Current Concepts in Caries Management
Diagnostic, Treatment and Ethical/Medico-Legal Considerations

Radiographic Caries Diagnosis

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November 4, 2011
Past: Caries Detection ➔ Restore

Present: Caries Detection / Caries Activity / Risk Assessment ➔ Manage
Caries Detection

- Location
- Size
- Depth
- Cavitation

Caries Activity/Risk

- Etiologic Factors
  - Hygiene
  - Microbiology
  - Fluoride Use
  - Diet
  - Socioeconomic Factors
    - Income
    - Education
Caries Initiation and Progression

- Initiation = 6.1 months (median)
- Progression to Dentin = 77.7 months (median)

# Diagnostic Performance

**Sensitivity:** The ability of a diagnostic test to accurately identify disease

\[
\frac{A}{A + C}
\]

Perfect Sensitivity = 1.0

<table>
<thead>
<tr>
<th>Caries Present</th>
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<td></td>
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<td>C (False -)</td>
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Diagnostic Performance

Specificity: The ability of a diagnostic test to accurately identify health

\[ D / B + D \]

Perfect Specificity = 1.0

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## Diagnostic Performance

- Improving sensitivity occurs at the expense of specificity and vice versa
- Sensitivity and specificity can be affected by disease prevalence

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Diagnostic Performance

Errors will be made in caries detection.
When are errors most likely?
In caries detection which error is preferable?

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Diagnostic Performance

What is the impact of the error?

- False Positive = Risk of unnecessary restoration.
- False Negative = Risk of missing an early carious lesion.

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Caries Initiation and Progression

- Initiation = 6.1 months (median)
- Progression to Dentin = 77.7 months (median)

Caries Detection

Visual Inspection

2002 - International Caries Detection Assessment System

- Cariologists and Epidemiologists
- Visual Exam aided by WHO probe
  - 0.5 mm spherical tipped probe
- Acceptable accuracy and reproducibility


Caries Detection

Visual Inspection

2002 - International Caries Detection Assessment System

- Occlusal Sensitivity 0.63 - 0.82
- Occlusal Specificity 0.63 - 0.94

- Less accuracy in enamel caries depth assessment in primary teeth likely due to thinness of enamel
Caries Detection

Visual Inspection

2002 - International Caries Detection Assessment System

- **Proximal caries** detection results in poor sensitivity (about 0.30), but specificity is high

- Consider ICDAS for proximal with additional diagnostics
Caries Detection

Radiographic Examination

Advantages

- Lesion detection

- Lesion depth assessment

- Lesion activity (longitudinal examination)
Caries Detection

Radiographic Examination

Disadvantages

- Lesion depth assessment – Usually depth is underestimated
- Early enamel lesion detection
- Ionizing radiation risk
- Caries activity (except in serial monitoring)
- Detecting cavitation
Caries Detection

Radiographic Examination Requirements

- No overlap of proximal surfaces
- No cone cut of relevant areas
- No missing relevant surfaces
- Diagnostic image
  - Adequate imaging factors – kVp, mA, Time, Receptors
  - Adequate processing factors
    - Chemistry, Temperature, Time
    - Contrast, Brightness
  - Adequate viewing conditions
  - Interpretative factors
Caries Detection

Bitewing Examination and ICDAS

- Score 0, 1, 2 - usually no radiograph indicated
  - 0 = No or slight change in enamel translucency after prolonged (5s) air drying
  - 1 = First visual change in enamel (seen after air drying or confined to pit/fissure)
  - 2 = Distinct visual change in enamel
Caries Detection

Bitewing Examination and ICDAS

- Score 3, 4 - Radiograph can be useful in occlusal assessment
  - 3 = Local enamel breakdown in opaque or discoloured enamel
  - 4 = Underlying dark shadow from dentin
Caries Detection

Bitewing Examination and ICDAS

- Score 5,6 - Radiograph not needed for detection but may be useful in pulp assessment. PA needed for periapical assessment, if indicated
  - 5 = Distinct cavity visible in dentin
  - 6 = Extensive (more than half of surface) distinct cavity with visible dentin
Caries Detection

Bitewing Examination and ICDAS

- Caries detection of early dentin lesions can be improved with bitewing imaging

- Failure to detect enamel caries does not necessarily have a negative impact on patient outcome. Provided regular clinical and radiographic examination is available and provided
Caries Detection

Bitewing Diagnostic Performance

Proximal Caries Detection (Primary & Permanent)
- Sensitivity 0.5 to 0.6
- Specificity 0.9

Occlusal Caries Detection
- Sensitivity 0.5 to 0.8
- Specificity 0.8
Caries Detection

Bitewing Diagnostic Performance

- Digital imaging performs similar to film

- primary advantage is potential to decrease patient dose
Caries Detection

Bitewings and Proximal Caries

- Radiographic enamel caries are usually non-cavitated

- Radiographic caries less than ½ into dentin ± cavitation
  - Consider follow-up radiographic examination in 12 months

- Radiographic caries ½ or more into dentin are usually cavitated

Caries Detection

Panoramics and Proximal Caries

A clinical study was designed to examine whether the orthogonal panoramic projection could improve diagnostic accuracy over standard projections in the detection of proximal surface caries. Thirty-five sets of radiographs that demonstrated optimal image characteristics were selected. The mean receiver operating characteristic areas for orthogonal and standard projection panoramic and bite-wing radiography to detect the presence of proximal dental caries were 0.68 +/- 0.03, 0.69 +/- 0.03, and 0.79 +/- 0.03 respectively. In overall performance, conventional bite-wing radiographs gave a significantly greater diagnostic yield for proximal caries than the Philips OrthOralix SD orthogonal or standard panoramic modalities (p > 0.05). The orthogonal projection did not improve diagnostic accuracy in the detection of proximal carious lesions compared with the standard projection.

Caries Detection

Panormics and Proximal Caries

- Overlap
Caries Detection

Cone-beam CT and Proximal Caries

Radiation Protection:
Cone Beam CT for Dental and Maxillofacial Radiology
Evidence Based Guidelines

SEDENTEXCT Project, 2011

SEDENTEXCT Project Members:

- Included medical physicists, dentists, dental radiologists, experts in guideline development, and industry representatives
- 51 Project members from the United Kingdom, Greece, Romania, Belgium, Sweden and Lithuania

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Caries Detection

Cone-beam CT and Proximal Caries

Caries Diagnosis

- CBCT is not indicated as a method of caries detection and diagnosis.
- If a CBCT is obtained, caries assessment should be part of the interpretation.
- Metallic restorations reduce diagnostic accuracy.

SEDENTEXCT 2011 Guidelines
Caries Detection

Cone-beam CT and Proximal Caries

- Artifact
Caries Detection

Cone-beam CT and Proximal Caries

- Artifact
## Caries Detection

### Radiation Dose and Caries Detection

<table>
<thead>
<tr>
<th>Examination</th>
<th>Effective Dose μSv</th>
<th>Background Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panoramic</td>
<td>9-26</td>
<td>1 - 3 days</td>
</tr>
<tr>
<td>Cephalogram</td>
<td>3-6</td>
<td>½ - 1 day</td>
</tr>
<tr>
<td><strong>Bitewing (PSP/F)</strong></td>
<td>5</td>
<td>½ day</td>
</tr>
<tr>
<td>Full mouth series PSP/F/Round</td>
<td>171</td>
<td>21 days</td>
</tr>
<tr>
<td>Full mouth series D/Round</td>
<td>388</td>
<td>47 days</td>
</tr>
<tr>
<td>CBCT exam</td>
<td>20-599</td>
<td>3 - 75 days</td>
</tr>
</tbody>
</table>

### Medical Examinations

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<th>Examination</th>
<th>Effective Dose μSv</th>
<th>Background Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest X-ray</td>
<td>20</td>
<td>2 days</td>
</tr>
<tr>
<td>Multi-Slice CT</td>
<td>860</td>
<td>105 days</td>
</tr>
</tbody>
</table>

Caries Detection

Current Radiographic Screening Guidelines

<table>
<thead>
<tr>
<th></th>
<th>Child Primary</th>
<th>Child Mixed</th>
<th>Adolescent</th>
<th>Adult</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clinical Caries or High Risk*</td>
<td></td>
<td>6-12 months</td>
<td></td>
<td>6-18 months</td>
</tr>
<tr>
<td>No Clinical Caries or Low Risk*</td>
<td></td>
<td>12-24 months</td>
<td>18-36 months</td>
<td>24-36 months</td>
</tr>
</tbody>
</table>

*Factors contributing to increased caries risk: current clinical caries, history of recurrent caries, high titers of cariogenic bacteria, failing restorations, poor oral hygiene, inadequate fluoride exposure, prolonged nursing, high sucrose diet, poor family dental health, enamel defects, acquired/developmental disability, xerostomia, genetic abnormality of teeth, many multisurface restorations, chemotherapy/radiotherapy, eating disorders, drug/alcohol abuse irregular dental care. Open contacts and missing teeth can reduce the number of radiographs required.