

# Dental Radiology 1 (Final) - 2022

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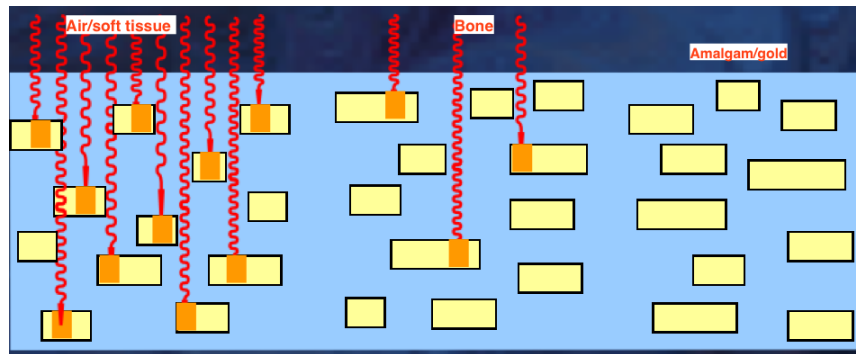


Lecture 1 (pt 2)

Film Processing

## latent Image

- As we previously mentioned, silver halide crystals in the film absorb the x-radiation during x-ray exposure and store energy from that radiation.
- This stored energy forms an Invisible pattern on the emulsion that is known as the **latent Image**. (Pattern formed by the Interaction of x-rays or light with silver halide crystals in the emulsion)
- It's created with development centers for processing (orange squares in the pic)
- It remains invisible within the emulsion until it undergoes chemical processing under darkroom conditions
- X-ray penetration according to the subject being imaged :
  - Air/ soft tissue: Many x-rays penetrate and expose many silver halide crystals
  - Bone: Fewer x-rays penetrate and not as many silver halide crystals are exposed
  - Amalgam/gold: Few, if any, x-rays penetrate; (silver halide crystals are not exposed)

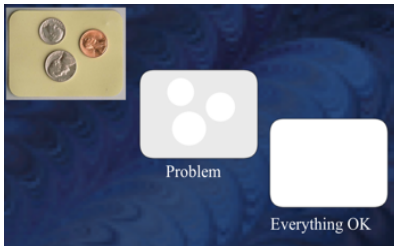
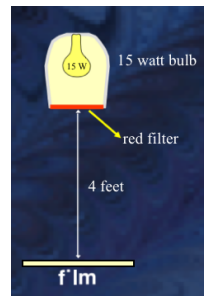


## Darkroom

- Its function is to provide a completely dark environment in which the X-ray film can be processed to produce diagnostic radiographs.
- Darkroom requirements:
  - Must be light-tight: meaning that it must be completely dark without any light leaks (any white light that leaks into the darkroom)
  - Must contain both hot and cold water (used in some steps of processing) with a mixer
  - Must be clean
  - Must have an adequate size (enough for at least one person to work in)

## Safelight

- It is a special type of lighting used to provide illumination in the darkroom so the person working in there could carry out processing activities safely without exposing or damaging the film
- (Additional) It is a low-intensity light composed of long wavelengths in the red-orange portion of the visible light spectrum
- Example: KODAK LED safelight: provides twice as much light and may be used for extraoral and Intraoral films
- Must be used with a **safelight filter**: removes the short wavelengths in the blue-green portion of the visible light spectrum that are responsible for exposing and damaging the x-ray film. (permits the passage of the safe light only). Examples:
  - Mortile: used with D-speed
  - GBX-2: may be used with all films (extraoral or intraoral)
- The safelight must have a 15-watt bulb (older style safelight) and must be mounted to the wall or ceiling at least 4 feet from the area where the films are unwrapped and loaded into the film processor.
- Improper safe lighting or light leaks result in films that appear fogged (appears dull gray, lacks contrast, and is non-diagnostic) (explained later with examples and images)
- Safelight test:



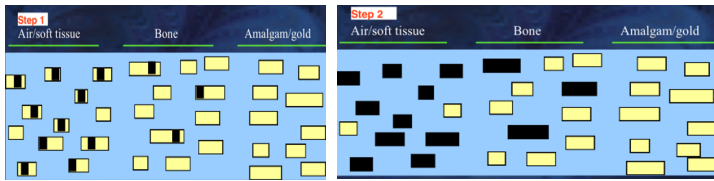
Lay a coin on a sheet of unexposed paper and leave it in the room in safelight conditions for about eight minutes, which is more than enough time to allow for a print to be made. Then, when processed, if the area where the coin has been is lighter than the rest, the safelight is fogging the paper or the room isn't light tight.

### ➤ Basic steps of processing latent images:

1. Developing: done using a developing solution (explained in the next page)
2. Rinsing: to remove the developer from the film and stop the development process
3. Fixing: done using a fixing solution (explained in the next page)
4. Washing: to thoroughly remove all excess chemicals from the emulsion
5. Drying: films must be completely dried before handling or mounting and viewing

## ❖ (1) Developing

- Steps:
  - 1- Development centers converted to black metallic silver
  - 2- Entire crystal converted to black metallic silver



- Done using a Developing solution; it contains 4 basic ingredients:
  - **Developer** (developing agent): made of two chemicals (hydroquinone and Elon) and converts exposed silver halide crystals into black metallic silver grains
  - **Preservative**: Helps prevent the developer solution from oxidizing in the presence of air
  - **Activator** (accelerator):
    - ✓ Provides alkaline environment required by developer (so It activates the developer)
    - ✓ Softens the gelatin in film emulsion, allowing the developer to reach the crystals more effectively
  - **Restrainer**:
    - ✓ Slows down rate of development of unexposed crystals (thus controls the developer)
    - ✓ Prevents the radiographic image from appearing fogged

## ❖ (3) Fixing

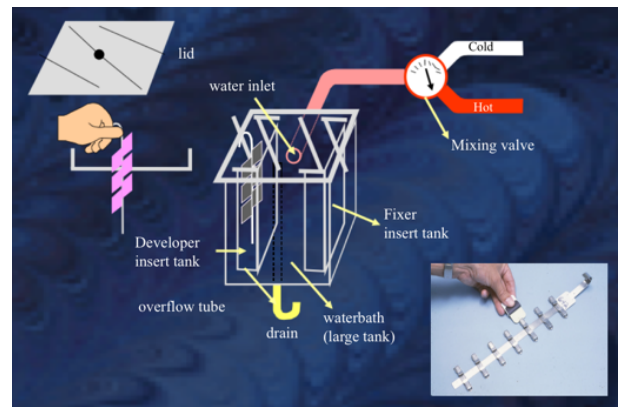
- To remove the unexposed, unenergized silver halide crystals from the film emulsion (yellow squares in the pic)
- Done using a fixing solution; has 4 basic ingredients:
  - **Clearing agent** (fixing agent): Dissolves and removes (clears) unexposed silver halide crystals from emulsion
  - **Acidifier**:
    - ✓ Neutralizes any contaminating alkali from the developer (Any unneutralized alkali may cause the unexposed crystals to continue to develop in the fixer)
    - ✓ Produces the necessary acidic environment required by the fixing agent
  - **Preservative**: Inhibits decomposition (oxidation) of the clearing agent



- **Hardener:** Hardens (and shrinks) the gelatin in the film emulsion after the activator in the developer solution had softened it (so the film can be handled)

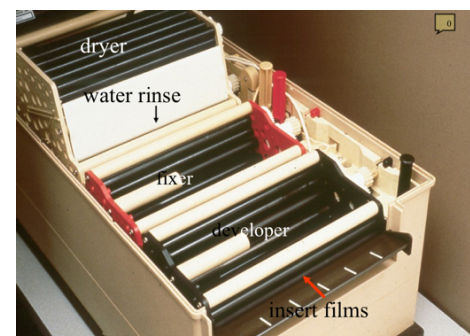
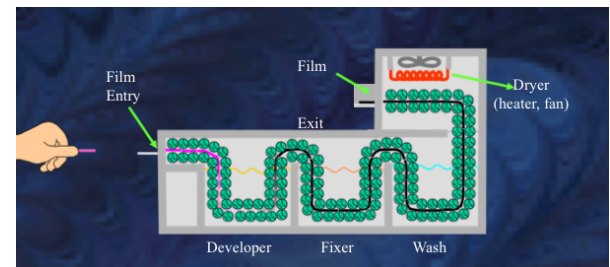
### Manual processing

- It is a simple method of developing, rinsing, fixing, and washing dental x-ray films
- When you manually process films you need to:
  - Check solution levels
  - Stir solutions frequently
  - Check temperature often
  - Replenish 8 ounces daily (up to 30 films; add 1 oz. per 4 films over 30)
- **Steps:**
  - Develop: 5 minutes 20° C (68° F)
  - Rinse: 30 seconds (agitate continuously)
  - Fix: 10 minutes (agitate intermittently, 5/30)
  - Wash: 10 minutes in clean running water
  - Hang films to dry



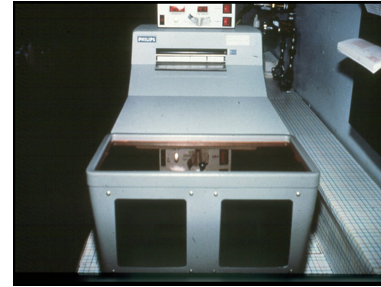
### Automatic Processor

- (Additional) It's preferred by many dentists as it requires less processing time, less equipment use, and less space. Also, time and temperatures are automatically controlled
- Films are ready in 5 minutes
- Requirements :
  - Developer: 28° C (83° F)
  - Replenisher: (refills solution) 230 ml (8 ounces) daily (up to 30 films; add 30 ml (1 oz.) per 4 films over 30)
- Some automatic film processors are restricted to use under safelight conditions





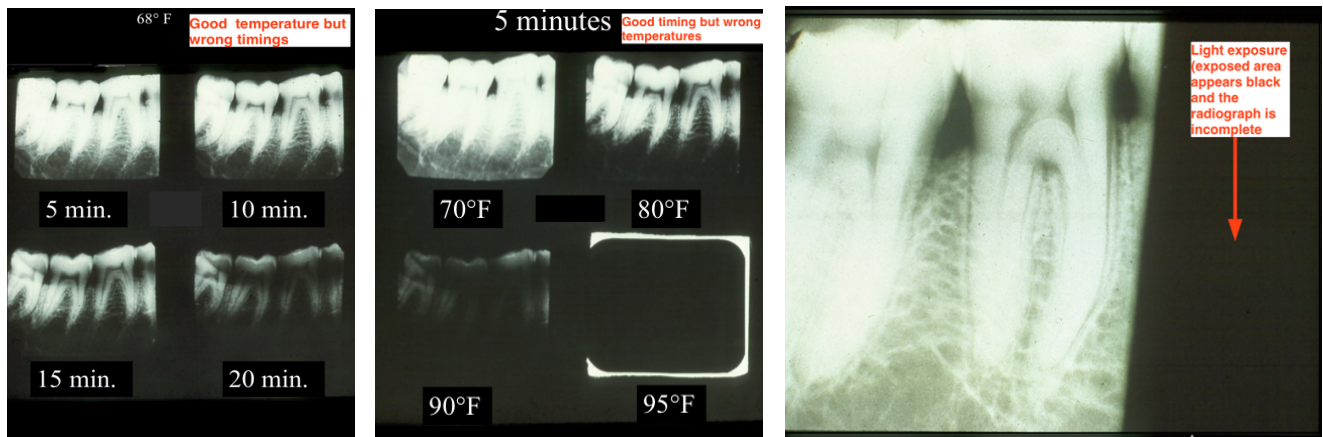
- Other automatic films are used with **daylight loaders**:
  - May be used in a room with white light
  - Used for intraoral films only
  - Must be placed in an area of subdued lighting (not too bright or harsh)
- An automatic processor requires routine preventive maintenance. (Must be cleaned regularly):
  - Use Roller Transport Clean-up Film daily to clean rollers before processing films
  - Clean automatic processors at every solution change (every 2 to 4 weeks)
  - Clean rollers with warm water/soft brush



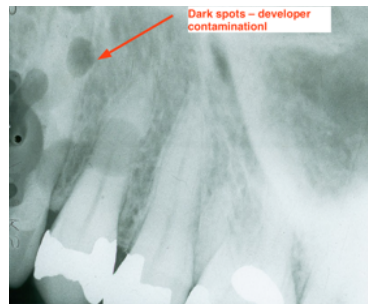
Processing Errors



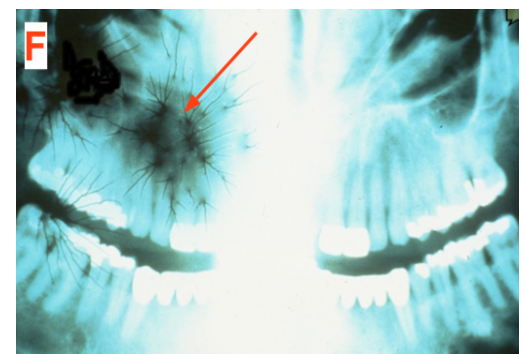
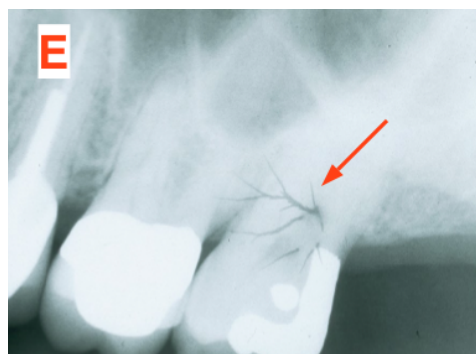
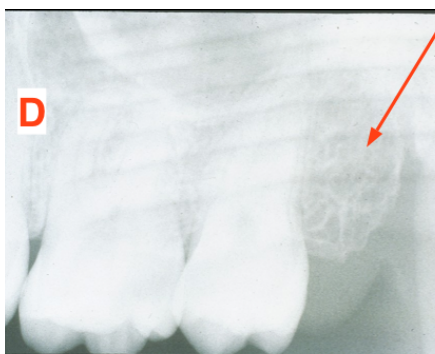
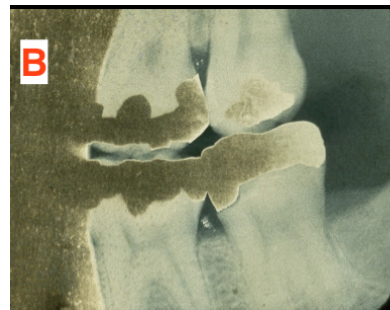
- Dark Film
  - Solutions were too warm
  - Very long time in developer
  - Developer concentration was too high
  - Light leaks (white light that leaked into darkroom); incorrect filters



- Light Films
  - Solutions were too cool
  - Short development time
  - Under-replenishment
  - Contaminated developer
  - Excessive fixation



- White spots : fixer contamination or air bubble (Air trapped on the film surface after being placed in the processing solutions) (pic A)
- Yellow/brown stain: Inadequate wash or fixing time , depleted (exhausted) fixer (pic B)
- Films overlapped during processing: additional: excess development time, inaccurate timer, high developer temp. (pic C)
- Dirty rollers (pic D)
- Static electricity: additional: opening film packet quickly, Opening a film packet before touching another object such as the film processor (pic E & F)



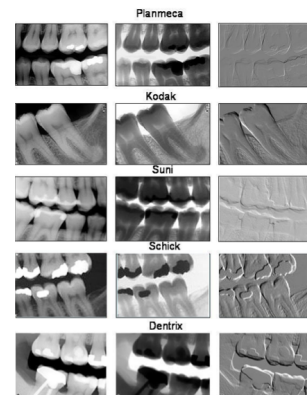
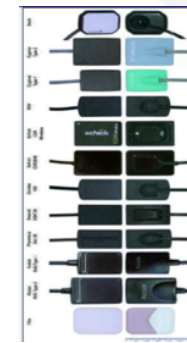
## Digital images

- An image composed of pixels that can be stored in a computer.
- ❖ Direct digital imaging
  - An intraoral sensor (replacing conventional film) is exposed to x-radiation to capture a dental image that can be viewed on a computer monitor. (The sensor is directly connected to computer by cord)
  - Uses normal conventional X-ray generating equipment
  - There are two types of sensors:
    - CCD (charge coupled device)
    - CMOS (complementary metal oxide semiconductor)
  - Different sizes of sensors are produced
    - Intraoral periapical sensor (bulkier than traditional films which makes them uncomfortable for patients)
    - Extraoral panoramic sensor
  - Component of Direct Digital Imaging:
    - Sensor
    - USB
    - windows software program
    - computer

Step 1: Take x-ray with sensor hooked to the x-ray machine



Charge-coupled-device System



## ❖ Indirect Digital Imaging

- We use an image plate (coated with phosphors) instead of a conventional film and it is not attached to the computer (cordless) ( a sensor is scanned following exposure to x-radiation and then converted into a digital form that can be viewed on a computer monitor.)
- Extra step is scanning
- Reusable PSPP (Photo stimulator phosphor storage plate ) is used instead of a film
  - PSPP contains a layer of barium fluorohalide phosphor
- A range of intraoral plate sizes are available as well as extraoral plates.

Step 1: Load imaging plates



Storage Phosphor Plate System

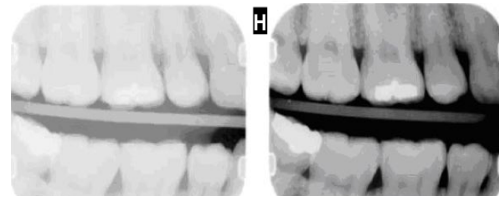
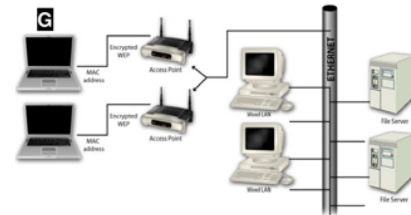


- Components:
  - PSPP
  - Scanner
  - Windows software
  - Computer



#### ➤ Advantages of digital Imaging

- Requires a lower dose of radiation
- No need for conventional processing.
- Easy storage & archiving of patient information.
- Easy transfer of images electronically. (Pic G)
- Image enhancement and processing. (Pic H)
- Improves the communication between the doctor & the patient which earns the patient self-confidence and easy acceptance of treatment.



#### ➤ Disadvantages of digital film imaging

- Expensive
- Connecting cable can make intraoral placement difficult.
- Loss of image quality or resolution on the hard copy print-out.
- Image manipulation can be time consuming for inexperienced.
- It is easy to get access & change the original images.

#### ➤ Digital Image Enhancement

- Brightness and contrast
- Sharpening and smoothening.
- Color
- Digital subtraction radiography

### Digital Subtraction Radiology

- Used to enhance a diagnostic image (eliminates distracting background information)
- We take a digital radiograph for diagnosis and after time we take another one of exactly the same region and with identical exposure time, tube current and tube voltage
- The numbers of gray values should be the same except for site where changes have occurred.

- So we subtract the gray value and if the difference is non-zero, there is change, this change appear as brighter area when the change represent gain and as a darker area when the change represent loss.
- **Additional** With digital subtraction, the gray-scale is reversed so that radiolucent images (normally black) appear white and radiopaque images (normally white) appear black

## TEST YOURSELF

1- The first step in manual film processing is:

- development
- rinsing
- fixing
- washing
- drying

2-In manual film processing, the rinsing step is necessary because it:

- removes the silver halide crystals from the emulsion
- slows down the fixing process
- removes the developer from the film and stops the development process
- thoroughly removes all excess chemicals from the emulsion
- reduces the energized silver halide crystals to black metallic silver

3- The film emulsion is hardened during:

- development
- rinsing
- fixing
- washing
- drying

4-The hydroquinone in the developer brings out the \_\_\_\_\_ tones, whereas the Elon in the developer brings out the \_\_\_\_\_ tones on a dental radiograph.

- black; white
- white; black
- gray; gray
- white; gray
- black; gray

5- In manual film processing, the optimal temperature or the developer solution is:

- 55° F
- 68° F
- 78° F
- 80° F
- 90° F

6-The size of a darkroom is determined by all the following factors except:

- type of processing equipment used
- humidity level of the room
- space required or duplication of films
- number of persons using the room
- All of the above

7- Any leaks of white light into the darkroom will cause:

- Film fogging
- Film reticulation
- overdeveloped films
- underexposed films
- any of the above

8-The safelight must be placed a minimum of how many feet from the film and the work area?

- 1
- 2
- 3
- 4
- 5

9-A universal safelight filter such as the GBX-2 by Carestream Health is recommended for:

- intraoral films only
- extraoral screen films only
- extraoral nonscreen films only
- intraoral and extraoral films
- none of the above

10- Unopened boxes of radiographic film should not be stored in the darkroom because:

- a) chemical fumes from processing solutions may fog the film
- b) continued exposure to the safelight is not recommended
- c) the box may have a tear that may expose the film
- d) processing solutions could splash onto the boxes of film
- e) all of the above

11-The thermometer or manual processing should be placed in the:

- a) developer solution
- b) water bath
- c) Fixer solution
- d) either a or c
- e) all o the above

12- At 68° F, what is the optimal development time in minutes for manual film processing?

- a) 2
- b) 3
- c) 4
- d) 5
- e) 6

13- All factors affect the life of the processing solutions except:

- a) number of films processed
- b) care in preparation of solutions
- c) type of safelight filter used
- d) age of solutions
- e) proper care and maintenance of the automatic processor

14- A replenisher is added to the processing solution to: (refills the solution)

- a) compensate for the loss of solution strength
- b) ensure uniform results between solution changes
- c) compensate or the loss of volume of solution
- d) compensate for oxidation
- e) All of the above

15- How often should the processing tank be cleaned?

- a) once per week
- b) once per month
- c) once per day
- d) whenever solutions are changed
- e) none o the above

16- Which can be used to clean the processing tank?

- a) commercial tank cleaner
- b) hydrochloric acid and water solution
- c) abrasive-type cleansers
- d) both a and b
- e) all of the above

17- A breakdown of chemicals in the processing solution that results rom exposure to air is termed:

- a) reduction
- b) selective reduction
- c) oxidation
- d) replenishment
- e) none of the above

18- The super-concentrated solution that is added to the processing solution to compensate or the effects of oxidation is termed the:

- a) acidifier
- b) hardener
- c) oxidizer
- d) replenisher
- e) emulsifier

1.a	4.e	7.a	10.a	13.c	16.d
2.c	5.b	8.d	11.a	14.e	17.c
3.c	6.b	9.d	12.d	15.d	18.d

**Best of Luck <3**