Histopathology of The Developing Caries Lesion

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Etiology of Caries Lesion

Causative Factors
- Presence of caries pathogens (MS, LB)
- Frequent or prolonged exposure to fermentable carbohydrates

Potentiating Factors
- Low fluoride exposure level
- Inadequate salivary flow

Smooth Surface Caries

SUBCLINICAL
- Colonization
- Eradication
- Suppression
- Remineralization

CLINICAL

Gram stained plaque on enamel surface
(± coci, ± filamentous, scattered - forms)
Lesion Initiation

- MS present in low numbers in plaque (carrier state)
- Frequent sugar supply gives MS competitive advantage
- ECP helps adhere them firmly to tooth surface
- Metabolism of sugar to acid byproducts lowers pH
- Few organisms can survive in low pH (aciduric)
- MS proportions increase
- This lowers the pH further and decreases the number of competing organisms
- Once the pH low enough (critical pH, 5.0-5.5) tooth mineral begins dissolving
- Mineral loss follows down the grain of the enamel rods

incipient caries lesion

visible as white spot
not visible on radiographs

incipient caries lesion at contact area
**Demin/Remin Cycling**

- Saliva dilutes & buffers acid & contains concentrated calcium & phosphate ions
- When sugar present, net demineralization rapidly occurs
- Between sugar episodes, remineralization slowly occurs
- If remin periods exceed demin periods, subsurface lesion will mineralize & arrest
- If demin periods exceed remin periods, cavitation will occur
- Demin periods exceed remin periods when sugar is frequent or prolonged

**Stephan Curve** (pH at plaque-tooth interface by time after sugar)

- A. rapid pH drop indicates sugar instantaneously converted to acids—overwhelming salivary buffers
- B. persistence of low pH (plateau) due to catabolism of ICP—can be >60 minutes
- C. gradual return to resting pH due to diffusion, dilution, & buffering of acid

**Mineral loss follows down the grain of the enamel rods**

Leads to characteristic cone shape pointing at dentin

MS too small to be removed by brushing & flossing

For this reason, debriding procedures alone will not prevent decay
• Translucent zone: advancing lesion front, large pores
• Dark zone: small & large pores, small pores may be remineralizing large pores
• Body of the lesion: enough mineral loss to be visible radiographically
• Intact surface zone: F catalyzed precipitation of Ca & PO4 from subsurface dissolution & saliva

Slowly progressing lesions go through more demin/remin cycles leading to dark shallow lesions

Rapidly progressing lesions go through fewer demin/remin cycles leading to lighter-colored, more aggressive lesions
Dentinal Lesion

- decay progresses slowly through enamel & quickly through dentin
- enamel is 99% mineral, whereas dentin is a living tissue with 30% organic content
- salivary buffers are more potent at the enamel surface than deeper in the dentin
- dentinal lesion is more isolated from the diluting effects of the saliva
- in dentinal lesion low pH is more steady
- this selects more strongly for aciduric organisms (LB)
- low pH demineralizes dentin & denatures collagen (gelatin)
- proteolytic organisms increase in prominence

decomposed dentin
decalcified dentin
bacteria in tubules
sclerosed dentin
dead tracts
visible on PBWs as E2 lesion
bacteria begin to spread laterally from the dentinal tubules

invasion and destruction of dentin is not uniform
demineralization of matrix occurs unevenly

infected tubule with localized destruction of surrounding interactubular matrix forming micro-cavities

transverse clefts open up perpendicular to dentin tubules
probably following incremental growth lines & fill with breakdown products & bacteria

macroscopically dentin becomes leathery pieces are easily peeled away by an explorer

increasing proteolytic bacteria activity tears the demineralized matrix apart

until finally only traces of recognizable dentin tissue remain

extensive areas of tissue breakdown form

saprophytic micro-organisms help complete destruction
4) surface zone of decomposed dentin
3) decalcified matrix with bacteria in tubules
2) zone of sclerotic dentin where mineral fills tubules & optical distinction between tubules & matrix lost
1) dead tracts: tubules containing degenerating odontoblastic processes

the pulp responds as soon as the lesion enters the dentin

DEJ is weak point exploited by pathogens
destruction spreads laterally at DEJ
this effectively uncouples the enamel and dentin
breakdown in surface integrity linked to lesion reaching DEJ

enamel becomes brittle when decoupled from dentin
lateral spread of lesion at DEJ leads to unsupported enamel peripheral to cavity
this is why a prepared cavity should contain no stain at DEJ

cavitated lesion at contact area
the pulp responds as soon as the lesion enters the dentin
secondary dentin forms beneath affected tubules

dentin caries lesion
secondary dentin
dead tracts
decomposed dentin
note peeling surface

oral cavity
ground section
clinical cavity

pulp

ground section
advanced caries lesion
bacteria penetrated full thickness of dentin & into tubules of secondary dentin

X13

primary dentin
secondary (reparative) dentin

Pit & Fissure Caries

stained material in fissure lumen must be differentiated from dental caries

enamel
plaque
fissure
dentin

stained fissures
where in the fissure

does the caries lesion

begin?

incipient fissure caries is not clinically
detectable

the fissure brings surface of tooth closer to DEJ

it does not take long for the lesion
to reach dentin

because of enamel rod direction, lesion develops
cone shape pointing toward surface of tooth

salivary buffers &
dilution protective

active plaque
acid production

sugars do not diffuse
this far through
fissure plug

THE “STICK” OR “CATCH”
on contact with dentin lesion spreads laterally, undermining adjacent enamel
ground section
cavitated fissure caries lesion
softened unsupported enamel caves in forming cavitated caries lesion

note narrow cavity orifice this is often the first clinically detectable stage of fissure caries
ground section
cavitated fissure caries lesion
carious dentin sound dentin
cavitated lesion in fissure

ENAMEL
DENTIN

caries spreads laterally at DEJ
shadow transmitted through translucent enamel
cavitated lesion in pit

“Caries Removal”
Carious Dentin Removal Exercise
Objectives

- identify carious and sound tooth tissue
- remove infected tooth tissue
- establish sound dentoenamel junction
- develop surgical precision in what amount of caries affected tissue must be removed and what should be allowed to remain

Surgical removal of infected dentin

Accepted Terminology

- excavating carious dentin
- removing carious dentin

Jargon

- chasing caries
- removing caries
- “caries removal”

HUMAN TISSUE BIOHAZARD

- FACE MASK
- SAFETY GLASSES
- SURGICAL GLOVES
- SAFEGUARD AGAINST SKIN PUNCTURE OR LACERATION
- DISPOSE OF TEETH IN BIOHAZARD CONTAINER

CHOOSE THE LARGEST CARIES LESION YOU CAN FIND INCIPIENT LESIONS WILL NOT DO

HAVE BENCH INSTRUCTOR APPROVE CHOICE

Mount

In

Small

Amount

Of

Plaster

To

Simplify

Handling

#245 bur highspeed light touch
• In health, enamel is firmly attached to the underlying dentin
• Unsupported enamel is not backed up by dentin
• It hangs out from the perimeter of the cavity and is easily chipped away

Unsupported enamel:
- Demineralized enamel: opaque, soft, chalky
- Carious dentin: soft, mushy, gummy, leathery, tacky
- Stained DEJ
- Sound DEJ
largest round bur
lowspeed
light touch

remove carious dentin
down to sound dentin

carious dentin
soft, mushy,
gummy, leathery, tacky

remove carious dentin
down to sound dentin

carious dentin
soft, mushy,
gummy, leathery, tacky

remove carious dentin
down to sound dentin

sound dentin
hard, glass-like

remove carious dentin
peripherally first
adjacent to DEJ

establish sound dentin
in concentric pattern
excavating closest to pulp last
judging dentin soundness with explorer
1. use light pen grasp
2. gently move tip laterally
3. sense depress on tip
never poke tip into dentin

sound DEJ
sound dentin
sound DEJ
sound dentin

sound dentin is hard & glassy, not necessarily shiny or stain-free
last carious dentin removed is over pulp horn may be intentionally less thorough to prevent exposure

DEJ must be free of stain and unsupported enamel