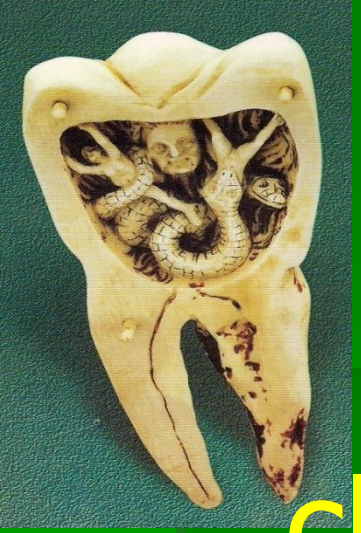
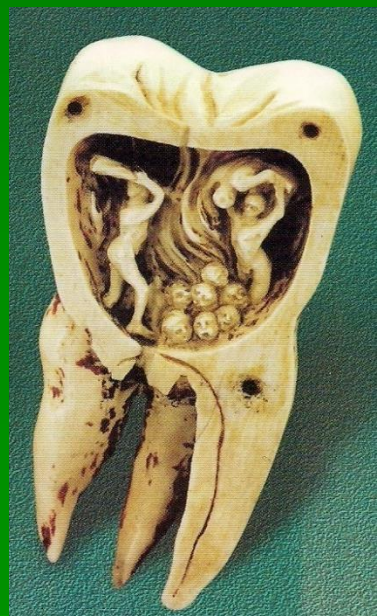


POLTAVA STATE MEDICAL UNIVERSITY
THERAPEUTIC STOMATOLOGY PROPAEDEUTICS CHAIR

CARIES:
clinical and morphological changes on various stages of carious process



Lecture for 3-rd year students
of international faculty

The lecturer: PhD in Medical Sciences,
Associate Professor
Marchenko Iryna Yaroslavovna

Lecture plan

- The definition of notion «caries». Epidemiological indexes of caries.
- Etiology of caries. The role of microorganisms.
- Caries resistance. Notions of permeability and acid resistance of hard tissues of tooth (HTT).
- Up-to-date conceptions of pathogenesis of caries. The role of dental plaque.
- Caries classification.
- Morphological changes, clinic, diagnostics and differential diagnostics of caries.

I. The definition of notion (determining by WHO)

- Caries (lat.-caries dentis) is the pathological process, which appears after tooth cutting, characterized with **demineralisation** of HTT and following formation of cavity-like defect.

Acute middle caries 36, patient I. 24 y.

Multiple (plural, blossoming) caries

II. Epidemiological indexes of caries

- Prevalence;
- Intensity;
- Accretion of intensity (case rate).

- **Prevalence** of caries – is the index, which determines the percent of persons with caries, fillings and extracted teeth among general quantity of inspected persons.

$$P = \frac{\text{quantity of persons with CFE + cf}}{n} \times 100\ \%$$

where: n – general quantity of inspected per's,

C – permanent teeth with caries,

F – permanent teeth with filling,

E – permanent extracted teeth;

c – deciduous teeth with caries;

f – deciduous teeth withfilling.

- **Intensity** – average quantity of damaged teeth on one inspected patient.

$$I = \frac{CFE + cf}{n}$$

Intensity indexes by WHO:

	Adults 35 – 44y.	Children 12y.
1. Very low	0 – 1,1	0,2 – 1,5
2. Low	1,2 – 2,6	1,6 – 6, 2
3. Moderate	2,7 – 4,4	6,3 – 12,7
4. High	4,5 – 6,5	12,8 – 16,2
5. Very high	> then 6,6	> then 16,3

- **Accretion of intensity** (case rate) – is difference between indexes of intensity at first and following inspections (visit) in the same group of patients.

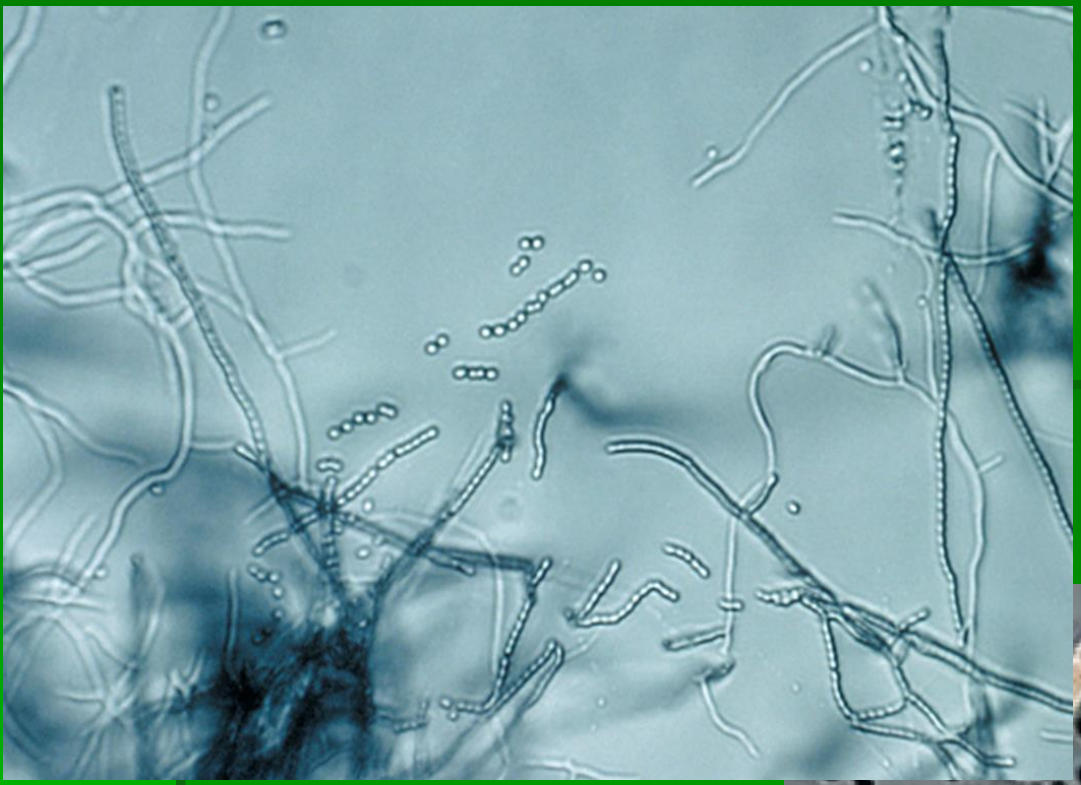
AI = I last insp. - I first insp.

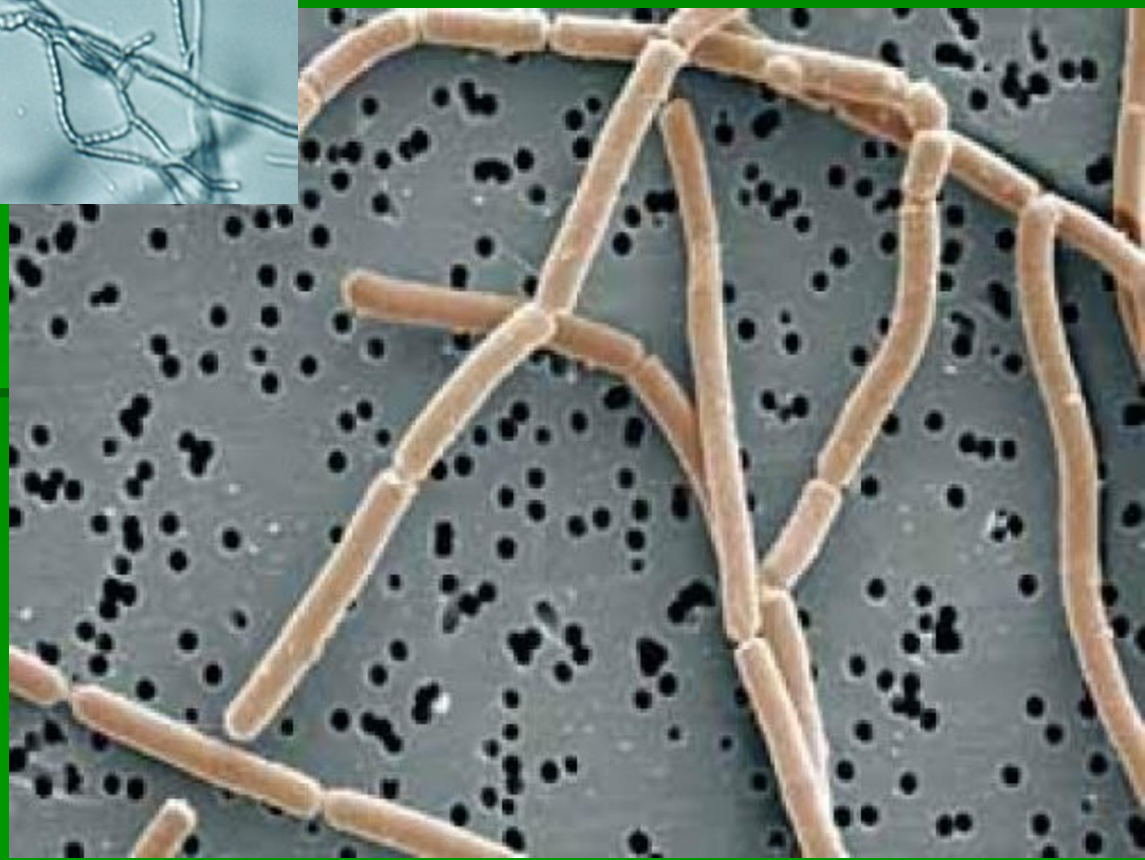
- According to WHO data the highest AI is in Japan, the lowest is in Switzerland, Burma, Mozambique, Ethiopia, Sri Lanka (data of 1982).

III. Aetiology (reason of ccurrence).

With out microorganisms caries does not arise!

- Microorganisms of oral cavity:
- 1. Acidophilic (are able to educe in acid environment – lactate streptococci, lactobacilli, leprotrishies, actinomycetes). 70% of these bacterias are streptococci. Str.mutans, sanquis, salivarius belong to cariesogenic forms. Str.mutans has very high biochemical activity and are able to ferment saccharose and other carbohydrates with formation of lactic acid.
- 2. Proteolytic microorganisms (produce proteinases – it is enzyme). Most of them are anaerobes, using proteins, amino acids during life activity – all of them can split collagen. Peptostreptococci, neiserias, vibriones, spirochetes, rhystells belong to this group.





- Cariesogenicity of m/o caused :

- Ability to create organic acids, first of all lactate, as final product of carbohydrates' fermentation;

- To produce glycans from saccharose extracellular;

- Ability to fix and to grow on sleek surfaces;

- To produce destructive ferments.

Among them are:

- a) Hyaluronidase (factor of distribution) – can split hyaluronid acid (base of intracellular substance), enlarging penetration of tissues;
- b) Neuraminidase – oppressing cellular immunity;
- c) Phospholipase – lysing of leucocytes' membrane;
- d) Phosphatase – lysing of mineral components of enamel.

V. Caries resistance – ability of enamel to resist cariogenic factors

- Permeability – ability of HTT to absorb different substances.

Today it is proved, that enamel is permeable from 2 sides: pulp and saliva. Due to this fact HTT is get mineral substance during its development as from pulp, as from saliva. After tooth eruption during of several years there is a definitive mineralization of enamel, thanking remineralizational properties of a saliva. But a teeth can be permeable and for microorganisms and products of their vital functions (the same dairy acid)

How tooth tissues can protect themselves from action of adverse factors?

V. Caries resistance

Structural

- Favorable genetic code;
- High-grade structure of enamel and dentine;
- Degree of a maturity of enamel;
- State of organic and inorganic components of an enamel.
- Ca / P = 1,3 – 2,0

Functional

Composition and locomotion of tooth liquor controlled by a pulp of tooth

- Tooth liquor moves in dentine tubules and intraprism interspaces of enamel and has centrifugal direction of movement. In dentine Sm = 4 mm/hour, in enamel Sm= 1 mm/hour (prof. Okushko V.R.)
- It's movement very important – during one day **tenfold** exchange is arisen.

- Action of tooth liquor – having alkaline pH, goes upon the surface of enamel, neutralizes acids, which is formed under dental plaque.

ERT (Enamel resistance test) –

determining of structure-functional acid resistance of enamel. Essence : on cleaned, dried and isolated from saliva vestibular surface of 11 on distance 2 mm from cutting edge on center a 1 drop of sol. HCl with diameter 1-2 mm applies. After 5 sec the drop had to be removed.

ERT (Enamel resistance test)

- Then a drop of 1% sol. of methylene blue applies on, which takes of with dry tampon. This place will be colored in blue, intensity of which depends from solubility (acid resistance). The color is compared with 12-poled typographical scale : 1-3 points – high, 4-6 moderate, 7-9 –insufficient, > 10 – low caries resistance.

VI. Pathogenesis of caries.

- Acknowledged mechanism of caries development is progressive demineralization of HTT under action of organic acids, which concentrated under dental plaque and formed by m/o as a result of carbohydrates fermentation.
- Cariesogenic action of m/o is connected with formation of dental plaque. It is soft dental debris connected with tooth surface.

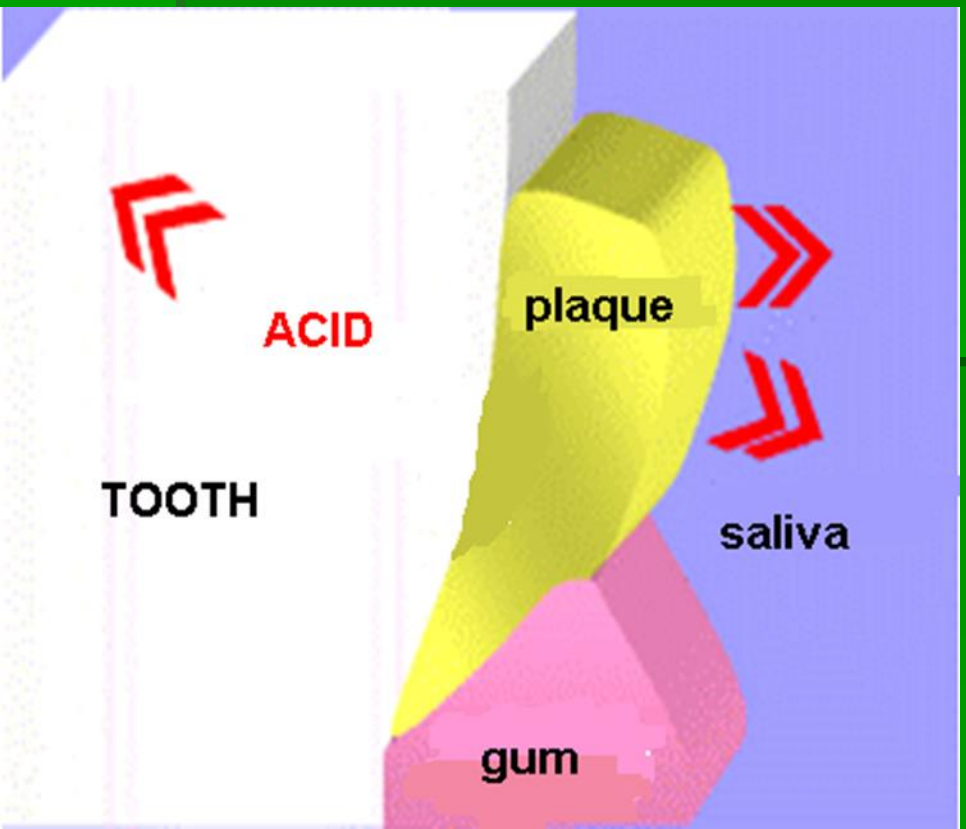
Stages of dental plaque formation

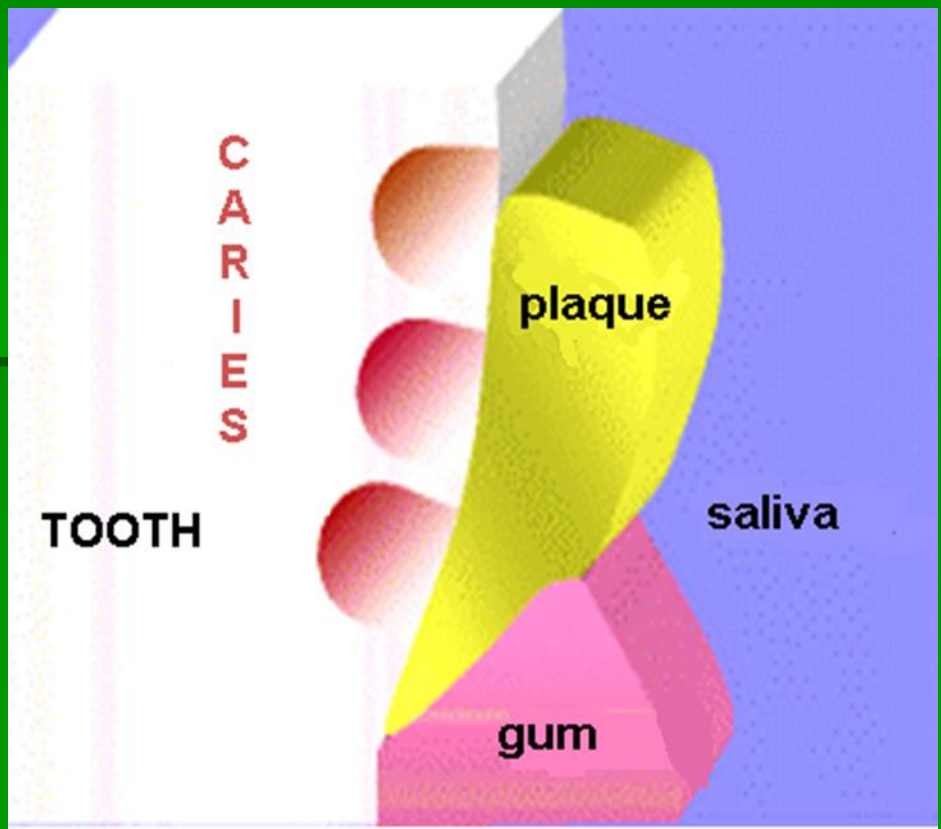
- 1. Formation of pellicle is precipitation of saliva glycoprotein on enamel surface (thickness 1-10 mk. and forms after a half of an hour after teeth cleaning or hard meal).
- 2. Formation of soft dental debris. A layer of m/o is adsorbed on the surface of pellicle (especially Str's) which in presence of sucharose synthesizes intra- and extracellular polysaccharides like dextrin. Intracellular dextrin are used as energy by m/o. Extracellular dextrin enhance adhesion of m/o to enamel and so increase thickness of soft dental debris.

Stages of dental plaque formation

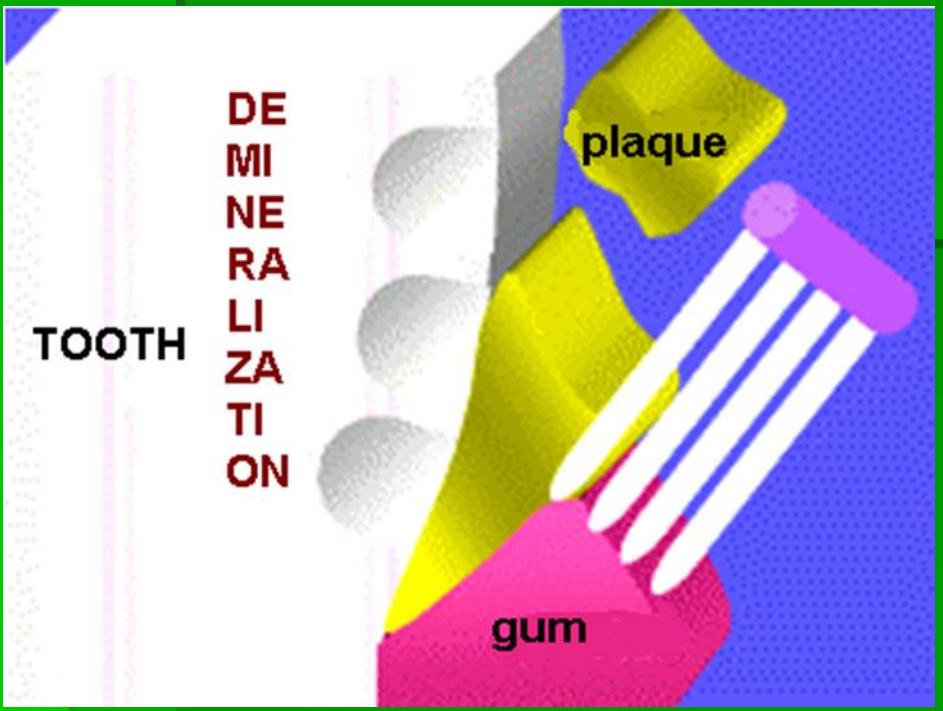
- 3. Formation of dental plaque. After 3-4 days the debris consists of many m/o and has thickness 200 mk, hardly connected with surface of tooth. At this period it has the most cariogeniciable ability. As a result of carbohydrates' fermentation in dental plaque is formed lactic, propionic, acetic, pyroracemic, formic acids, which after certain concentration pick down locally (under plaque) pH to 4,5 – 5,0.

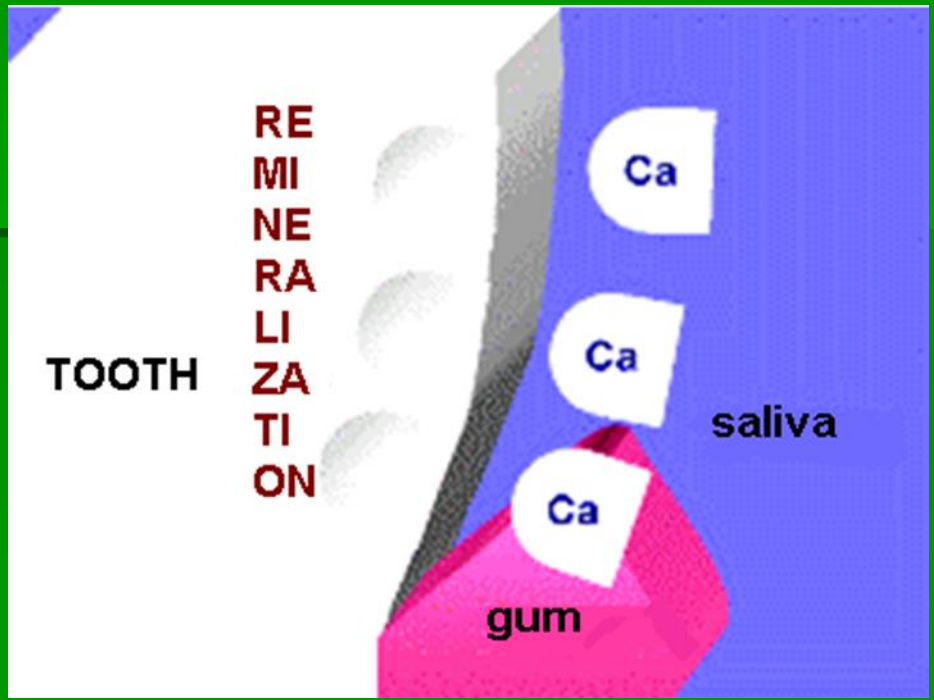
- It causes dissolution of appetites in the least resistant parts of enamel (lines of Retsiuse, intraprysmaticale spaces) what leads to penetration by acids in under superficial layer and its demineralization.





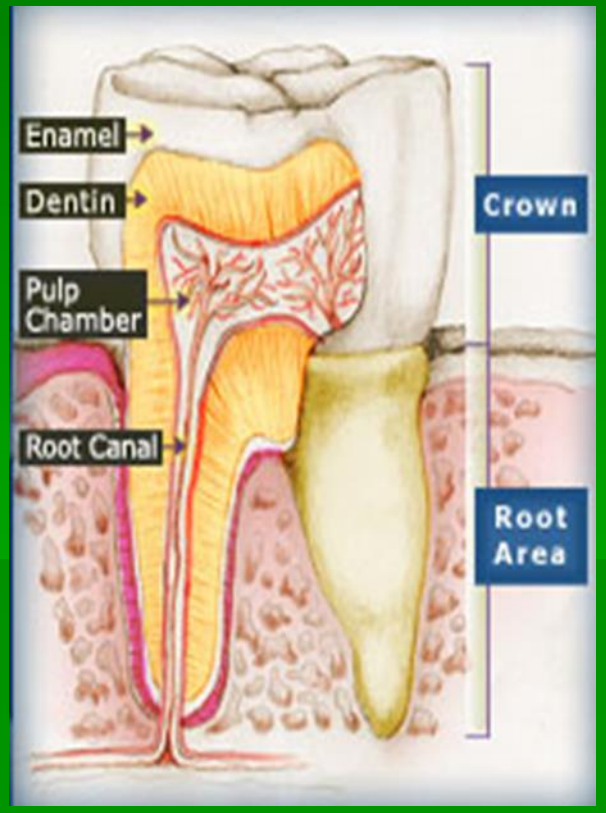
- In enamel can happen arise 2 process: remineralization and demineralization. If the environment around tooth doesn’t provide domination of remineralization, then it causes formation of local demineralization – caries stain. At enough buffer capacity, present of antimicrobial system, fluorine, microelements in saliva this process can be convertible.





Classification of caries (working)

1. Clinical (topographical).
   - Initial (white, pigmented stain) (macula cariosa)
   - Superficial (c. superficialis)
   - Middle (c. media)
   - Deep (c. profunda)
2. The anatomic
   - Caries of enamel (c. enameli)
   - Caries of dentine (c. dentini)
   - Caries of cement (c. cementi)
3. On localisation
   - fissure (c. fissuralis)
   - aproximal (c. aproximalis, c. contactus)
   - in area of neck (c. cervicalis) Circulating (ring)



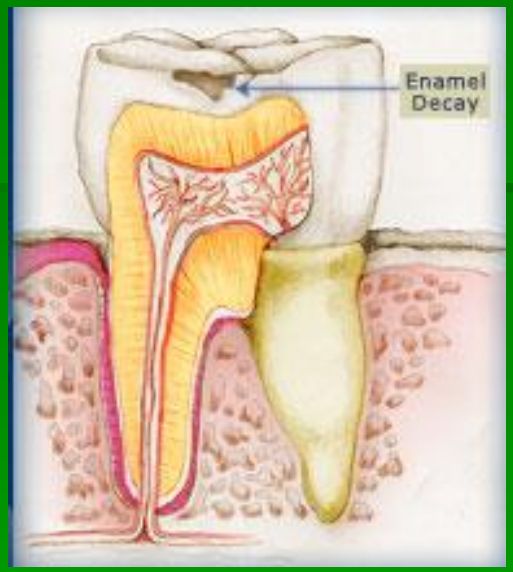
Classification of caries (working)

4. On a current
   - Acute (c. acuta)
   - Chronic (c. chronica)
   - Plural (blooming, system) (c. florida)
   - Secondary (c. secundaria)
   - Stationary (stopped) (c. stationaria)

5. On intensity of defeat
   - The compensated
   - The subcompensated
   - The decompensated

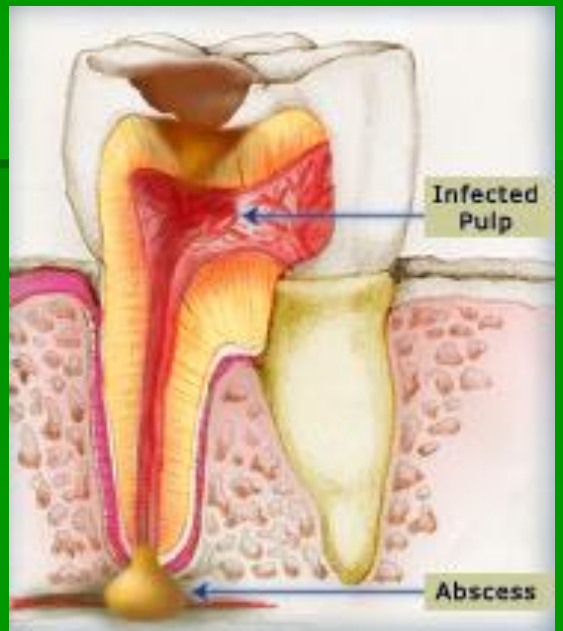
6. On presence of complications
   - Simple (not complicated) (c. simplex, c. incomplicata)
   - Complicated (c. complicata)

Classification of caries



Caries of enamel

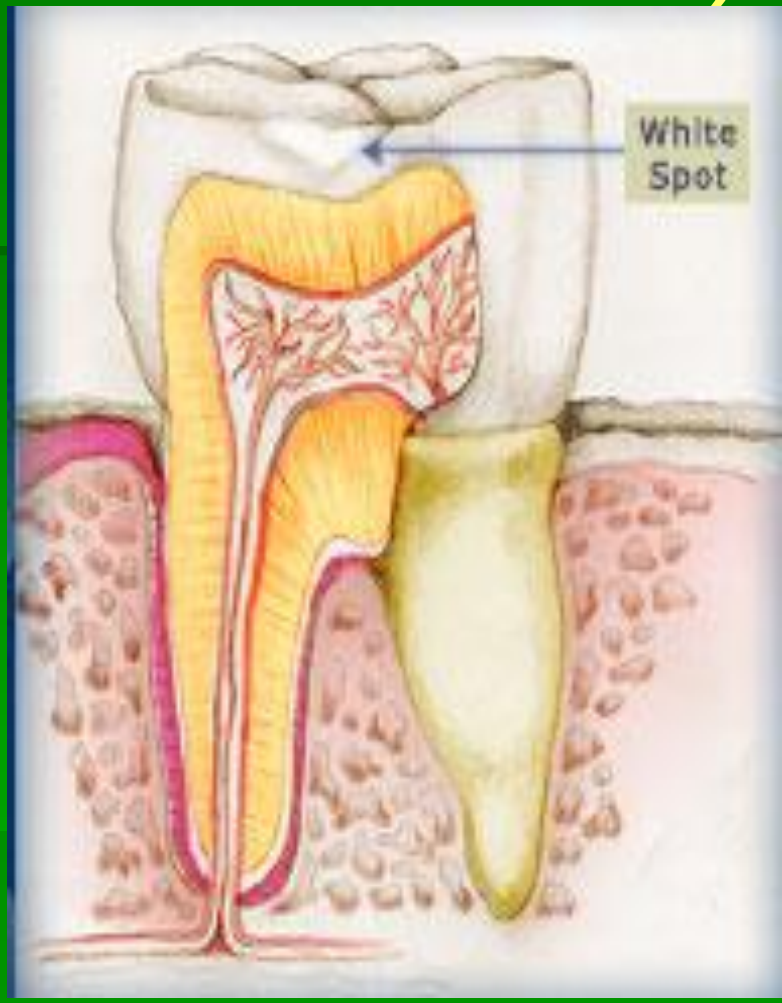
Caries of dentine



Complicated caries

Acute initial caries (macula cariosa)

- is a pathological process which is characterized by demineralization of subsuperficial and central layers of an enamel with formation of cosmetic defect in view of white or pigmented spot without formation of cavity-like defect.



Pathomorphology of acute initial caries

In the basis of pathological process demineralization of an enamel layers lies, which begins on so-called Retzius lines (regions the least degree of a mineralization of enamel). But feature consists that demineralization is exposed to the greatest degree in the subsuperficial and **the central** layers of enamel. And the outside layer remains enough mineralizational, that explains activity of saliva.

Pathomorphology of acute initial caries

S.P.Onishchenko and V.P.Zenovsky have secured 5 layers of a lesion:

1. The superficial region, is characterized by the greatest stability;
2. The subsuperficial, in which reduction of the content of calcium in comparison with norm is observed, the volume of microspaces is enlarged to 14 % at norm of 1 %. Permeability of an enamel sharply increases;
3. The central region (lesion body) – region of maximum changes. The volume of microspaces is enlarged to 20-25 %;
4. The intermediate region;
5. The intrinsic (region a lustrous enamel) - region the relative well-being.

Clinic of acute initial caries

- **Complaints:** on cosmetic defect in a view whitish maculae various shades, inappreciable (weakly) sensitivity from chemical irritants (acidic, sweet, bitter) – hyperesthesia.
- **Anamnesis of diseases:** causal tooth earlier was not treated, complaints occurred several weeks ago.
- **Objective examination of a disease place:**
- At survey - whitish, opaque macula small dimension with accurate borders. This macula can be defined on any, accessible to survey surfaces, except for a place of the most frequent localization of caries lesions - at the bottom of sulcus and proximal surfaces of teeth.
- At probing the smooth surface of this maculae, painlessness is defined.
- A vertical and horizontal percussion and palpation of mucosa in range of apexes' projection of tooth root are painless.
- A thermo diagnostic painless or inappreciable short-time painful sensitivity. EOD: 2-6 mkA.
- Maculae is imbued by 2 % solution of the methylene dark blue.

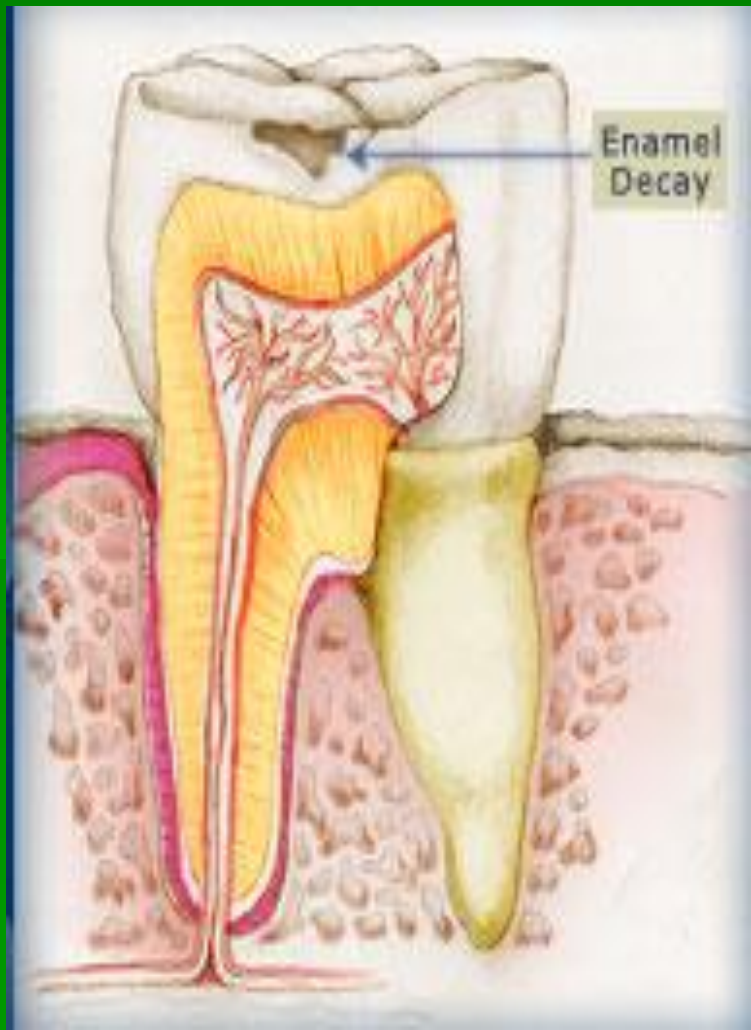
Clinic of chronic initial caries

Difference:

- Complaints on presence of dark stain, if it is localised on places accessible to its survey. Complaints often are absent, because the pain or sensitivity from irritants does not arise. Caries often find out at routine inspection.
- Long current. Development of this caries can stop.
- At survey: the dark stain of various shades - from light brown to black in typical places for localisation of caries defects is defined.

The acute superficial caries

- is a pathological process which is characterised by demineralization of all layer of enamel with formation of defect in the form of a cavity within enamel.



Pathomorphology of acute superficial caries

In situ whitish macula destruction of outside layer of enamel is occurred. Disorientation of crystals in frame hydroxiapatite, change of their shape and the dimensions are occurred. In intermediate and intrinsic regions enlargement of volume of microspaces is found out and this area of enamel becomes look like a sponge. Defect the enamel-dentine border and changes in a pulp is not observed.

Clinic of acute superficial caries

- **Complaints:** short-time pain from chemical (acidic, sweet, bitter) and less often from temperature irritants. It is more often observed at localization of defect in the field of tooth neck, where enamel are the most thin.
- **Anamnesis of diseases:** causal tooth earlier it is not treated, complaints have occurred 1 month ago.
- **Objective examination of disease place :**
- At survey: on the centre of whitish macula defect of an enamel is defined.
- At probing: the rough surface of enamel and its fragility, painlessness are defined.
- A vertical and horizontal percussion and palpation a mucosa in range of apexes' projection of tooth root are painless.
- At thermo diagnostic: inappreciable short-time painful sensitivity. EOD: 2-6 mkA.

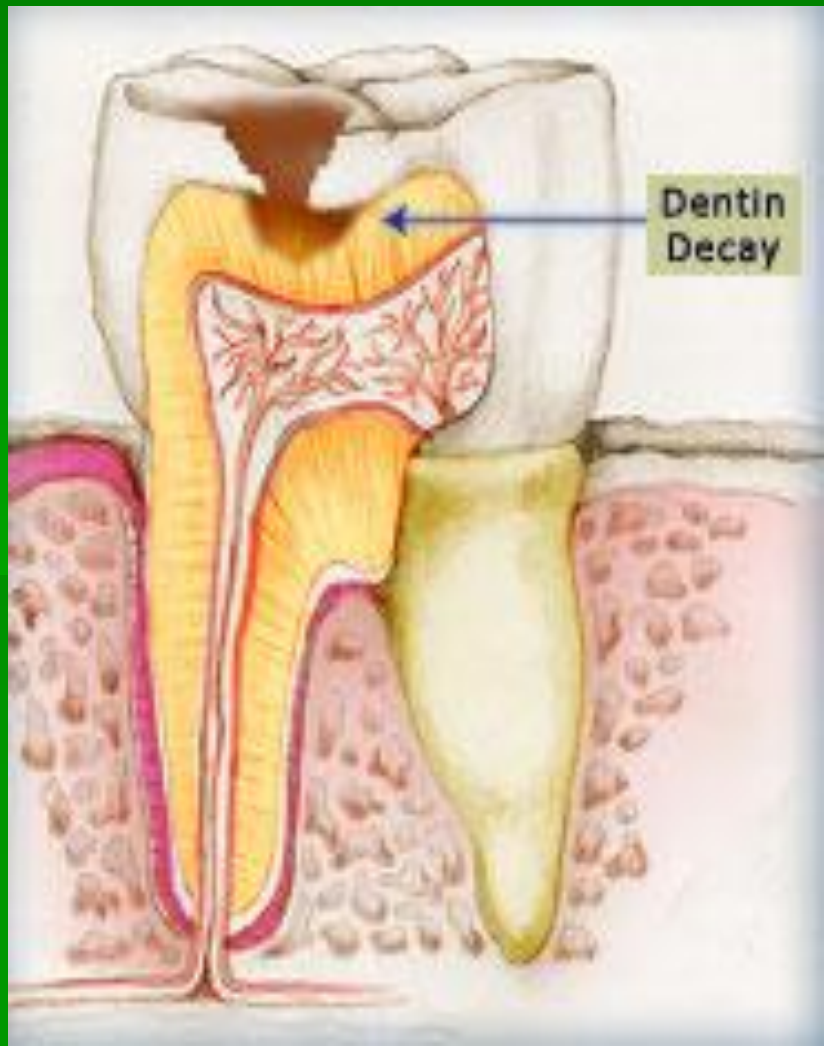
Clinic of chronic superficial caries

Difference:

- Absence of painful sensitivity.
- Long current.
- Enamel defect has a dark colour.

The middle caries

- is a pathological process which is characterised by demineralization of an enamel and a cloak layer of a dentine with formation of like-cavity defect within a cloak dentine.



Pathomorphology of chronic middle caries

In light microscope 4 regions are defined:

1. Decay and demineralization enamel and dentine;
2. The transparent dentine;
3. Intact dentine;
4. Replaceable (tertiary, substitute) dentine and changes in a pulp.

Layer of decay and demineralization

- In first zone the rests of destruction of enamel and dentine with a considerable quantity of microorganisms are visible. The cloak dentine is softened, dentinal tubules are dilated or some are merged, forming microcavities (flaw), filled with bacteria. Processes of odontoblasts are exposed fatty dystrophic.

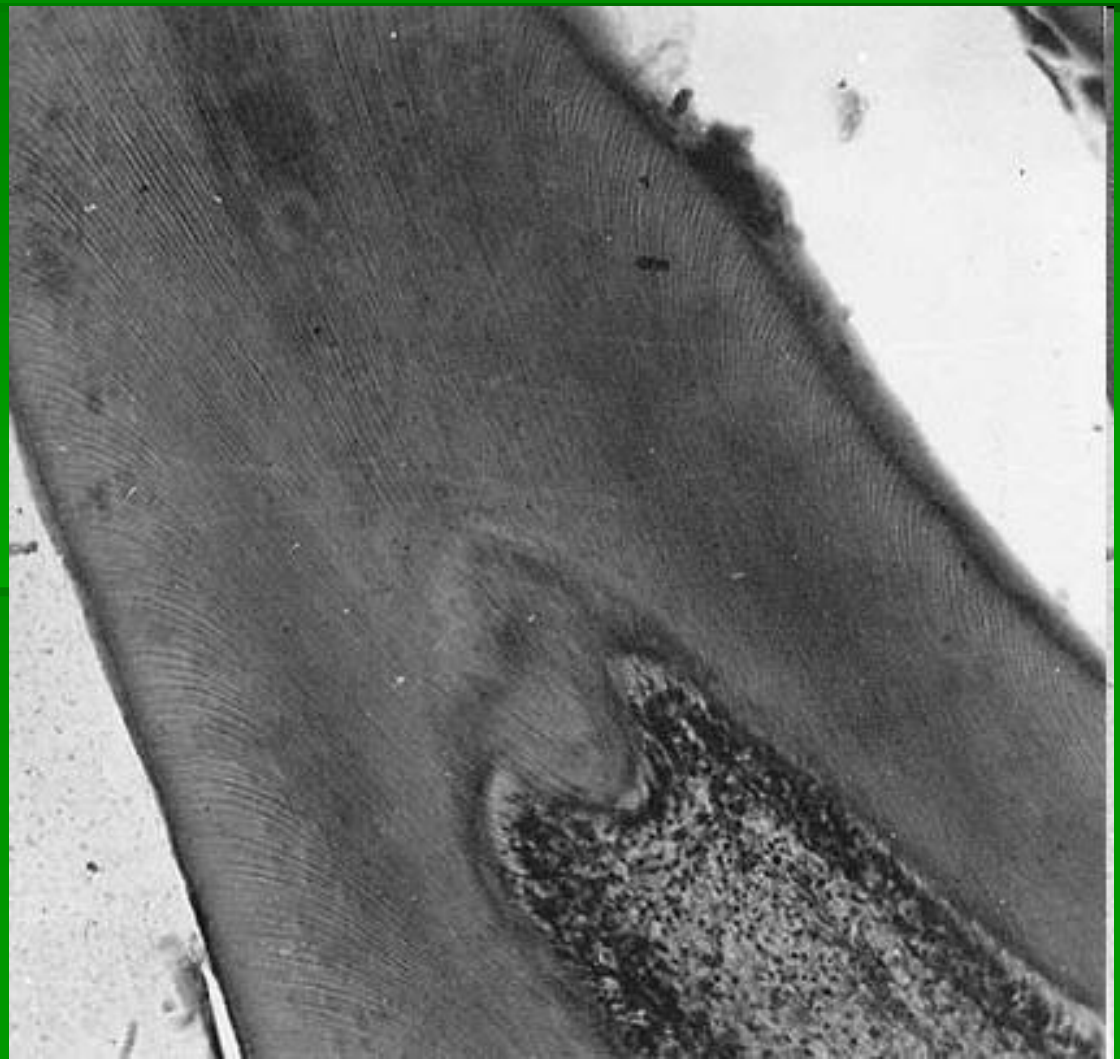
Layer of transparent dentine

- The (region hypermineralizations) - a layer of the compacted dentine with considerably reduced dentinal canaliculuses. This region is characteristic only for **chronic** caries since for its formation the long-term current and expressed enough remineralizational properties of a saliva and blood is necessary. This region is termed so because of optical effect: at the expense of an obliteration of dentinal canaliculuses there is "wipeout" of borders between canaliculuses and a dentine. Rays of light, transiting through tissues with the homogeneous frame is not quenched, and yields the homogeneous light emission (on microsections these fields look homogeneously transparent).

Layers of intact and tertiary dentine

- At chronic middle caries the layer of nearpulpul dentine is intact.
- In forth zone (replaceable dentine and changes in pulp) at arch of pulp chamber in projective of carious lesion the layer replaceable (tertiary) dentine is formed. It differs from the secondary dentine less oriented locating of dentinal canaliculuses or their full lack. Region a replaceable dentine is characteristic only for **chronic current** of caries. Transparent and substitutional dentin layers are a defence for pulp. Its protect pulp from approaching carious lesion and irritants, which can provoke a pain.

Replaceable dentine



Clinic of chronic middle caries

- **Complaints** at pain is absence, patients complain at presence of a carious cavity, get in and hold (fix) of food.
- **The disease anamnesis:** tooth earlier was not treated, complaints occurred about 6 months ago.
- **At survey** of tooth the middle depth caries cavity with a wide inlet opening is defined. A dentine of bottom and sides is dark, dense at probing.
- A vertical and horizontal percussion and a palpation of a mucosa in the field of apex projection of tooth root are painless.
- Response to probing and a thermodiagnostic are painless. EOD - 2-6 мкА.
- The test for preparation: during diagnostic preparing on a dentine-enamel border without previous

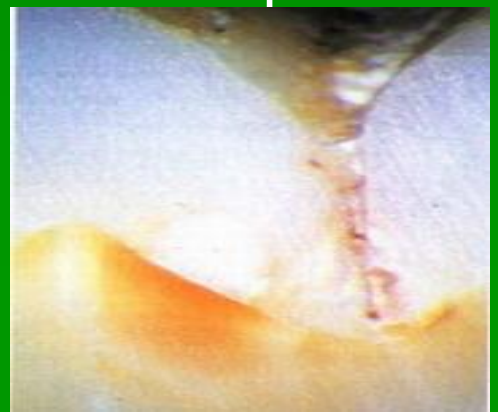
The acute middle caries

At this caries allocate following zones:

1. Decay and demineralization enamel and cloak dentine;
2. Intact nearpulpul dentine;
3. Changes in a pulp.

At an acute caries the process is distributed along dentin-enamel junction, in this connection the undermined (hanging) edges of enamel are formed. The cavity has the form of a rhombus, which long diagonal settles down on dentin-enamel junction.

Transparent and replaceable dentine has not time to be developed, therefore process quickly passes on nearpulpul dentine.



Clinic of acute middle caries

- **Complaints:** short-time pain from chemical and temperature irritants, get in and hold of food; Sometimes, if the cavity is settled down on aproximal surfaces, acute caries proceeds with out complaints.
- **Anamnesis of diseases:** causal tooth earlier was not treated, complaints occurred 2-3 month ago.
- **Objective examination:**
- At survey – caries cavity settles down in limits of cloak dentine, with narrow entrance aperture. The defect of enamel is insignificant, does not correspond to the size of a cavity in dentine. The edges of defect in enamel sometimes are transparent, fragile (easily break off by an excavator). A dentine of bottom and walls are light and softened at probing.
- At probing painfulness at enamel-dentine border are defined.
- A vertical and horizontal percussion and palpation of mucosa in range of apexes' projection of tooth root is painless.
- At thermo diagnostic: inappreciable short-time painful sensitivity. EOD: 2 -12 mkA.

The acute deep caries

At this caries following zones are allocated :

1) Disintegration and demineralization of enamel and dentin (both layers);

2) The thin zone of an intact dentine (sometimes is absent);

3) Changes in a pulp. In the third zone take place: quantity reduction of odontoblasts, their disorientation and fatty dystrophic.

At a light microscopy at a deep caries the changes in vessels of a pulp externally similar to the basic inflammation are defined.

The degenerative changes in some nervous fibers of a pulp, even to complete disintegration of their axial cylinder are visible.

Clinic of acute deep caries

- **Complaints:** on a short-term pain from mechanical (as a result of entering and hold of firm particles of food which create pressure upon a bottom of caries cavity), chemical and temperature irritans, get in and hold (fix) of food, cosmetic defect (at defeats of frontal teeth). **The disease anamnesis:** a causal tooth earlier was not treated, complaints have appeared about 2-4 months ago.
- At survey: the deep cavity with the rests of food is found out. Dentine of a bottom and walls is softened, weak pigmented. The entrance aperture narrow with hanging edges of enamel.
- Probing of bottom of caries cavity is poorly painful (sensitive). In some cases there can be characteristic signs for a pulpitis: aching pain in a tooth in case hold of food, sensation of discomfort in a tooth.
- Vertical and horizontal percussion and palpation of mucosa in the field of apex's projection of tooth root are painless.
- Thermodiagnostics can cause considerable, but short-term painful reaction. EOD: 10-12 мкА.

The chronic deep caries

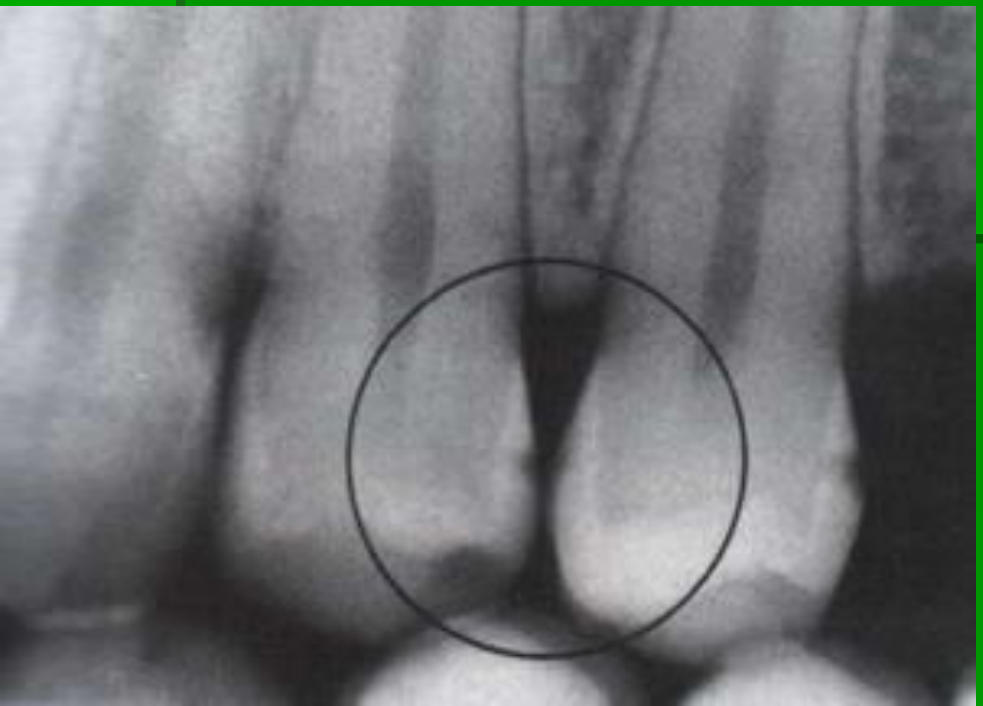
Difference:

- Absence of painful sensitivity from mechanical irritants;
- Long current;
- Wide entrance aperture with out hanging edges of enamel;
- Dentine of a bottom and walls of caries cavity is dense and pigmented;
- Painless probing.

Additional method of diagnostics of a caries

X-ray diagnostics

Intraoral contact roentgenography



Concealed caries cavities

Additional method of diagnostics of a caries

The caries-marking


Thanks' for attention!