

Operative dentistry (lecture 7)

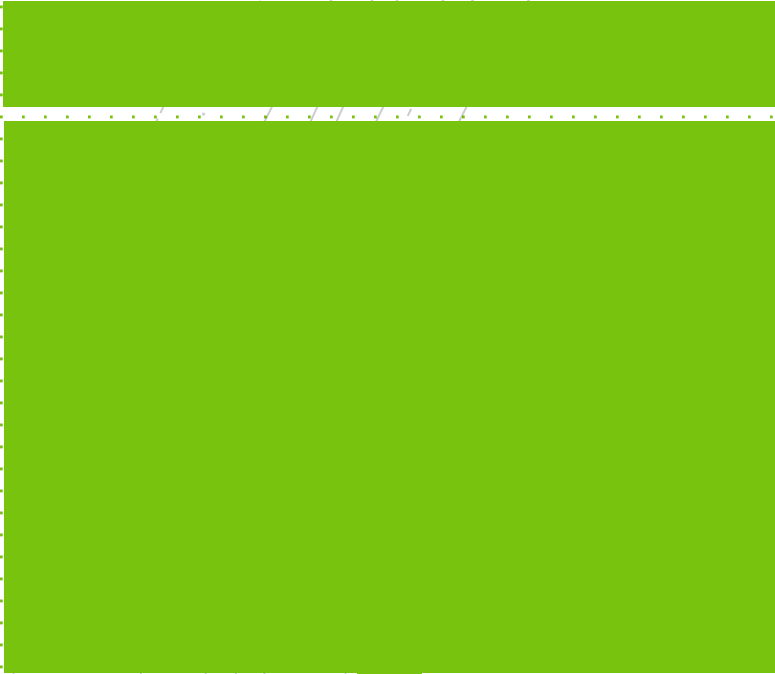
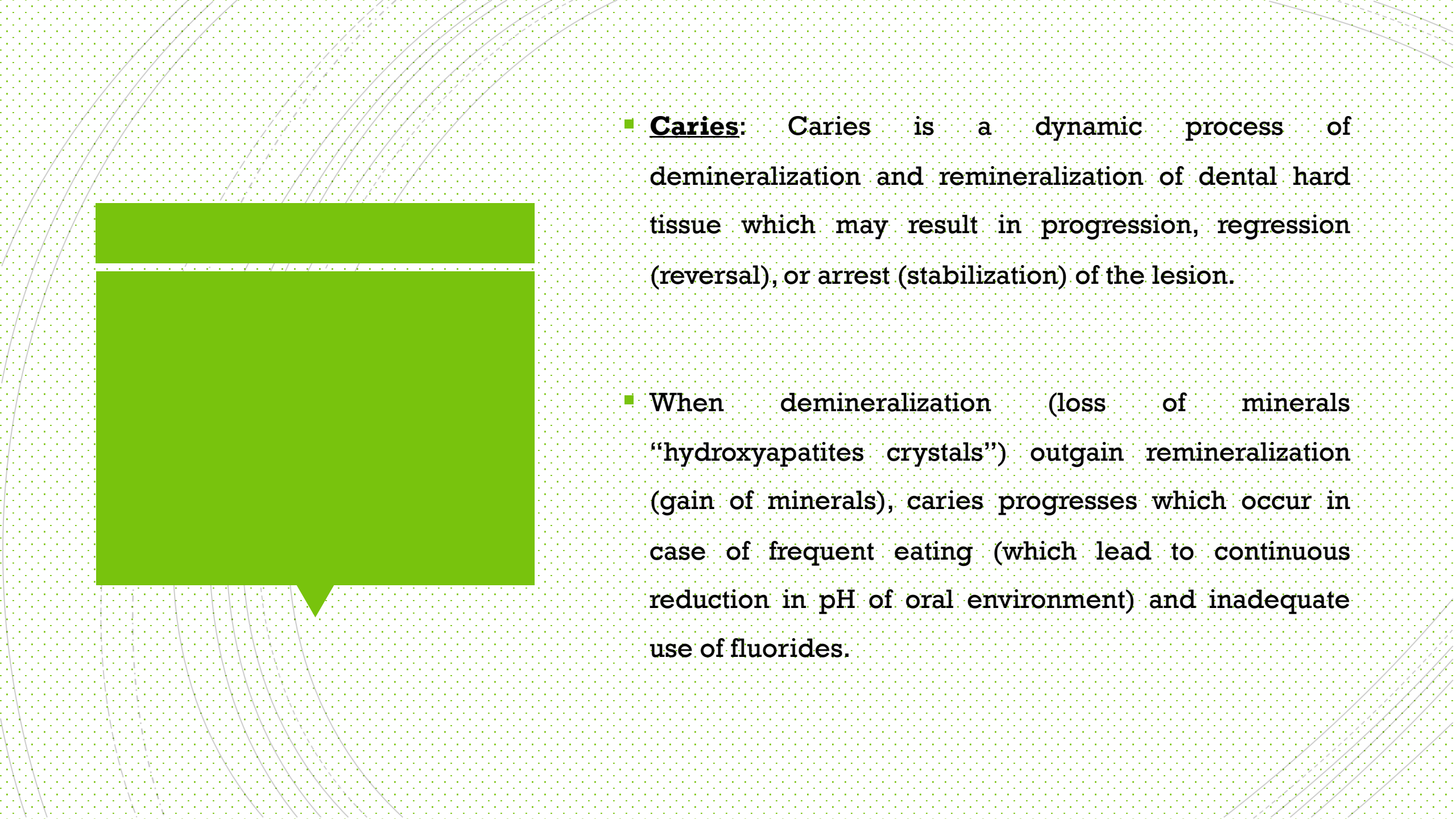
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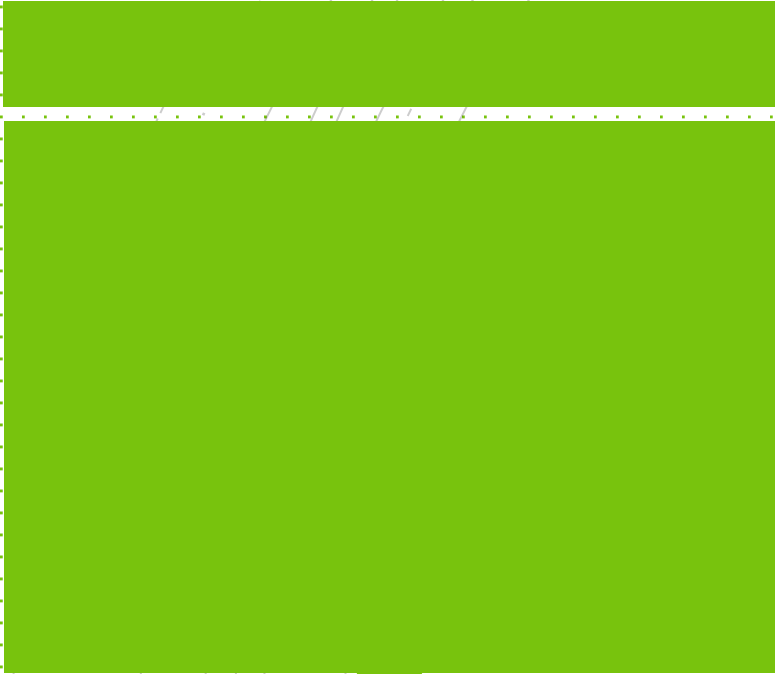


- **Caries detection and diagnosis**



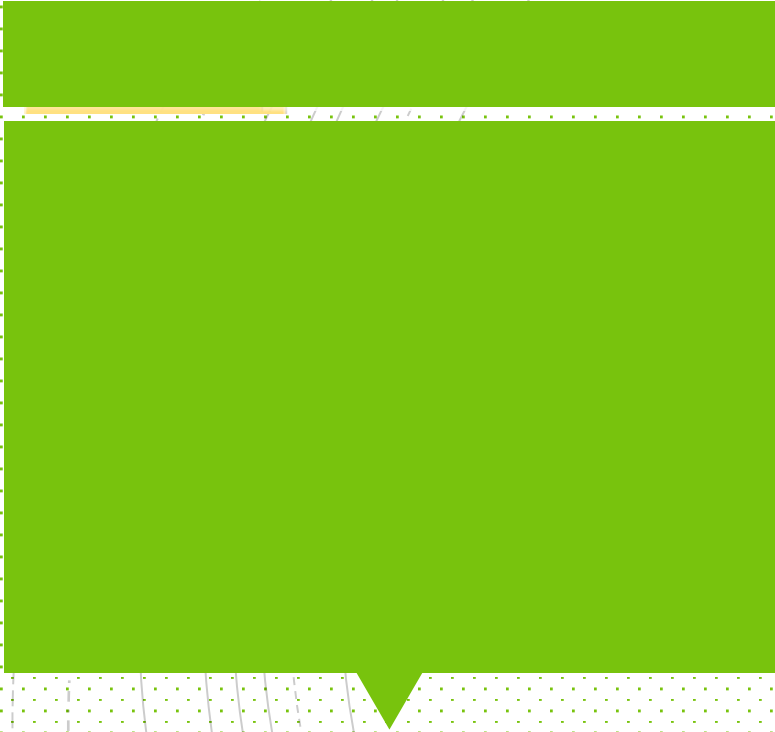
- **Caries:** Caries is a dynamic process of demineralization and remineralization of dental hard tissue which may result in progression, regression (reversal), or arrest (stabilization) of the lesion.

- When demineralization (loss of minerals “hydroxyapatites crystals”) outgain remineralization (gain of minerals), caries progresses which occur in case of frequent eating (which lead to continuous reduction in pH of oral environment) and inadequate use of fluorides.

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- **Caries detection** involves determining whether or not clinical signs of caries are present at one point in time.
 - On the other hand, **caries diagnosis** is the determination of activity and causes of the caries lesion in addition to caries detection.
 - Caries detection process can be performed by mixing of information obtained from:
 - 1- **Clinical examination.**
 - 2- **Use of caries diagnostic aids.**
 - 3- **Communication with patient.**
 - 4- **Knowledge about caries process.**



- **Aim of detection of early caries lesions**

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- The aim of detection of early carious lesions is to **limit the progression of caries as early as possible and monitor caries lesion activity.**

- Early caries is a **reversible disease** and can be prevented by prevention of demineralization and promotion of remineralization by an effective prophylactic intervention which employed to reverse or arrest the lesion before the need for restorative intervention.



- **Methods of caries detection**

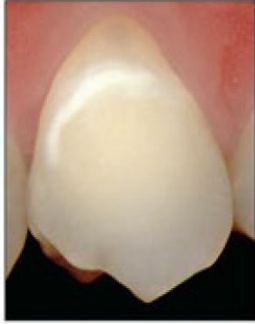
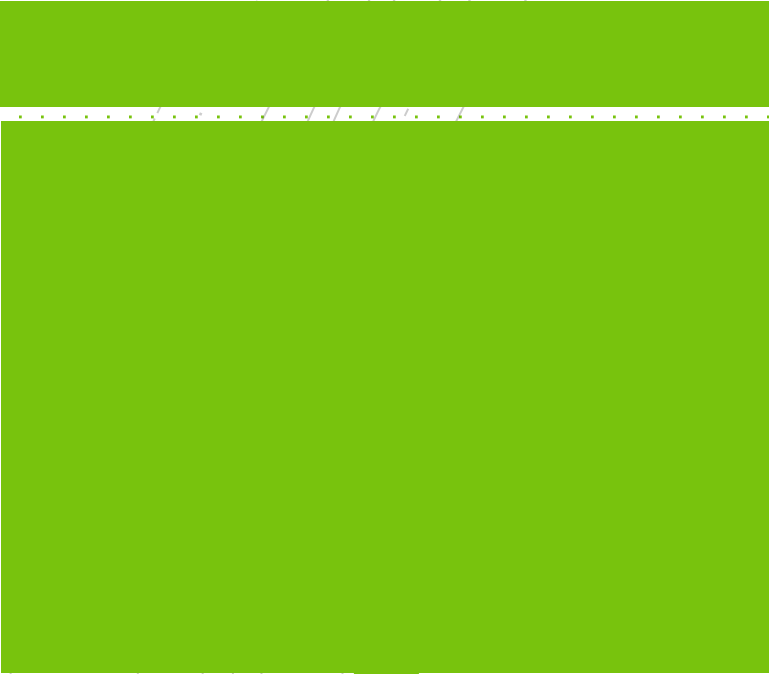


Fig 5-7 The first clinical sign of caries: a chalky and matte whitish surface.



Fig 5-8 White spot lesion discolored by staining has turned into a brown spot lesion.

- The conventional caries detection methods are **visual** and **radiographic** examinations.
- Visual examination of early caries lesion can be seen either as a **white** or as a **brown/black** spot lesion.
- There are **noncavitated** and **cavitated** stages of progressed dental caries that can be identified and described using clinical signs.

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- ***Detection of carious lesions with visual examination must be performed while the teeth are:***

1. cleaned from plaque by a probe or a prophylactic cleaning.

2. dried with air-water syringe for more than **5 seconds**, because removing water from the porous tissue enables the dentist to gauge how far through the enamel a lesion has **progressed**.

3. Use of magnification devices such loupes or operating microscope can improve caries detection by **50%**.



- **Carries detection in different types of lesions**

1- pit and fissure lesions:

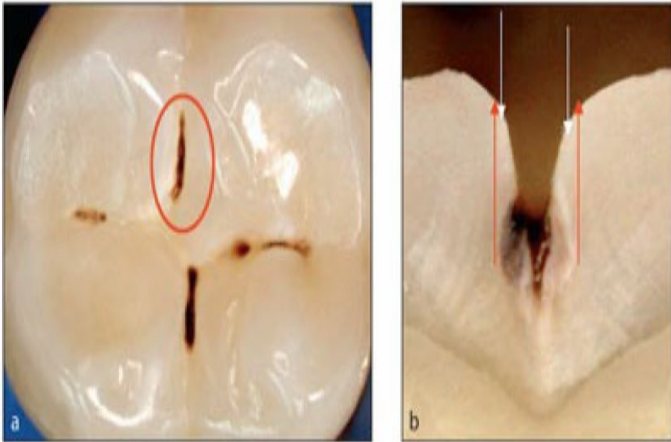
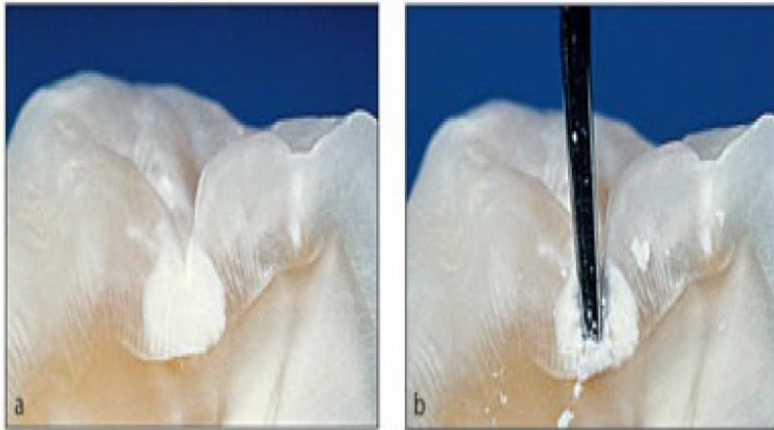


Illustration of the visual detection of lesions on the walls of stained pits/fissures. (a) A stained fissure (*red circle*) under visual examination. (b) looking perpendicularly through the translucent adjacent healthy enamel along the fissure (*white arrows*), lesions on the walls of the fissure are seen as discoloration extending (i.e., underneath the translucent enamel) beyond the confines of the fissure with a "bottle-brush" appearance (*red arrows*).

- Detection of these lesions most often performed by **visual inspection**. **Good lightening & dry clean** teeth.
- It appears that any sign of visible cavitation in the occlusal surface corresponds to the progression of the lesion into the dentin.
- **Opaque, matte texture** of enamel adjacent to the stained pits and fissures may **indicate** the presence of active caries underneath the pit and fissure.
- When there is **no caries underneath**, discoloration will remain within the confines of the pit and/or fissure.

Radiograph shows large pit and fissure caries lesion.



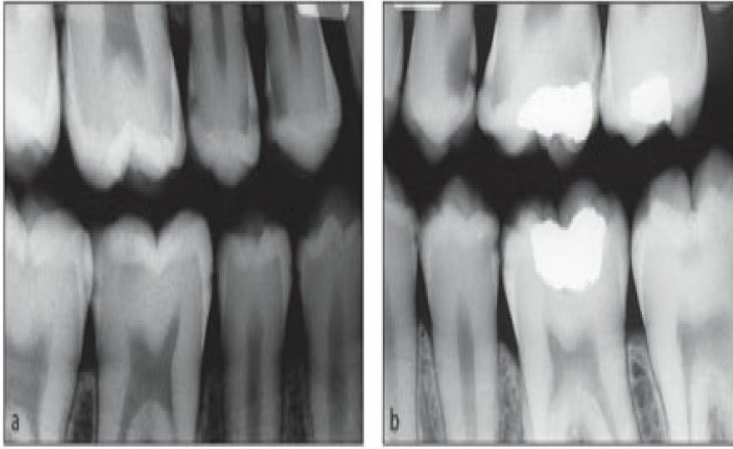
b) The explorer tip can easily damage white spot lesions.

- **Bite-wing** radiographs can **detect** only large occlusal lesions.
- Small lesions **can't be detected** with bitewing radiographs because of the large amounts of surrounding sound enamel.

- **Tactile** examination of fissures with sharp probe is **unreliable method** because the explorer can damage a white spot lesion by breaking through intact surface zone & cause a cavity which will trap dental plaque & encourage lesion progression.

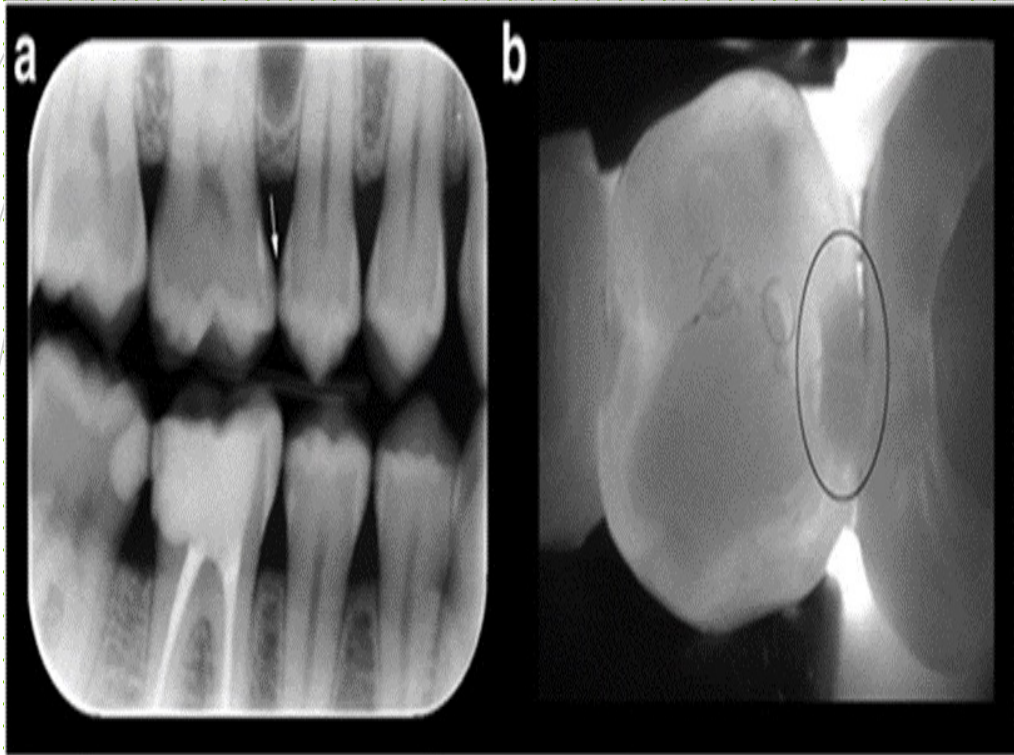


- **2- lesions involving proximal surfaces:**
- Extensive active proximal lesions can be **revealed** by shadowing or grayish discoloration of the undermined occlusal enamel ridge.



(a and b) Radiographs showing proximal demineralizations in the outer enamel to the dentinoenamel junction and inner half of dentin. (Occlusal lesions are visible on the mandibular left second molar and right first and second molars, and a recurrent caries lesion is underneath the restoration on the maxillary left first molar.)

- **Bitewing** radiographs are the **most effective method** for evaluation of the proximal smooth surfaces for evidence of demineralization because these areas are not readily assessed visually or tactilely when there is contact between proximal surfaces.
- The radiograph should be **assessed** to determine penetration of the lesion either into **enamel, DEJ, outer half** or in the **inner half** of dentin.
- However, the bitewing radiograph still **cannot distinguish** between cavitated and noncavitated proximal lesions.



- **Fiberoptic transillumination** techniques have **proven** useful in detection of proximal caries lesion.
- In these techniques, a fine light is transmitted through the contact area.
- Lesions appear as a **dark shadow**; however, it is difficult to determine penetration of lesion into enamel or dentin.
- The use of **orthodontic separator** has been **advocated** in some cases to allow the dentist to see more clearly & gently feel for a break in the enamel surfaces.



3. Lesions in smooth free surfaces (buccal and lingual):

- enamel of smooth free surfaces of the crown usually located close to the gingival margin and characterized by **chalky matte, whitish/ yellowish surfaces.**

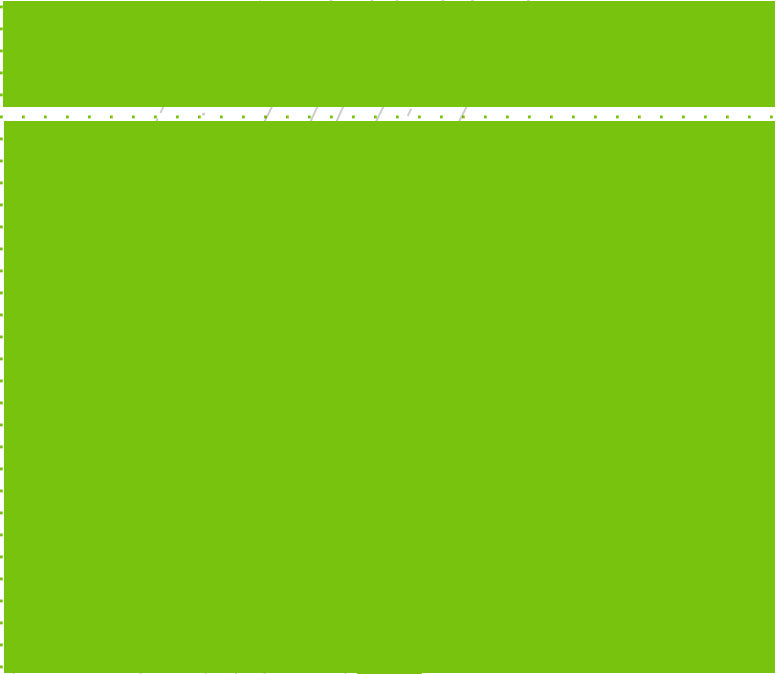


■ **4. Root surfaces:**

- Root surfaces exposed to the oral environment, usually due to **gingival recession**, are at risk for caries and should be examined **visually** and **tactilely**.
- Discoloration of such areas (**light brown, dark brown, or black discolored area on the root surface or at the cementoenamel junction**) is common and usually is associated with remineralization.
- Generally, ***the darker the discoloration, the greater the remineralization.***
- On the other hand, active, progressing caries **shows** little discoloration and is primarily detected by the presence of **softness** and **cavitation**.



- ***New Caries
Detection Methods***

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- The conventional caries detection methods, **visual** and **radiographic** examination, cannot quantitatively measure the continued changes in mineral status of the caries lesion.
 - The development of several new devices and detection methods is **promising**.
 - Most of these devices claim to detect and monitor caries activities based on the change in the **reflectance**, **transmission**, **fluorescence**, **electrical conductance**/impedance properties of enamel following demineralization.



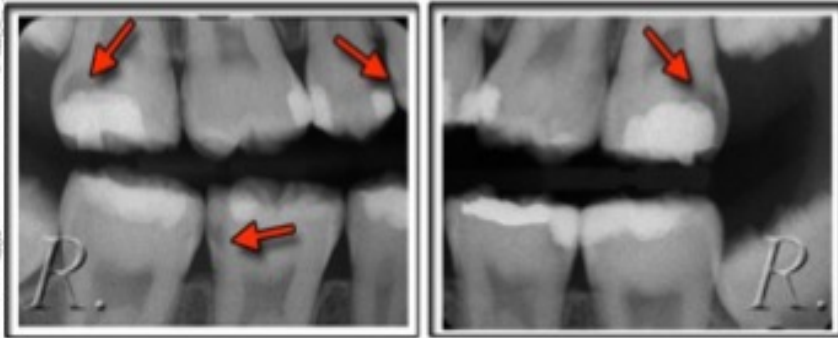
- **Reasons for employing new caries detection methods are:**

- Early lesion detection as well as hidden occlusal lesions detection.
- Objective and quantitative lesion assessment (for monitoring purposes).
- Visualization of the caries process.
- Avoiding of potentially harmful ionizing radiation.

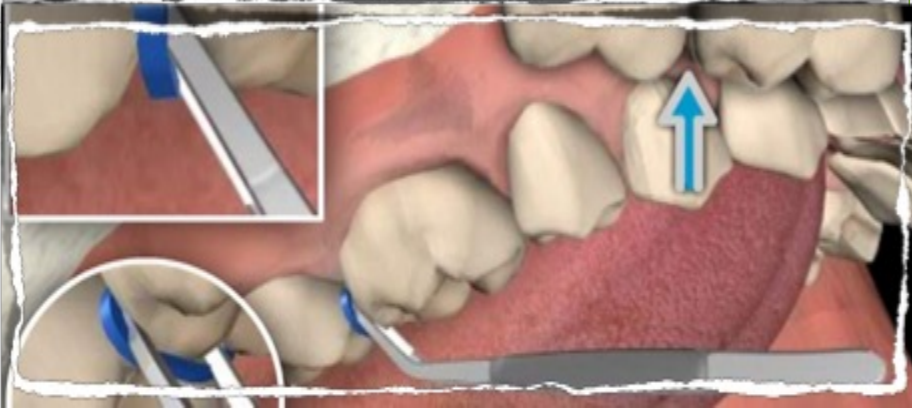
Methods for detection of dental caries

**Conventional
caries diagnostic
methods**

**Advanced
caries diagnostic
methods**

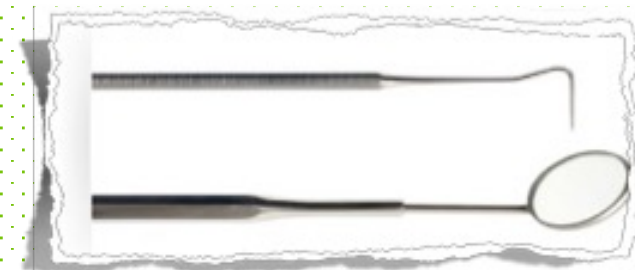


These are cavity detecting X-rays dentists call "bitewings". Red arrows show decay under fillings (white) and between teeth.



1) Conventional caries diagnostic methods

- 1. Visual inspection methods
- 2. Visual-tactile methods probe
- 3. Radiographic methods
- 4. Tooth separation
- 5. Magnification using Loupes, and Dental Microscope.
- 6. Intra-Oral camera for caries detection and for patient motivation.



2) Advanced caries diagnostic methods

■ Radiographic methods

- Digital radiographs(Logicon Caries Detector)
- Subtraction radiography

■ Fluorescence-based Technology

- Infrared Laser Fluorescence (Diagnodent)
- Infrared and red Fluorescence (Caries ID)
- Spectra technology

■ Transillumination

- Fibreoptic Transillumination
- Digital Fibreoptic Transillumination (DIFOTI) (Diagnocam–Carivu)

■ Electrical Impedance Measurement

■ Caries Scan

**The key is to understand
what the device is measuring**

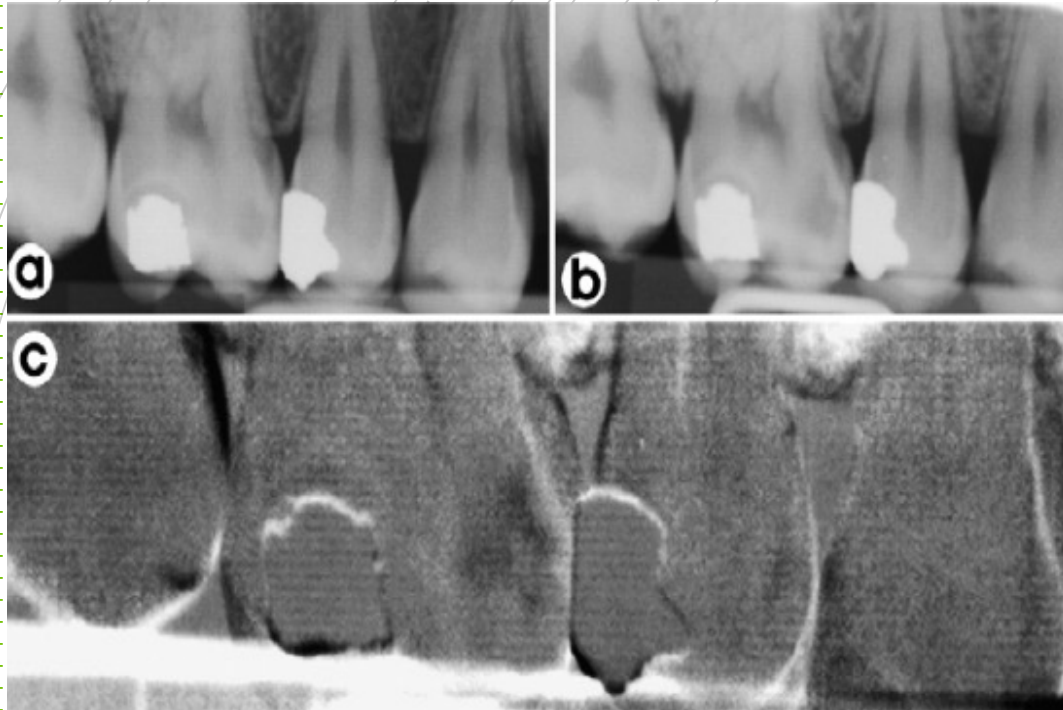


- **Direct digital radiographs** for caries detection ((**LOGICON Caries Detector**))
- This system use a **wire-based sensor** that contains a computer chip inside a protective casing, the sensor is connected to a PC by wire.
- The sensor is **placed** in the patient's mouth, when this sensor hit by x-ray the information is transmitted directly to the computer and displayed as an x-ray image on the computer screen.
- The use of digital radiography **permits** image manipulation and **reduces** the amount of radiation required to obtain a diagnostic image.
- Darkroom is **not required**; instant image is viewed.
- Capability for **tele-transmission**.

■ **Some advantages of digital radiograph:**

- reduced radiation of the patient compared with classic X-ray up to 80%
- faster imaging without X-ray film and developing images
- digital intraoral sensor is used instead of X-ray film
- immediate imaging on the computer screen
- high quality of the digital image that can be analyzed and processed
- saving images in the patient's file

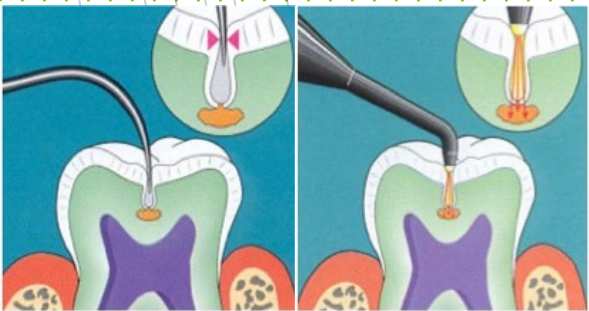




Example of a subtraction of two digital bitewing radiographs.(a) Radiograph showing proximal lesion on mesial surface of first molar, (b) follow up radiograph taken 12 months later, (c) the areas of difference between the two films are shown as black, ie. In this case the proximal lesion has become more radiolucent and hence has progressed.

- **Digital Subtraction radiography**
- Used for **detection of recurrent caries**.
- The basis of subtraction radiology is that two radiographs of the same object can be compared using their pixel values.
- any differences in the pixel values must be due to change in the object.
- Two standardized radiographs produced with identical exposure and geometry.
- The reference and the subsequent image for comparison.
- The reference image is **displayed** on the screen.

DIAGNOdent



- **Infrared Laser Fluorescence (DIAGNOdent)**
- It can be used for detection of caries on ***occlusal and smooth surfaces***.
- **The principle** is that when Diode laser with 655nm wavelength is irradiated on dental surface, it is absorbed by metabolites of caries lesion bacteria and these metabolites emit a red fluorescence.
- This fluorescence reflected by the dental surface is indicated as a number between **0** and **99** on the screen of the device.
- The **higher** the number the more is the caries, however, **DIAGNOdent** is used as a ***complementary tool beside visual examination for diagnosis of occlusal caries***.



- **Advantage:**
- It is most useful in confirming the presence of caries in suspicious fissure and detecting deep dentinal caries (hidden caries).
- It is non-invasive method for caries detection. However, it is **not used for the detection of recurrent caries or to detect proximal caries.**
- Due to this **limitation**, a new version of the method was designed and introduced, named **DIAGNOdent pen**, this new version permits the assessment of both occlusal and proximal surfaces.



- **INFRARED AND RED FLUORESCENCE (MIDWEST CRIES ID)**
- The handheld device emits a soft LED light **measure** the reflectance of the emitted light from the tooth surface.
- When the detection is **negative** i.e., healthy tooth area, the green LED is dominant resulting in a green illumination when healthy structure is detected and red illumination when caries are detected.
- Used on all tooth surfaces.
- Neither DIAGNOdent nor this instrument is capable of **detecting noncavitated lesions confined to the outer half of enamel.**

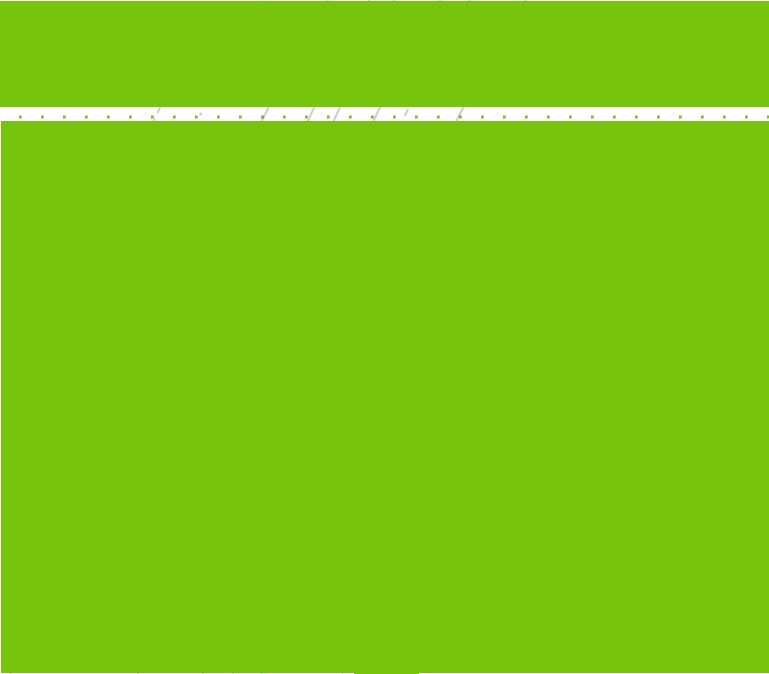
- **Spectra from air technique**

- Spectra uses fluorescence technology to enable reliable tooth-by-tooth detection of **fissure caries** and **caries on smooth surfaces** that are too small to be detected by an x-ray.

- Special light intensities LEDs project safe **high energy violet blue light** onto the tooth surface.

- This **violet blue light** stimulates metabolites of cariogenic **bacteria** (called **porphyrins**) to appear **red** when viewed on a monitor, while healthy enamel fluoresces **green**.



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- After capturing the image within our existing imaging software, the extent of the decay will be interpolated and indicated: the color will either be **blue**, **red**, **orange**, or **yellow**.
 - Spectra can be used during the restorative phase to make sure all caries are removed.
 - Spectra can detect **hidden cavities** between the margins of existing composite and amalgam restorations.



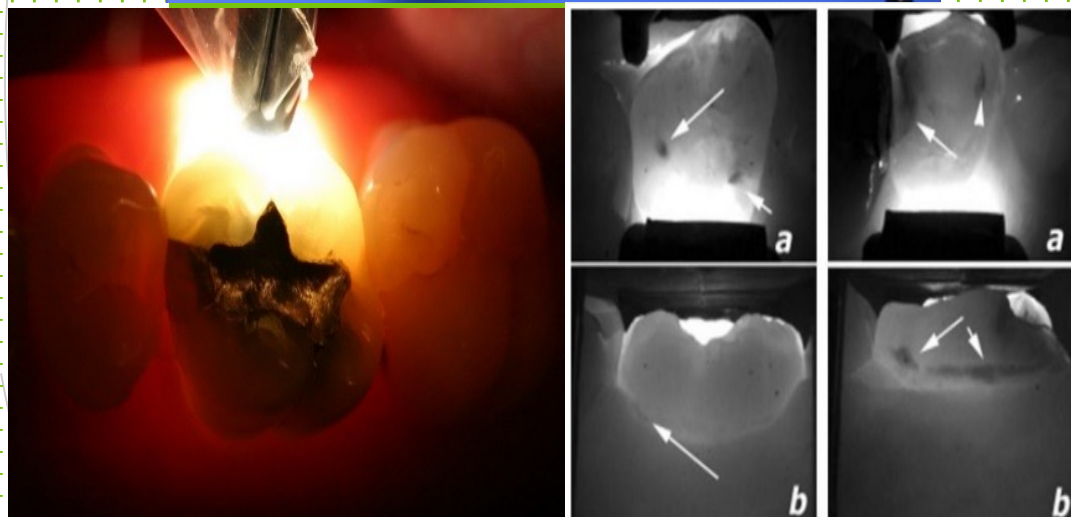
- **Fiber-optic transillumination**

- Fiber-optic transillumination (FOTI) as a caries detection technique is **based on** the fact that ***carious enamel has a lower index of light transmission than sound enamel.***

- The intact tooth **absorbs** very little light allowing it free passage.

- In contrast areas of caries **absorb and scatter** light thus appear as **dark shadow**.

- This method is mainly used to determine ***proximal caries as well as cracks.***



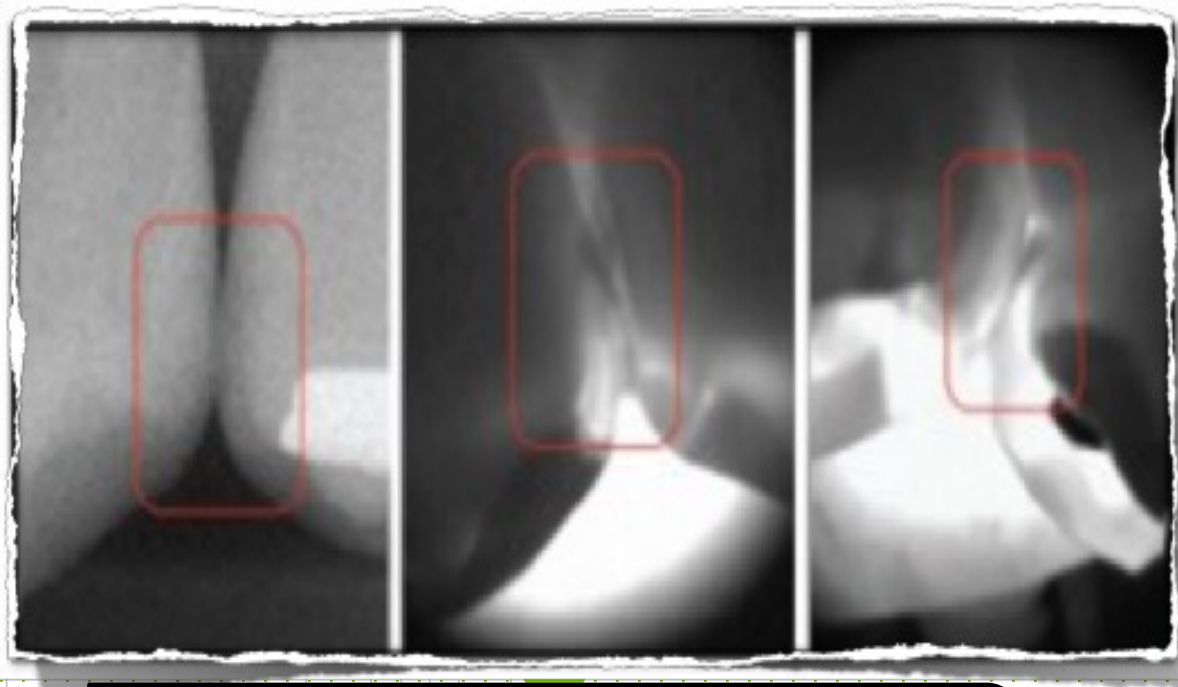


■ **Advantages:**

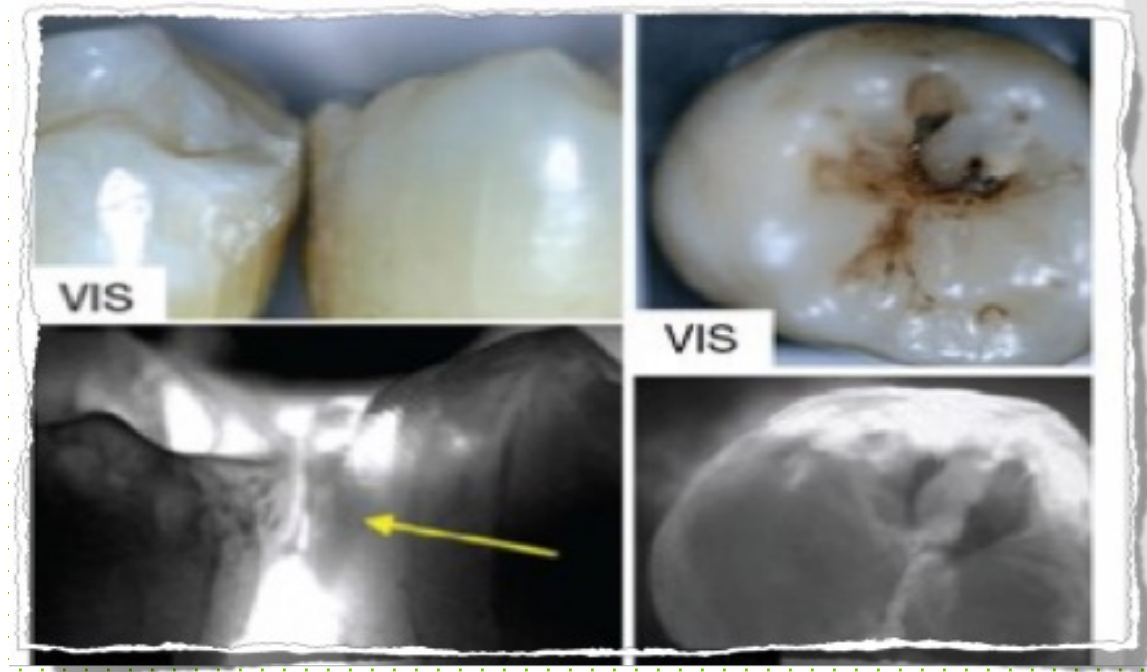
1. Lesions which cannot be diagnosed radiographically can be diagnosed,
2. No radiation hazard,
3. Comfortable to the patient.

Disadvantages:

1. FOTI is not possible in all locations of carious lesions.
2. Cannot detect small lesions.

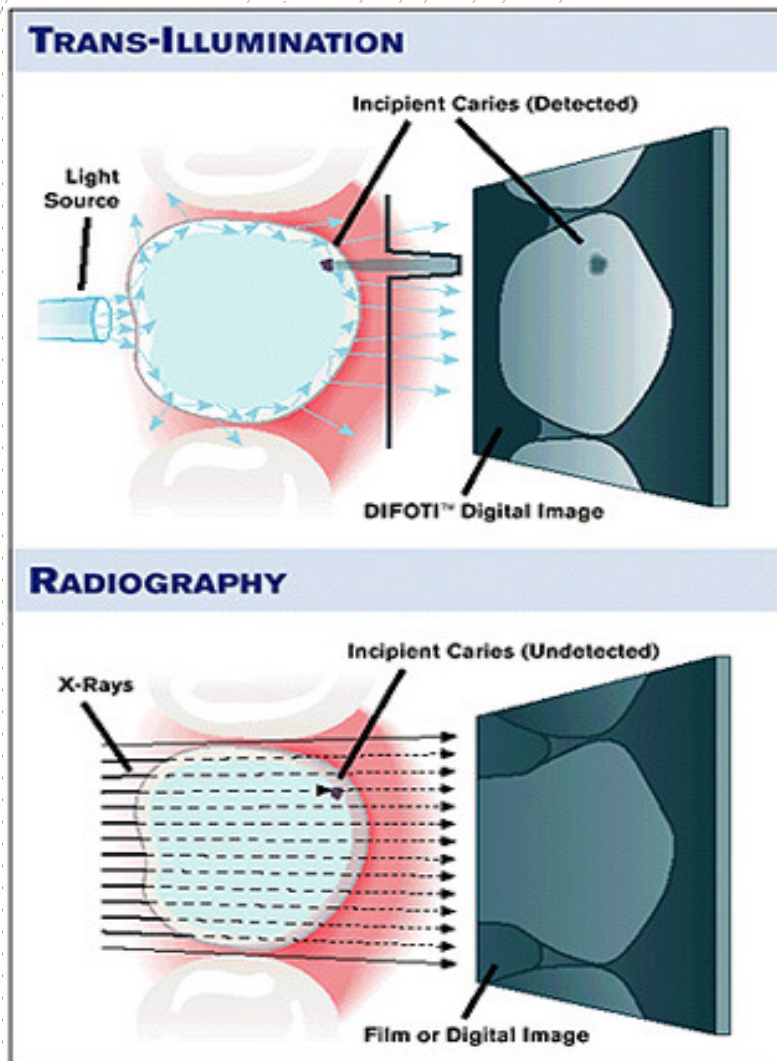


**Bitewing Radiograph vs fiberoptic
transillumination**



**visual vs fiberoptic
transillumination**

Difference between DIFOTI and
conventional Radiography.



- **Digital Imaging Fiberoptic Transillumination (DIAGNOcam-CariVU)**

- is a brilliant new approach to caries detection combining FOTI with a digital camera which allow immediate imaging and detection of early lesions and can be used on **proximal** and **occlusal lesions**.



- ***Advantages:***

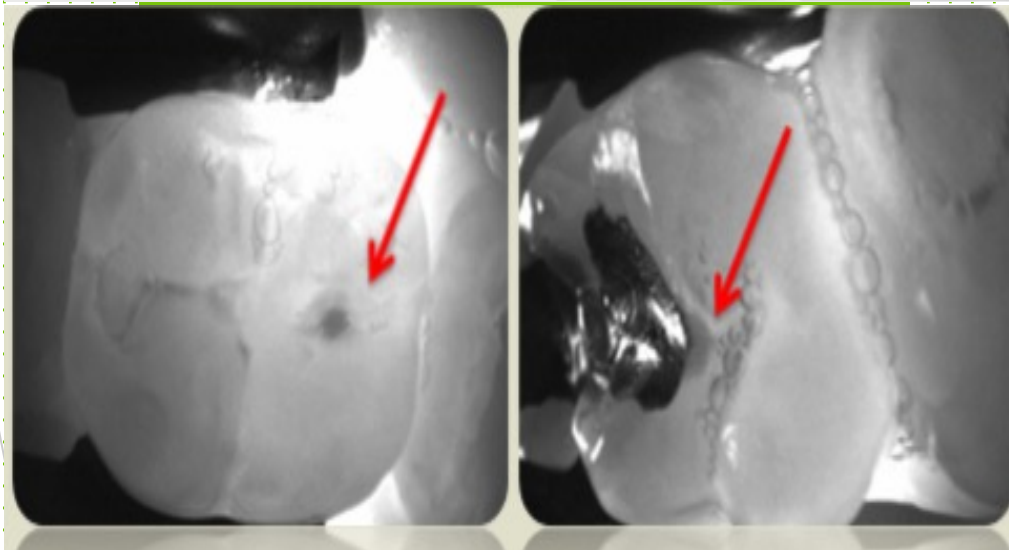
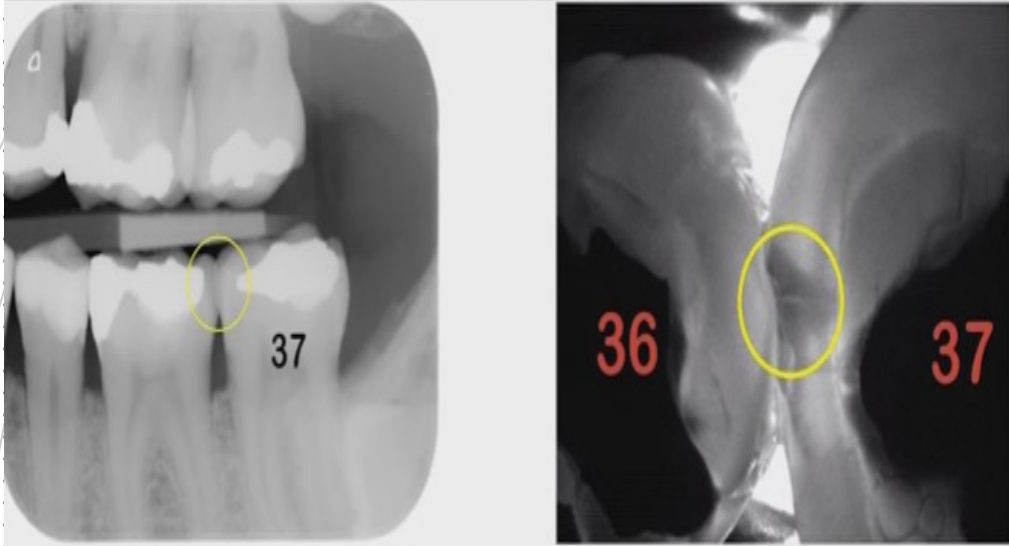
1. The use of digital camera allows instantaneous image.

2. Detect early lesions.

3. Can be used on the proximal and occlusal surfaces.

- ***Disadvantage:***

- Not able to determine the depth of lesions.



■ **Contraindication:**

1- Large fillings.

2- Crown.

3- Subgingival caries.

4- Calculus or discoloration can lead to light scattering
can be shown like a shade.



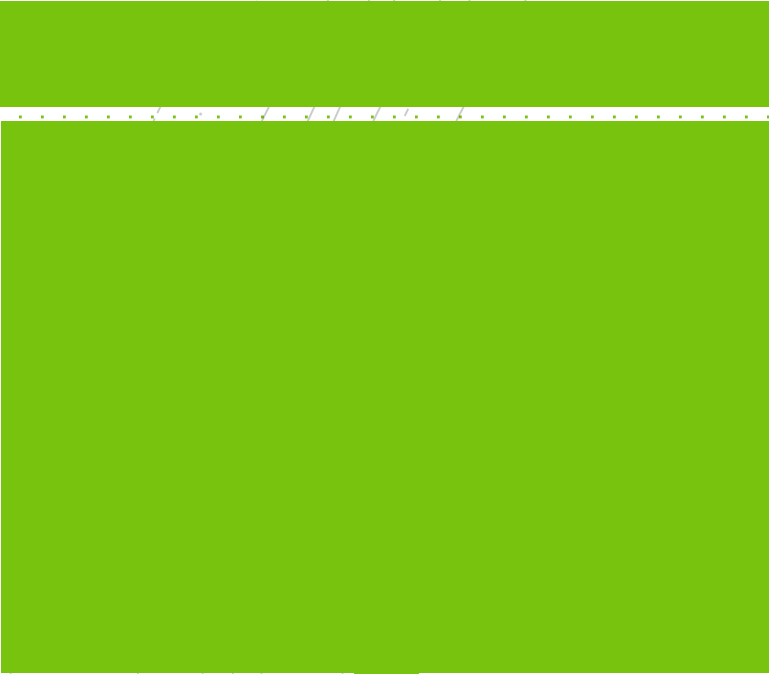


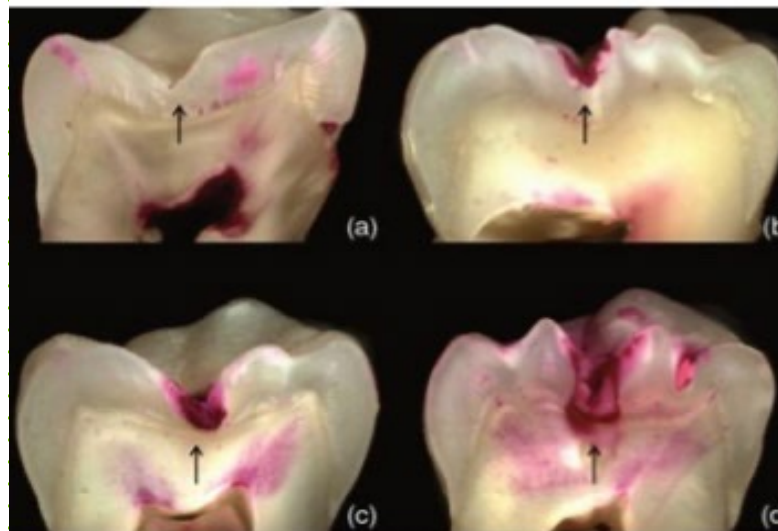
- **Electrical Conductance Measurement Method (Carie scan)**
- ***The idea of this method is that:***
- sound tooth structure should possess ***limited or no conductivity***.
- Whereas, carious enamel should have ***measurable conductivity that will increase with increasing demineralization***.
- (Tooth demineralization **due to** caries process causes increased porosity of tooth structure. This porosity contains fluid containing ions)
- Conductivity from the occlusal surface to a ground electrode is measured with a ***probe***.
- The only drawback is the fact that it is **time consuming** to use in a routine full-mouth examination.

Carie scan



- Simple to use
- Minimal false positives
- Bluetooth enabled
- More than 92.5% accurate
- Cutting edge technology

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- A study that compared ECM with visual examination, fiber -optic transillumination, and conventional and digital bitewing radiography concluded that "ECM was the most accurate diagnostic tool for the in vitro diagnosis of early, noncavitated occlusal lesions on posterior teeth"
 - ***Journal of Dentistry, March 1998, Vol. 26:2, p. 83-88***



- **Caries detector dyes**

- Various dyes such as **silver nitrate**, **methyl red** have been used to **detect** carious sites by change of color.
- These dyes aid the dentist in differentiation of **infected dentin**.
- These dyes enhance the visual recognition of caries by selectively staining the infected demineralized dentin which should be removed during preparation leaving the inner **affected dentine** (demineralized but not infected) that should be kept and not removed because it could be remineralized.



درهم وقاية خير من قنطار علاج

Thank you