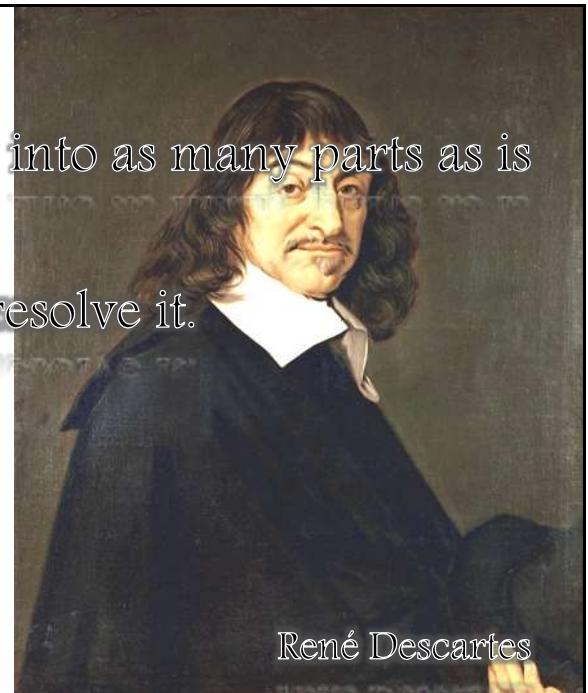


Divide each difficulty into as many parts as is
feasible and necessary to resolve it.



René Descartes

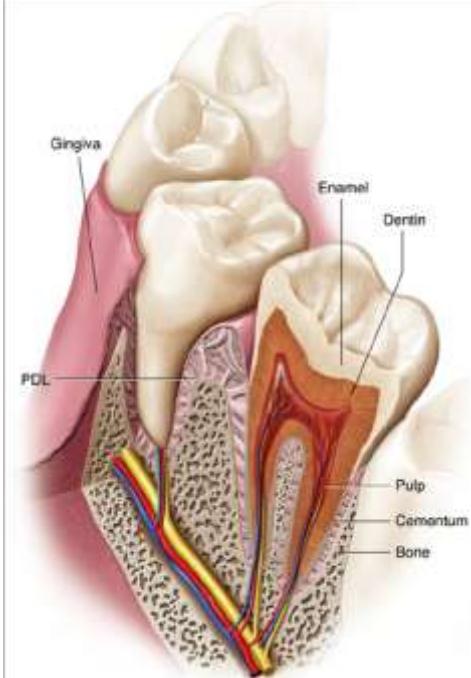
Periodontium... Components

Gingiva

Periodontal ligament (PDL)

Cementum

Alveolar bone



Periodontium... What you should know

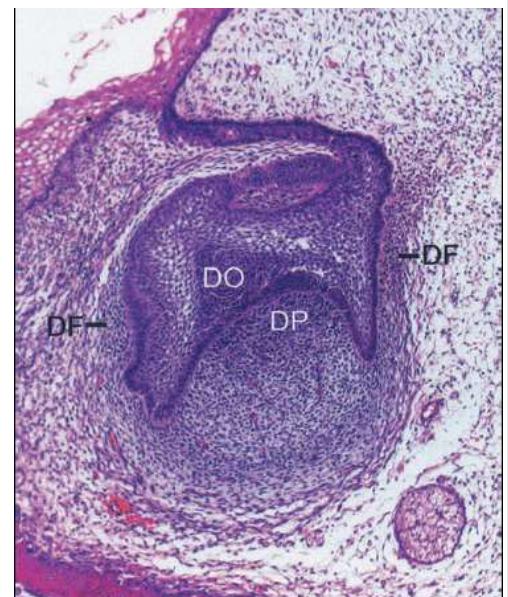
Structure

Macroscopic anatomy

Microscopic anatomy

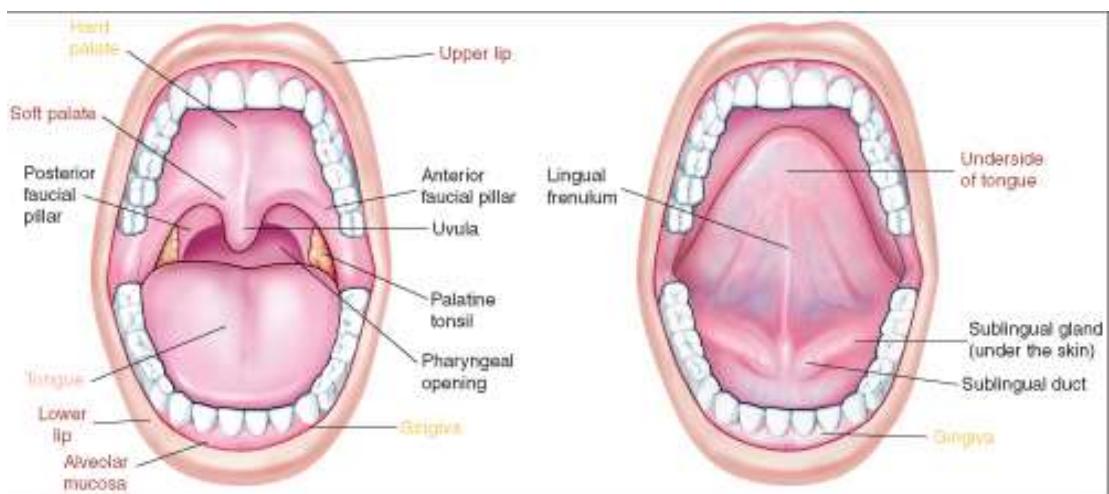
Development

Physiology



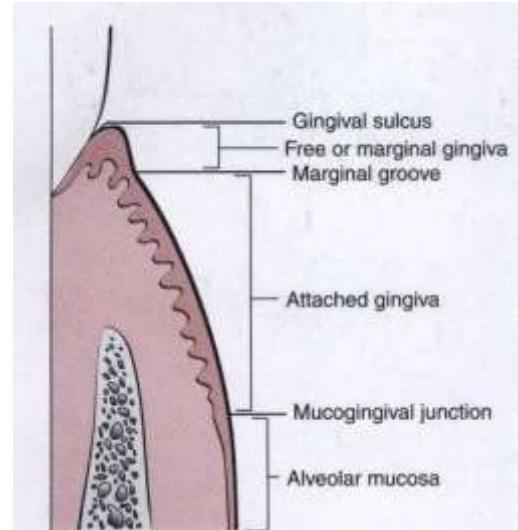
PERIODONTIUM... THE GINGIVA

gingiva



Gingiva... Components

The part of the masticatory mucosa which covers the alveolar process and surrounds the cervical portion of the teeth

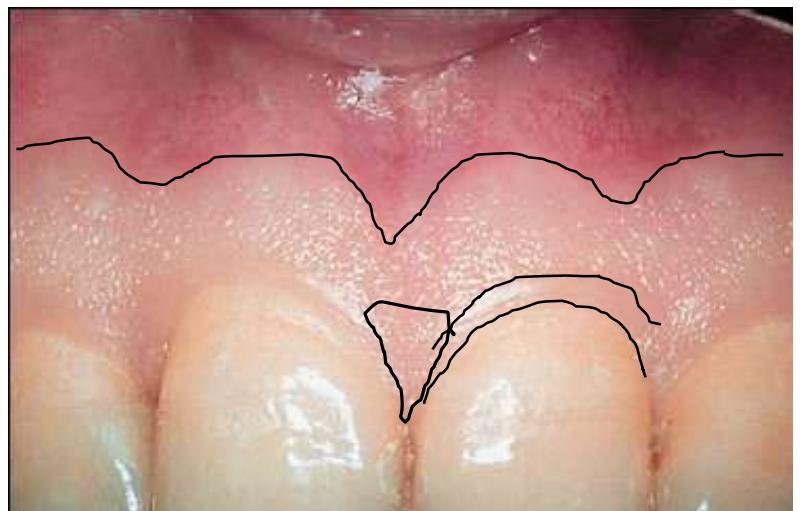


Gingiva... Components

Marginal Gingiva

Attached Gingiva

Interdental Papillae



Gingiva... Clinical Features

[...] The specific structure of different gingiva reflects its effectiveness as a barrier to the penetration by microbes & noxious agents into the deeper tissue.

Fiorellini JP, Kim DM, et Ishikawa SO

Gingiva... Components... Marginal gingiva

Unattached (free)

Extends from “free gingival margin” to “free gingival groove”

Demarcated from attached gingiva by “free gingival groove”
(50% of population)

Forms soft tissue wall of “gingival sulcus”

Separated from tooth surface with “periodontal probe”

Located 1.5-2 mm coronal to CEJ



Gingiva... Components... Gingival sulcus

Shallow crevice or space around teeth, V-shape

Bounded by tooth surface & epithelium lining the marginal gingiva "sulcular epithelium"

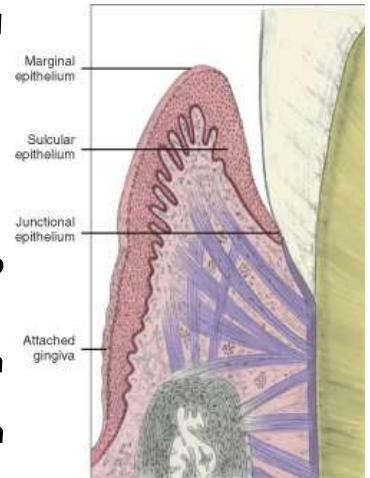
V-shape

Theoretically, depth is ≈ 0 (germ-free animals)

Histologically, depth varies between 0.69-1.8 mm according to studies

Clinically, "Periodontal Probe" is used to determine sulcus depth

Probing depth (PD) of clinically normal healthy sulcus is 2-3 mm



Gingiva... Components... Interdental gingiva

Shape dependent on:

Contact relationships between teeth

Width of approximal tooth surfaces

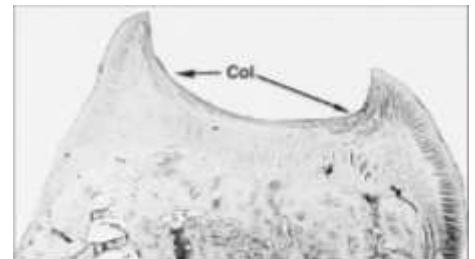
Course of CEJ

Shape

Pyramidal in the anterior region (contact point)

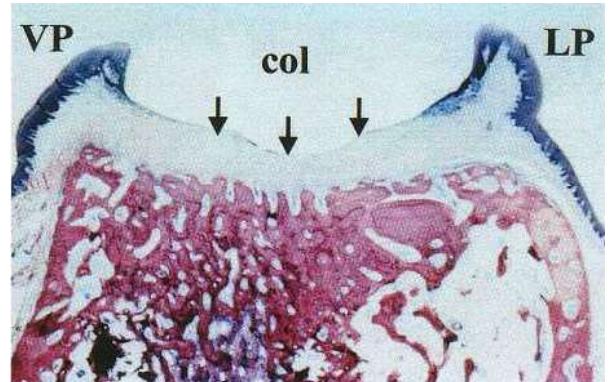
"Col" shape in the posterior region (contact surface)

Gingiva... Components... Interdental gingiva



Gingiva... Components... Interdental gingiva

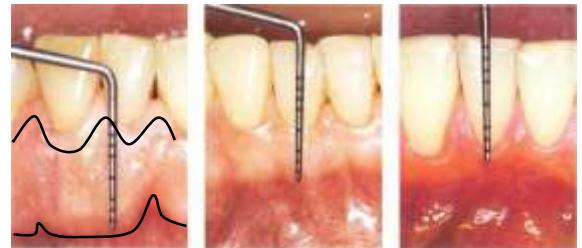
Col region is covered by thin non-keratinized epithelium, with many features in common with junctional epithelium



Gingiva... Components... Attached gingiva

Firm, resilient

Coral pink

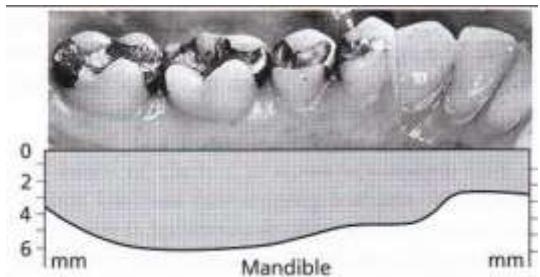
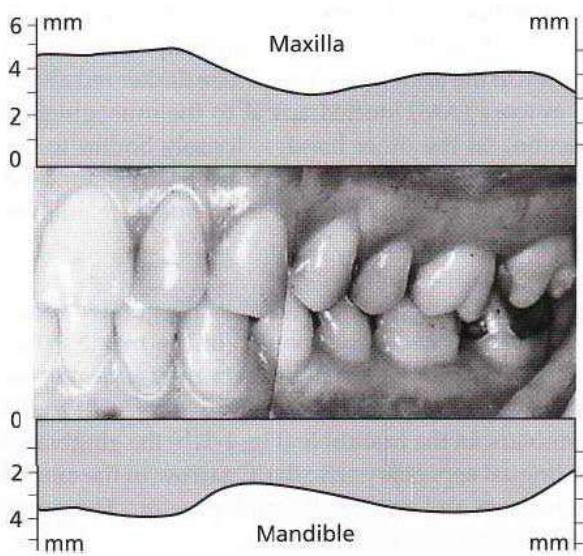


Tightly bound to underlying periosteum, with small depressions on surface called "stippling", giving the appearance of orange peel

Width: distance between gingival groove & MGJ

Differs in different areas (Ant > Post)

Gingiva... Components... Attached gingiva

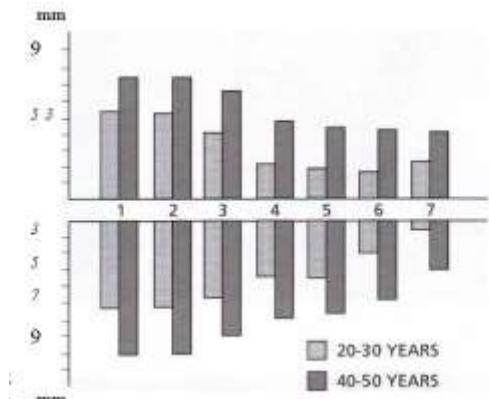


Gingiva... Components... Attached gingiva

Lingually, it terminates at junction with lingual alveolar mucosa

Palatally, no demarcation

Width increases with age



Gingiva... Microscopic Features... Gingival Epithelium...

General aspects

Stratified squamous epithelium

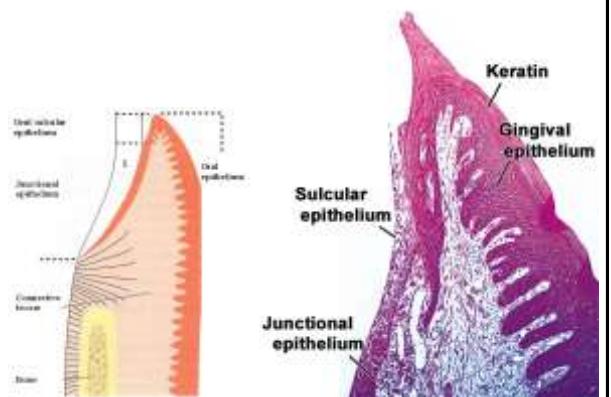
Different parts:

Oral epithelium

Dento-gingival epithelium

Sulcular epithelium

Junctional epithelium



Gingiva... Microscopic Features... Oral Epithelium...

General aspects

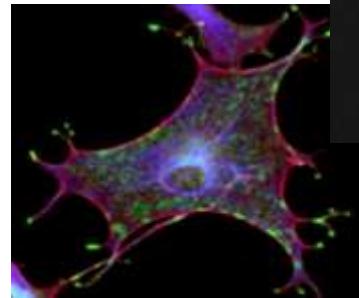
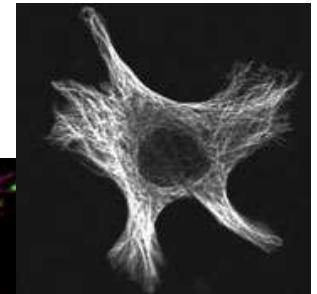
Keratinocytes

Non keratinocytes

Langerhans cells

Merkel cells

melanocytes

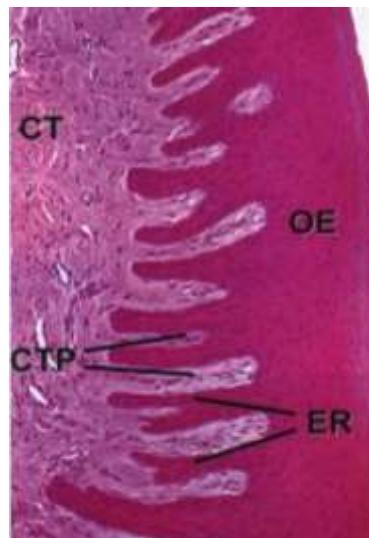


Function

Protection

Selective interchange with oral environment
(sensation, secretion, thermal regulation)

Gingiva... Microscopic Features... Oral Epithelium...



Microscopic Features... Oral Epithelium... keratinocytes...

Proliferation in the basal layer (supra-basal layer)

Differentiation (process of keratinization)

Migration to surface

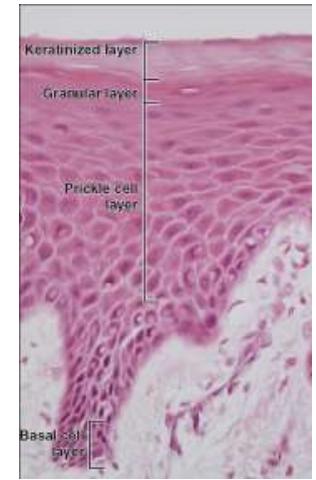
Progressive flattening

Keratinization

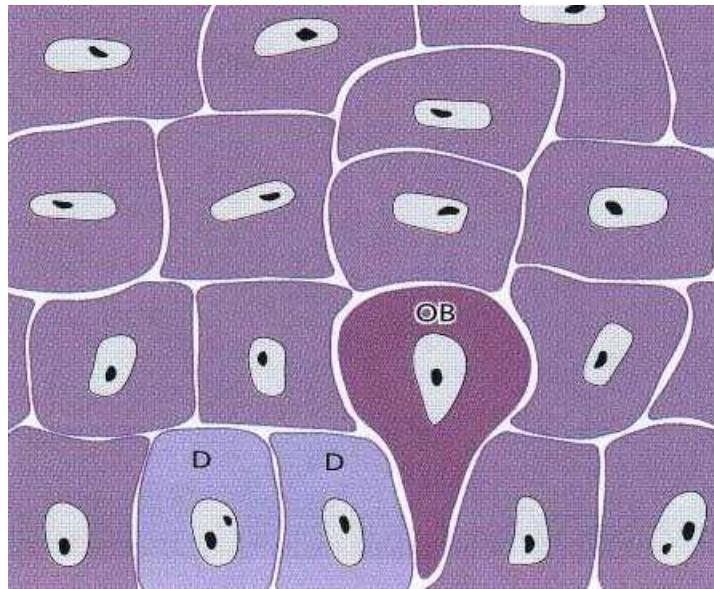
↑ Tonofilaments & intracellular junctions

Production of keratohyalin granules

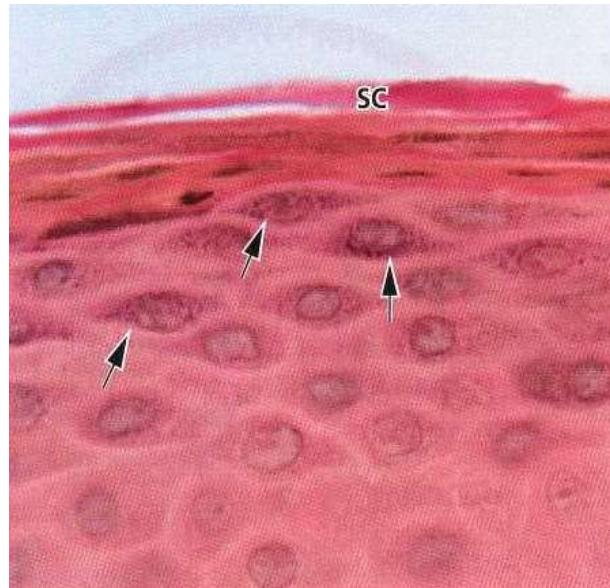
Disappearance of nucleus



Microscopic Features... Oral Epithelium... keratinocytes...



Microscopic Features... Oral Epithelium... keratinocytes...



Microscopic Features... Oral Epithelium... keratinocytes...

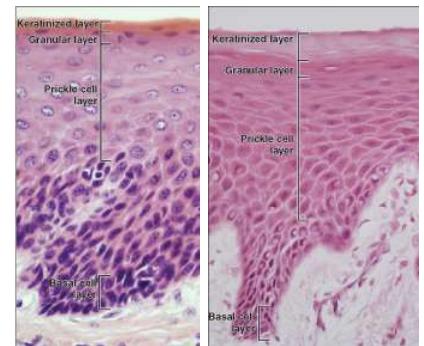
Keratinization

Ortho-keratinization (complete)

Superficial horny layer

No nuclei in stratum corneum

Well-defined stratum granulosum



Para-keratinization

Pyknotic nuclei in stratum corneum

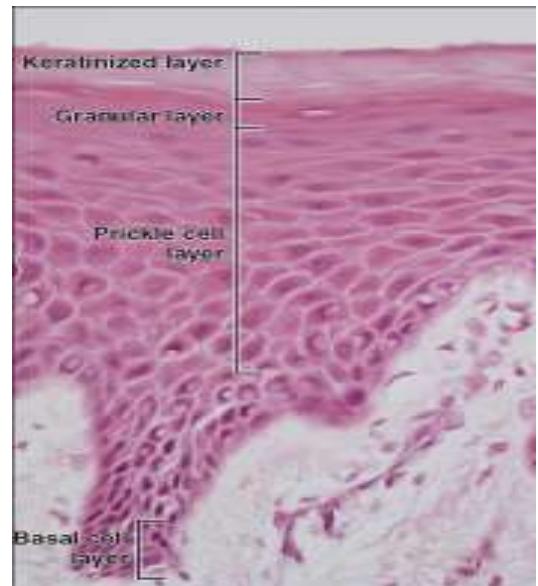
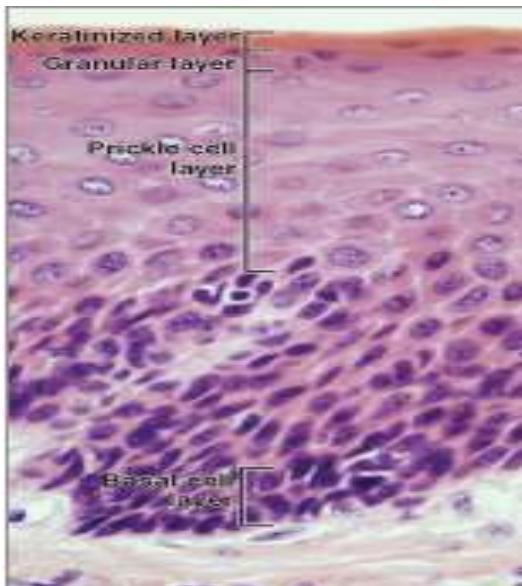
No stratum granulosum

Non-keratinization

Neither granulosum nor corneum strata

Superficial cells with visible nuclei

Microscopic Features... Oral Epithelium... keratinocytes...



Microscopic Features... Oral Epithelium... keratinocytes...

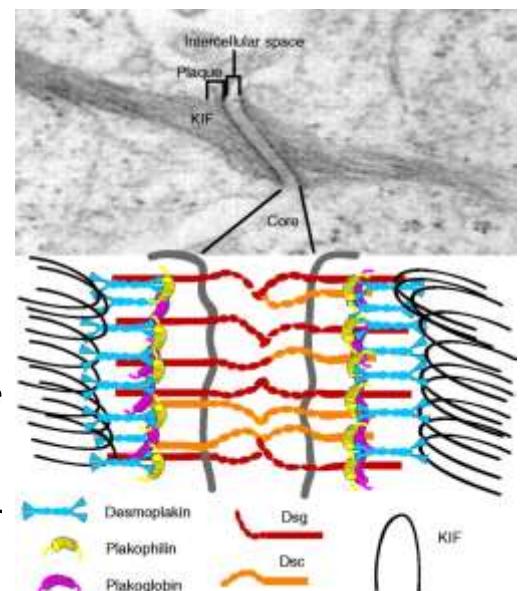
Desmosomes

2 Dense attachment plaques

Intermediate electron-dense line in extra-cellular compartment

Tonofilaments radiate in brushlike fashion into cytoplasm

Cytoplasmic projections in inter-cellular space



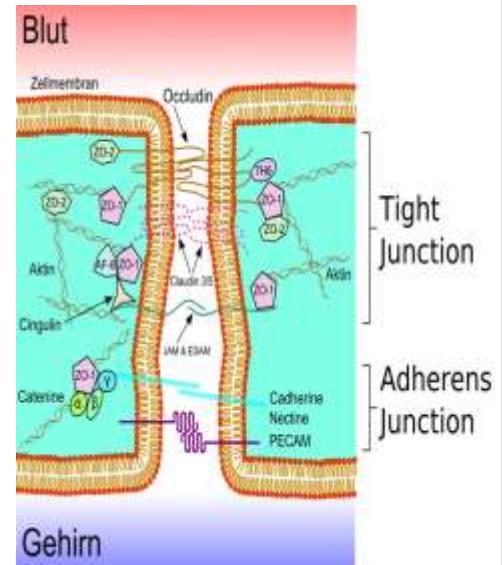
Microscopic Features... Oral Epithelium... keratinocytes...

Tight junctions

Cell membranes in close contact "fused"

Normally, don't allow for passage between cells

Control passage in the inter-cellular space

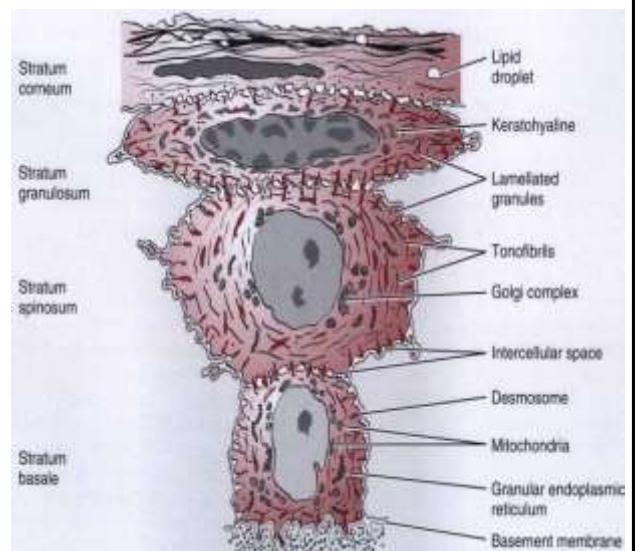


Microscopic Features... Oral Epithelium... keratinocytes...

Cellular organelles

- ↓ Mitochondria toward surface
(Alternative pathways of glycolysis)
- ↓ Golgi complexes, Endoplasmic reticulum toward surface

Keratosomes (Oidland bodies)
Modified lysosomes
Destruction of organelle membrane
Uppermost cells in stratum spinosum



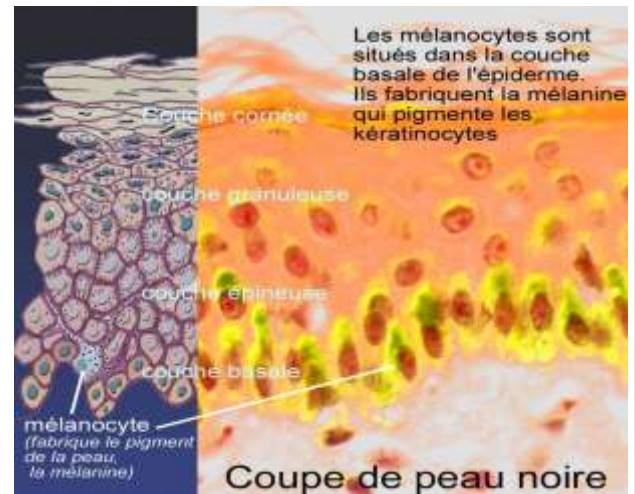
Microscopic Features... Oral Epithelium... Non-keratinocytes...

Melanocytes

Dendritic cells

Basal & spinous layers

Melanin production



Coupe de peau noire

Microscopic Features... Oral Epithelium... Non-keratinocytes...

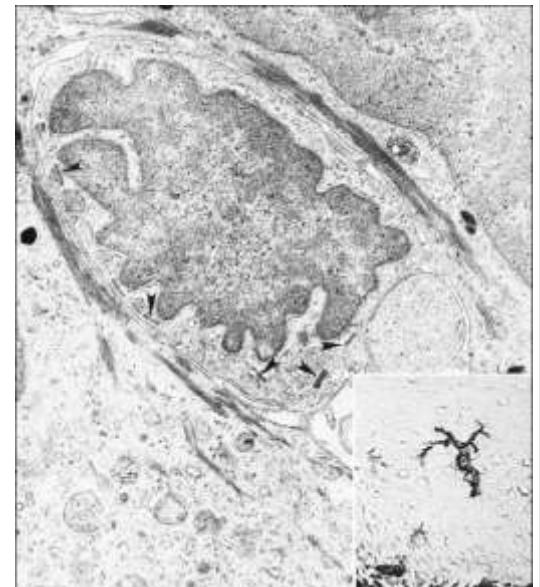
Langerhans cells

Dendritic cells

Characterized by Birbeck granules

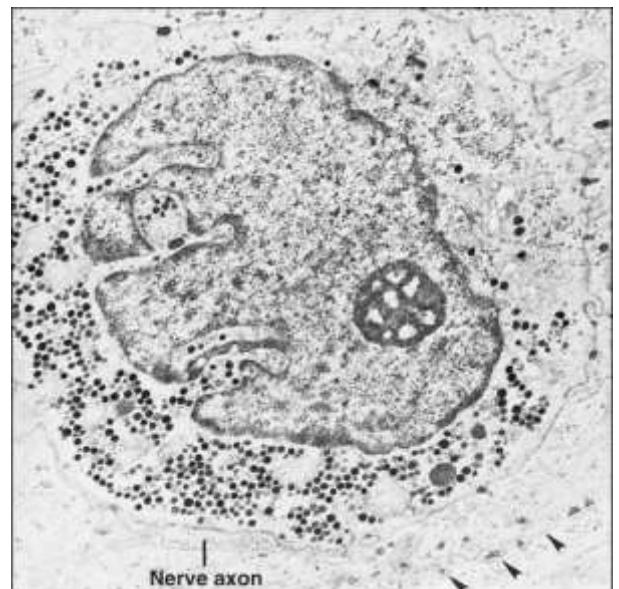
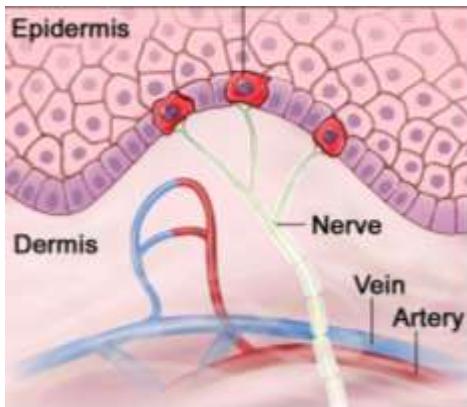
Move in & out of epithelium

Immunologic function of recognizing & processing antigens in the epithelium & presenting it to T-lymphocytes



Microscopic Features... Oral Epithelium... Non-keratinocytes...

Merkel cells

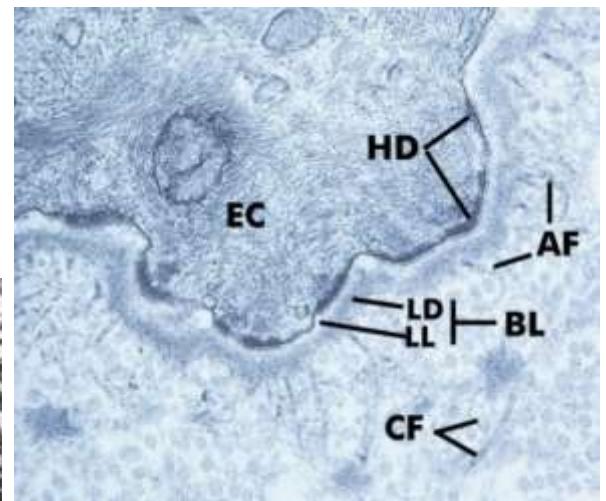


Microscopic Features... Oral Epithelium... Basement membrane...

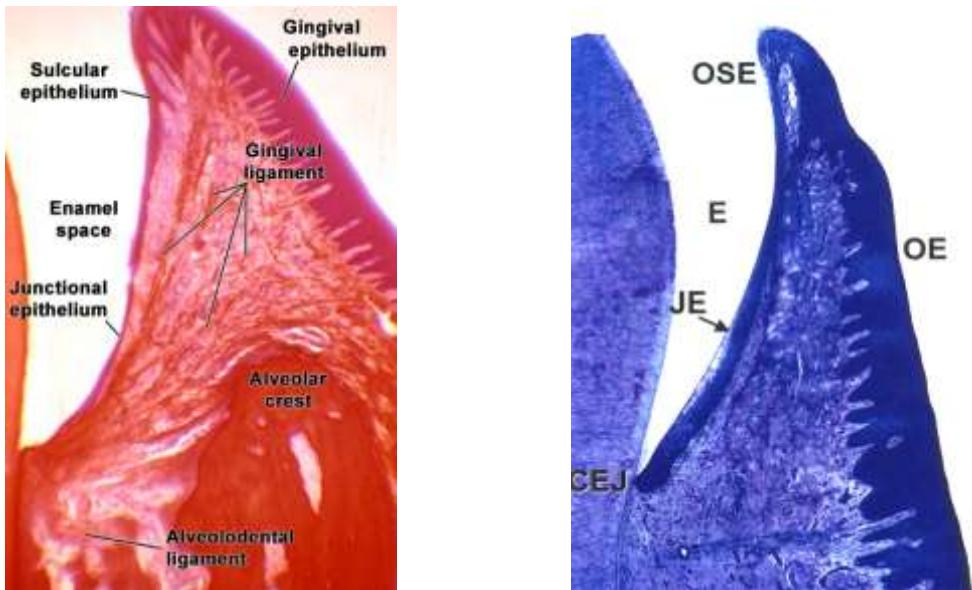
Lamina lucida ($40 \mu\text{m}$)

Lamina densa

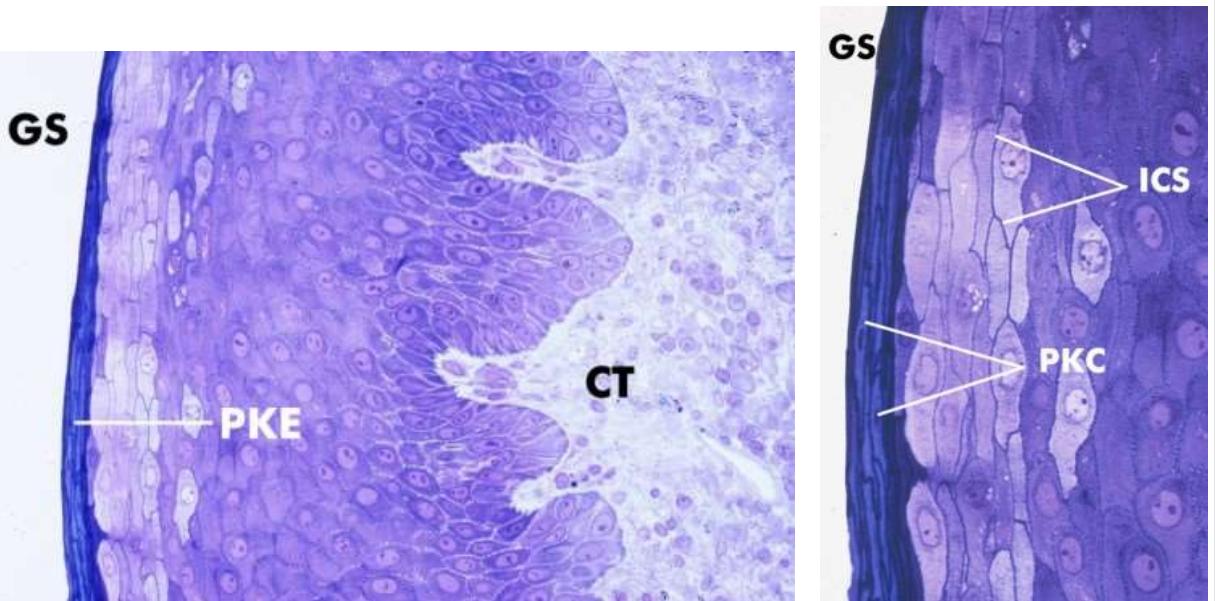
Anchoring fibers



Microscopic Features... Dento-gingival Epithelium...



Microscopic Features... Dento-gingival Epithelium... Sulcular epithelium



Microscopic Features... Dento-gingival Epithelium... Sulcular epithelium

Crevicular fluid:

Cleansing action

Contains plasma proteins that may improve epithelial adhesion to tooth

Antimicrobial properties

Antibody activity

Microscopic Features... Dento-gingival Epithelium... Junctional epithelium

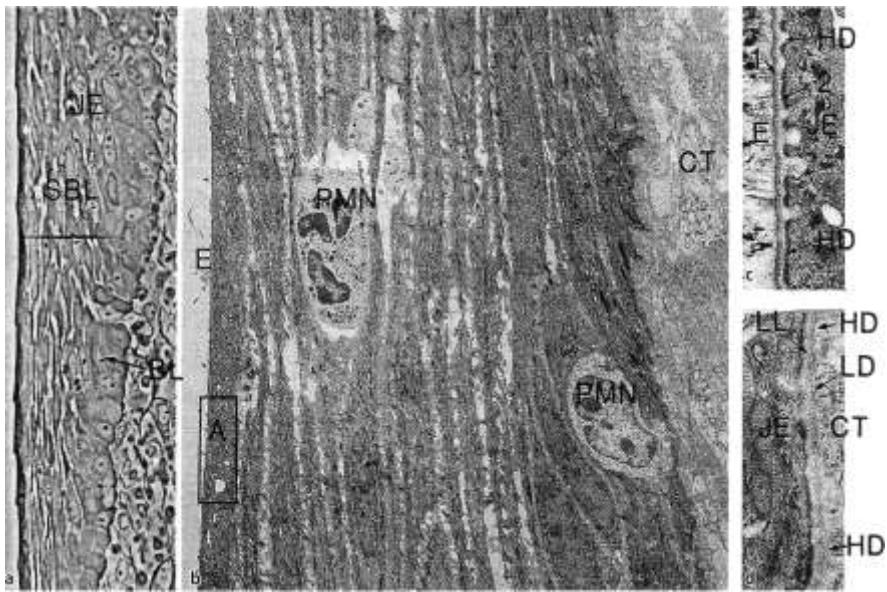
Differences between oral epithelium & junctional epithelium

Cell size in JEs, relative to tissue volume, larger than OE

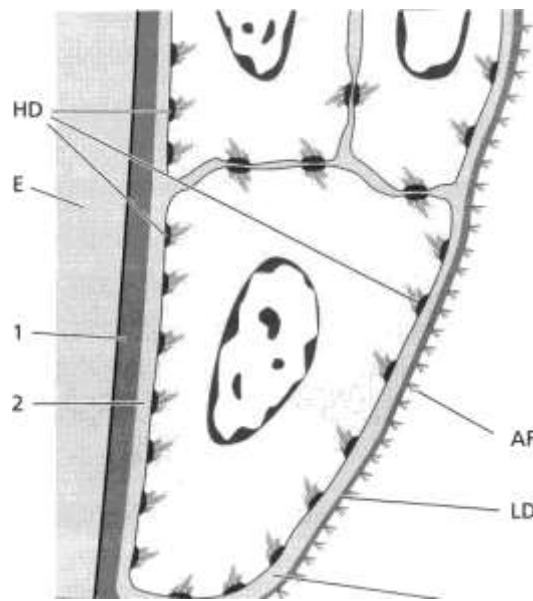
Intercellular space in JE is, relative to tissue volume, wider than OE

Number of desmosomes is smaller in JE

Microscopic Features... Dento-gingival Epithelium... Junctional epithelium



Microscopic Features... Dento-gingival Epithelium... Junctional epithelium



Microscopic Features... Lamina propria...

Major components:

Collagen fibers (60%)

Fibroblasts (5%)

Vessels & nerves (35%)

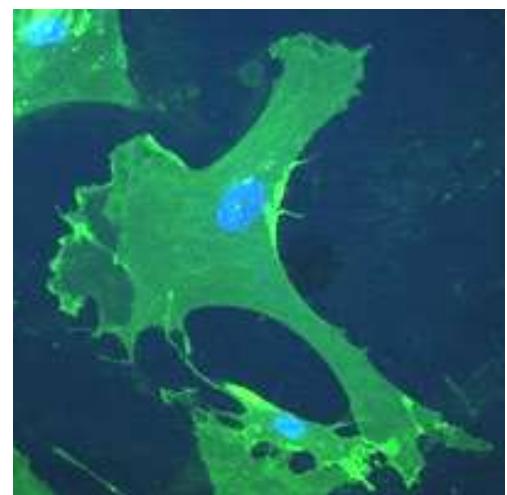
Microscopic Features... Lamina propria... cells

Fibroblasts

Mast cells

Macrophages

Inflammatory cells



Lamina propria... cells... Fibroblasts

65% of cell population

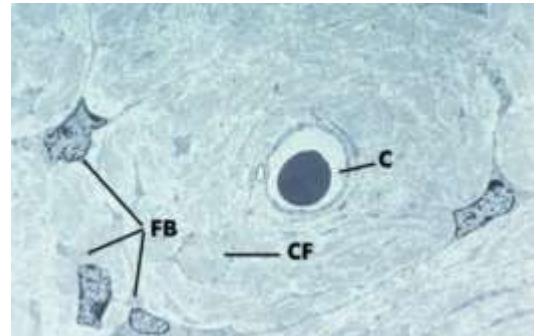
Collagen production

Contractile function (wound healing)

Well developed ER

Large Golgi apparatus (complex)

Large & numerous mitochondria



Lamina propria... cells... Mast cells

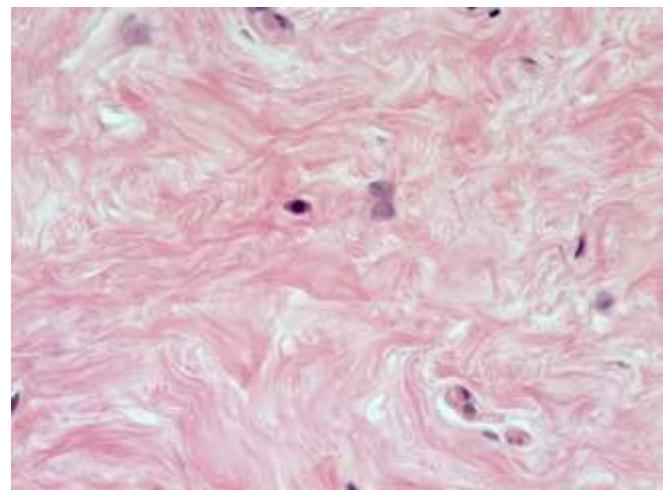
Vasoactive substances

Proteolytic enzymes

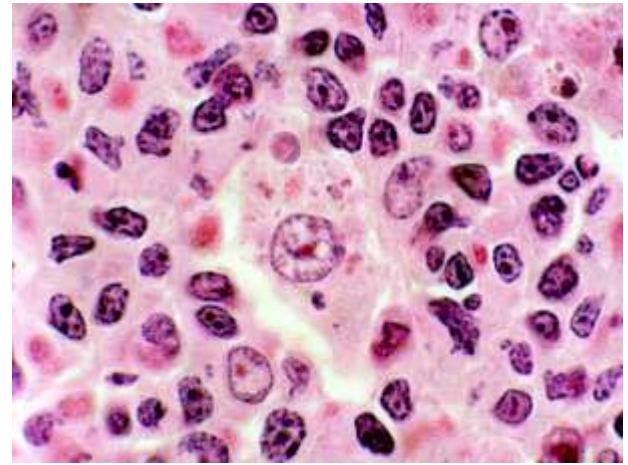
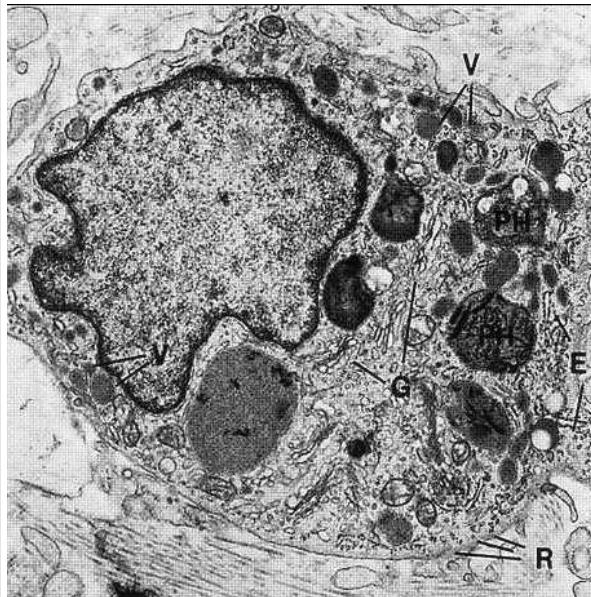
Histamine

Heparin

Well developed Golgi



Lamina propria... cells... Macrophages



Lamina propria... cells... Inflammatory cells

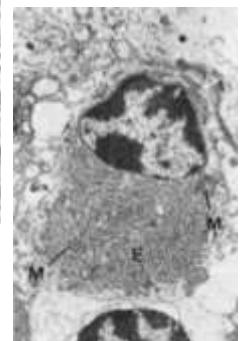
PMNs



Lymphocytes



Plasma cells



Lamina propria... Fibers...

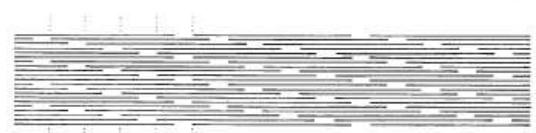
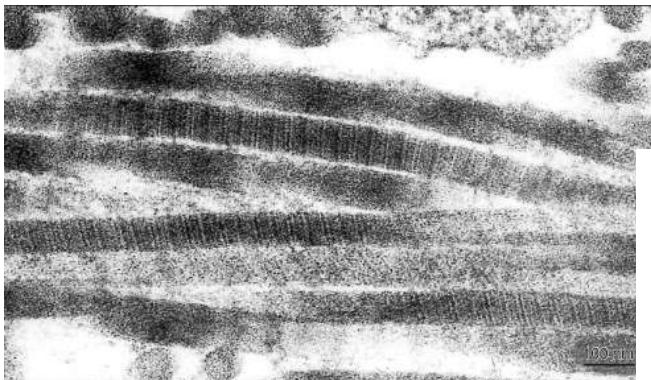
Collagen fibers

Reticulin fibers (collagen type III)

Oxytalan fibers

Elastic fibers

Lamina propria... Fibers... Collagen fibers



Approx. 1/4 stagger
— 300 nm —
Overlap region ← → Gap region

Lamina propria... Fibers... Collagen fibers

Main groups of collagen fibers

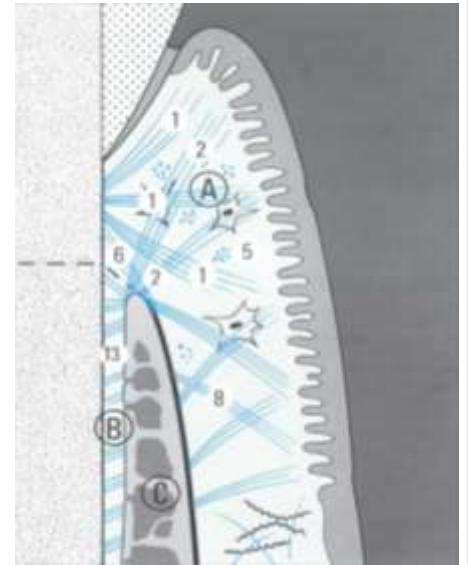
Dento-gingival fibers

1. Coronal
2. Horizontal
3. Apical

Alveolo-gingival fibers

Inter-papillary fibers

trans-gingival fibers



Lamina propria... Fibers... Collagen fibers

Main groups of collagen fibers

Circular, Semi-circular fibers

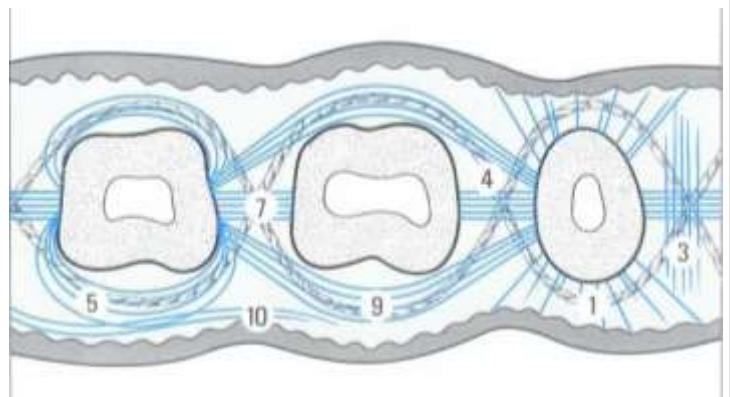
Dento-periosteal fibers

Trans-septal fibers

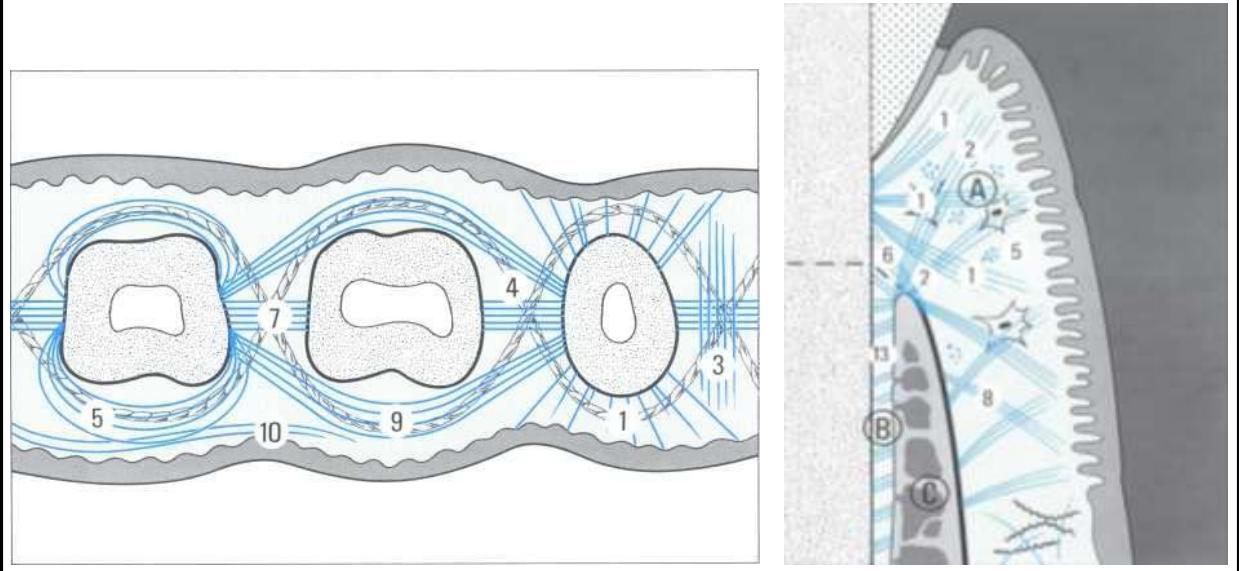
Periosteo-gingival fibers

Inter-circular fibers

Intergingival fibers

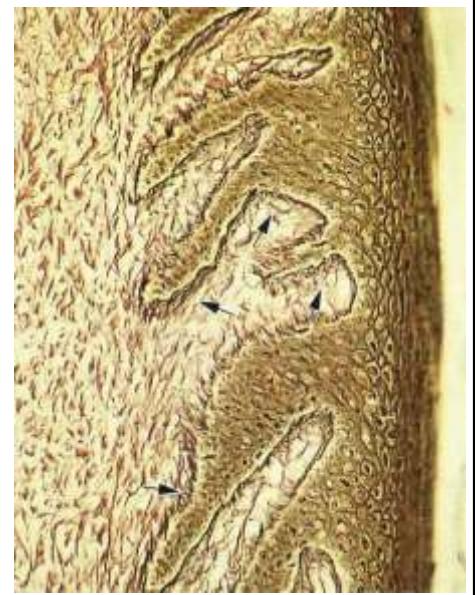


Lamina propria... Fibers... Collagen fibers



Lamina propria... Fibers... Reticulin fibers

Reticulin fibers (collagen type III)



Lamina propria... Fibers... Oxytalan fibers



Lamina propria... Fibers... Elastic fibers

Only in association with blood vessels
(gingiva & PDL)

Numerous in lining mucosa



Lamina propria... Matrix (ground substance)...

Proteoglycans

Glycoproteins

Function

Regulate diffusion & fluid flow

Regulate cell migration in the tissue

Gingiva... Anatomy & clinical features

Color

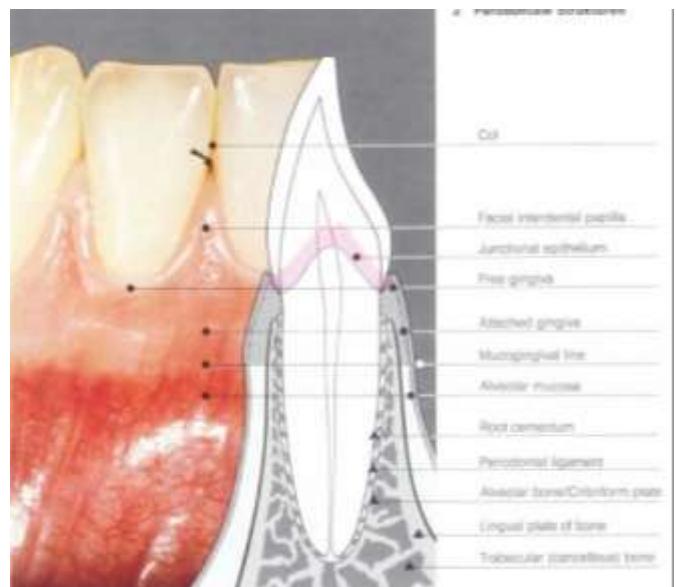
Size

Contour

Shape

Consistency

Surface texture



Gingiva... Anatomy & clinical features... Color

Vascular supply

Thickness of epithelium

Degree of keratinization

Presence of pigmentation

Gingiva... Anatomy & clinical features... Color

Oral mucosa is red, not pink

Thinner epithelium

Non-keratinized epithelium

No rete pegs

Loosely arranged connective tissue

Numerous blood vessels



Gingiva... Anatomy & clinical features... Size

Total sum of the bulk of cellular & intercellular elements & their vascular supply



Gingiva... Anatomy & clinical features... Contour

Shape of teeth & their alignment

Location & size of proximal contacts

Bone levels



Gingiva... Anatomy & clinical features... Shape

Flat proximal surfaces

Narrow papillae

Proximal surface flaring away from contact area

Broad papillae



Gingiva... Anatomy & clinical features... Consistency

Firm & resilient

Collagen fibers

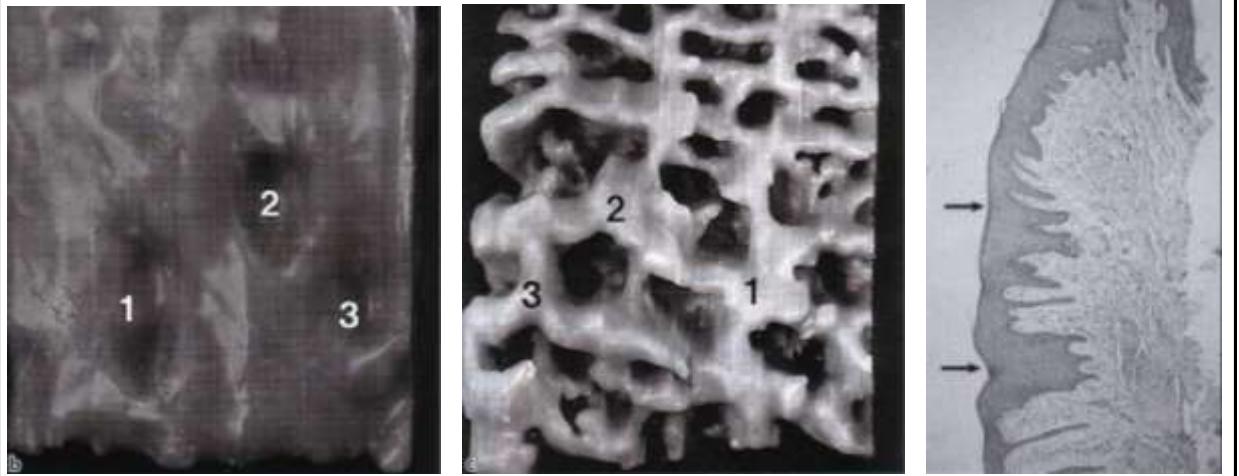
Flexible & movable alveolar mucosa

Elastic fibers

Gingiva... Anatomy & clinical features... Surface texture



Gingiva... Anatomy & clinical features... Surface texture



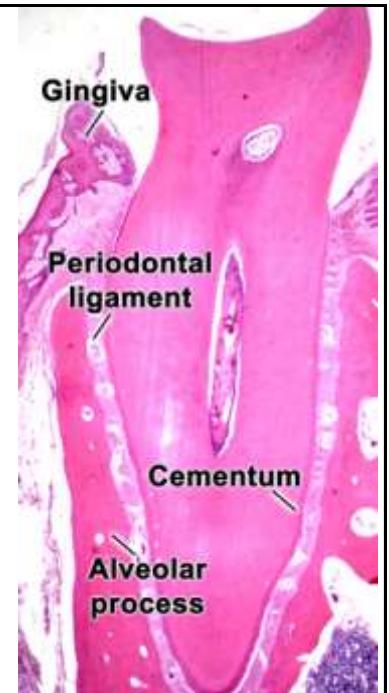
PERIODONTIUM... THE PERIODONTAL LIGAMENT

Periodontal ligament

The connective tissue that surrounds the root & connects it to the bone

Width 0.2-0.4 mm (average 0.25)
Narrowest around middle 1/3

Width decreases with age

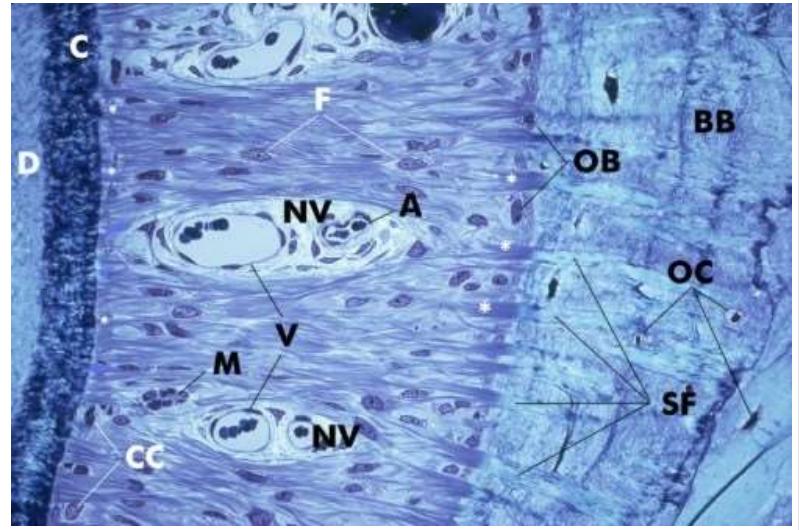


Periodontal ligament... Components

Fibers

Cells

Ground substance



Periodontal ligament... Components... fibers

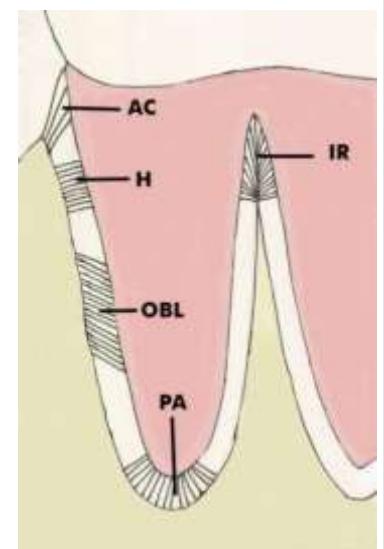
Alveolar crest fibers

Horizontal fibers

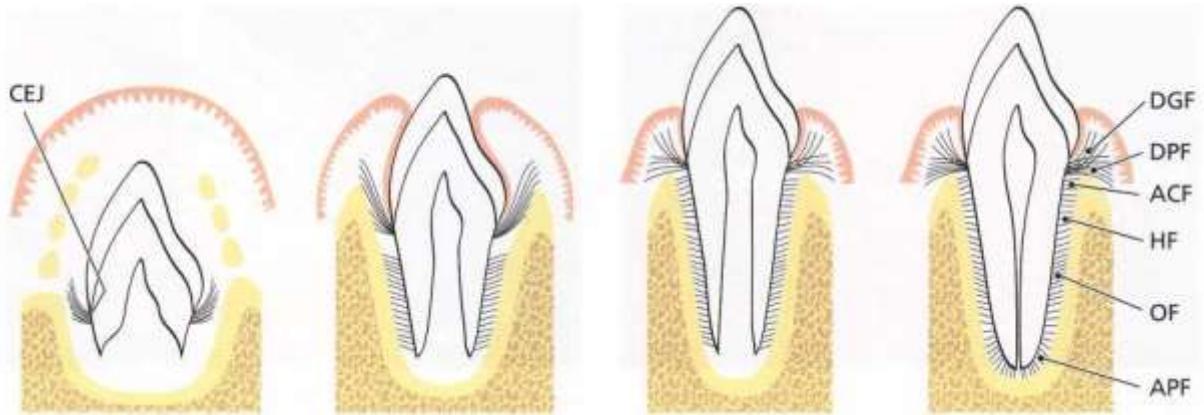
Oblique fibers

Apical fibers

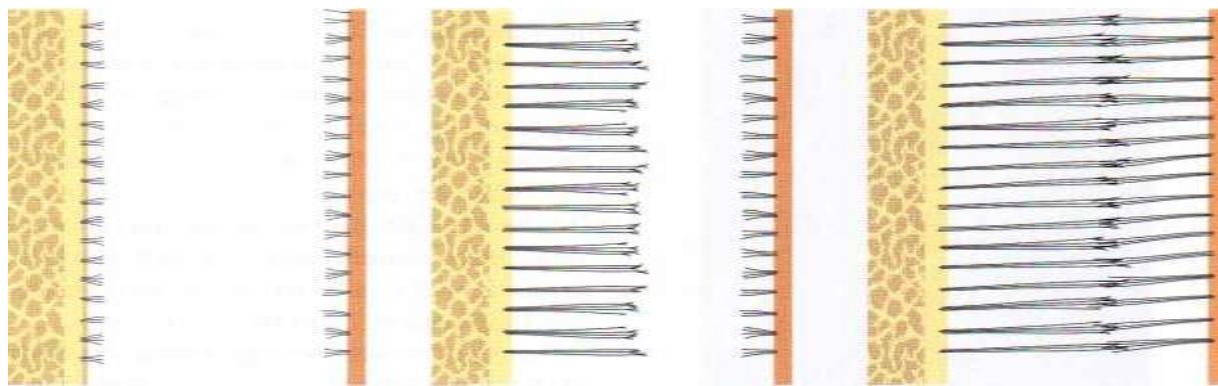
Inter-radicular fibers



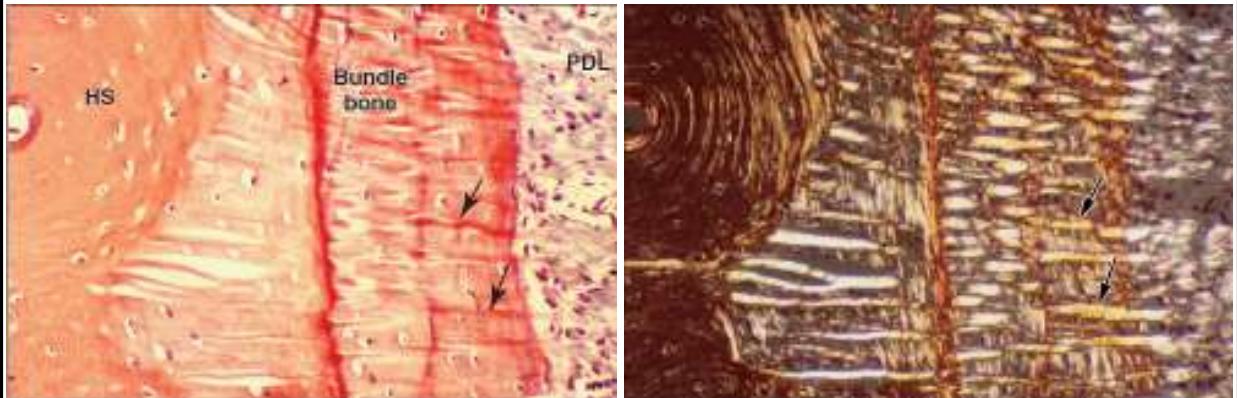
Periodontal ligament... Components... fibers



Periodontal ligament... Components... fibers



Periodontal ligament... Components... fibers



Periodontal ligament... Components... Cells

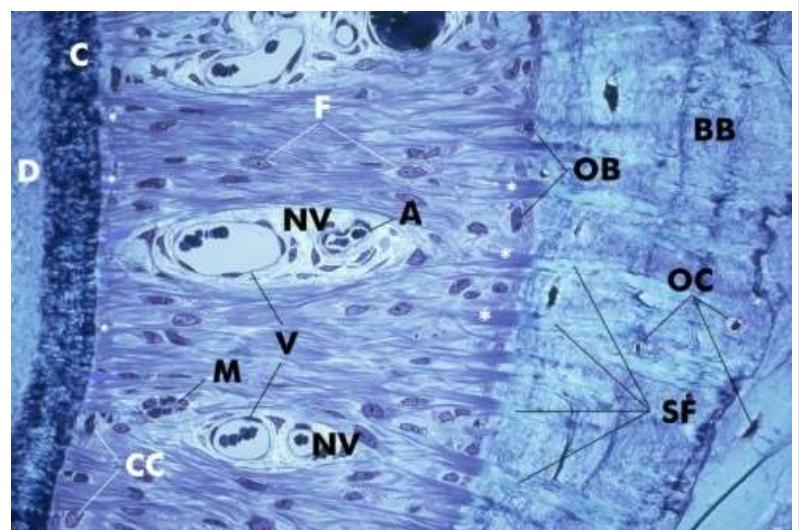
Connective tissue cells

Epithelial cells

Immune cells

Neural & vascular cells

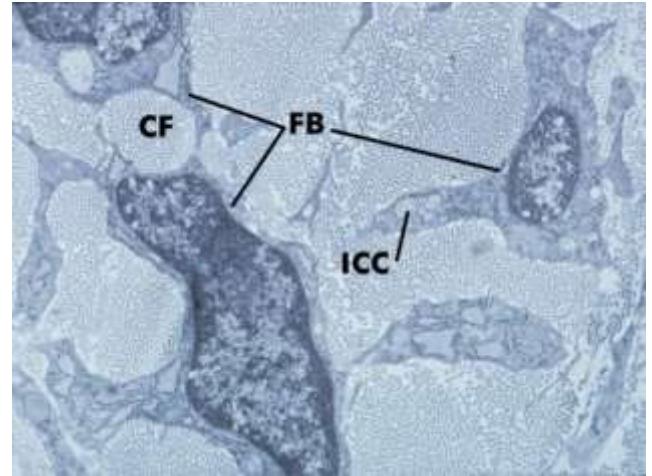
Undifferentiated mesenchymal cells



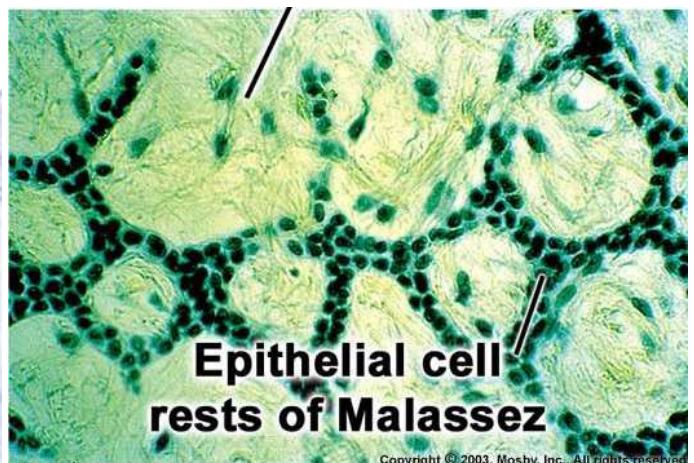
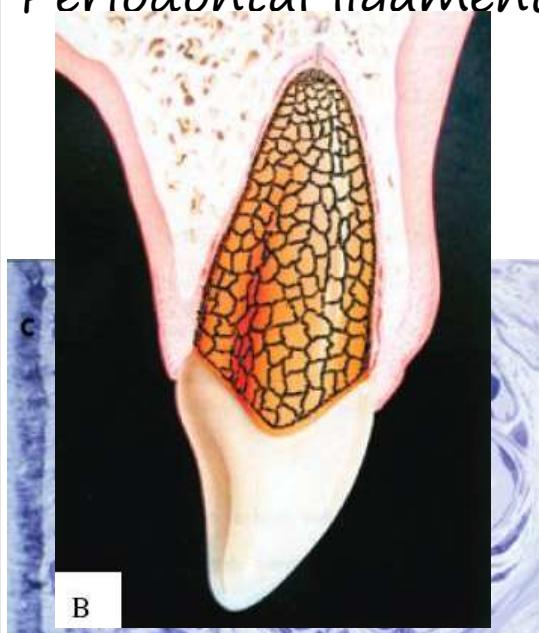
Periodontal ligament... Components... Cells

Fibroblasts synthesize & degrade collagen fibers

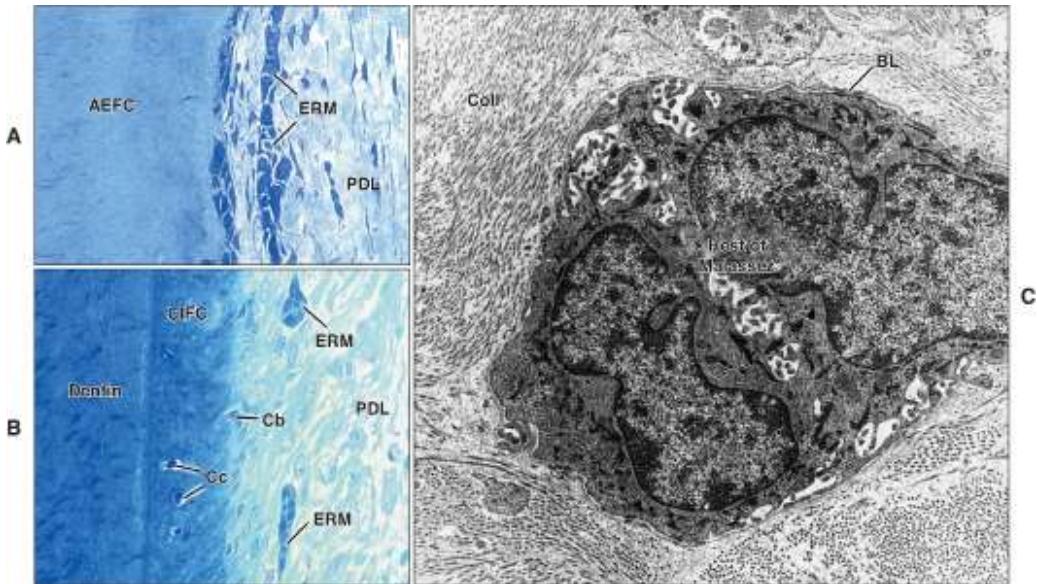
High rate of turnover of collagen



Periodontal ligament... Components... Cells



Periodontal ligament... Components... Cells



Periodontal ligament... Components... Ground substance

Proteoglycans

Glycoproteins

Function

Regulate diffusion & fluid flow

Regulate cell migration in the tissue

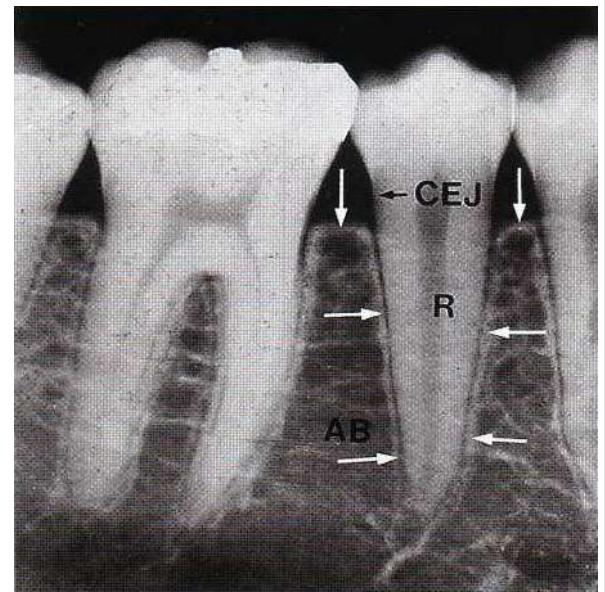
Periodontal ligament... Function

Physical

Formative & remodeling

Nutritional

Sensory



Periodontal ligament... Function... Physical

Soft tissue “casing” to protect nerves & vessels from injury by mechanical forces

Transmission of occlusal forces to bone

Attachment of teeth to bone

Maintenance of relationship of gingiva with teeth

Shock absorption (resistance to impact of occlusal forces)

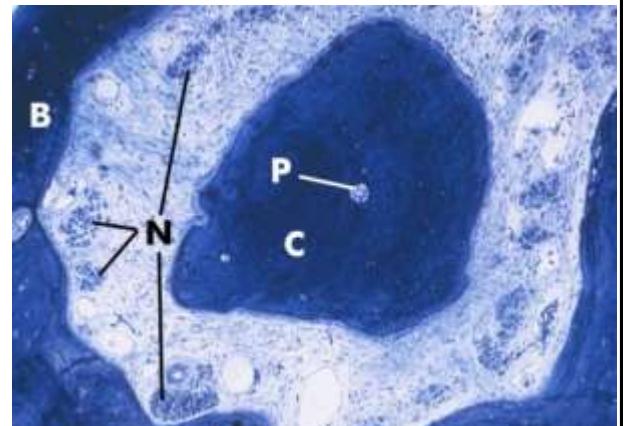
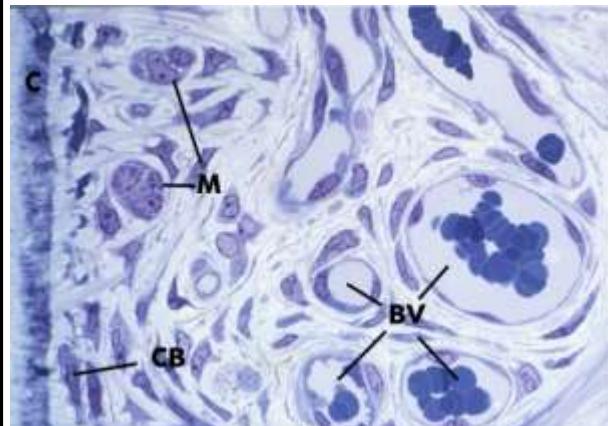
Periodontal ligament... Function... Formative & Remodeling

Physiologic stimuli

Collagen turnover

Mesenchymal stem cells

Periodontal ligament... Function... Nutritional & Sensory



PERIODONTIUM...

THE CEMENTUM

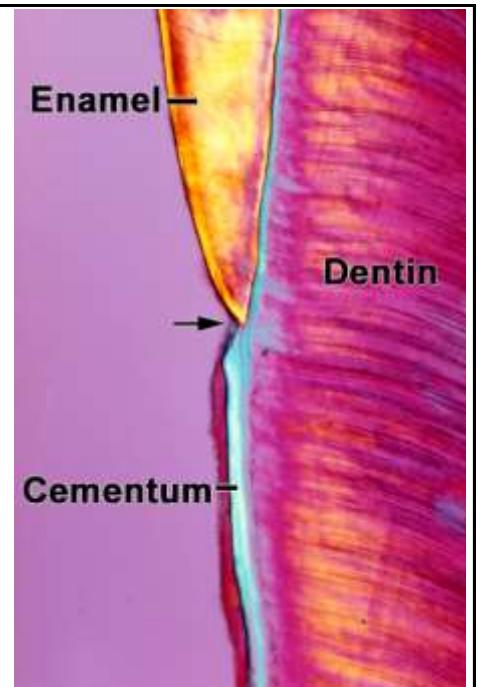
Cementum

Hard, avascular connective tissue that covers the root

No vessels, nerves, lymph

No physiologic resorption or remodeling

Continuing deposition throughout life



Cementum... Classification

Presence of cells

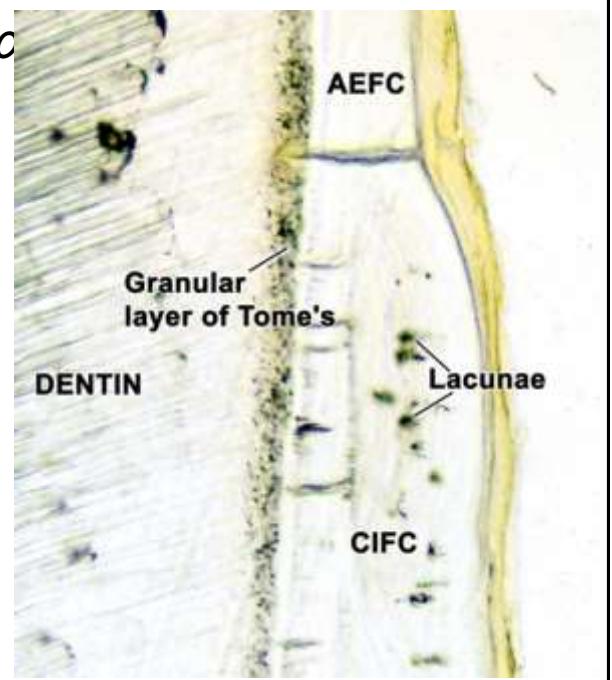
Cellular

Acellular

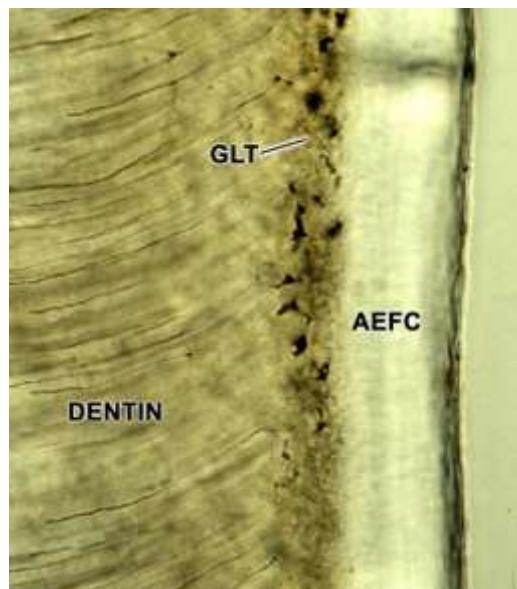
Origin of fibers

Intrinsic

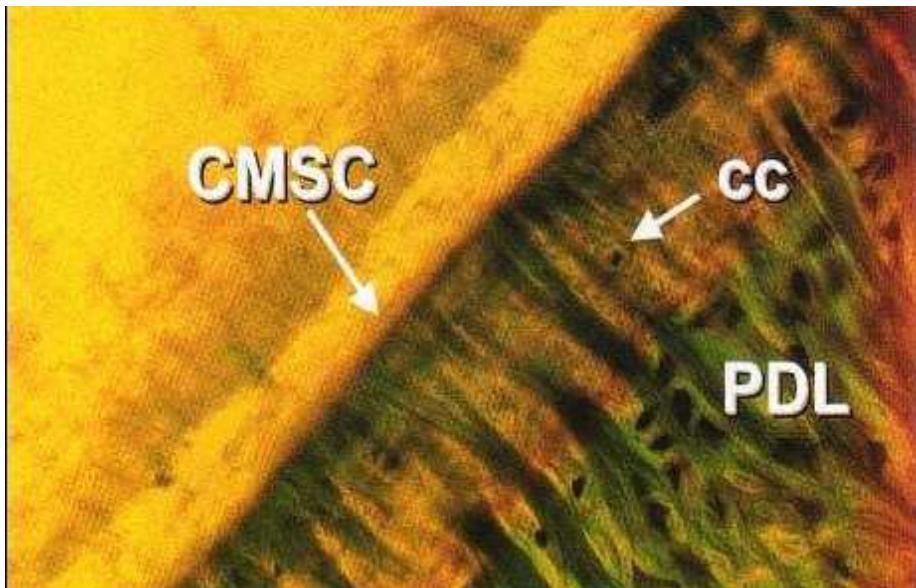
Extrinsic



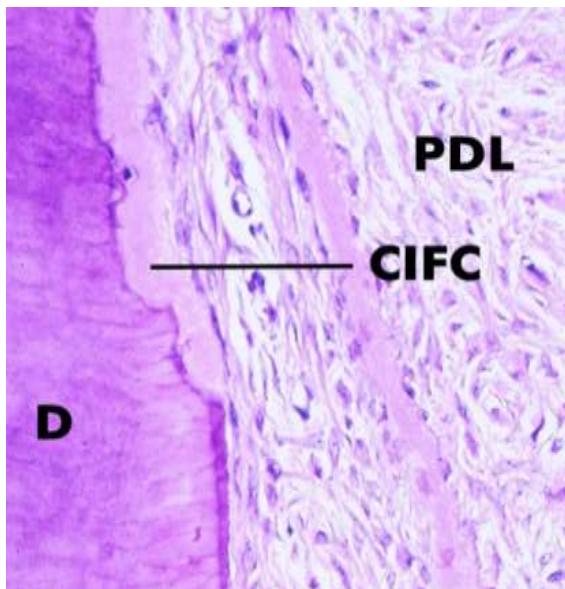
Cementum... Classification... AEFC



Cementum... Classification... CMSC



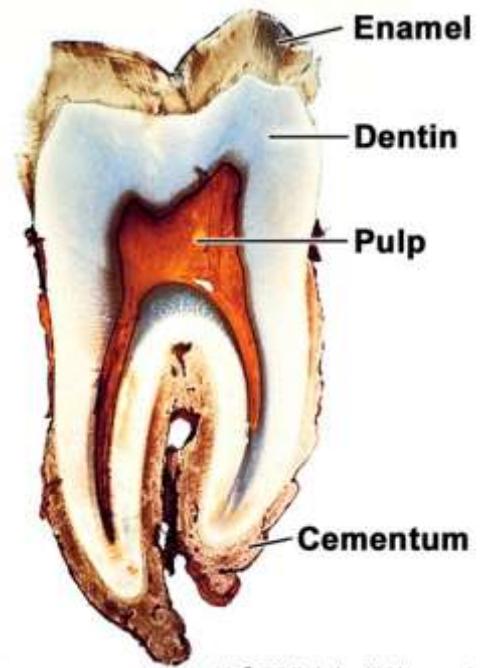
Cementum... Classification... CIFC



Cementum... Thickness

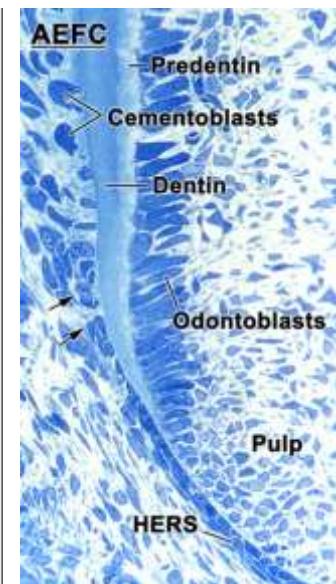
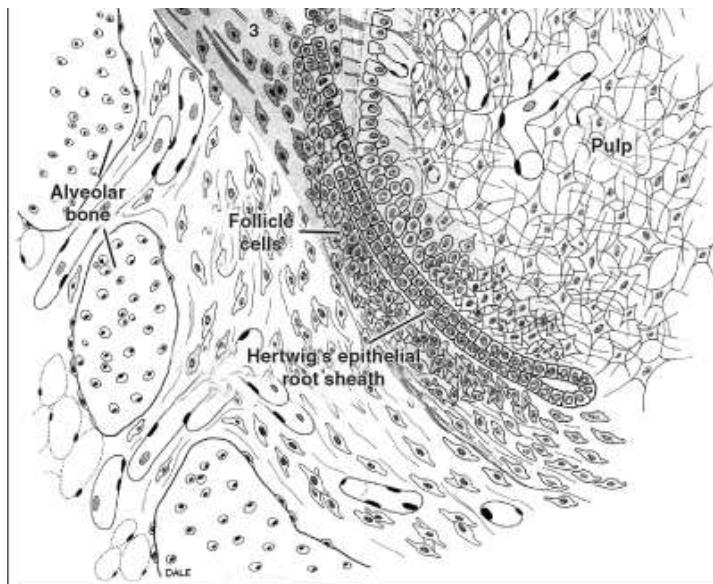
20-50 μm coronally

150-250 μm coronally

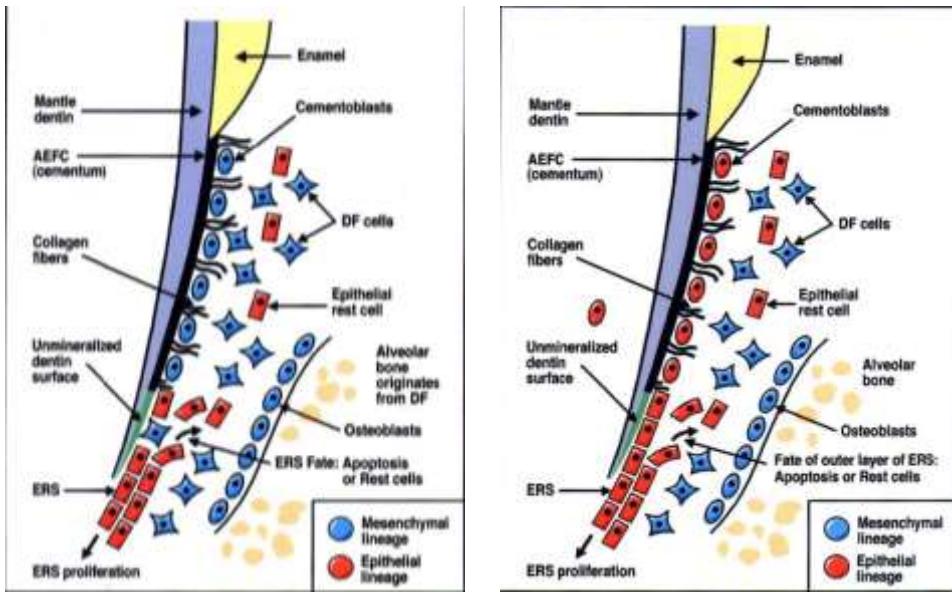


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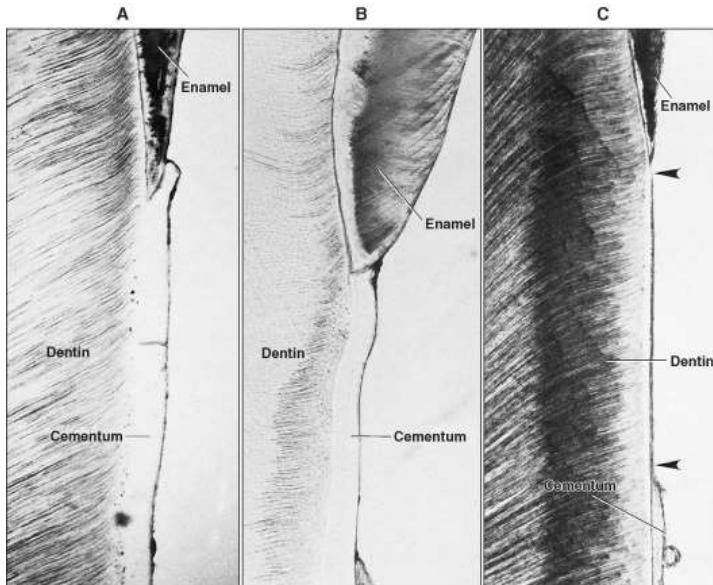
Cementum... Formation



Cementum... Formation

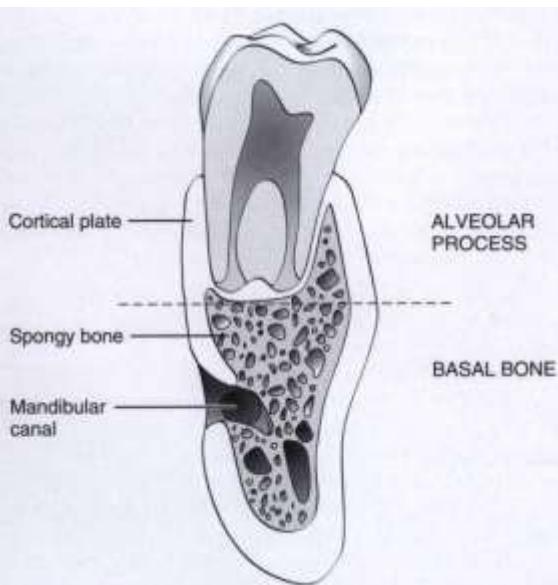


Cementum... Cemento-enamel Junction

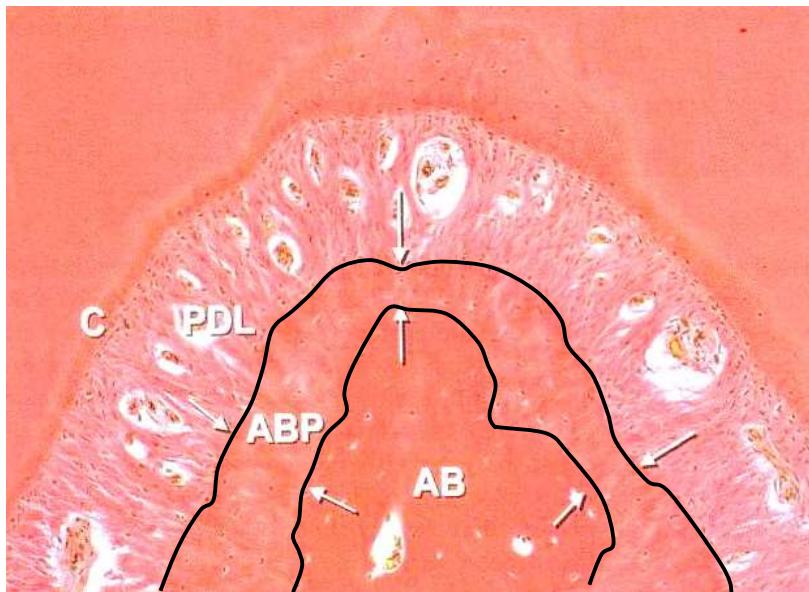


PERIODONTIUM... THE ALVEOLAR BONE

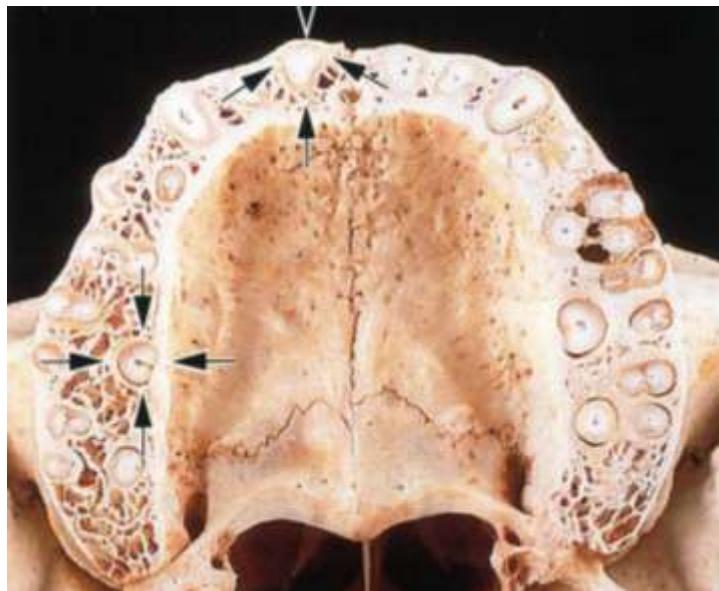
Alveolar bone



Alveolar bone



Alveolar bone... Maxilla



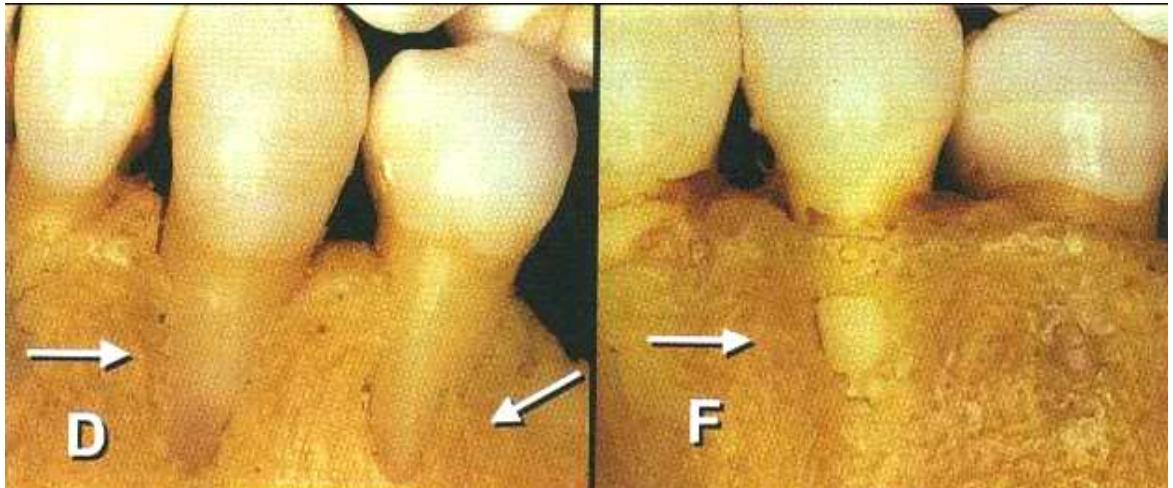
Alveolar bone... Mandible



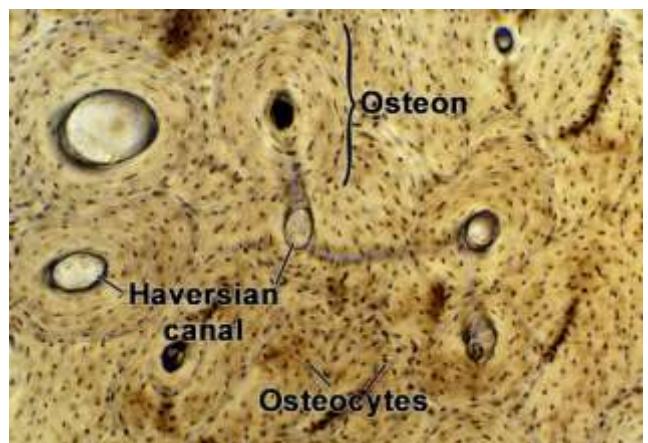
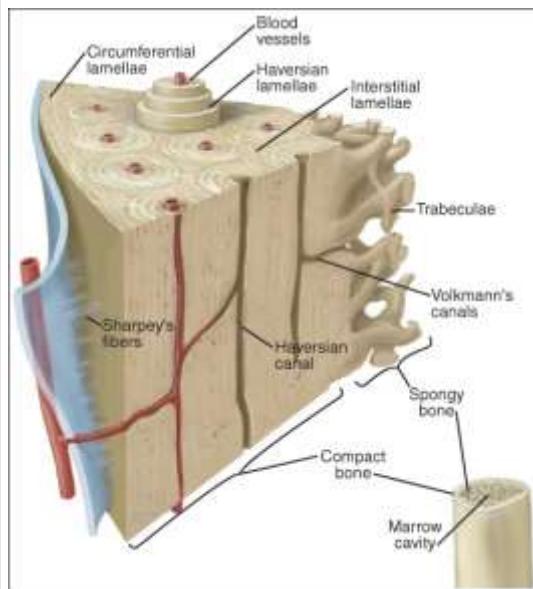
Alveolar bone... Mandible



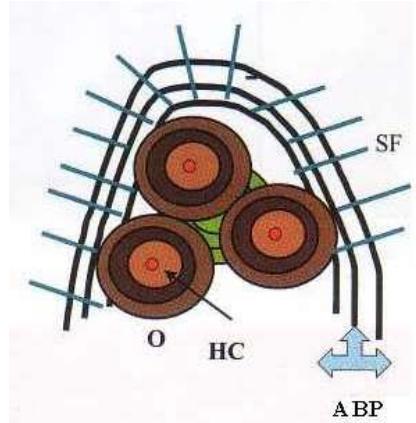
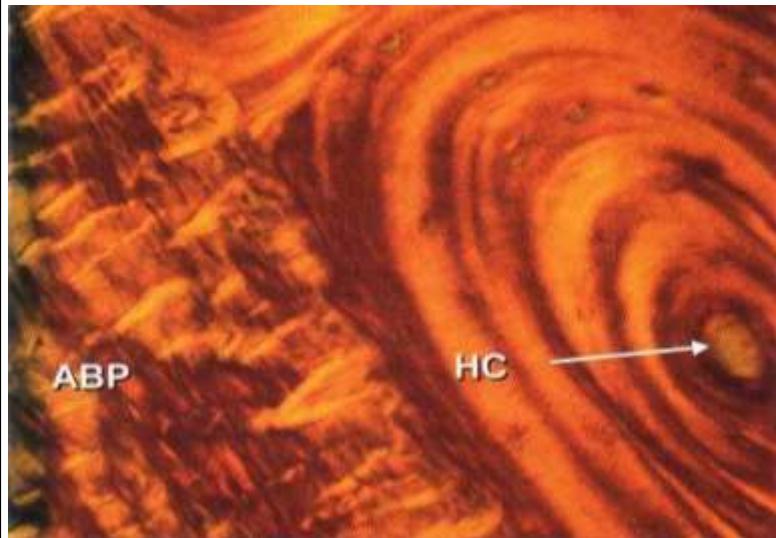
Alveolar bone... Dehiscence & Fenestration



Alveolar bone... Alveolar bone



Alveolar bone... Alveolar bone proper

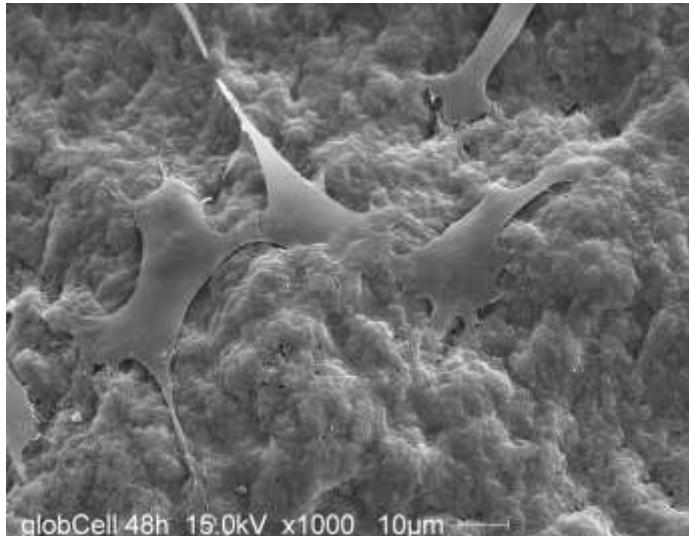


Alveolar bone... Periosteum & Endosteum

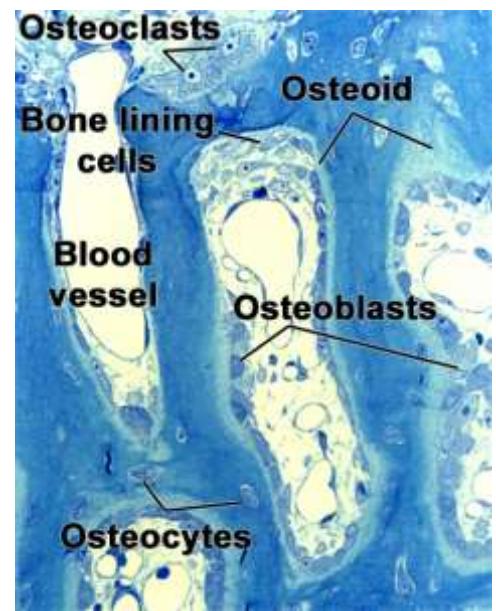


Alveolar bone... Bone formation...

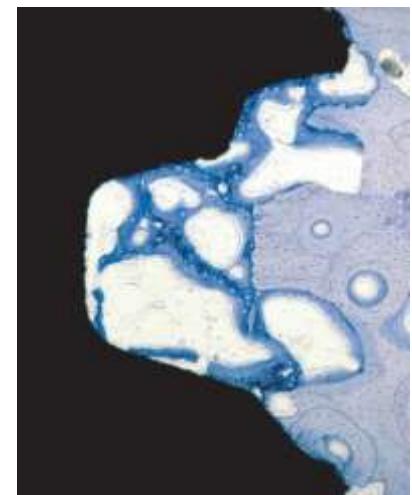
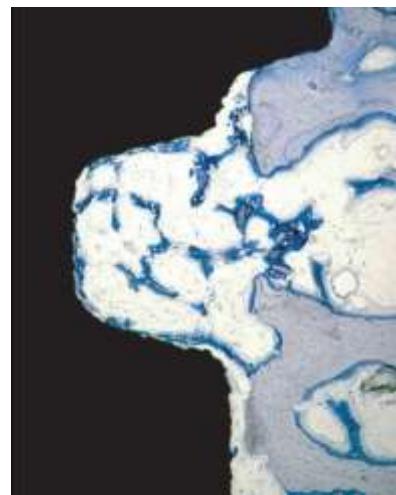
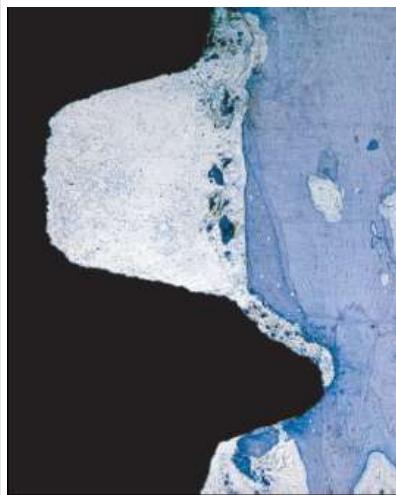
Osteoblasts



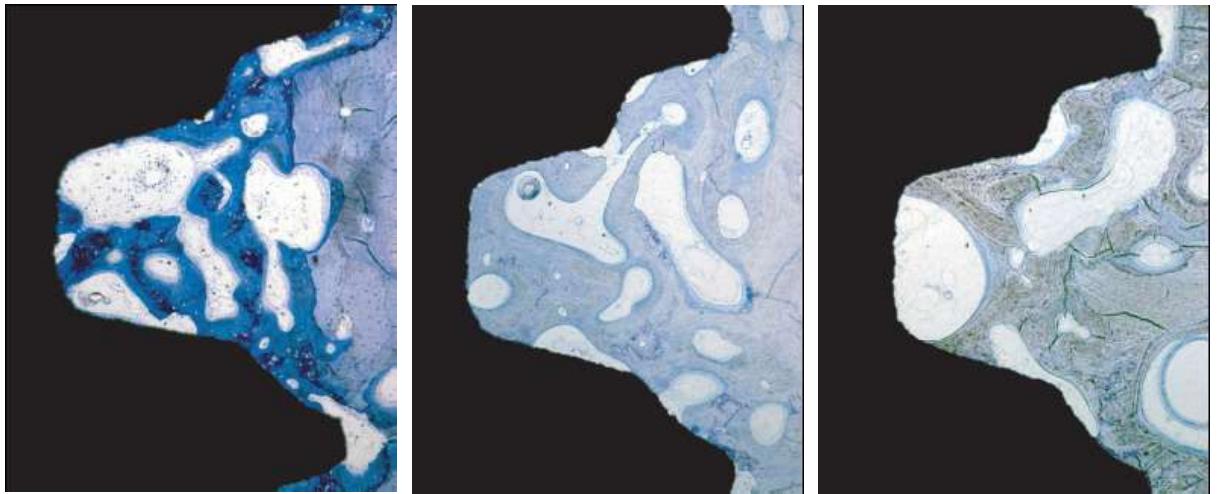
globCell 48h 15.0kV x1000 10µm



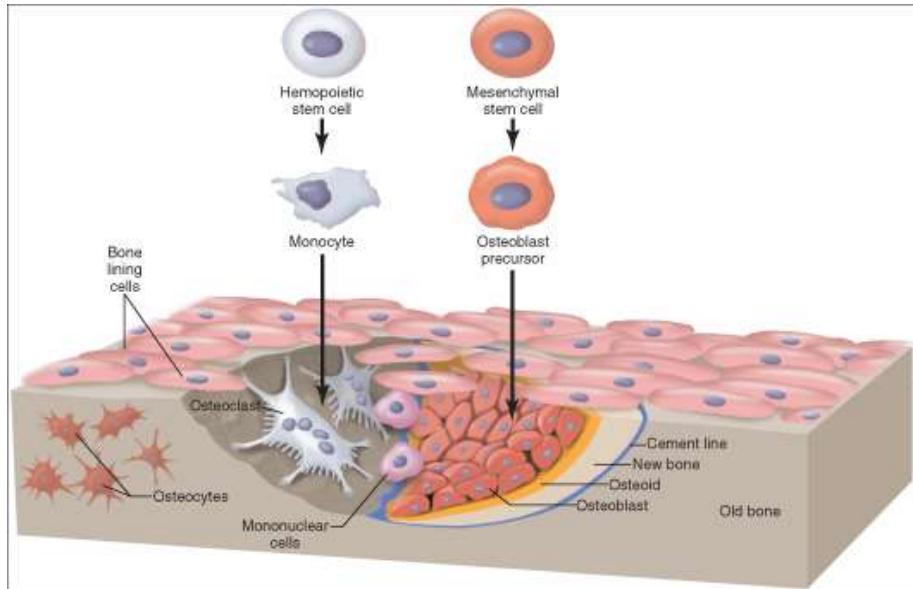
Alveolar bone... Bone formation



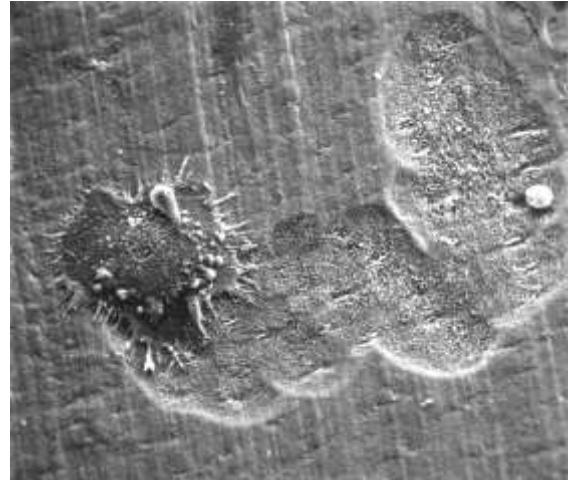
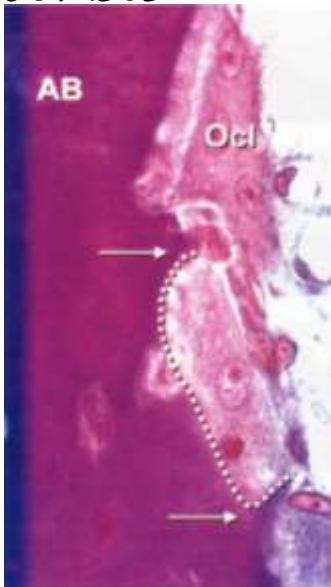
Alveolar bone... Bone formation



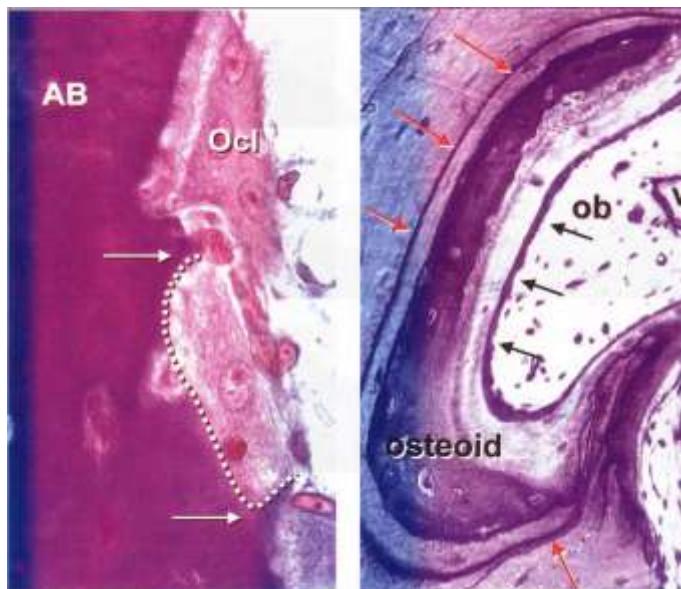
Alveolar bone... Bone remodeling



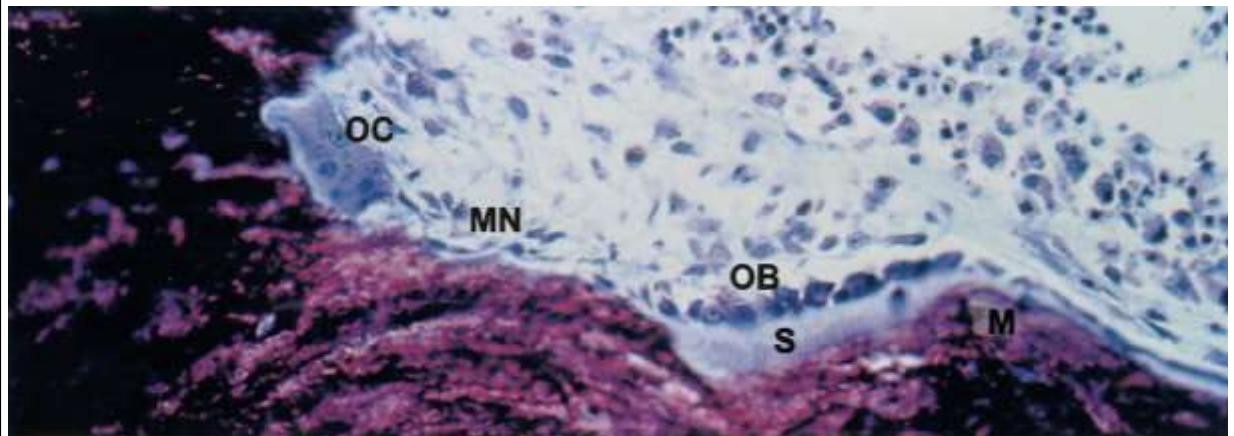
Alveolar bone... Bone remodeling...
Osteoclasts



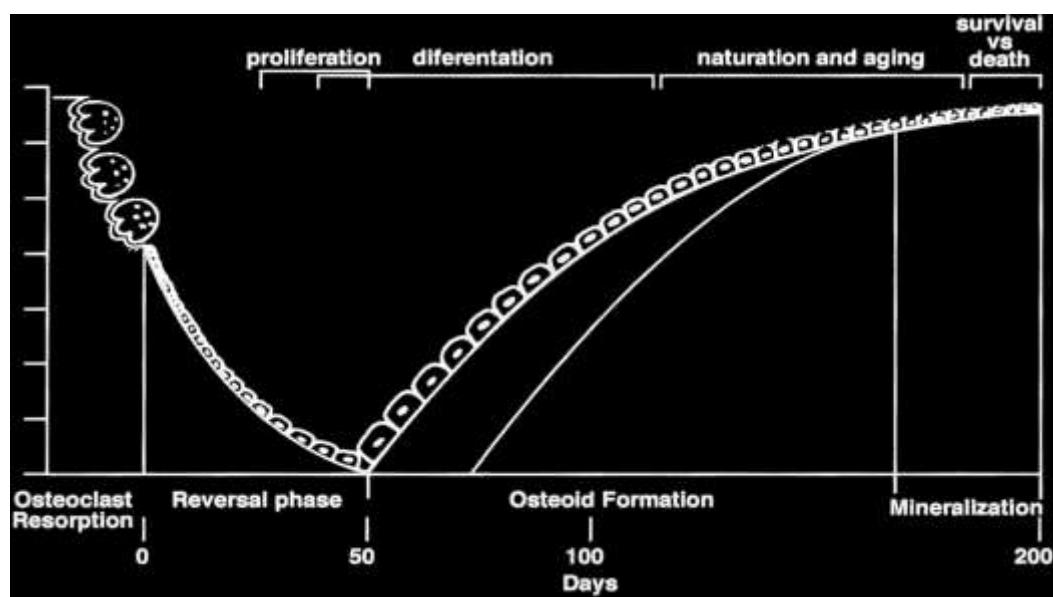
Alveolar bone... Bone remodeling



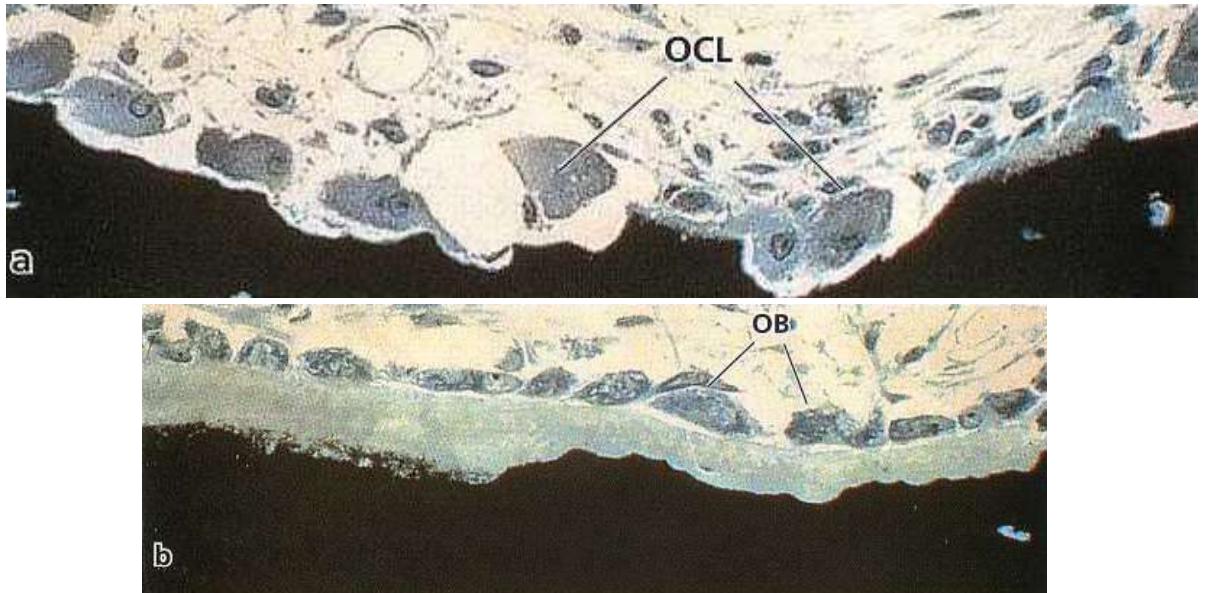
Alveolar bone... Bone remodeling



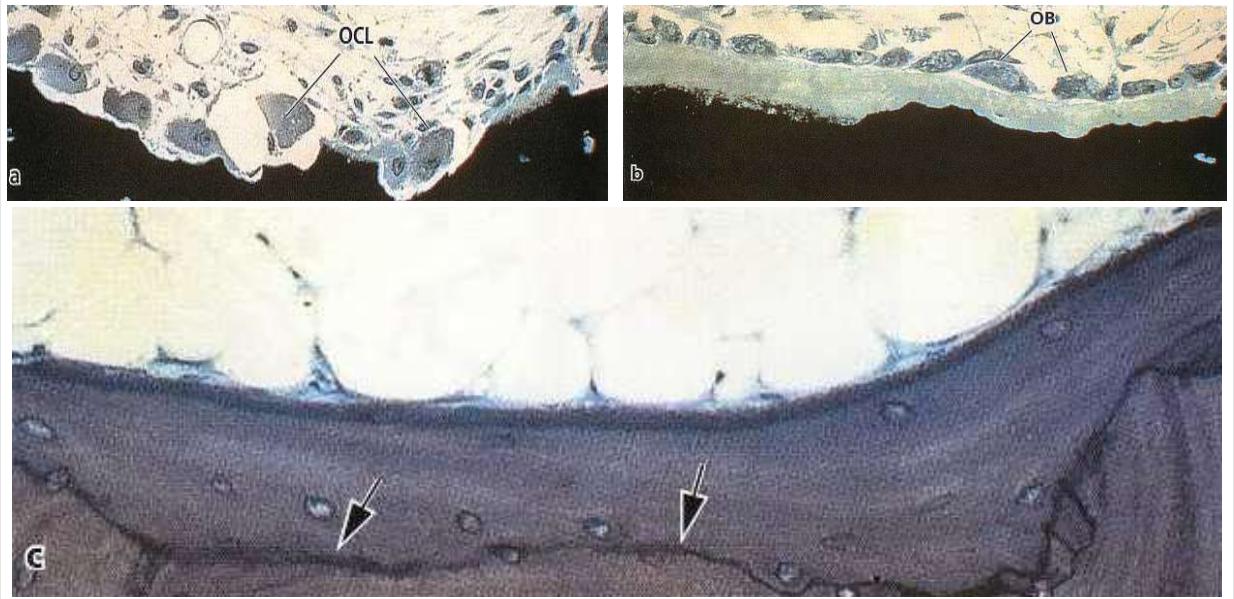
Alveolar bone... Bone remodeling



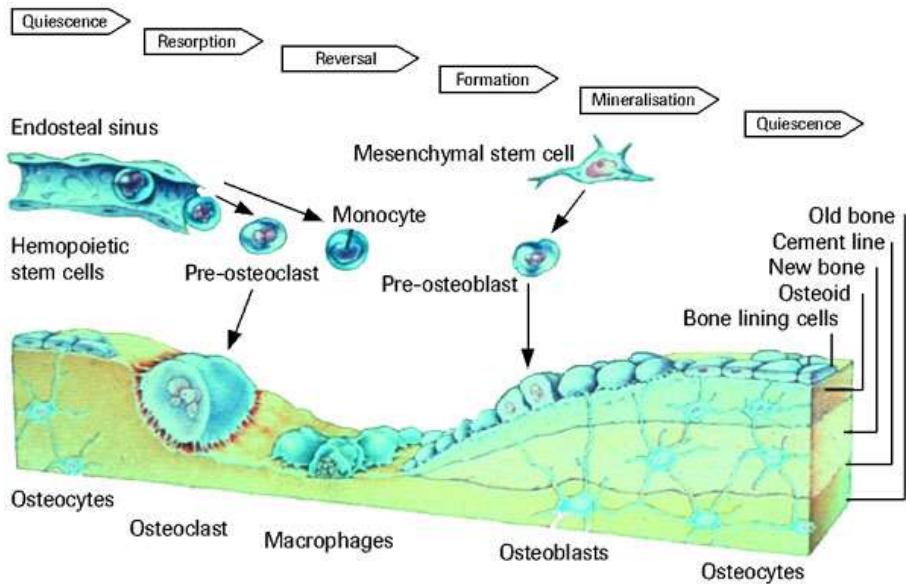
Alveolar bone... Bone remodeling



Alveolar bone... Bone remodeling



Alveolar bone... Bone remodeling



PERIODONTIUM... BLOOD SUPPLY

Blood supply... Gingiva

Sublingual artery (a.s.)

Mental artery (a.m.)

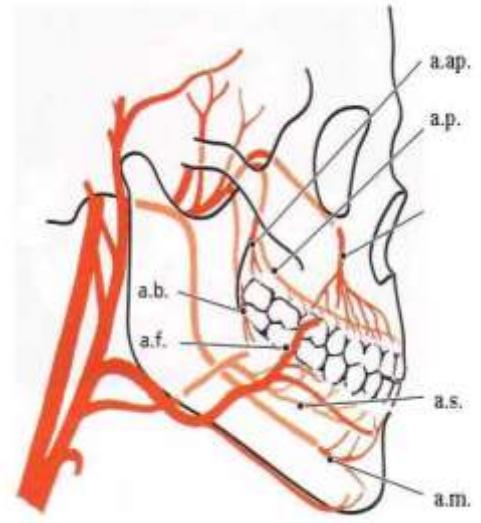
Buccal artery (a.b.)

Facial artery (a.f.)

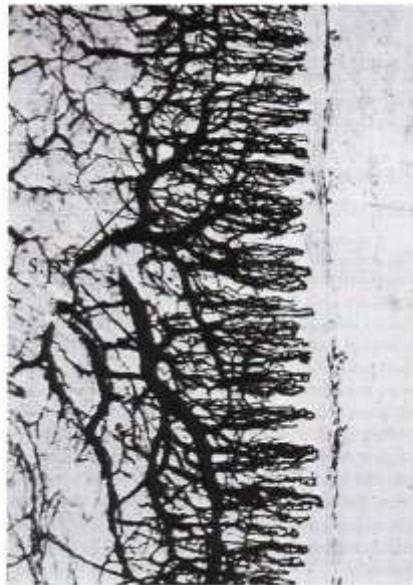
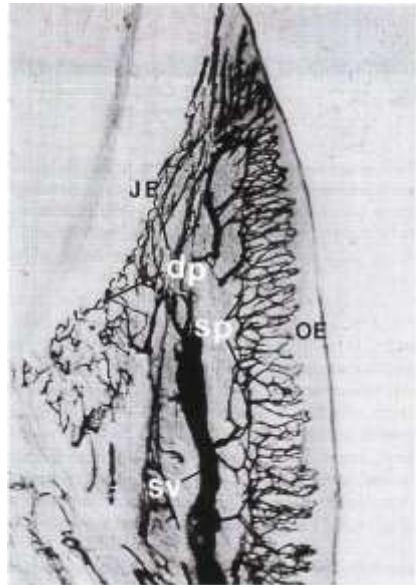
Greater palatine artery (a.p.)

Infra-orbital artery (a.i.)

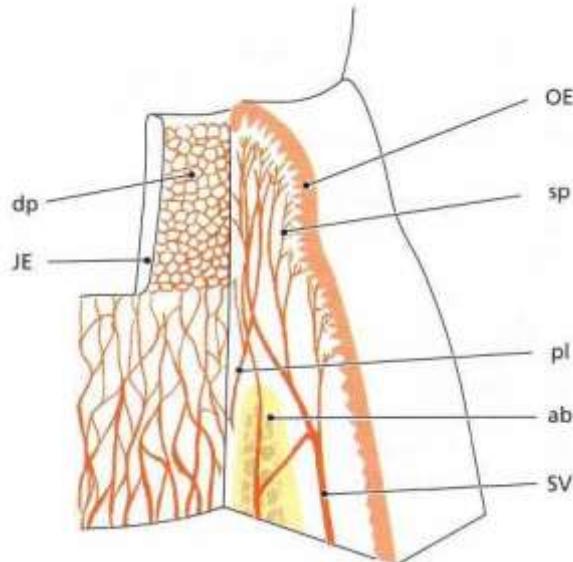
Posterior superior dental artery (a.ap.)



Blood supply... Gingiva



Blood supply... Gingiva



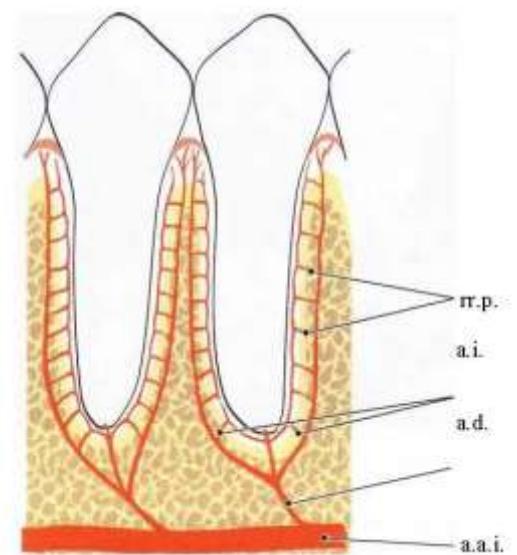
Blood supply... Periodontal ligament

Superior or inferior alveolar artery
(a.a.i.)

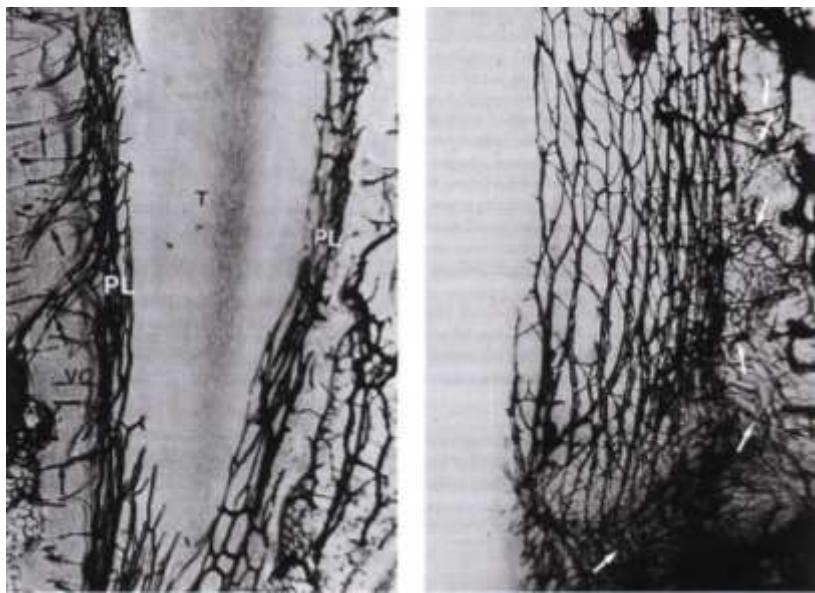
Dental artery (a.d.)

Intraseptal artery (a.i.)

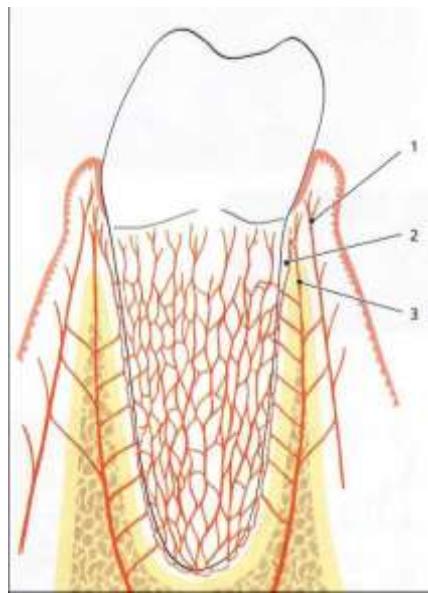
Rami perforantes (terminal branches
of a.i.) (rr.p.)



Blood supply... Periodontal ligament



Blood supply... Periodontal ligament



PERIODONTIUM... LYMPHATIC SYSTEM

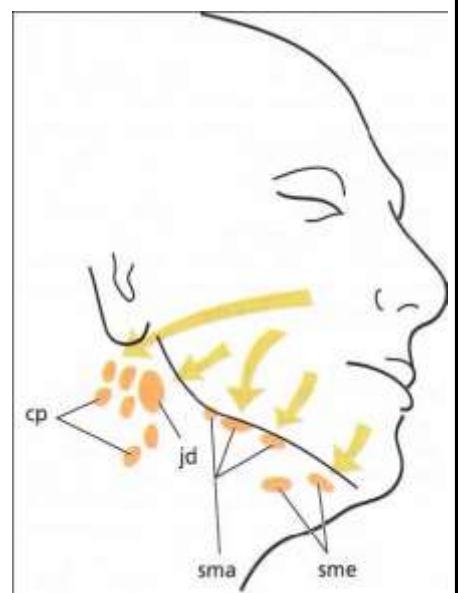
Lymphatic system

Submental lymph nodes (sme)

Deep cervical lymph nodes (cp)

Submandibular lymph nodes (sma)

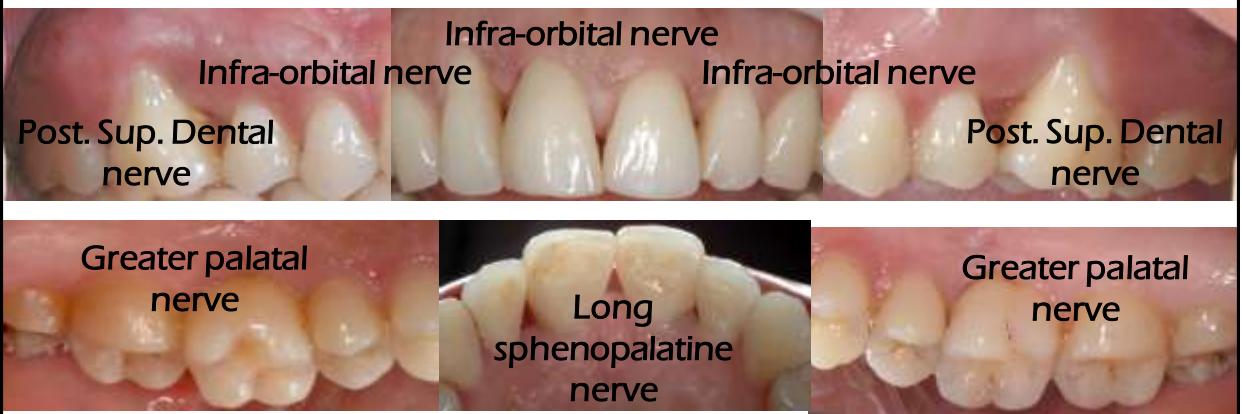
Jugulo-digastric lymph nodes (jd)



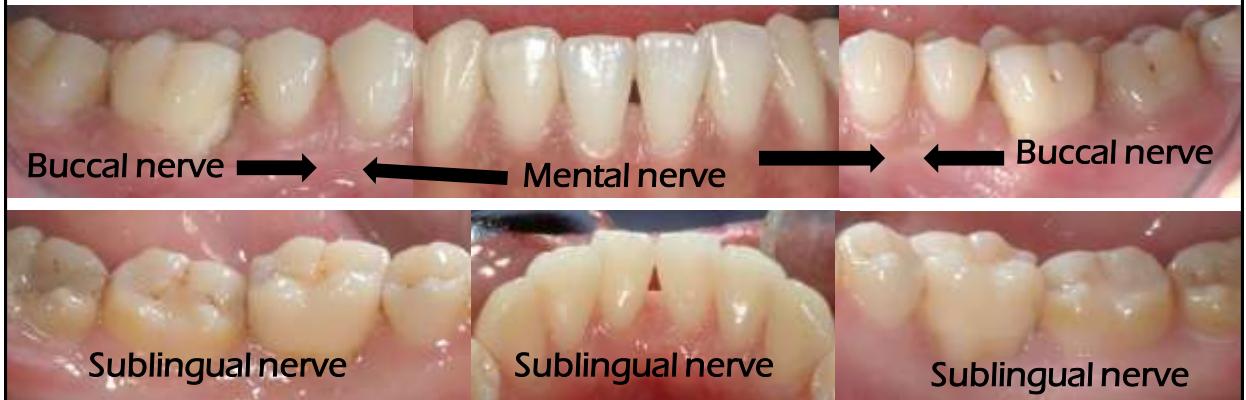
PERIODONTIUM...

NERVE SUPPLY

Nerve supply...



Nerve supply...



You cannot make men good by law, and without good men you cannot have a good society

C.S. Lewis