Caries

car·ies  n. pl. caries

n. pl. caries

Pronunciation Key (kâr z)

• Decay of a bone or tooth, especially dental caries.

[Latin: caries.]

Multifactorial Disease

1. Tooth
2. Microflora
3. Diet

Caries formation requires biofilm (plaque), fermentable carbohydrates, and, of course, a tooth surface.

Prevalence

• In epidemiology, the prevalence of a disease in a statistical population is defined as
  – the total number of cases of a given disease in a specified population at a specified time and/or
  – the ratio of the number of cases of a disease present in a statistical population at a specified time and the number of individuals in the population at that specified time.

Source: www.wikipedia.org
Incidence

- **Incidence** is the number of new cases of a condition, symptom, death, or injury that arise during a specific period of time, such as a year. It is often expressed as a percentage of a population (e.g., 25% of American residents were diagnosed with the flu in 2002).
- **Incidence** conveys the likelihood that an individual in that population will be affected by the condition.


Caries Incidence in the News

- In general, caries has been decreasing in Western countries
- However, according to an article in *The New York Times*, caries has been increasing in the United States for poor and minority children
- Therefore, the interval between examinations must be individually based on several factors

What do we see on a radiograph? 🌼

- Radiographs are useful for caries detection because caries causes demineralization of the tooth structure
- Demineralized tooth structure attenuates the x-ray photons to a lesser extent than sound tooth structure
- A minimum of 60% demineralization must occur before the lesion can be seen on a film-based radiograph. Digital radiographs are in the 50-55% range.

What do we see on a radiograph? 🌼

- The demineralized area appears more radiolucent than healthy tooth structure
- The contrast between healthy tooth structure and caries allows us to detect the lesion

What do we see on a radiograph? 🌼

- Bitewing projections provide optimal visualization of proximal and occlusal caries in the posterior teeth
- Periapicals are appropriate for anterior proximal caries. Paralleling technique improves visibility of the lesion
- Occlusal caries can often be detected on panoramic projections
Which radiographs are best for caries detection?

• As always, aligning instruments are mandatory for optimal results!
• Since carious lesions often have low contrast with surrounding healthy tissue, optimal viewing conditions are imperative.

Which radiographs are best for caries detection?

• Optimal viewing conditions include:
  – Masking borders with a dark mount,
  – Bright, even illumination
  – Dim, indirect room light
• Bitewings should have proper contrast and clear, non-overlapped contacts between teeth

Diagram courtesy of UNC School of Dentistry

Which radiographs are best for caries detection?

Appropriate viewing conditions

Photo credit: Betty Huang '09
Which radiographs are best for caries detection?

Active versus Arrested caries

- From a single radiograph, it is not possible to determine whether or not a lesion is active.
- A follow-up radiograph may be able to determine that the lesion is active, or if the caries is arrested.
- Remineralized lesions may leave a scar, as the remineralized area remains near the surface of the tooth.

Active versus Arrested caries

- Factors to consider when determining bitewing interval for caries follow-up include:
  - Hygiene
  - Fluoridated water
  - Prior lesions
  - Existing restorations
  - Diet
  - Age of patient

Sensitivity and Specificity

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<tr>
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<td>Negative</td>
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<td>Total</td>
<td>TP +FN</td>
<td>FP + TN</td>
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Sensitivity and Specificity

As the size of the lesion gets smaller, it is more difficult to distinguish the lesion from healthy enamel. It is believed that 50% of all enamel lesions go undiagnosed.

Sensitivity and Specificity

Mileman PA, van der Weele, LT

PMID: 2205637 [PubMed - indexed for MEDLINE]
Mileman PA, van der Weele, LT
Accuracy in radiographic diagnosis: Dutch practitioners and dental caries.

“The pooled restorative treatment decisions of the dentists had a mean sensitivity of 62 per cent and a specificity of 96 per cent.”
Film Selection


• This study compares the diagnostic accuracy of caries detection using Ultra-speed (Eastman Kodak), Ektaspeed (Eastman Kodak) and Ektaspeed Plus (Eastman Kodak) films after they were developed in both new and used processing solutions. Ektaspeed Plus film provided significantly better diagnostic accuracy for small proximal-surface caries limited to the outer third of the dentin than did Ektaspeed film. Ektaspeed Plus film did not differ significantly from Ultra-speed film in aiding in the diagnosis of small carious lesions, and it maintained diagnostic accuracy in used processing solutions. Dentists can offer the X-ray dose-reducing technology of Ektaspeed Plus film to their patients and maintain consistently high diagnostic quality.

Detecting proximal surface lesions

• Triangular shape, with the broad base at the tooth surface
• Other shapes include:
  – Notch
  – Band
  – Dot
  – Thin line
Detecting proximal surface lesions

• Proximal lesions are generally located between the contact area and the gingival margin
• It is important to distinguish between caries and cervical burnout. Cervical burnout occurs between the bone height and the cemento-enamel junction

Detecting proximal surface lesions

• At the DEJ, the lesion broadens along the junction
• A second triangle is formed, with the apex toward the pulp
• The lesion progresses toward the pulp along the dentinal tubules

Detecting proximal surface lesions

Detecting proximal surface lesions
Detecting proximal surface lesions

Detecting proximal surface lesions

Detecting proximal surface lesions

Detecting proximal surface lesions

Detecting occlusal surface lesions

• Common in children and adolescents
• Starts in pits and fissures, which are often difficult to keep plaque-free
• Can often be detected visually as a discolored or chalky surface. These findings suggest follow-up with bitewings
• Mach band effect may produce false positives

Detecting occlusal surface lesions

• As the lesion progresses, there is a fine radiolucent line at the DEJ
• This line is obscured as the lesion progresses, causing false positives and needlessly restored teeth
• Therefore, the *sine qua non* for occlusal caries detection is a clinical examination followed up by radiographic confirmation
Detecting occlusal surface lesions

- The enamel portion of an occlusal lesion may not be seen on a radiograph
- The dentinal portion of the lesion is usually below a fissure
- The buccal pit or buccal pit caries may be superimposed and can be mistaken for occlusal caries. A clinical exam will help to differentiate.
Recurrent Caries

- Occurs on exposed root surfaces and, therefore, is associated with gingival recession
- Can be detected clinically
- Can be confused with cervical burnout
  - Cervical burnout extends from crestal bone to the CEJ
  - Caries will efface the proximal surface of the root and have more diffuse inner borders

Root Caries
Root Caries

Root Caries

Root Caries

Root Caries

Root Caries

Root Caries
Root Caries

False Positives
- Cervical Burnout
- Radiolucent Restorations
- Mach Band Effect

Cervical Burnout

Radiolucent Restorations

Radiolucent Restorations

Mach Band Effect
Mach Band Effect

• Where there is a sharply defined difference in density such as the dento-enamel junction, the dentin may appear more radiolucent as the DEJ is approached.
• This can contribute to a false positive reading and unnecessary restoration of sound tooth structure.

Alternative Methods of Caries Detection

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<td>Enhanced visual examination</td>
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Logicon Caries Detector


“Caries detector software enabled dentists to find 20 percent more cases of caries penetrating into dentin than they were able to find without it.”

Figure 1. Diagnostic output 1 from Logicon Caries Detector (Northrop Grumman Information Technology, Herndon, Va.): tooth image showing selected analysis contours and radiolucency site. DEJ: Dentinoenamel junction. Reproduced with permission of Northrop Grumman Information Technology.

Figure 2. Diagnostic output 2 from Logicon Caries Detector (Northrop Grumman Information Technology, Herndon, Va.): tooth density change through enamel and into dentin, with radiolucency center highlighted. Reproduced with permission of Northrop Grumman Information Technology.
Transillumination

Diagnodent

Diagnodent

The Take Home Message

- Caries detection on radiographs is a difficult task
- Requires attention in all phases from film selection through viewing
- Despite our best efforts, some lesions will go undetected, while some healthy tooth structure will be needlessly restored

The Raven

First published in 1845

'Be that word our sign of parting, bird or fiend!' I shrieked upstarting -
'Get thee back into the tempest and the Night's Plutonian shore!
Leave no black plume as a token of that lie thy soul hath spoken!
Leave my loneliness unbroken! - quit the bust above my door!
Take thy beak from out my heart, and take thy form from off my door!'
Quoth the raven, 'Nevermore.'