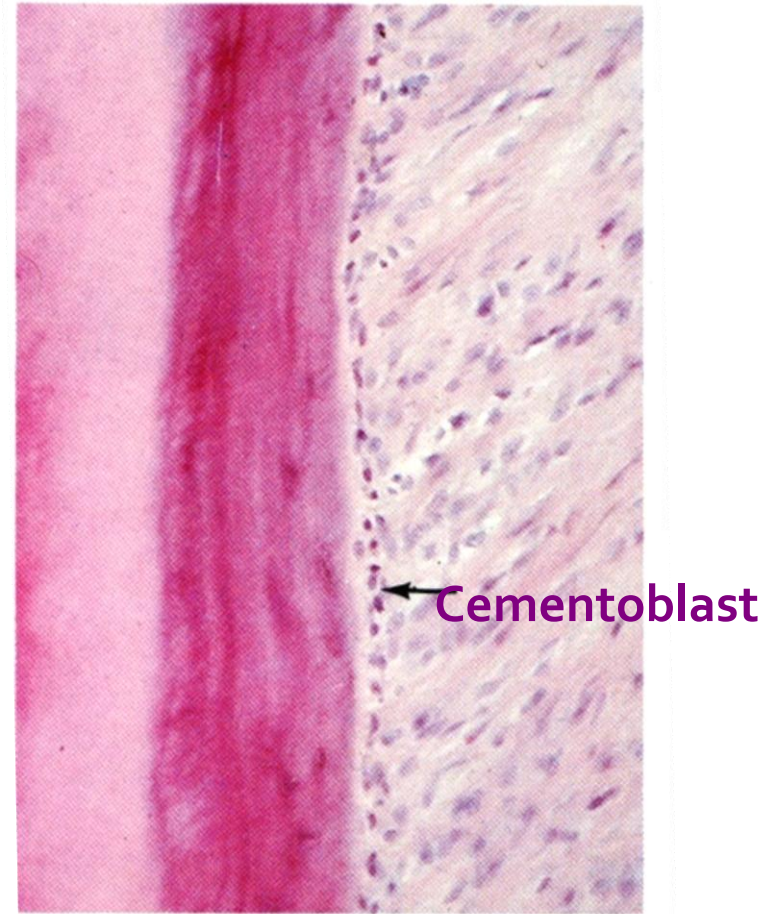
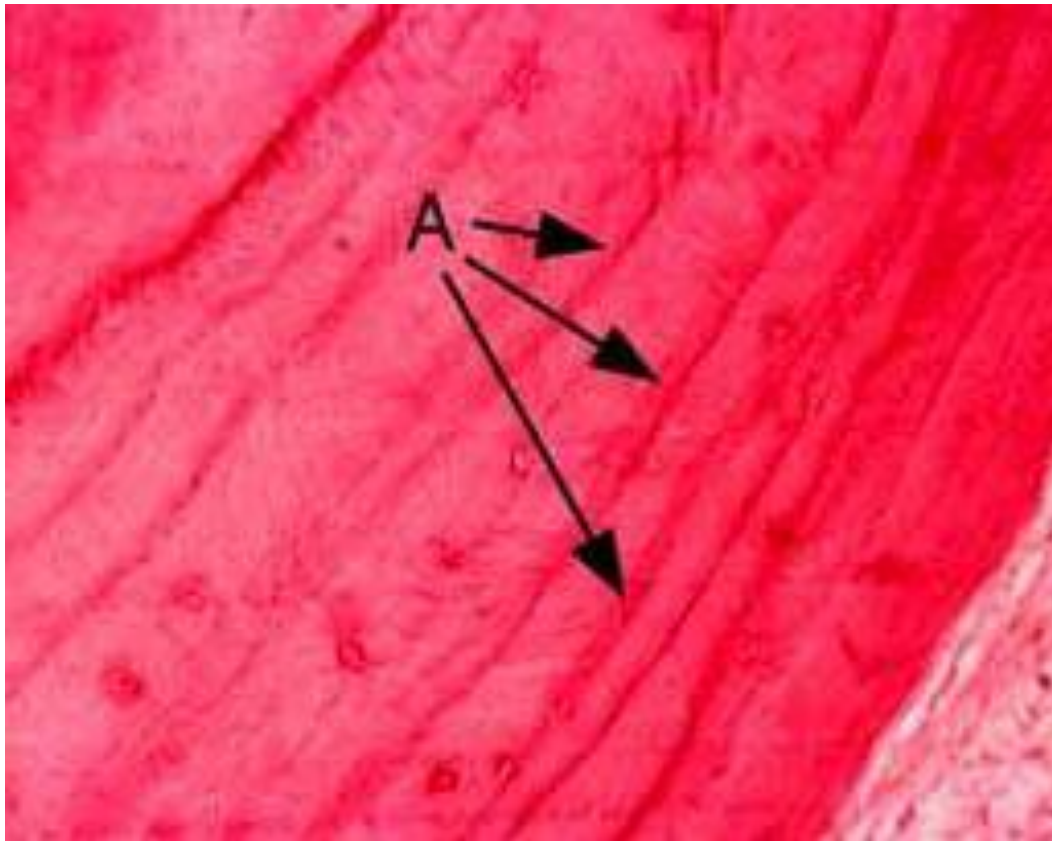
A thin layer of cementoid is seen on the surface of cementum lined by cementoblasts.

These fibers are embedded in the cementum and attaches tooth to the surrounding bone.

Sharpey's Fibers.

ZEMENTUM

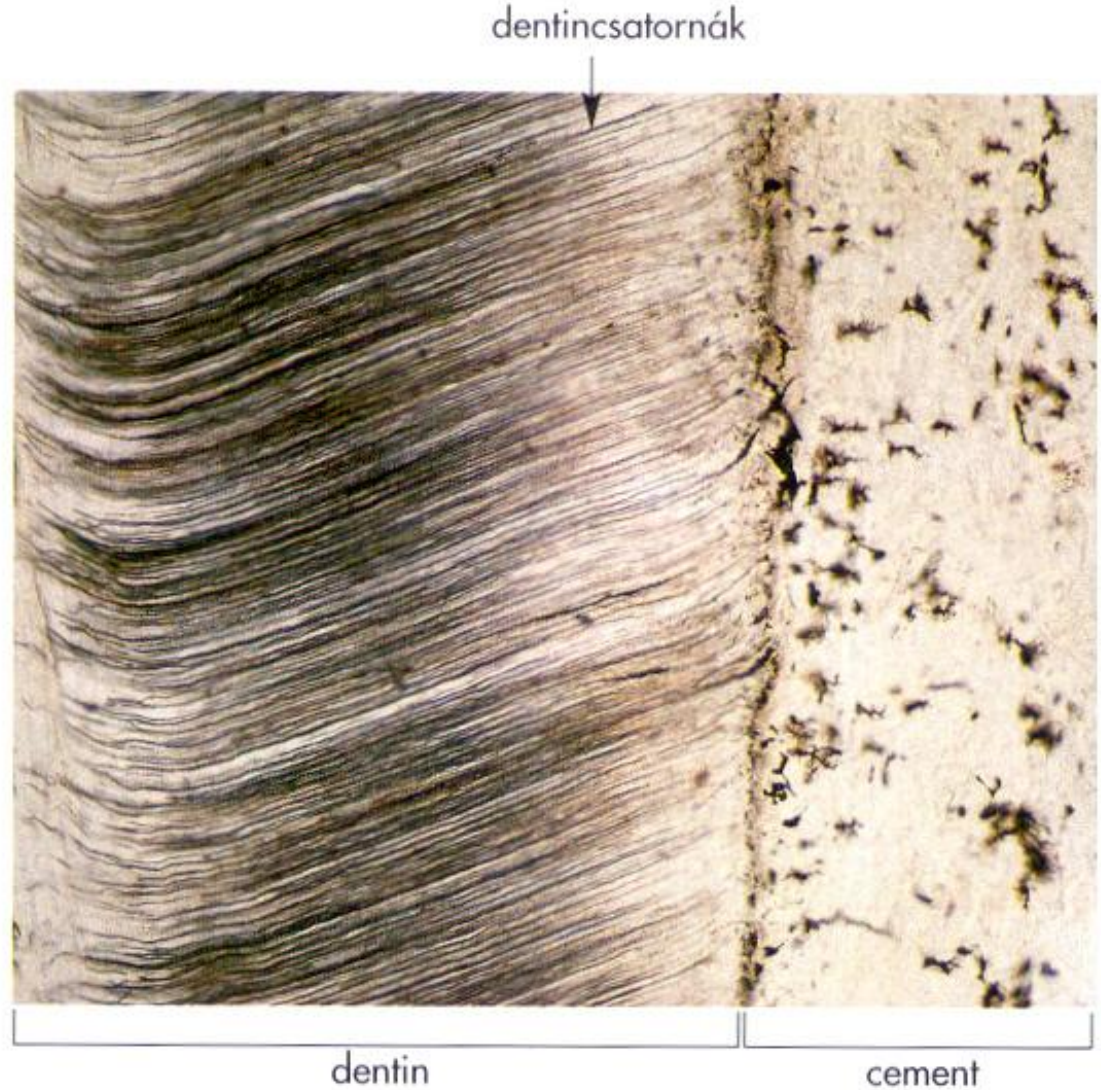
*SALTERs*che WACHSTUMLINIEN



ZEMENTUM

Verankert die
periodontalen
faserbündeln
(collagen) -

Bildet einen Ersatz
bei der
Wurzelspitze



ZEMENTUM

TYPEN

Azelluläres fremdfaseriges Zement

*Sharpeysche Fasern wachsen ein
5-7 micrometer dick*

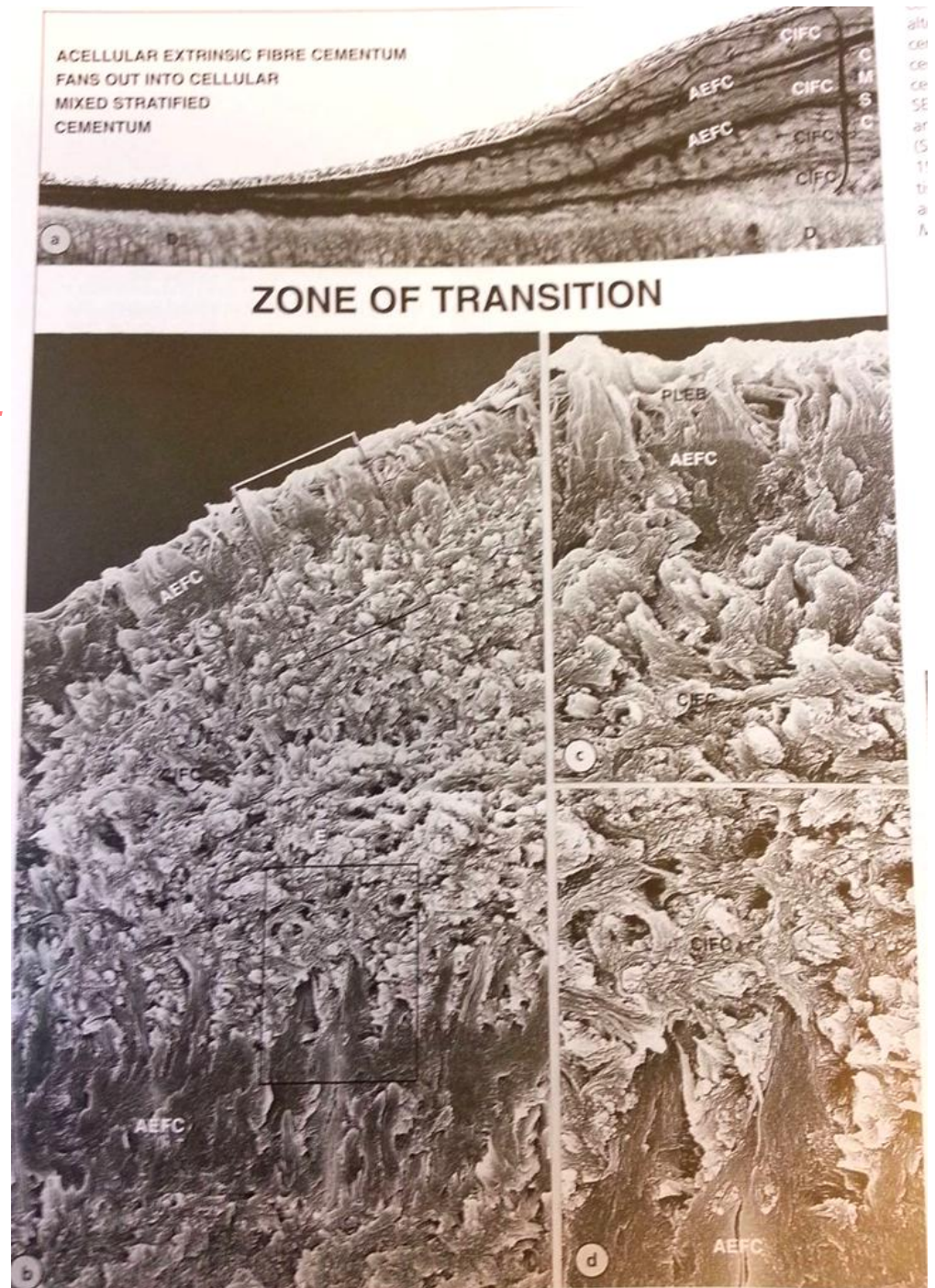
Zelluläres eigenfaseriges Zement

*parallel laufenden Fasern
1-2 micrometer dick*

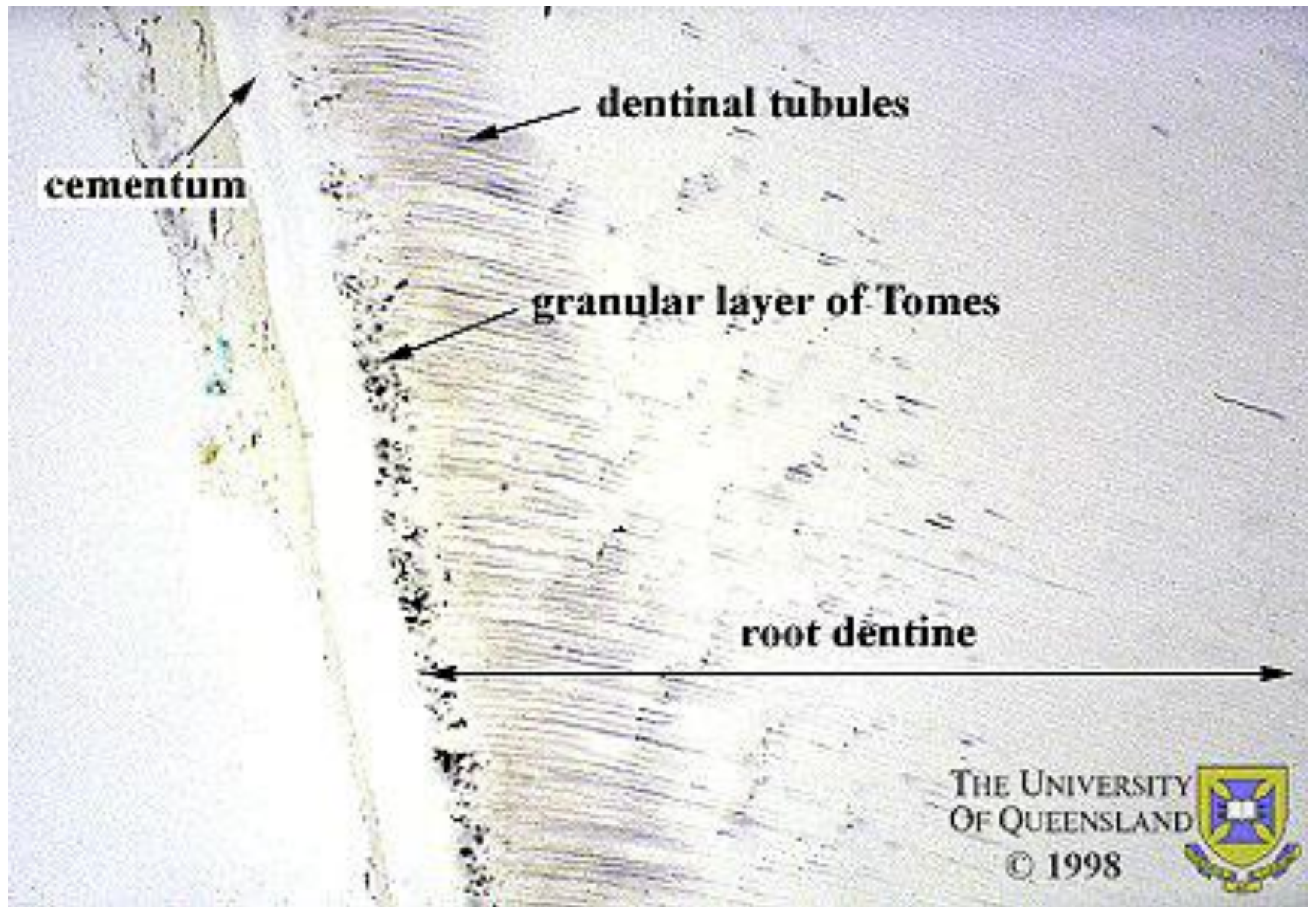
Gemischte faseriges Zement

Afibrilläre Zement

*Dünn azelluläre Schicht über z.B.
Zervikale Schmelz
(Kein Kollagenfibrillen)*



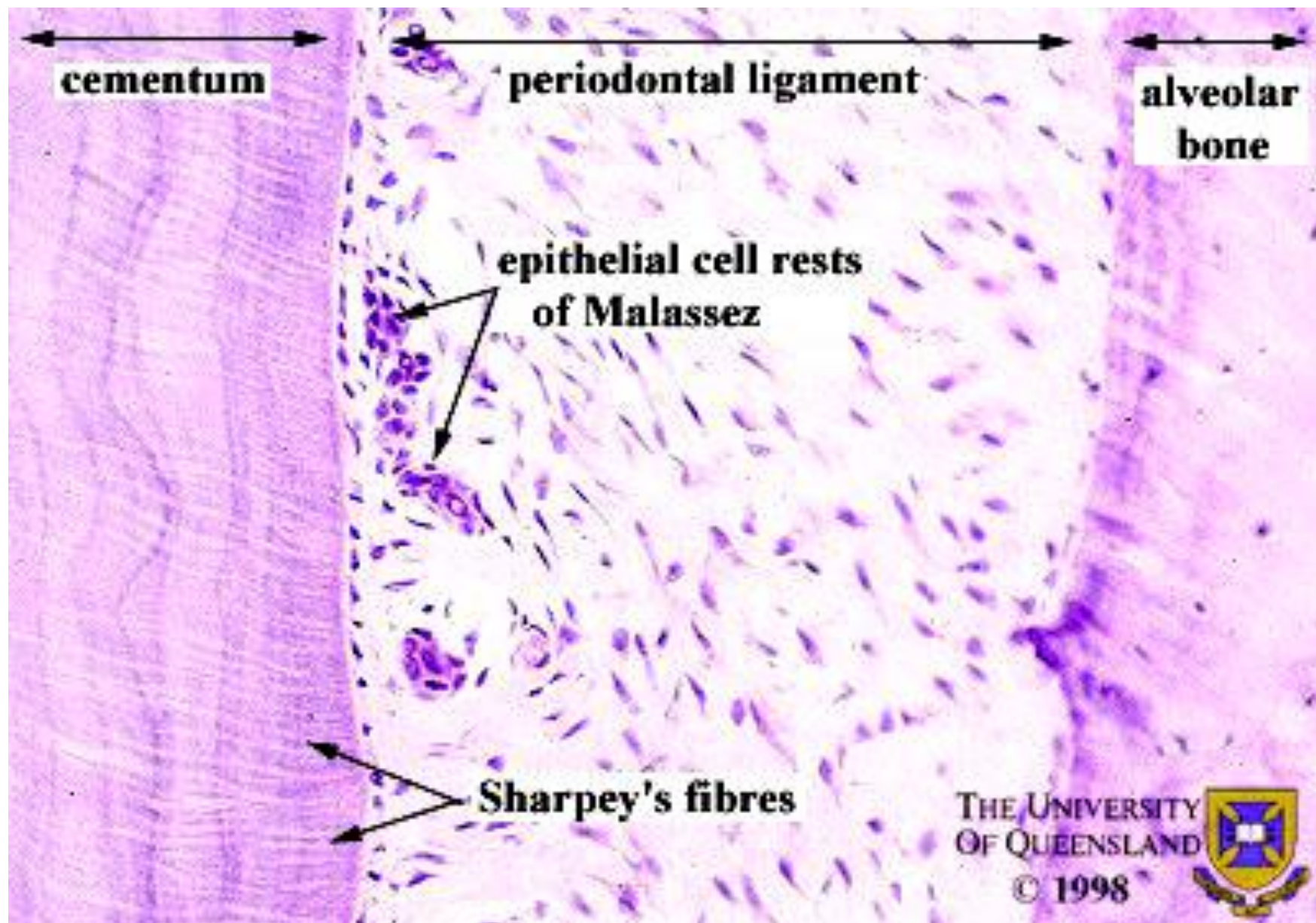
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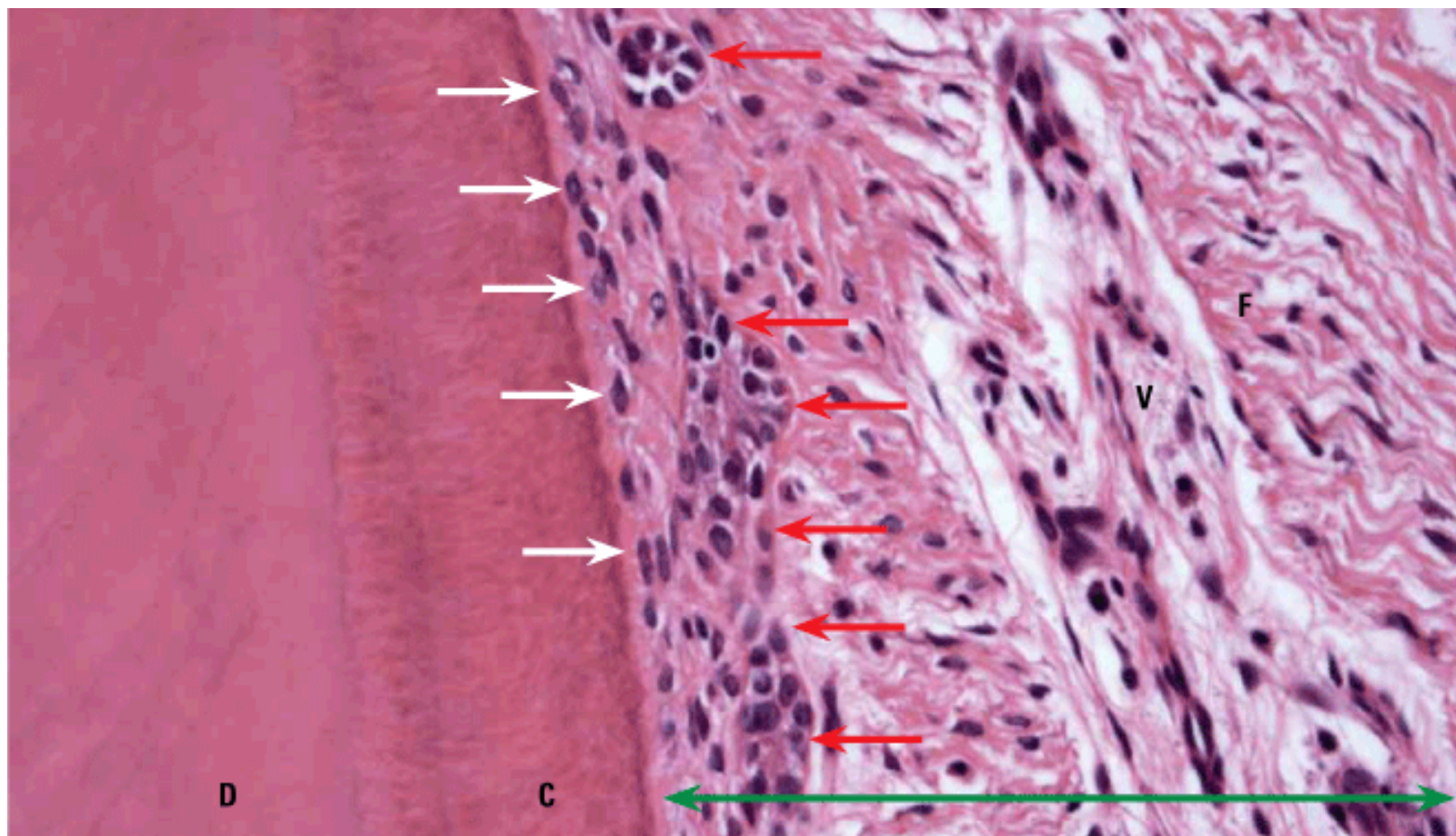
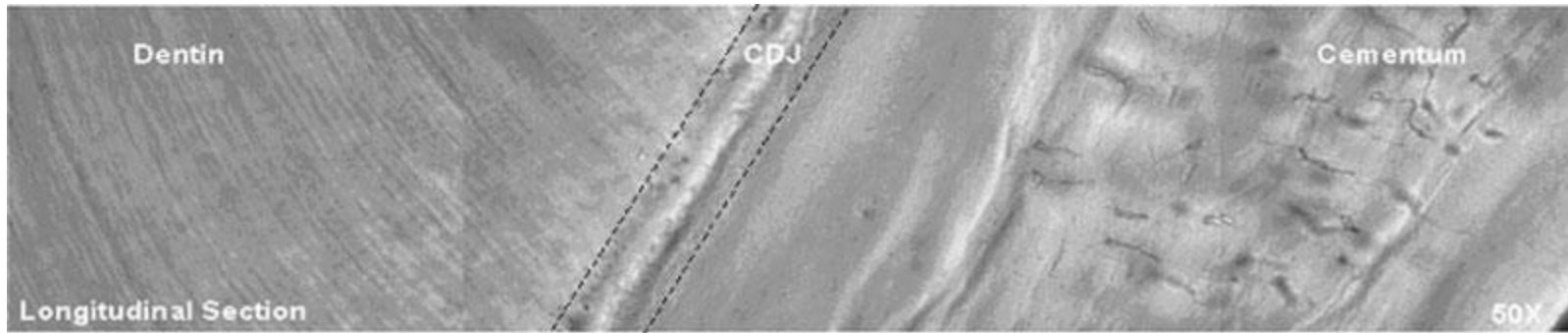


FIGURE 1 - On the root surface the cementum is covered by cementoblasts (**white arrows**). Collagen fibers—called Sharpey's fibers—penetrate amid these cells and attach themselves to the cementum (**C**). In the periodontal ligament (**green arrow**) epithelial cell islands and cords can be observed (**red arrows**) which form a three-dimensional network around the root, like a basketball hoop. This epithelial component of the periodontal ligament, called Epithelial Rests of Malassez (**red arrows**), constantly releases Epithelial (or Epidermal) Growth Factor (EGF), whose molecules diffuse through the cells in the extracellular matrix and stimulate osteoclasia on the periodontal bone surface, thereby promoting the maintenance of periodontal space (**D** = dentin; **F** = fibroblasts; **V** = blood vessels. HE; X25).

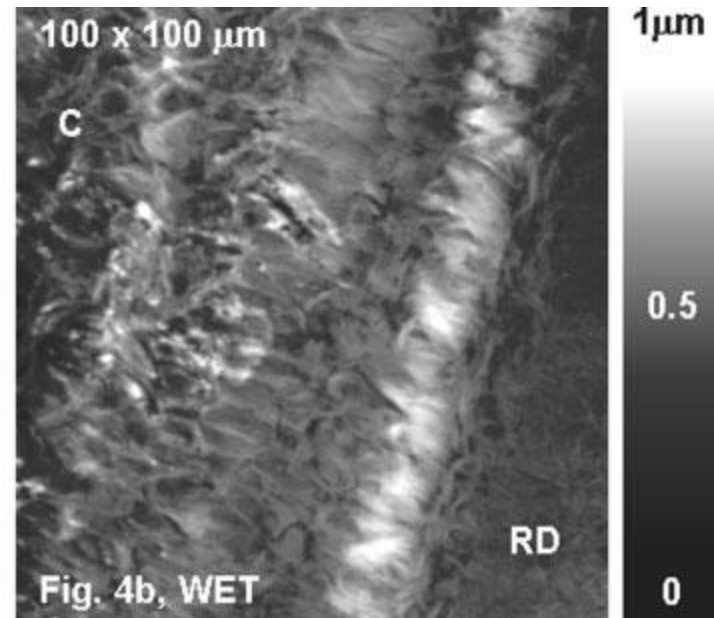
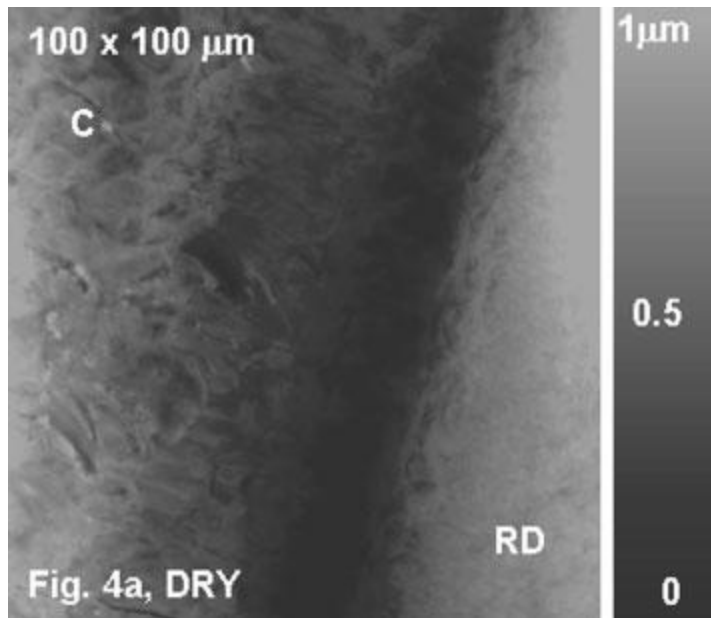
ZEMENT-DENTIN-JUNCTIO (CDJ)

(HOPEWELL-SMITH HYALINE SCHICHT)

(1-3 MM)



(a)



Pig

Human

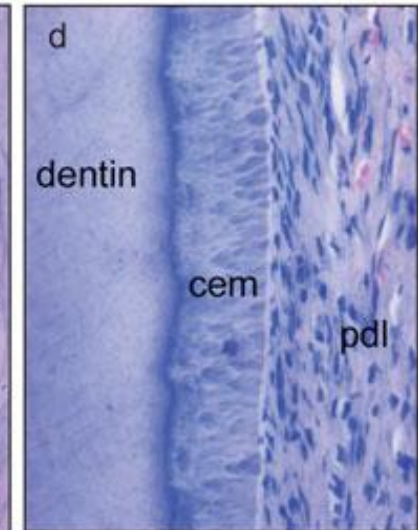
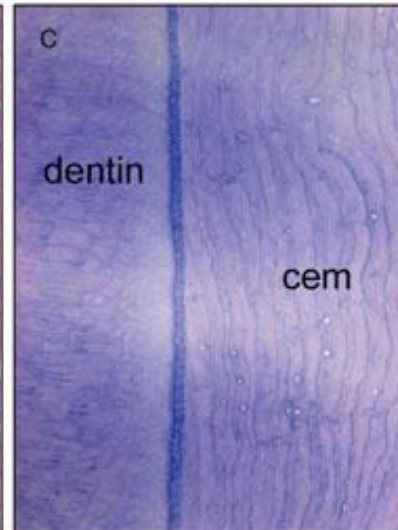
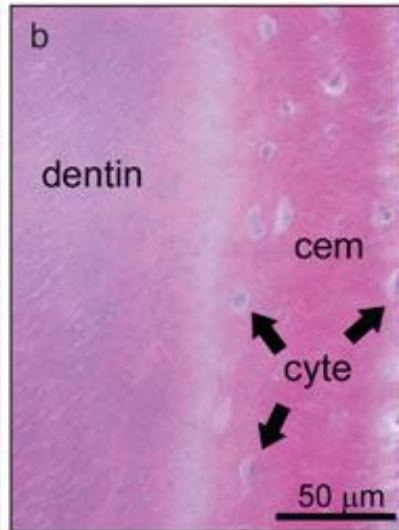
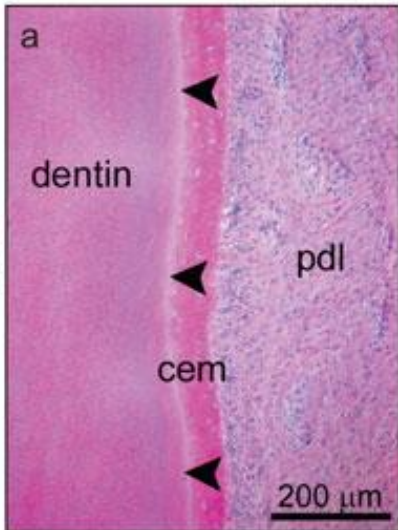
X100

X400

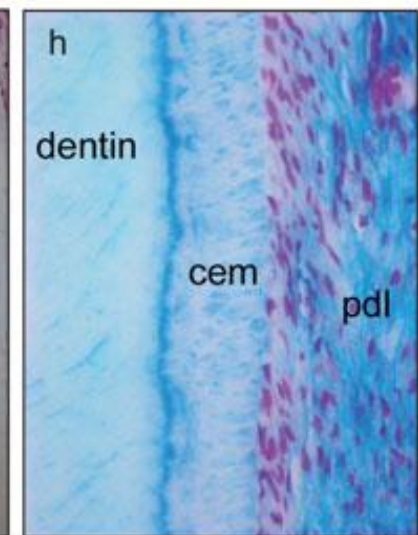
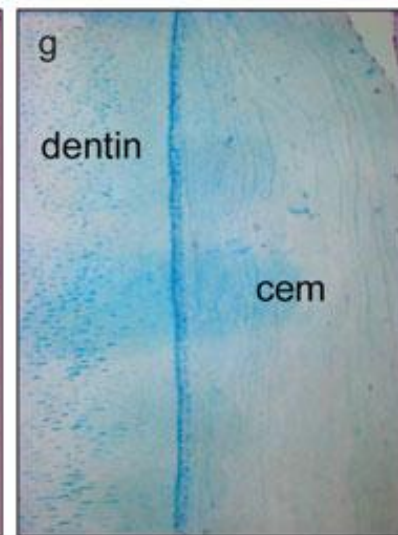
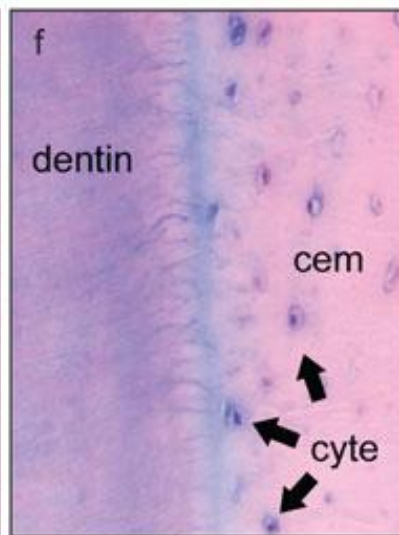
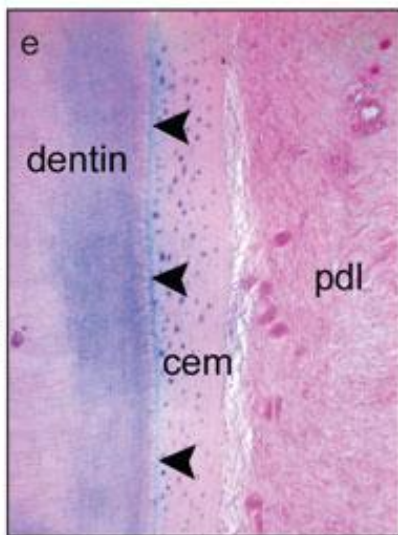
X100

X400

H&E



AB-NFR



Cervical root cellular cementum

Cellular / mixed stratified cementum

Acellular cementum