Diagnosis of caries and caries test

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CARIES – ROT / DECAY

Ernest Newbrun – 1989

“Dental caries is defined as a pathological process of localized destruction of tooth tissues by microorganisms.”

Shafer – 1993

“Dental caries is an irreversible 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, which often leads to cavitation.”
• Sturdevant – 2002

  “Dental caries is defined as an infectious microbial disease of the teeth that results in localized dissolution and destruction of the calcified tissues.”

• Fejerskov et al., - 2004:

  Dental caries is a complex disease caused by an imbalance in the physiologic equilibrium between tooth mineral and bio film fluid.
Dental caries is an infectious, communicable disease resulting in destruction of tooth structure by acid forming bacteria found in dental plaque, an intra oral bio film in the presence of sugar.

WHO

Defined dental caries as localized post eruptive, pathological process of external origin involving softening of the hard tooth tissue and proceeding to the formation of a cavity.
CHANGING CONCEPTS IN CARIES FORMATION

5000 BC (ancient sumerian text)

The legend of worm

Greek physicians

Humoral theory

Hippocrates, Celsius, Galen

Vital theory
<table>
<thead>
<tr>
<th>Name</th>
<th>Theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robertson, 1835</td>
<td>Chemical theory</td>
</tr>
<tr>
<td>Erdl, 1843</td>
<td>Parasitic theory</td>
</tr>
<tr>
<td>Egyedi</td>
<td>Glycogen theory</td>
</tr>
<tr>
<td>Eggers</td>
<td>Sucrose chelation theory</td>
</tr>
<tr>
<td>Leimgruber</td>
<td>Organotrophic theory</td>
</tr>
<tr>
<td>Neumann &amp; Disalvo</td>
<td>Biophysical theory</td>
</tr>
<tr>
<td>Brunch and Jackson</td>
<td>Auto immune theory</td>
</tr>
<tr>
<td>Author</td>
<td>Year</td>
</tr>
<tr>
<td>-----------------</td>
<td>-------</td>
</tr>
<tr>
<td>Miller</td>
<td>1882</td>
</tr>
<tr>
<td>Gottlieb</td>
<td>1944</td>
</tr>
<tr>
<td>Pincus</td>
<td>1950</td>
</tr>
<tr>
<td>Schwartz</td>
<td>1955</td>
</tr>
</tbody>
</table>
• Current concept

“demineralization and remineralization”
KEYS TRIAD, 1960

- MICRO FLORA
- SUBSTRATE
- HOST

- NO caries
- caries

- NO caries
MOIDIFIED KEYS TRIAD
Newburn, 1982

- Saliva
- Micro Flora
- Substrate
- Tooth
- Time
Figure 3: Illustration of the factors involved in caries development
Adapted from Fejerskov and Manji, 1990 with permission of the authors and the publisher.
$H^+ + OH^- \rightarrow H_2O$
Diagnosis

• Visual and tactile examination
• Radiographic method
• Tooth separation

RECENT METHODS

➢ Laser fluorescence
➢ Electrical conductance measurement
➢ Fiber optic transillumination
➢ Magnetic resonance micro-imagery
➢ Ultrasound
➢ Caries detector dyes
➢ Xeroradiography
➢ Endoscopic method of caries detection
LASER FLUORESCENCE

• Used in early 1980

• Scientific basis- enamel illuminated with blue light from an argon laser, emits yellow light by auto fluorescence

• When caries is present, the intensity of fluorescence is reduced by scattering of light within the lesion

• Dark grey areas of enamel indicates incipient caries
• Diagnodent – recently marketed compact hand held device

• It makes use of laser auto fluorescence technology, instead of using blue light it uses red light

Electric resistance/ECM

• Became popular in 1980’s

• Principle - sound enamel has a high resistance to electric current flow. Pores caries enamel filled with conducting media has an increasingly lower resistance therefore higher conductance
Fiber Optic Transillumination-

- Uses bright fiber optic light to transilluminate a tooth to investigate the presence of caries.

- Trans illumination will be less for carious tooth.

- Newer version of FOTI is digital imaging fiber optic trans illumination where the image is recorded by a CCD digital camera.
Magnetic resonance micro-imagery

- It uses a moderate magnetic field
- This technique is capable of producing highly accurate 3-dimensional picture of teeth
COMPARISON OF AVAILABLE TECHNOLOGY

• Studies show that ECDs is able to determine initial lesion, but unable to determine the extent of the lesion. In contrast radiograph is less capable of detecting initial lesions but give more reliable indication about extent of lesion “Ricketts 1995”.

• Studies show that ECM is the most accurate diagnostic method when compared to visual, FOTI, bite wing radiographic examination “Ekstrand 1998”
• Comparison of Diagnodent and ECMs show that diagnodent has high specificity for enamel caries than ECM but both has an identical sensitivity

• Sensitivity of ECM is more in caries involving dentin when compared to Diagnodent but Diagnodent has a greater specificity than ECM in such lesion
• FOTI diagnose 77% of proximal lesion compared with 49% by visual examination “Keem 1997”

**Current research and opinion**

• ECM is better in detecting occlusal and proximal lesion

• FOTI is suited for detection of established early proximal lesion

• Laser auto fluorescence is useful in assessing accessible smooth surface and pit and fissure lesions
CARIES ACTIVITY TESTS

• Defined as the sum total of new caries lesions and enlargement of existing carious cavities during a given period of time.

• To determine the need of personalized preventive measures.

• To motivate and monitor the effectiveness of Health education programs.

• To manage the progress of restorative procedures.

• To identify high risk individuals
CARIES SUSCEPTIBILITY

- Refers to the new number of lesions that may develop in an individual over a period of time
VARIOUS TEST

- Lactobacillus colony count test
- Synder test
- Strip mutans test
- Buffer capacity test
- Fordick Ca dissolution test
- Dewer test
- Swab test
- Reductase test
- Cariostat test
- Caries risk test – bacteria and buffer
LACTOBACILLUS TEST

• Hadley (1933)

Method:

• saliva is collected by having the subject chew paraffin before breakfast. This is stored in a bottle and shaken to mix well.
• 0.1cc of saliva is spread over Rogosa agar plate.
• The plate is incubated for 4 days.
<table>
<thead>
<tr>
<th>No. of organisms</th>
<th>Symbolic designation</th>
<th>Degree of caries activity suggested</th>
</tr>
</thead>
<tbody>
<tr>
<td>0--1000</td>
<td>+,--</td>
<td>Little or none</td>
</tr>
<tr>
<td>1000--5000</td>
<td>+</td>
<td>Slight</td>
</tr>
<tr>
<td>5000--10000</td>
<td>+ +</td>
<td>Moderate</td>
</tr>
<tr>
<td>More than 10000</td>
<td>+ + + or + + + + + +</td>
<td>Marked</td>
</tr>
</tbody>
</table>
SNYDER TEST

• This snyders test measures the ability of salivary micro organisms to form organic acids from a carbohydrate medium.

• snyders medium consists of:
  1. Casein
  2. Yeast extract
  3. Dextrose
  4. Agar
  5. Bromocresol green
METHOD

• Saliva is collected by having the subject chew paraffin. A tube of Snyder glucose agar is melted and then cooled at 50°C.

• 0.2ml of saliva is added to the agar tube. The Snyder agar tube with saliva is incubated at 37°C.

• The color change of indicator is observed after 24, 48 and 72 hours.
## Color Observations in Snyder test

<table>
<thead>
<tr>
<th>Duration</th>
<th>If Yellow</th>
<th>If Yellow</th>
<th>If Yellow</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hours</td>
<td>Marked caries susceptibility</td>
<td>Definite caries susceptibility</td>
<td>Limited caries susceptibility</td>
</tr>
<tr>
<td>48 hours</td>
<td>If green</td>
<td>Continue to incubate &amp; observe for 48hrs</td>
<td>If green</td>
</tr>
<tr>
<td>72 hours</td>
<td>If green</td>
<td>Caries inactive</td>
<td>If green</td>
</tr>
</tbody>
</table>
ALBANS TEST (modified Snyder test)

- Alban modified the Snyder test to make it easier and for use in regular dental office.

- In this method lesser amount of agar is used.

- The agar is taken from the refrigerator but is not heated. To this saliva is added and incubated for 4 days.

- Color observations are same as that of Snyder test.
SALIVARY REDUCTASE TEST

• The test measures the rate at which an indicator dye, *Diazoresorcinol* changes from blue to red to colorless.

• Method: 5ml of saliva is collected by the same method and stirred. It is then mixed with a fixed amount of Diazoresorcinol.

• Color change obtained after 15mins is taken as a measure for caries activity.
<table>
<thead>
<tr>
<th>COLOR</th>
<th>TIME</th>
<th>SCORE</th>
<th>CARIES ACTIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLUE</td>
<td>15mins</td>
<td>1</td>
<td>Non conductive</td>
</tr>
<tr>
<td>ORCHID</td>
<td>15mins</td>
<td>2</td>
<td>Slightly conductive</td>
</tr>
<tr>
<td>RED</td>
<td>15mins</td>
<td>3</td>
<td>Moderately conductive</td>
</tr>
<tr>
<td>RED</td>
<td>immediately</td>
<td>4</td>
<td>Highly conductive</td>
</tr>
<tr>
<td>PINK/WHITE</td>
<td>immediately</td>
<td>5</td>
<td>Extremely conductive</td>
</tr>
</tbody>
</table>
Strip test:

- Saliva or plaque samples are obtained by using tongue blade or tooth picks.
- This is transferred to S. mutans strip which is incubated in MSB agar (MITIS SALAVARIUS BACITRACIN AGAR).
- Number of S.mutans is then estimated.
- More than $10^5$ colonies per ml of saliva is indicative of high caries activity.
Caries risk test

• This is a new quick and effective caries activity test

• It has two components

1. CRT bacteria-It is used to determine cariogenic bacteria

2. CRT buffer- to determine buffering capacity
Method

- Stimulated saliva is collected and applied to both the sides of slide and then incubated for 48 hrs at 37°C

- CRT buffer strips are placed in mouth and the change in colour is used as an indicator for buffering capacity
Saliva as a diagnostic tool:

- Stimulated salivary flow rate
- Un stimulated salivary flow rate
- Viscosity of saliva
CARIES RISK ASSESSMENT

AAPD – CAT
Low risk

Oral conditions
- No enamel caries teeth in past 24 months
- Caries “white spot lesions”
- No visible plaque; no gingivitis

Environmental factors
- Optimal systemic and topical, fluoride exposure
- Consumption of simple sugars or foods strongly associated with caries initiation primarily at mealtimes
- High socioeconomic status.
- Regular dental care.
### AAPD – CAT

**Moderate risk**

<table>
<thead>
<tr>
<th>Oral conditions</th>
<th>Environmental factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Carious teeth in the past 24 months</td>
<td>- Suboptimal systemic fluoride exposure with optimal topical exposure</td>
</tr>
<tr>
<td>- Presence of white spot lesions</td>
<td>- Consumption of between – meal simple sugars</td>
</tr>
<tr>
<td>- Gingivitis</td>
<td>- Midlevel socioeconomic status.</td>
</tr>
<tr>
<td></td>
<td>- Irregular dental care.</td>
</tr>
</tbody>
</table>
# AAPD – CAT

## High risk

<table>
<thead>
<tr>
<th>Oral conditions</th>
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</thead>
<tbody>
<tr>
<td>- Carious teeth in the past 12 months</td>
</tr>
<tr>
<td>- Presence of white spot lesions</td>
</tr>
<tr>
<td>- Radiographic enamel caries</td>
</tr>
<tr>
<td>- Visible plaque on anteriors</td>
</tr>
<tr>
<td>- High titers of MS</td>
</tr>
<tr>
<td>- Enamel hypoplasia</td>
</tr>
<tr>
<td>- Ortho treatment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Environmental factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Frequent intake of sugars</td>
</tr>
<tr>
<td>- Low socio economic status</td>
</tr>
<tr>
<td>- No dental care.</td>
</tr>
<tr>
<td>- Systemic illness</td>
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</tbody>
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