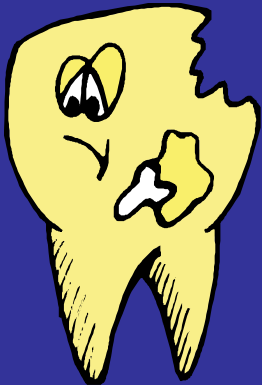


Histopathology of Dental Caries

Dr. Md. Nurul Islam

Ext. 3779

mnislam@kb.usm.my



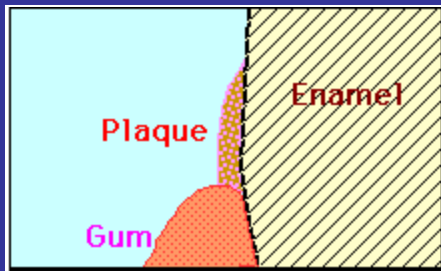
- ▶ Dental caries or tooth decay is one of the most common of all disorders, second only to common cold.
- ▶ Dental caries has afflicted more humans longer than any other disease. It was first appeared about 14000 years ago. From that time to the present, dental caries affected almost all human populations, at all socioeconomic levels, and at all ages.
- ▶ The first study about dental caries was published in 1870 and has continued uninterrupted to the present.
- ▶ Ever year \$20 billion is spent in USA for prevention of dental caries.
- ▶ Some isolated populations like Eskimos, some African natives, and inhabitants of rural India are “immune” to dental caries because they are not exposed to western food habits.
- ▶ The word 'caries' is derived from the Latin word 'rot'.
- ▶ In 1982 Dr. Louw calculated that it would take 470 dentists, working all year long , to restore the carious lesions in 12-year old 'colored' children in South Africa.

- It is the most prevalent disease affecting the human race,
- Practically spread all over the world,
- Affects both sexes and all races, all socio-economic strata and people of all ages,
- Starts soon after teeth erupt into the oral cavity
- It is a paradox that teeth are the hardest tissue in the body but can be easily destroyed relatively rapidly in vivo.

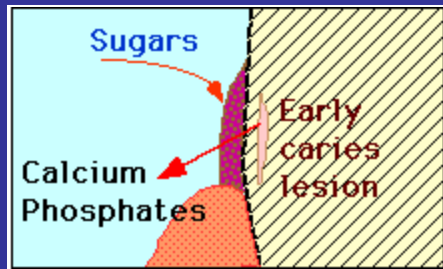
What is Dental Caries?

It is a microbial disease of the calcified tissues of the teeth, characterized by demineralization of the inorganic portion and destruction of the organic substance of the tooth.

Many researches/investigations for more than a hundred years have been done, still, many aspects of the etiology of this disease is obscure and efforts at prevention are only partly successful.

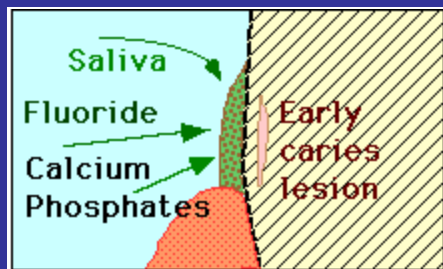


A detail of a tooth (to the right = enamel). It is covered by plaque, which consists mainly of bacteria. Plaque is often found close to the gum, in between teeth, in fissures and at other "hidden" sites.



Demineralization:

When sugar and other fermentable carbohydrates reaches the bacteria, they form acids which start to dissolve the enamel - an early caries lesion occurs due to loss of Calcium and Phosphates



Remineralization:

When sugar consumption has ceased, saliva can wash away sugars and buffer the acids. Calcium and Phosphates can again enter the tooth. The process is strongly facilitated by fluorides

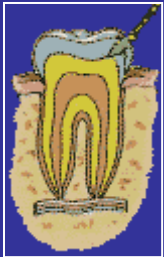
A **CAVITY** occurs if the Demineralization "wins" over the Remineralization over time



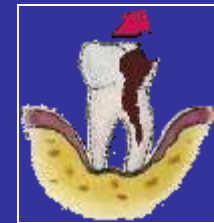
The first indication of tooth decay are white spots on the enamel caused by the loss of calcium.



The bacteria may also produce an abscess,



If the demineralization process outruns the natural remineralisation process, the lesion grows and a cavity is formed.

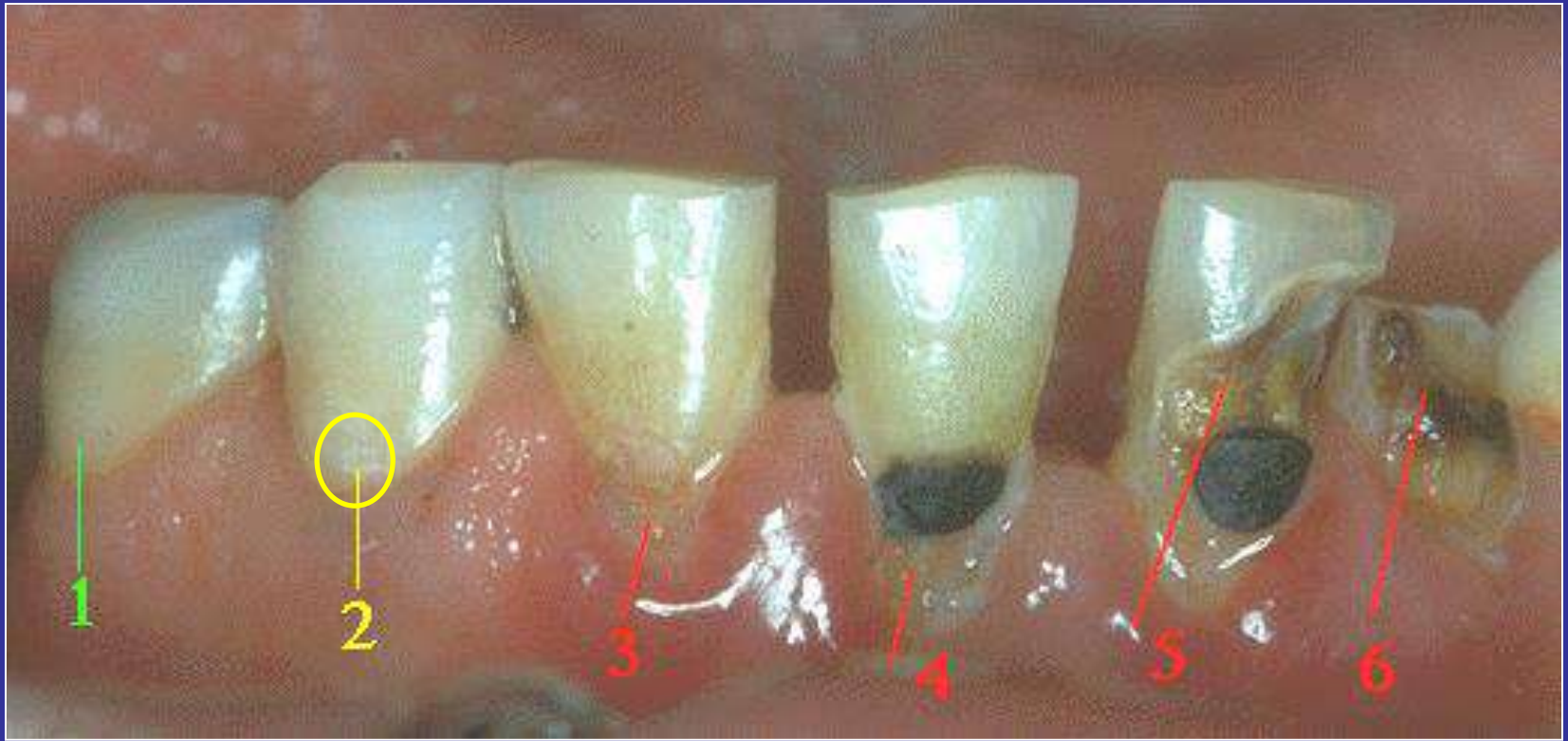


The bacteria may invade the pulp of the tooth,

and eventually the tooth may be extracted by the dentist.



causing a consistent tooth pain, especially during the night.



1. A tooth surface without caries.
2. The first signs of demineralization.
3. The enamel surface has broken down.
4. A filling has been made but the demineralization has not been stopped.
5. The demineralization proceeds and undermines the tooth.
6. The tooth has fractured.

Terminology

Primary Caries: lesions on unrestored tooth surface.

Secondary (recurrent) caries: lesions that developed adjacent to a filling.

Residual caries: demineralized tissue that has been left behind before a filling is placed.

Active caries lesion: a progressive carious lesion.

Arrested (inactive) carious lesion: A lesion that may have formed years previously and then stopped further progression.

White spot caries: the first sign of a caries lesion on enamel that can be detected with the naked eye. Also known as **initial** or **incipient** caries.

Rampant caries: is the name given to multiple active carious lesions occurring in the same patient. This frequently involves surfaces of teeth that do not usually experience dental caries eg, bottle or nursing caries, baby caries, radiation caries, or drug-induced caries.

Dental Caries

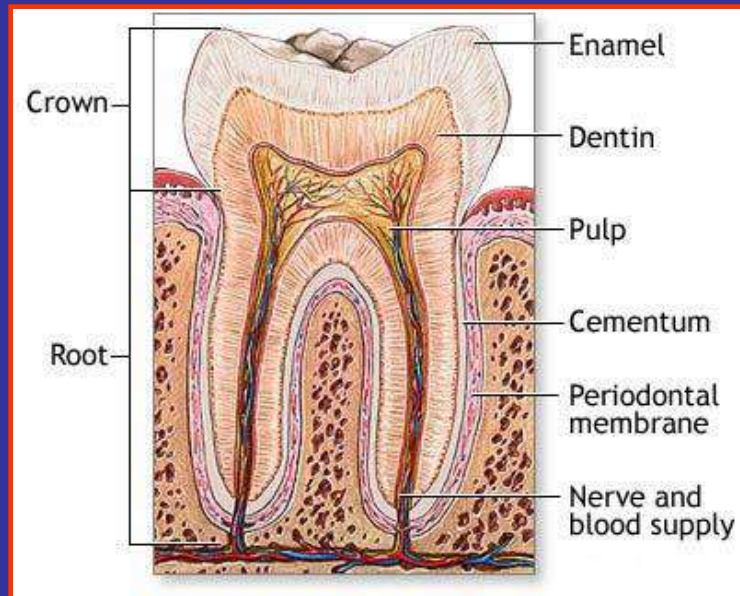
Enamel Caries

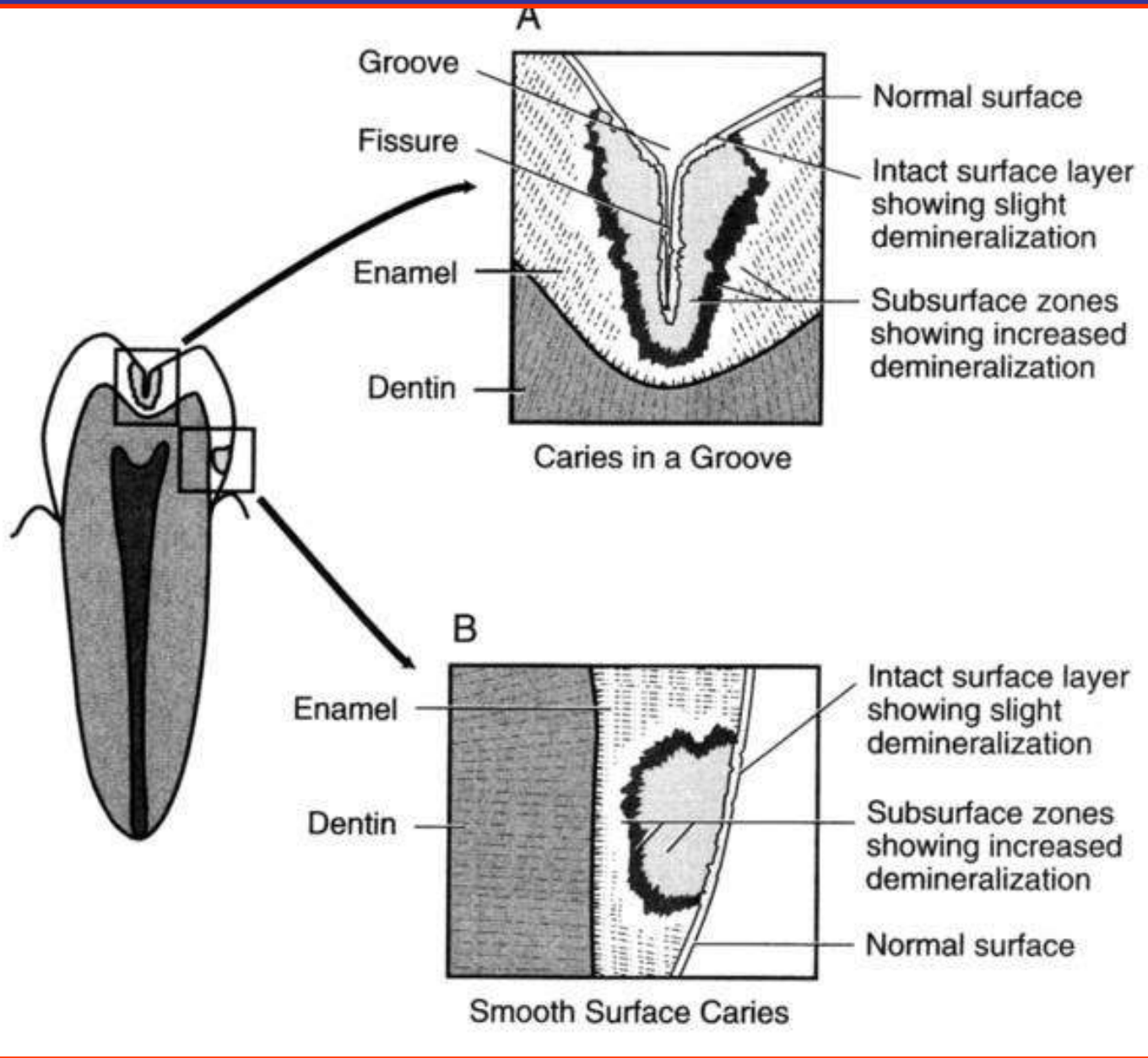
Dentin Caries

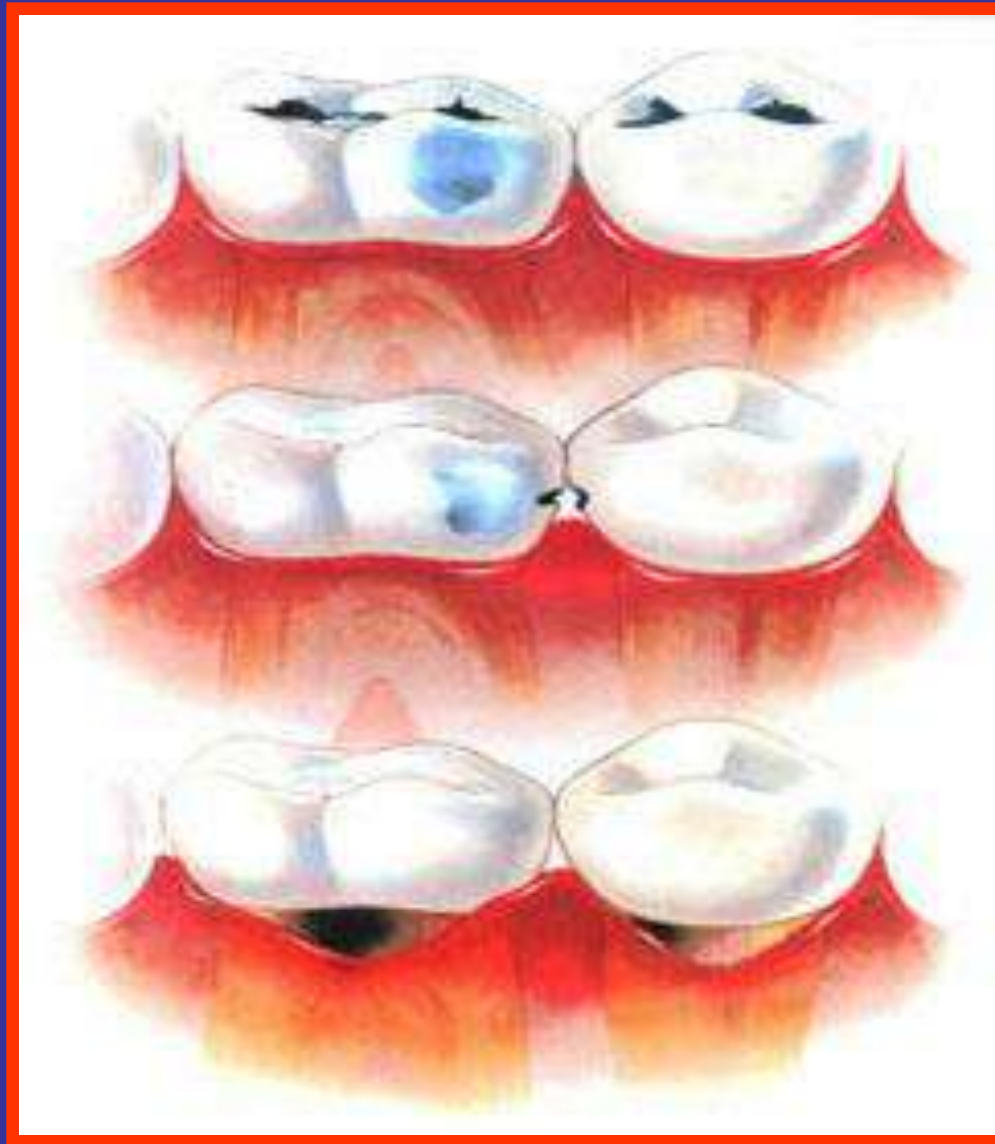
Cementum Caries
(Root caries)

Smooth surface caries

Pit and fissure caries







CARIES OF ENAMEL

Smooth surface Caries:

Due to plaque formation on enamel. The earliest manifestation of incipient caries (early caries) of enamel is usually seen beneath dental plaque as areas of decalcification (white spots).

The first change seen histologically is the loss of inter-rod substance of enamel with increased prominence of the rods.

- this is followed by the loss of mucopolysaccharides in the organic substance.

- presence of transverse striations of the enamel rods,

- accentuated incremental lines of Retzius

as it goes deeper, the caries forms a triangular pattern or cone shaped lesion with the apex towards DEJ and base towards the tooth surface. Finally there is loss of enamel structure, which gets roughened due to demineralization, and disintegration of enamel prisms.



Dr. Md. Nurul Islam



Enamel

**Subsurface
cariou lesion**

Striae of Retzius

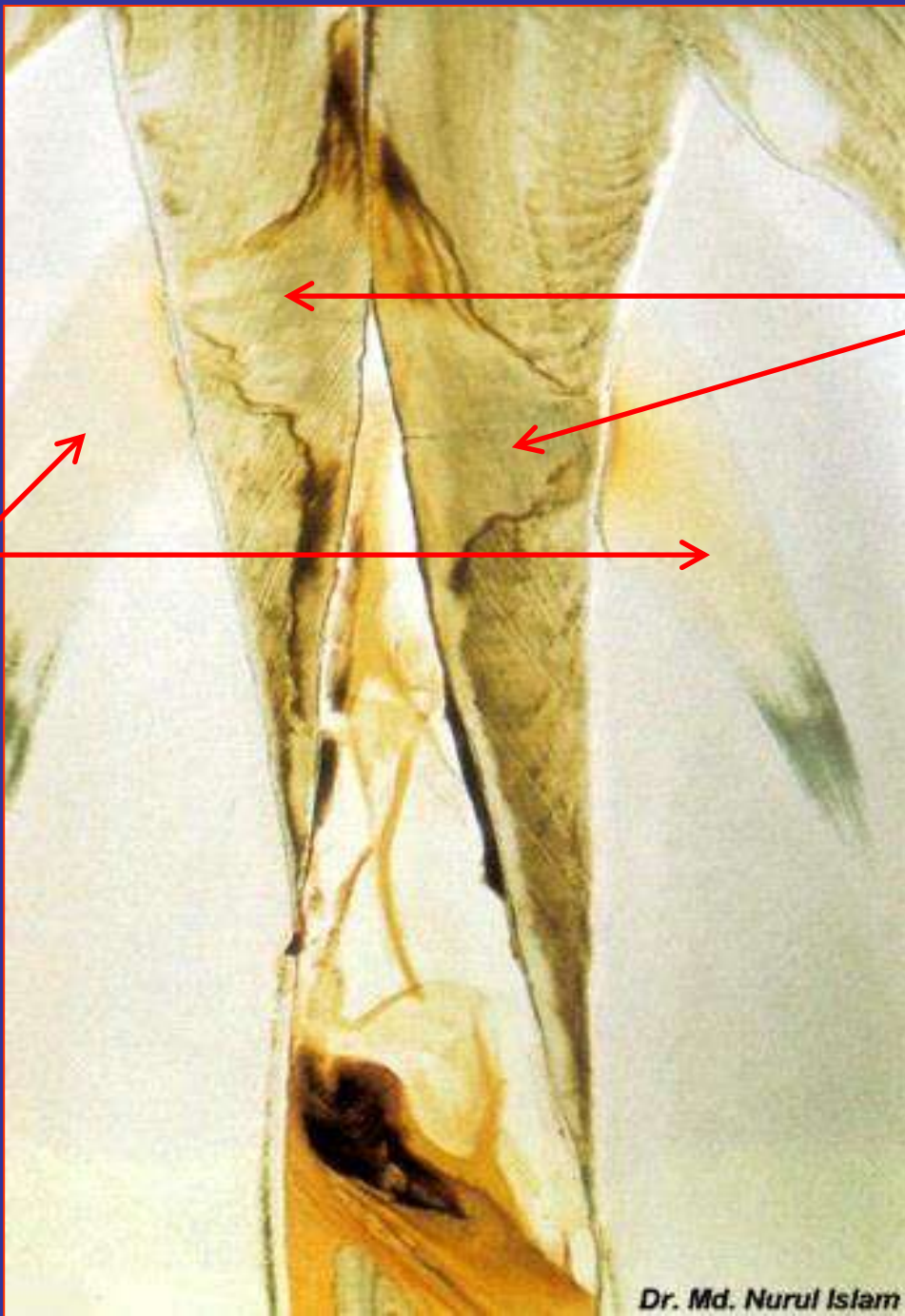


100 μ m

Dr. Md. Nurul Islam

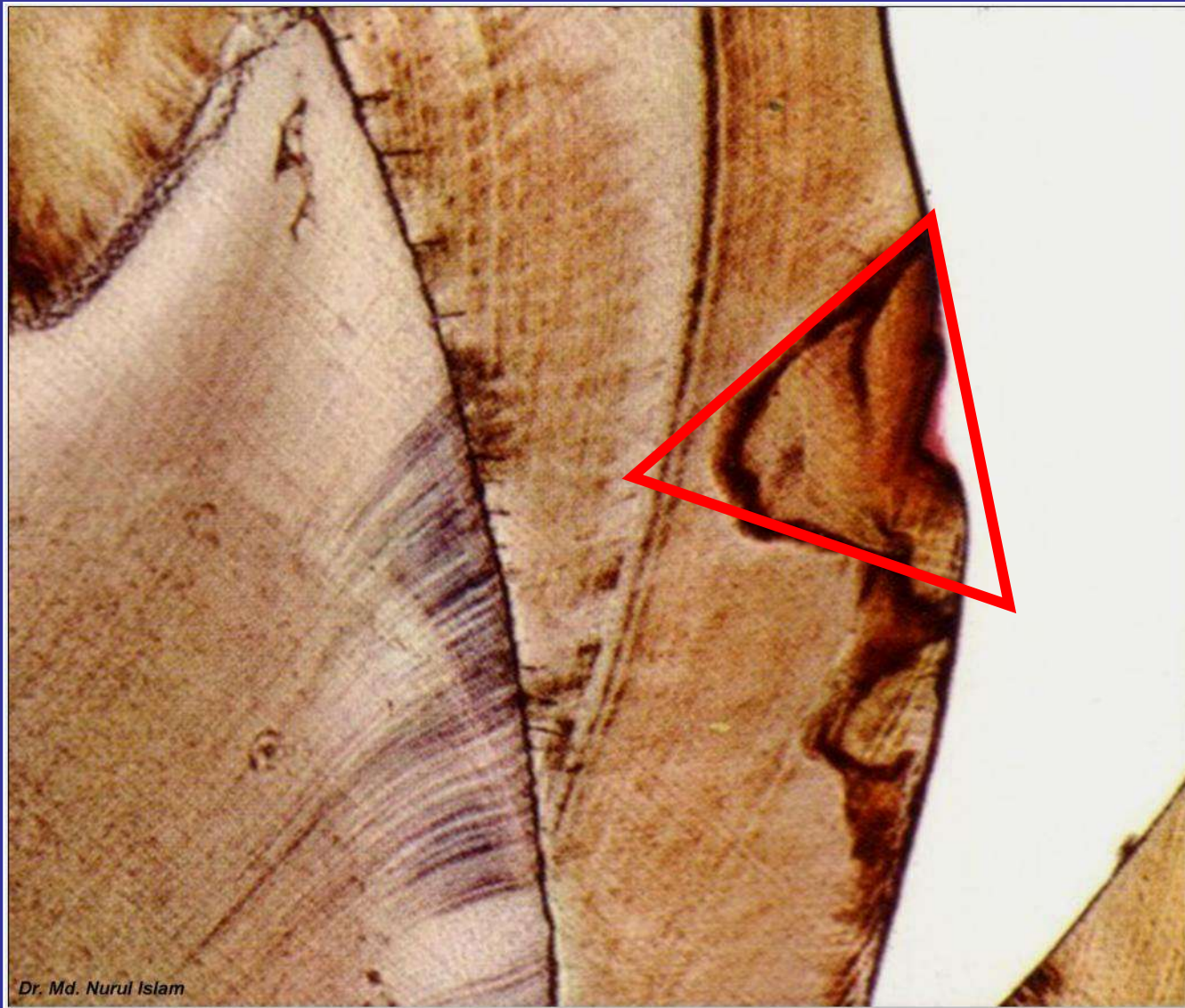


Dr. Md. Nurul Islam



Carious lesion

Dentin reaction to caries



Dr. Md. Nurul Islam

The zones seen before complete disintegration of enamel are:

Zone 1: Translucent zone,

- lies at the advancing front of the lesion,
- slightly more porous than sound enamel,
- it is not always present

Zone 2: Dark zone,

- this zone is usually present and referred to as positive zone
- formed due to demineralization.

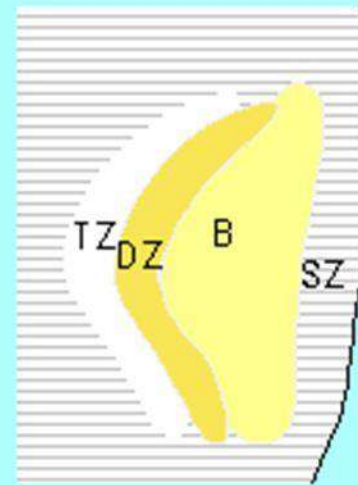
Zone 3: Body of the lesion,

- found between the surface and the dark zone,
- it is the area of greatest demineralization,

Zone 4: Surface zone,

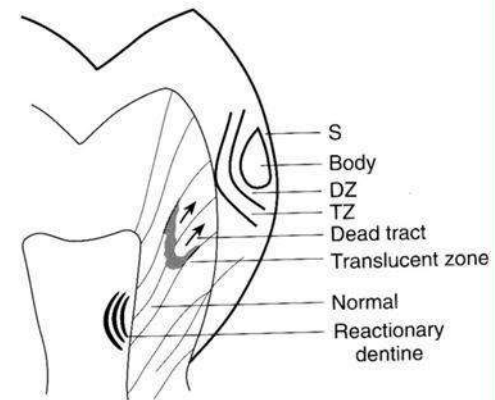
- relatively unaffected area,
- greater resistance probably due to greater degree of mineralization and greater F concentration.

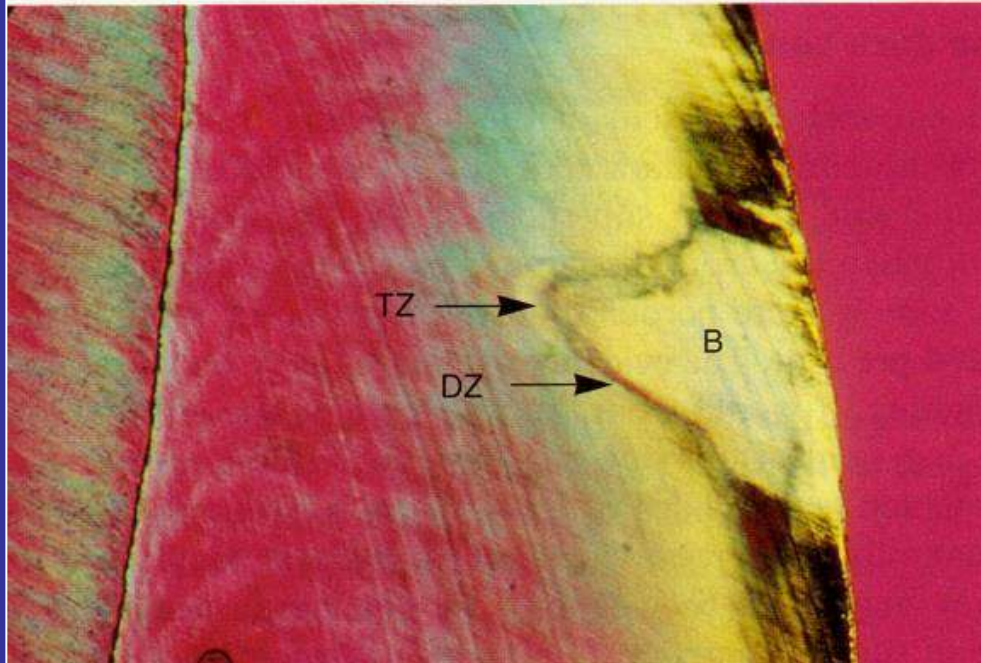
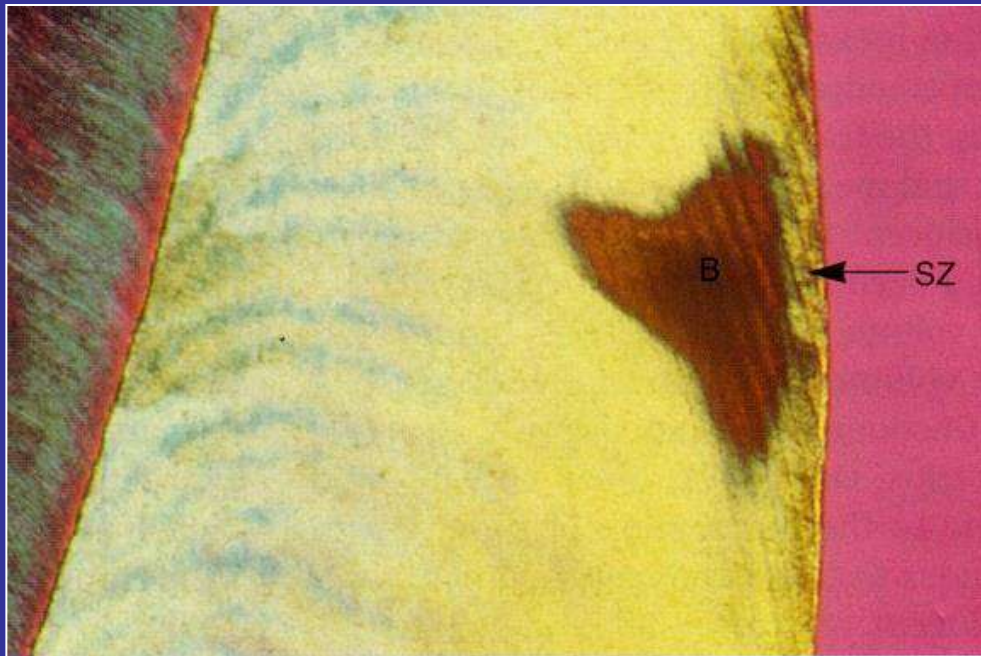
Dr. Md. Nurul Islam



SZ: Surface zone
B: Body of lesion
DZ: Dark Zone
TZ: Translucent zone

Dr. Md. Nurul Islam







Dr. Md. Nurul Islam

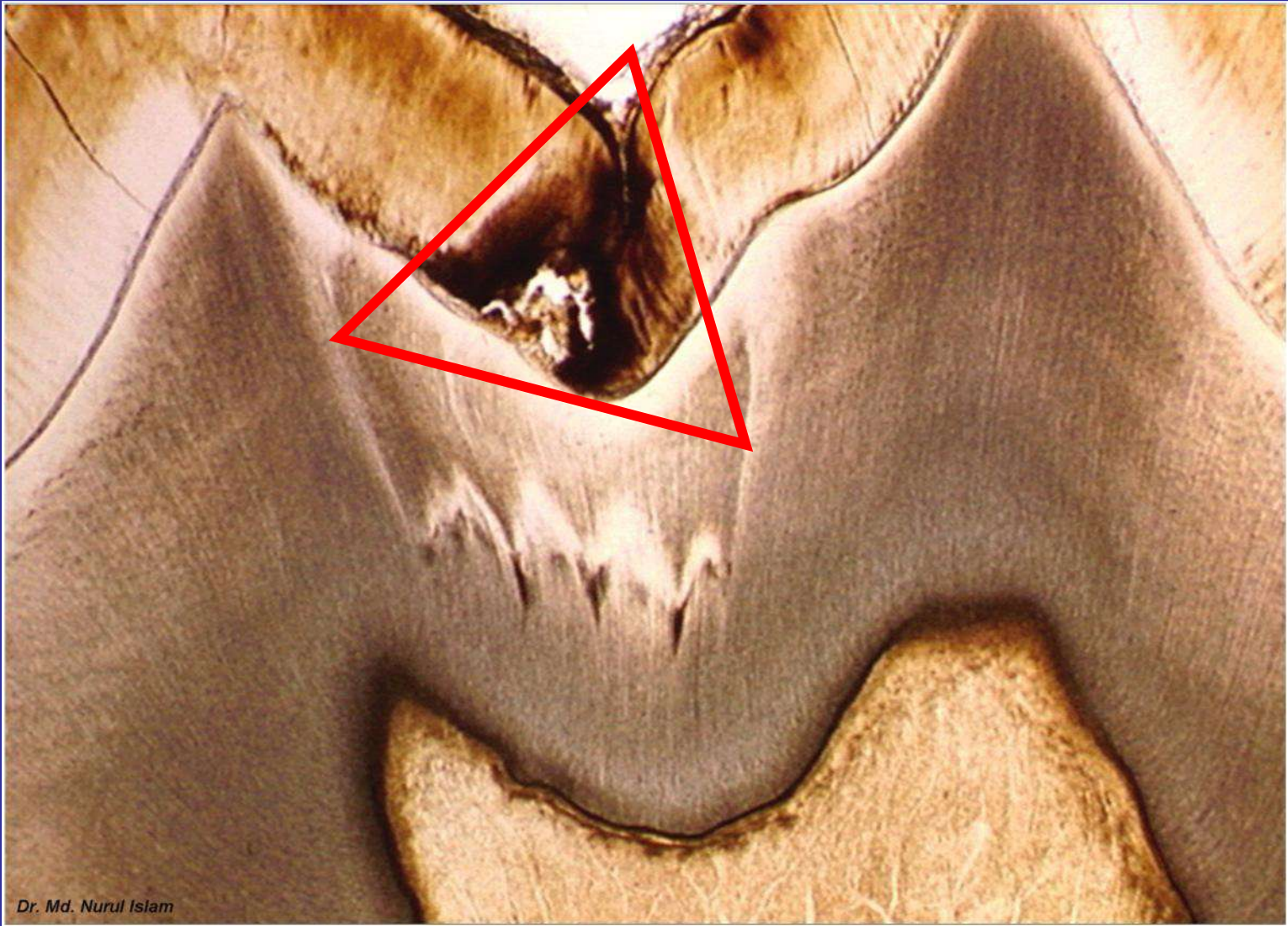
Dr. Md. Nurul Islam



Pit And Fissure Caries:

- lesion begins beneath plaque, with decalcification of enamel
- pit and fissures are often deep, with food stagnation,
- enamel in the bottom of pit or fissure is very thin, so early dentin involvement frequently occurs.
- here the caries follows the direction of the enamel rods.
- It is triangular in shape with the apex facing the surface of tooth and the base towards the DEJ.
- when reaches DEJ, greater number of dentinal tubules are involved.
- it produces greater cavitation than the smooth surface caries and there is more undermining of enamel.





Dr. Md. Nurul Islam



Dr. Md. Nurul Islam





CARIES OF DENTIN

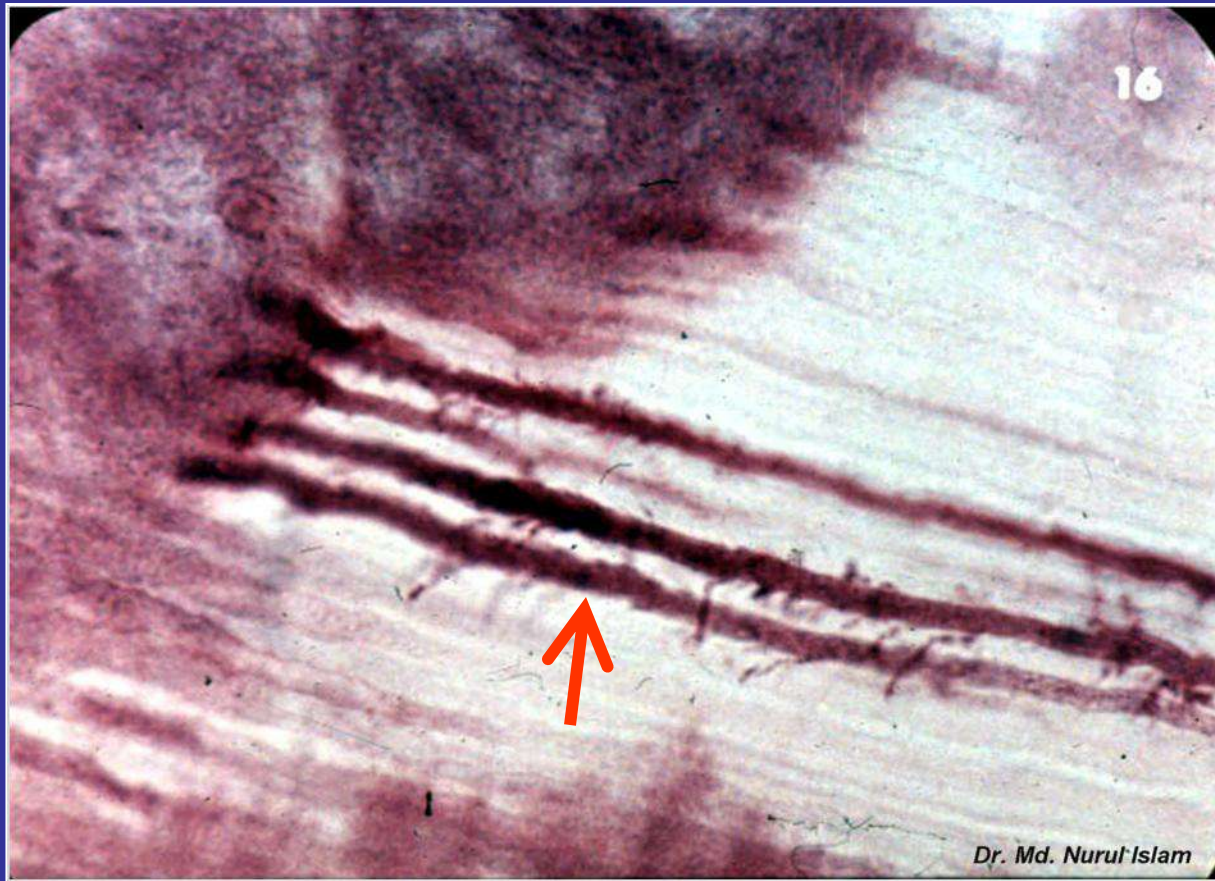
Begins with the natural spread of the process along the DEJ and rapid involvement of the dentinal tubules. The dentinal tubules act as tracts leading to the pulp (path for micro-organisms).

Early Dentinal Changes:

- initial penetration of the dentin by caries → dentinal sclerosis,
- calcification of dentinal tubules and sealing off from further penetration by micro-organisms,
- more prominent in slow chronic caries.



Behind the transparent sclerotic zone, decalcification of dentin appears. In the earliest stages, when only few tubules are involved, microorganisms may be found penetrating the tubules → Pioneer Bacteria.



This initial decalcification involves the walls allowing them to distend as the tubules are packed with microorganisms. Each tubule is seen to be packed with pure forms of bacteria, eg., one tubule packed with coccal forms the other tubule with bacilli.

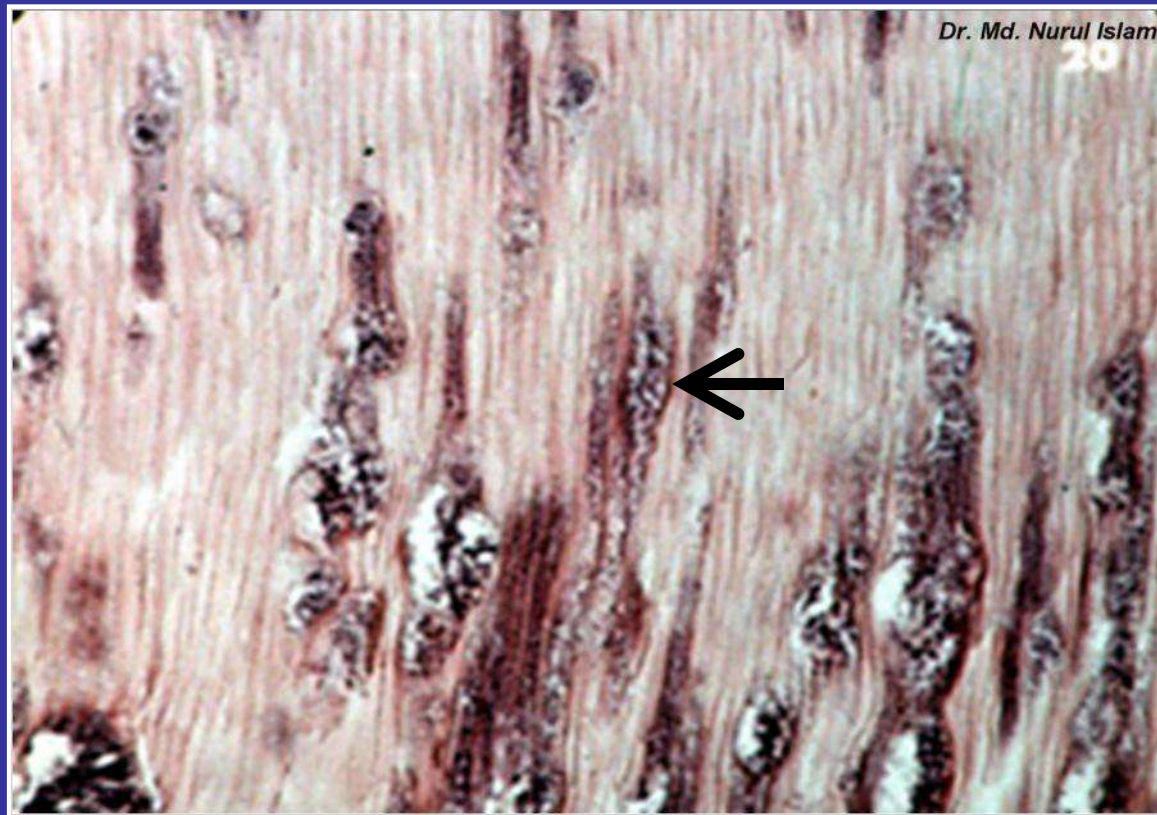


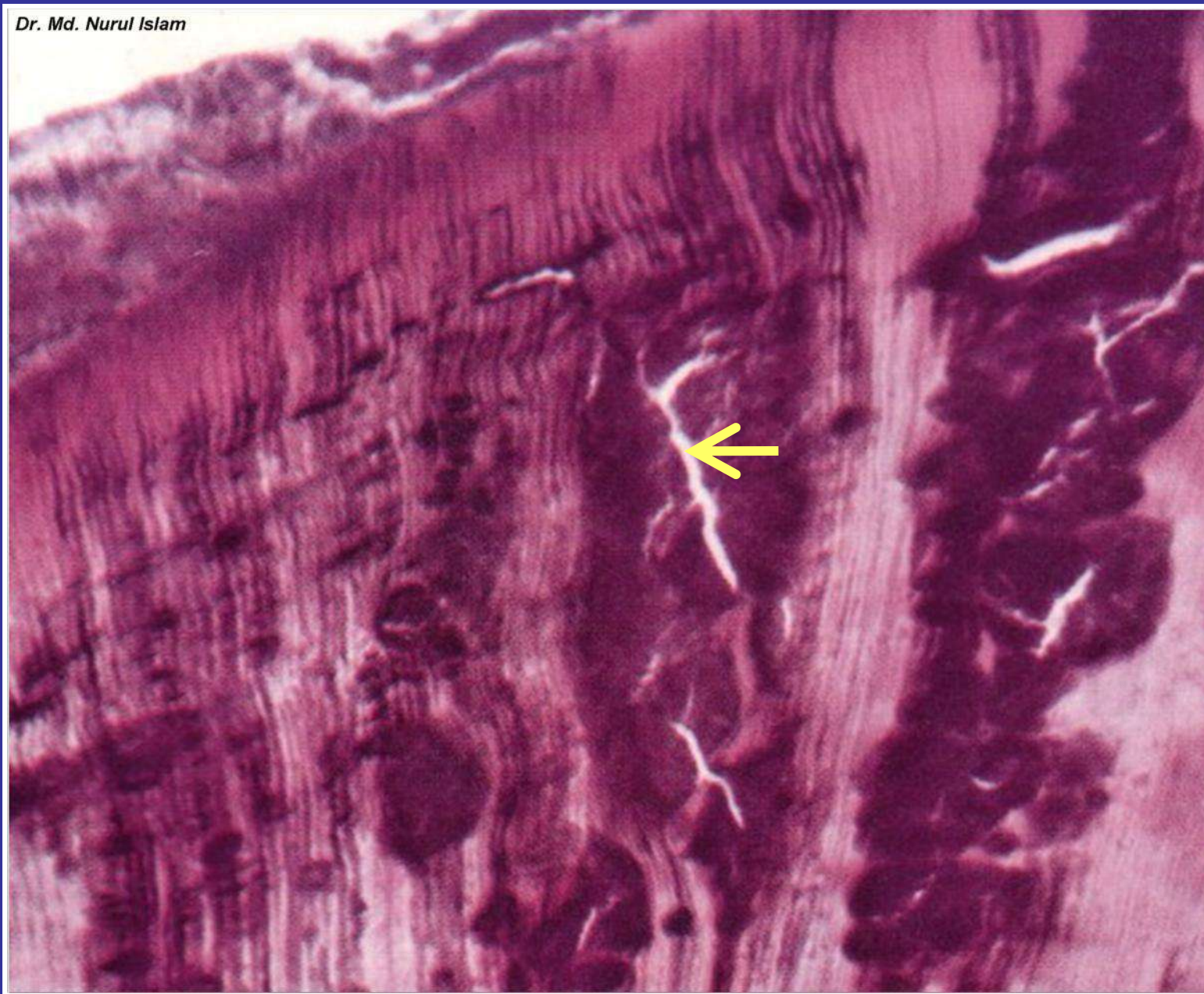
Dr. Md. Nurul Islam

As the microorganisms proceed further they are distanced from the carbohydrates substrate that was needed for the initiation of the caries. Thus the high protein content of dentin must favour the growth of the microorganisms. Therefore proteolytic organisms might appear to predominate in the deeper caries of dentin while acidophilic forms are more prominent in early caries.

Advanced Dentinal Changes :

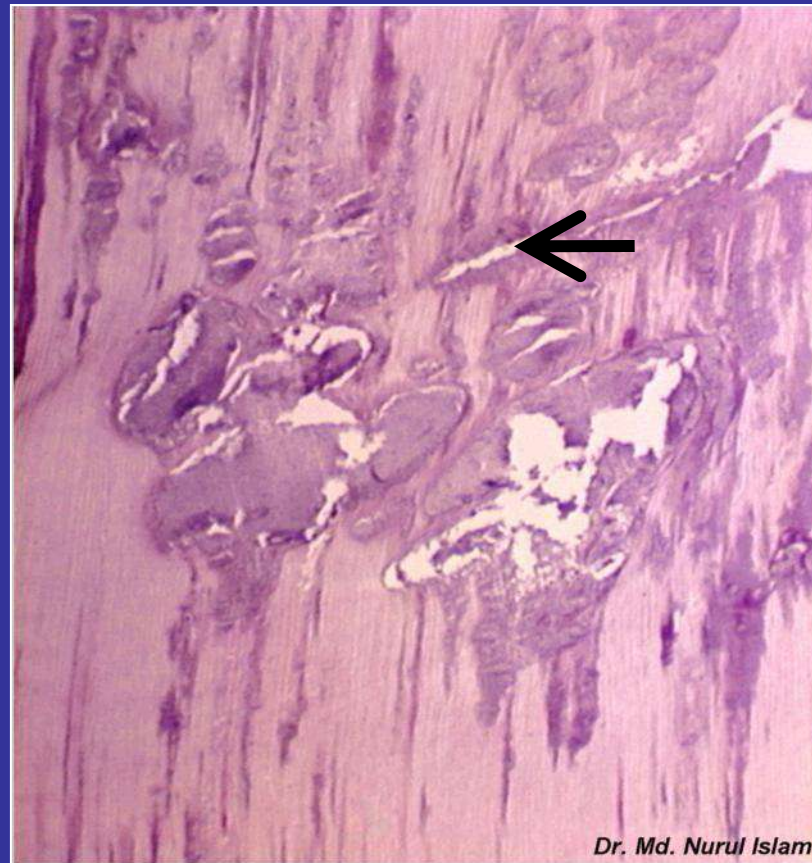
-decalcification of walls, confluence of the dentinal tubules,
-tiny "liquefaction foci", described by Miller are formed by the focal coalescing and breakdown of dentinal tubules. These are ovoid areas of destruction parallel to the course of the tubules which filled with necrotic debris and increase in size by expanding. The adjacent tubules are distorted and their course is bent due to this expansion.

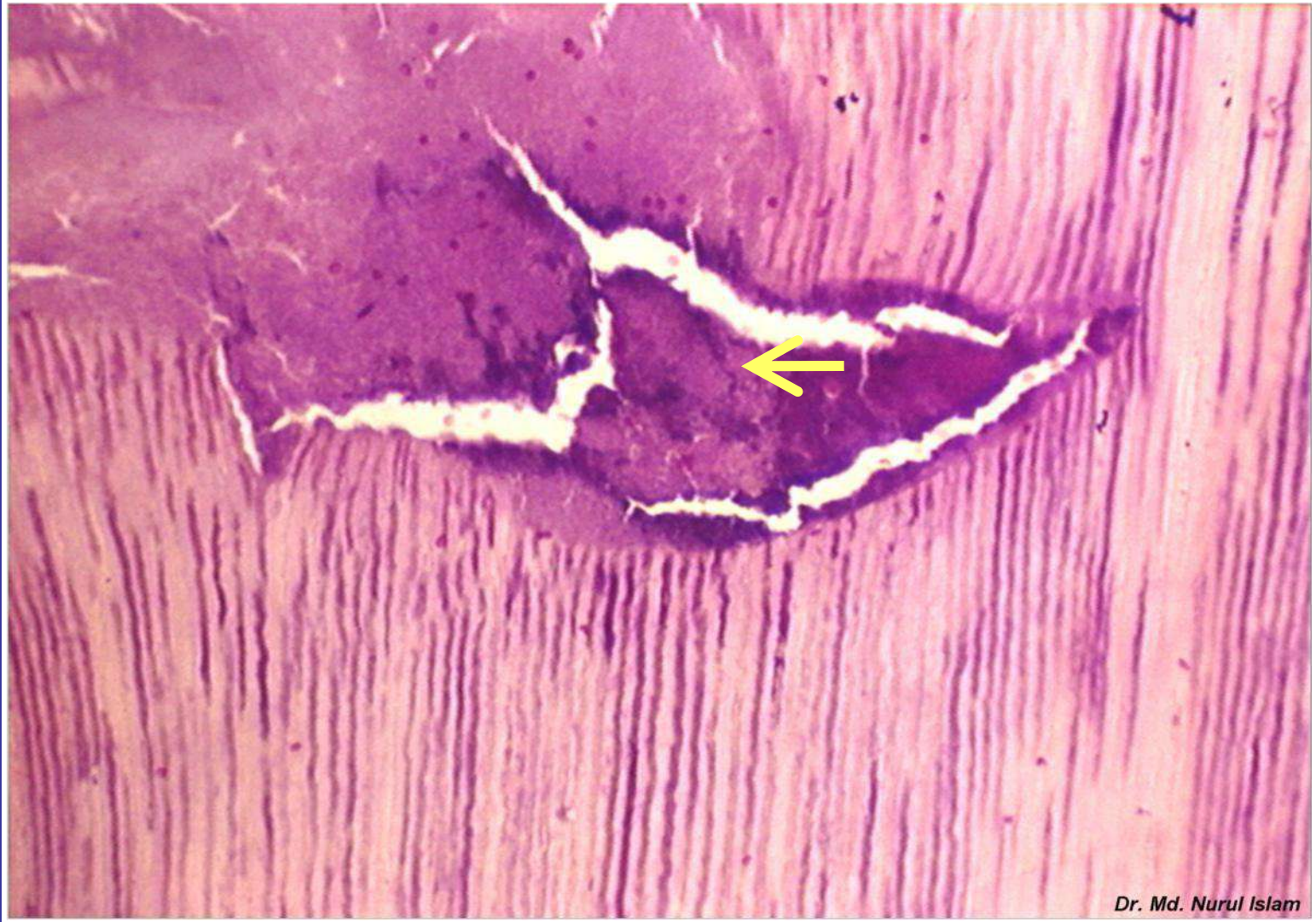




The destruction of dentin by decalcification and then proteolysis occurs in numerous focal areas- leading to a necrotic mass of dentin of a leathery consistency.

-clefts present in the carious dentin that extends at right angles to the dentinal tubules, accounts for the peeling off of dentin in layers while excavating.





Dr. Md. Nurul Islam



Dr. Md. Nurul Islam

Shape of the lesion is triangular with the apex towards the pulp and the base towards the enamel.

Zone 1; Zone of Fatty Degeneration of Tome's Fibers,(next to pulp)

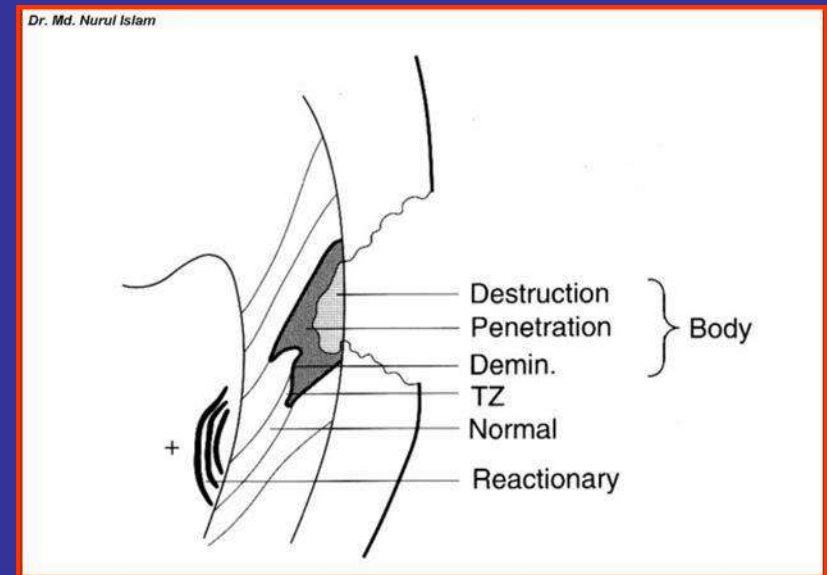
-due to degeneration of the odontoblastic process. This occurs before sclerotic dentin is formed and makes the tubules impermeable.

Zone 2; Zone of dentinal sclerosis,
-deposition of Ca salts in the tubules.

Zone 3; Zone of decalcification of dentin

Zone 4; Zone of bacterial invasion

Zone 5; Zone of decomposed dentin due to acids and enzymes.



Root Caries

Root caries as defined by HAZEN, is a soft, progressive lesion that is found anywhere on the root surface that has lost its connective tissue attachment and is exposed to the environment.

- the root surface must be exposed to the oral environment before caries can develop here.
- Plaque and micro-organisms are essential for the cause and progression of the lesion, mostly *Actinomyces*,
- micro-organisms invade the cementum either along the Sharpey's fibers or between the bundles of fibers.
- spread laterally, since cementum is formed in concentric layers.
- after decalcification of cementum, destruction of matrix occurs similar to dentin with ultimate softening and destruction of this tissue.
- invasion of micro-organisms into the dentinal tubules, finally leading to pulp involvement.
- the rate is slower due to fewer dentinal tubules than crown area

Dental Caries

The Disease and its Clinical Management



Edited by
Ole Fejerskov and Edwina Kidd


Blackwell
Munksgaard