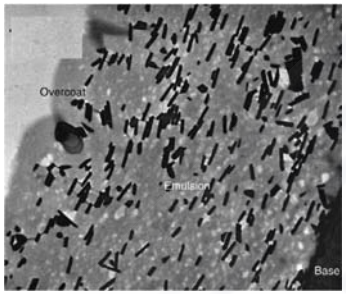
Syrian Private University
Faculty of Dentistry
Department of Oral Medicine

Dental X-ray films & Film processing



Lecture 5+6

Imad Brinjikji

Intraoral Film Sizes

0 (Children): for PA & BW or small mouths (22x35 mm).

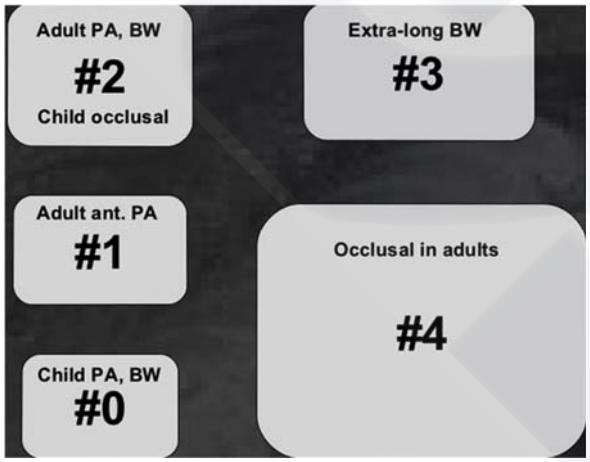
1 (Adult anterior): for PA (24x40 mm).

2 (Standard size for adult): for PA & BW (30x40 mm).

3 (Extra long BW): (27x54 mm)

4 (Adult Occlusal): (57x76 mm).

Dental X-ray films



Dental X-ray films

Film composition

- All intraoral X-ray films consist of:
  - o Film sheet (1 or 2).
  - o Black paper wrapper.
  - o A lead foil behind the film.
  - o Outer Wrapper (plastic or paper).

Dental X-ray films

- The second film sheet serves as a duplicate record that can be sent to insurance companies or to a colleague (patient referrals).
- One corner of each dental film has a small, raised dot that is used for film orientation.
- The convex side of the dot faces the x-ray tube.

Dental X-ray films

The black paper

- Ensures that the film sheet is protected against light and moisture.

Dental X-ray films

The lead foil

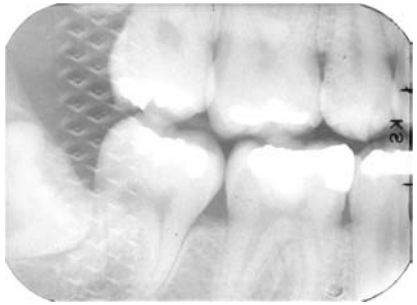
- It is away from the tube (Why?)
  - It reduces patient exposure.
  - It shields the film from backscatter (secondary) radiation, which fogs the film and reduces subject contrast (image quality).
- It has an embossed pattern (why?)

Dental X-ray films

The lead foil

- When the film packet is exposed backward in the mouth, the pattern of the lead foil will be seen in the radiograph.

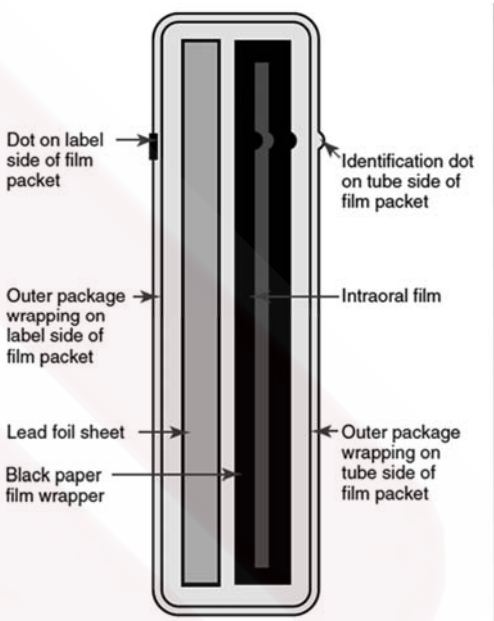
- The dentist will know that the sides on the radiograph are inverted.



Dental X-ray films

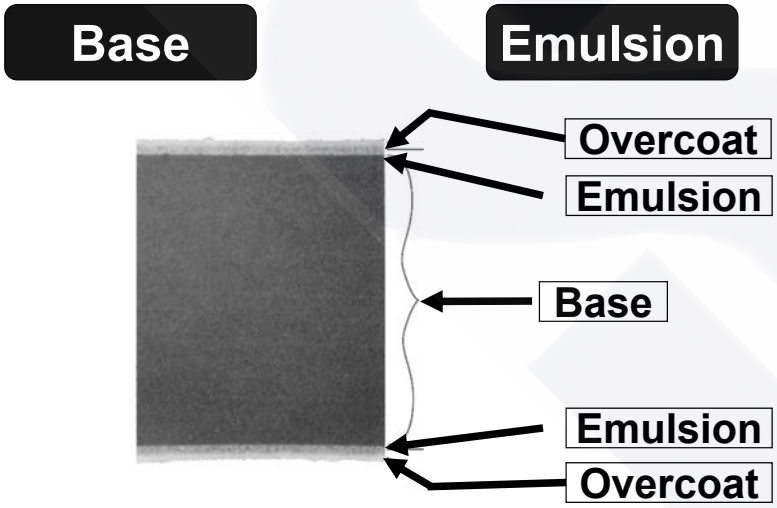
The outer package

- o The outer package is made of paper or plastic.
- o It is resistant to moisture (saliva).
- o The face that should face the tube-head is indicated (tube side). The other side is the label side.



Dental X-ray films

The film sheet



Dental X-ray films

The base

- o The base is made of a flexible plastic.
- o It supports the emulsion.
- o It is not affected by the processing solutions.
- o It is about 0.2 mm thick.

Dental X-ray films

The emulsion

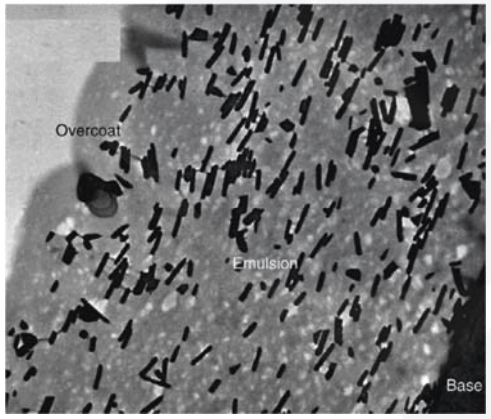
- Dental x-ray films are made as a double-emulsion film, because less radiation is required to produce an image.

Dental X-ray films

The emulsion

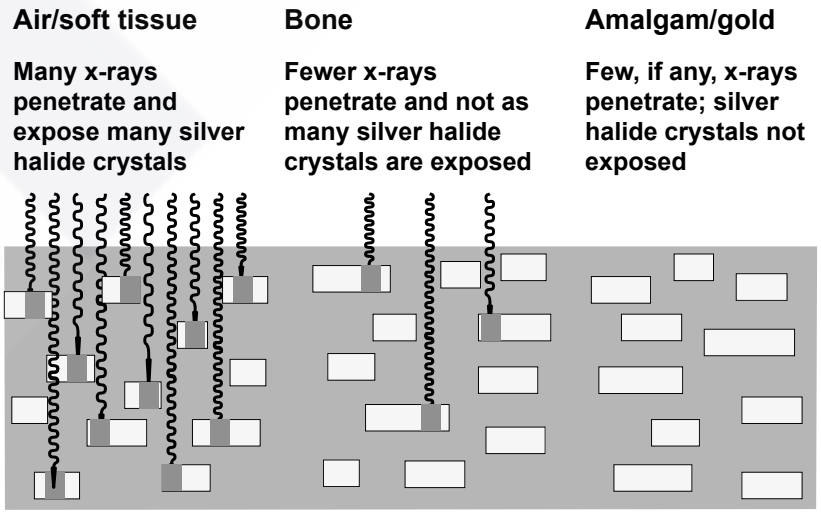
- Consists of silver halide crystals and a vehicle matrix of gelatin.

Crystals component



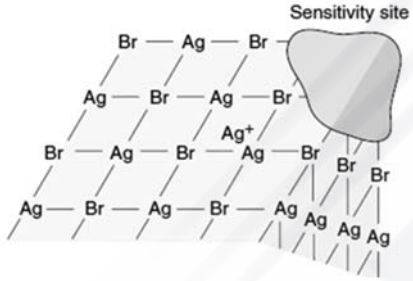
The crystals are silver bromide (AgBr) + little amount of silver iodide (AgI). Very little amount of Sulphur is also added.

Latent image



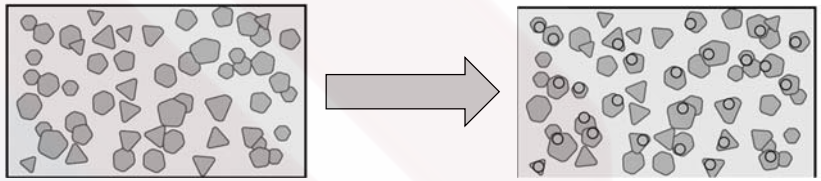
Processing X-ray films

- Sensitive sites are physical irregulating in the crystal (due to the presence of I^- ions and Sulphur).
- Each crystal has many sensitive sites.
- Sensitive areas are sensitive to radiation.



Latent image

- After exposure, the film is chemically altered (the formation of the latent image).
- (Latent = invisible).
- The latent image cannot be seen except after processing the film.

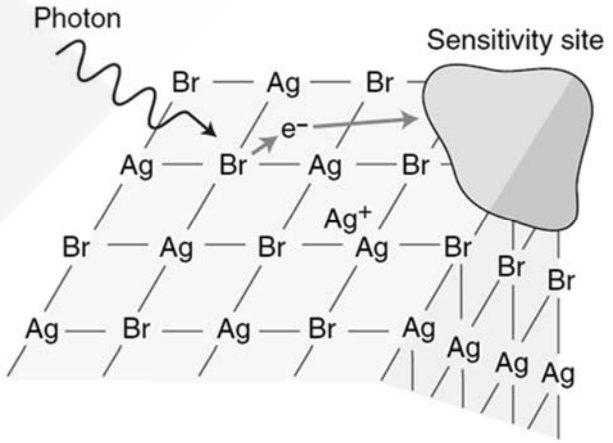


Chemical interactions

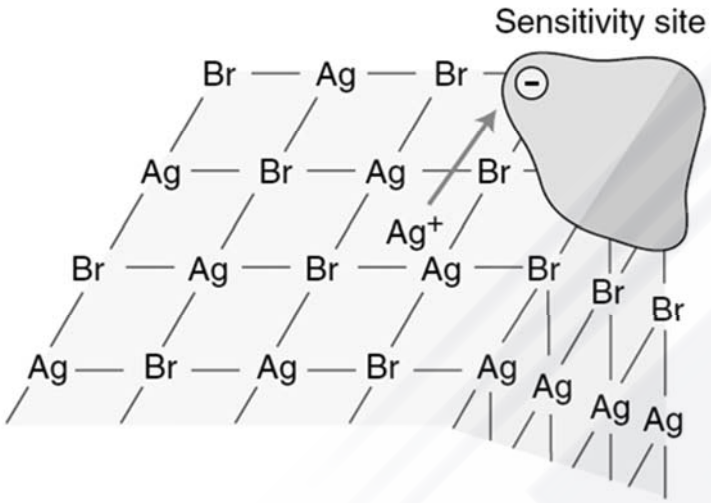
$$Br^- \xrightarrow{\textbf{X-ray photon}} Br_{(atom)} + e^-$$

$$Ag^+ + e^- \longrightarrow Ag_{(atom)}$$

Chemical interactions

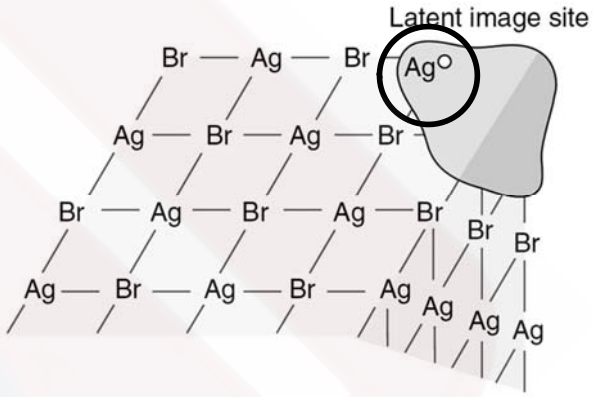


Chemical interactions



Chemical interactions

- This process occurs one time or more within a crystal.



Processing X-ray films

- Neutral silver atoms [black metallic silver] (Ag^0) are responsible to initiate the interaction between the developer and the crystals.

Basic Steps of Processing

Developing

Rinsing

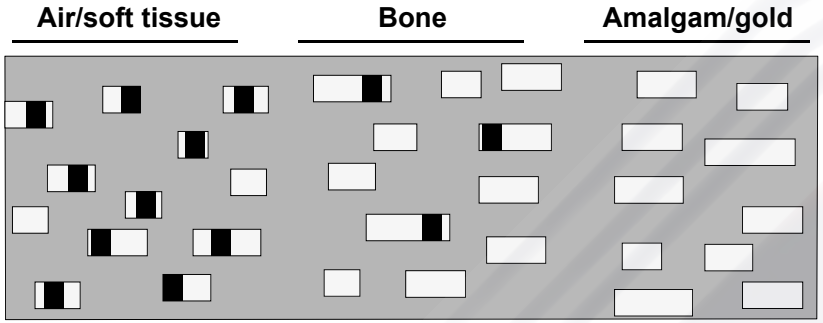
Fixing

Washing

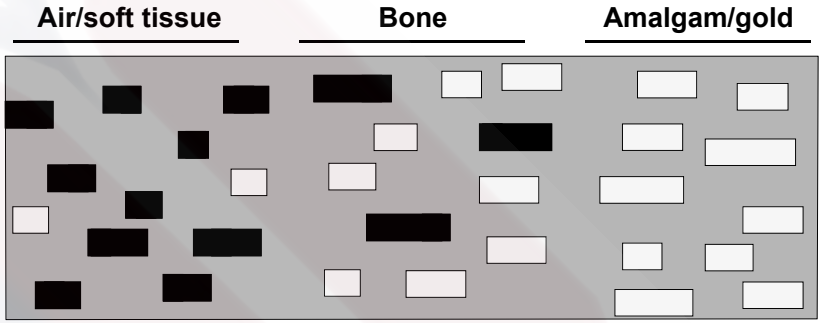
Drying

Developing

Entire crystal that contains silver atoms (Ag^0) is converted into a black crystal by the developer.

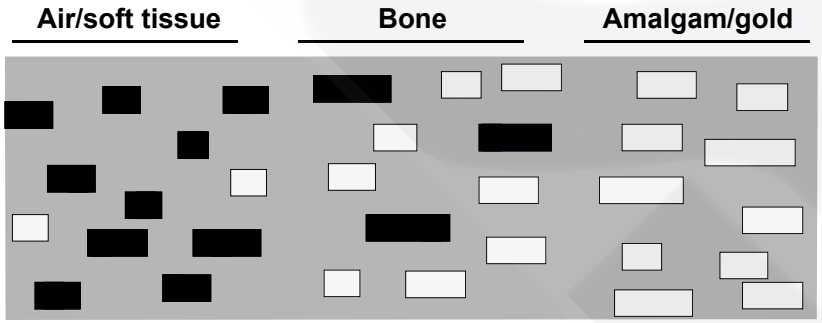


Developing



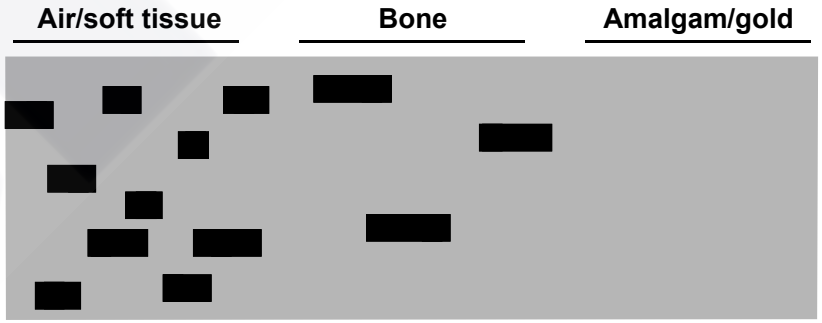
Fixing

Unexposed crystals removed from film.



Fixing

Unexposed crystals removed from film



Developing Solution

I. Developer

II. Preservative

III. Activator

IV. Restrainer

I. Developer agent

- Converts exposed silver halide crystals into black metallic silver grains.
- Unexposed crystals are unaffected during the time required for reduction of the exposed crystals.
- Phenidone and hydroquinone.

II. Activator

- Provides alkaline solution needed by developers (Ph≈10).
- Activator also softens the emulsion, allowing developer to reach crystals more rapidly.
- Sodium or potassium hydroxide (NaOH / KOH).

III. Preservative

- This is an antioxidant agent helps prevent developer from being oxidized by the air.
- Sodium sulfite.

Developing Solution

IV. Restrainer

- Restrain the development of unexposed crystals.
- Bromide containing compounds.

Rinsing

- Rinsing dilutes the developer, slowing the development process.
- It also removes the alkali activator, preventing neutralization of the acid fixer.

Fixing Solution

Fixing Solution

A. Clearing Agent

B. Acidifier

C. Preservative

D. Hardener

Fixing Solution

A. Clearing Agent

- Dissolves and removes unexposed silver halide crystals from emulsion.
- Excessive fixation (hours) results in a gradual loss of film density, because the grains of silver slowly dissolve in the fixing solution.
- Ammonium thiosulfate (hypo).

Fixing Solution

B. Acidifier

- It promotes the diffuse of thiosulfate into the emulsion.
- Neutralizes any contaminating alkali from the developer.
- Acetic acid (Ph =4-4.5).

Fixing Solution

C. Preservative

- Inhibits decomposition (oxidation) of clearing agent.
- It prevents oxidation of the thiosulfate clearing agent.
- Sulfite compounds.

Fixing Solution

D. Hardener

- Hardens the emulsion so film can be handled.
- Reduces swelling of the emulsion.
- Aluminum sulfate.

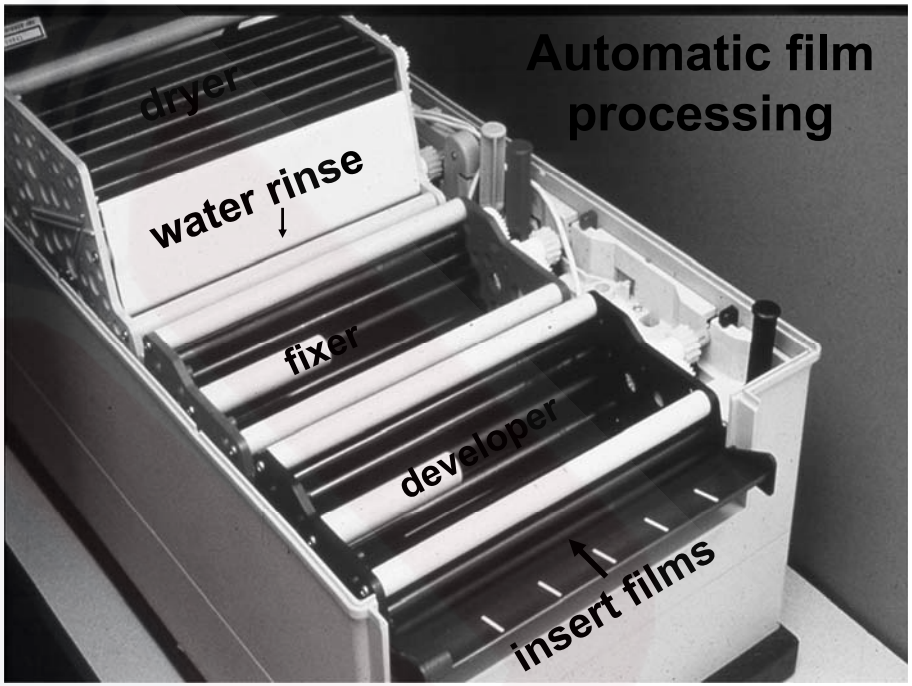
Manual Processing

- Follow the instructions of the manufacturer regarding the appropriate temperature and the recommended processing times.
- Solutions may be classified to
  - Regular-processing solutions.
  - Rapid-processing solutions.

Manual Processing

For drying

- **Hang films to dry.**
- **Or, use an electric fan to speed the drying of films, but the electric fan should not be pointed directly at the films.**



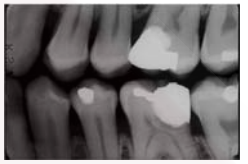
Automatic Processor

- **Use Roller Transport Clean-up Film daily to clean rollers before processing films.**
- **Clean rollers with warm water/soft brush.**

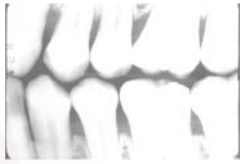
Technical and film processing errors

I. Inappropriate film density and contrast

too dark



correct density



too light

I. Inappropriate film density and contrast

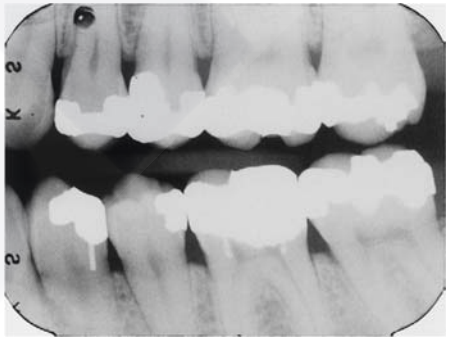
Dark Film

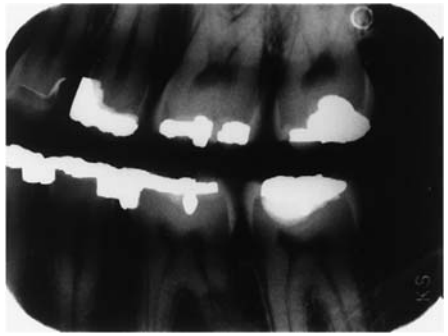
- Solutions too warm
- Too much time in developer
- Developer concentration too high
- Light leaks

Technical and film processing errors

I. Inappropriate film density and contrast

Dark Film



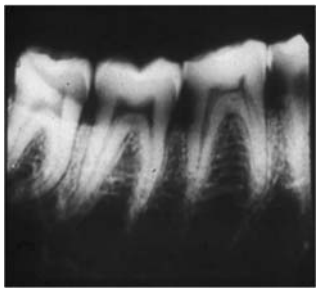


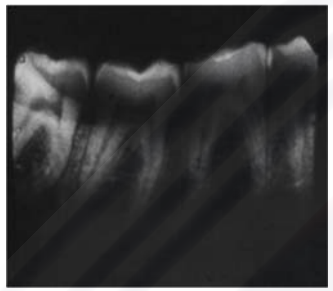
Over-exposed film.

Technical and film processing errors

I. Inappropriate film density and contrast

Dark Film





Over-developing
Less contrast than the over-exposed film.

Technical and film processing errors

I. Inappropriate film density and contrast

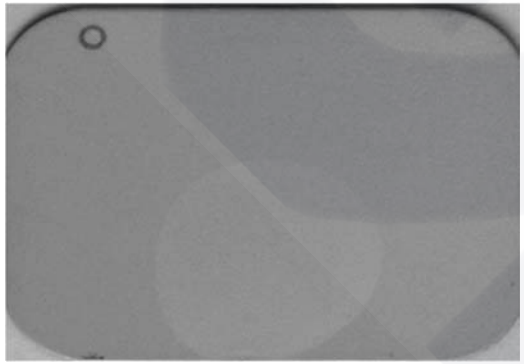
Light Film

- **Solutions too cool**
- **Short development time**
- **Excessive fixation (<u>hours</u>)**
- **Expired film**

Technical and film processing errors

I. Inappropriate film density and contrast

Clear film



Unexposed film was processed.
Exposed film immersed in fixer before developer.

Technical and film processing errors

I. Inappropriate film density and contrast

Totally black film

Excessive over-developing.
Light exposure.

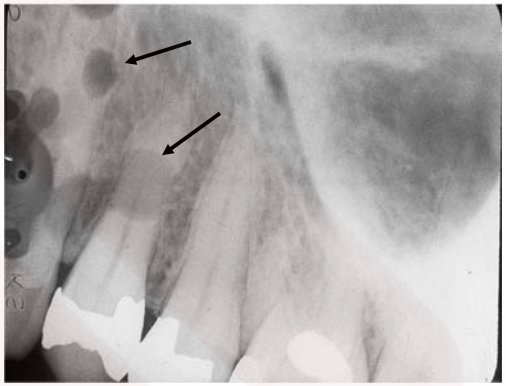
Technical and film processing errors

I. Inappropriate film density and contrast

Part of the image was exposed to light.

Technical and film processing errors

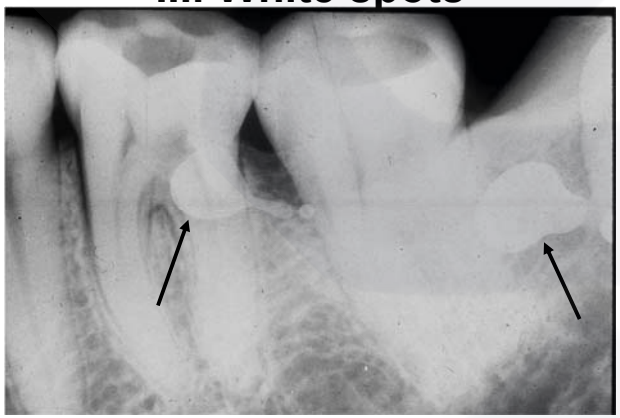
II. Developer contamination



Dark spots

Technical and film processing errors

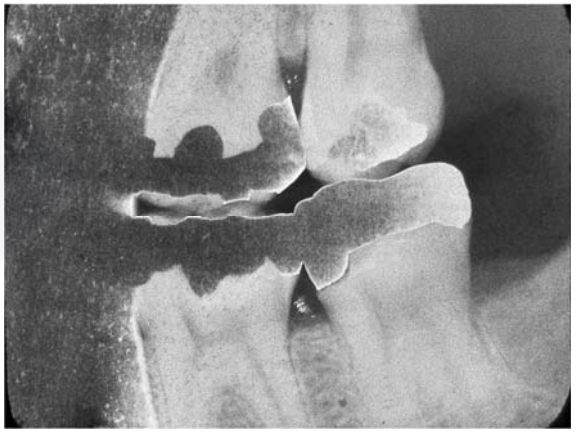
III. White spots



Air bubbles
Fixer contamination
Water contamination before developing

Technical and film processing errors

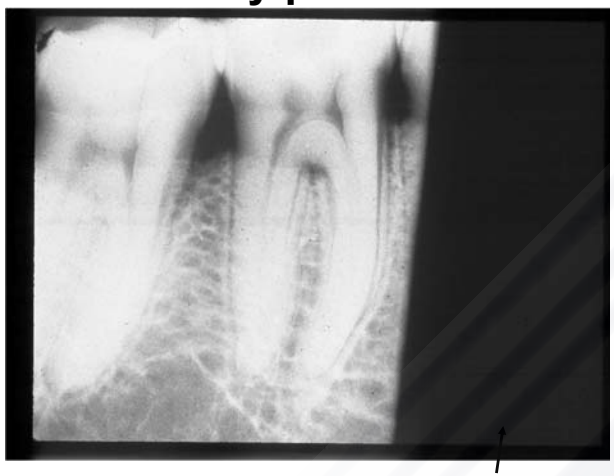
IV. Yellow / brown stain



Inadequate wash
Depleted developer or fixer

Technical and film processing errors

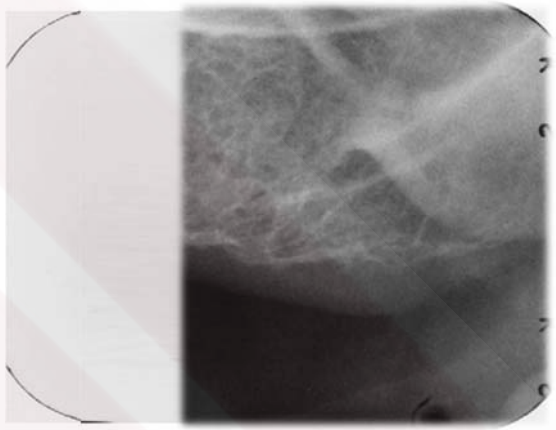
V. Partially processed film



Not completely immersed in fixer

Technical and film processing errors

V. Partially processed film



Not completely immersed in developer.

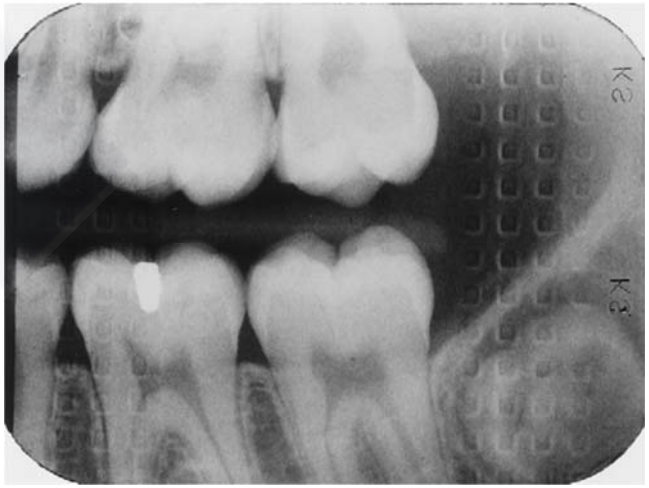
Technical and film processing errors

VI. Inadequate fixation

Inadequate fixation.

Technical and film processing errors

VII. Reversed film



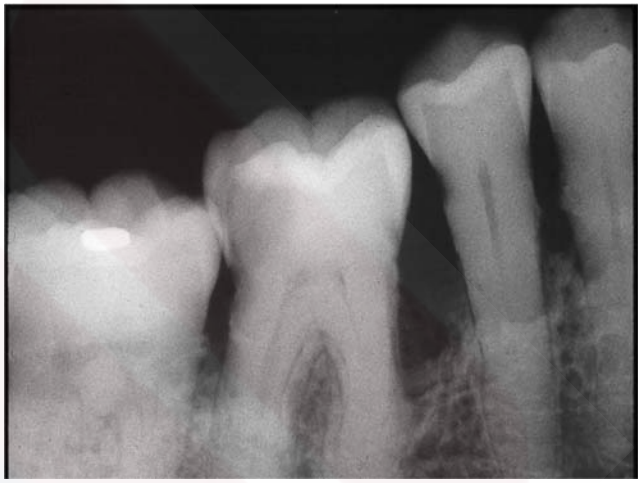
Be careful. The sides also are reversed.

Technical and film processing errors

IX. Double exposure

Technical and film processing errors

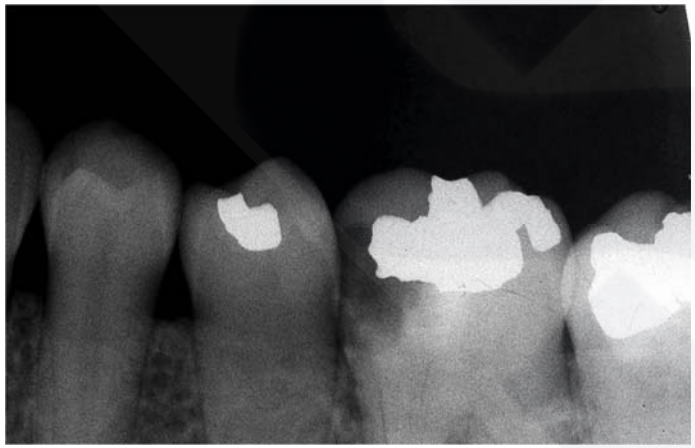
X. Inappropriate film placement



Tipping

Technical and film processing errors

X. Inappropriate film placement



> 3-4 mm of film beyond occlusal

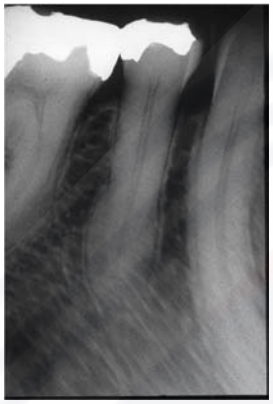
Technical and film processing errors

X. Inappropriate film placement

Usually, the film was moved by the patient just before exposure (though well placed).

Technical and film processing errors

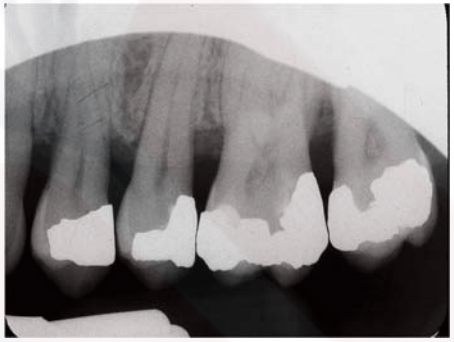
X. Inappropriate film placement

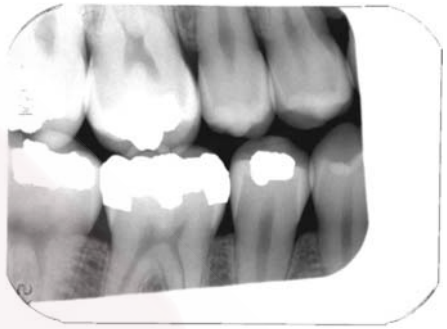


Partial curving the Film.
Excessive finger pressure.

Technical and film processing errors

XI. Cone cut

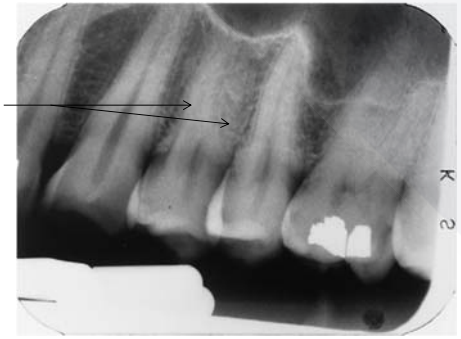


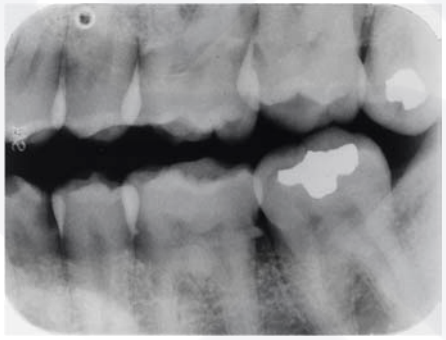


Partial image (poor alignment of the tube head).

Technical and film processing errors

XII. Technical errors

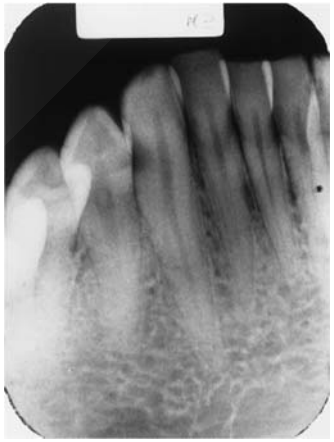




Overlap (incorrect horizontal angulation)

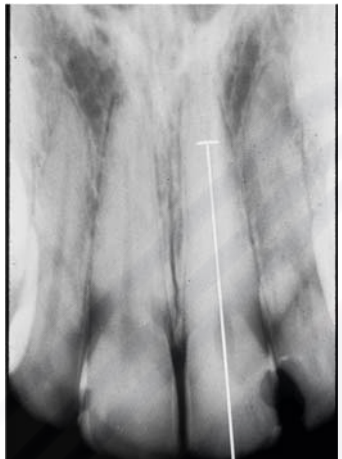
Technical and film processing errors

XII. Technical errors



Overlap (incorrect horizontal angulation)

XII. Technical errors



Elongation (decreased vertical angulation)

XII. Technical errors

Foreshortening (excessive vertical angulation)

XIII. Patient movement

XIV. The patient's finger on the radiograph

Technical and film processing errors

XIV. The patient's denture not removed

Complete upper denture.
the denture helps to retain and stabilize the bite-block holding the film.

Cast dentures are not acceptable.

Technical and film processing errors

XV. Inappropriate film handling

Fingerprint on the film.

Technical and film processing errors

XV. Inappropriate film handling

Scratched emulsion from rough handling of the film.

Technical and film processing errors

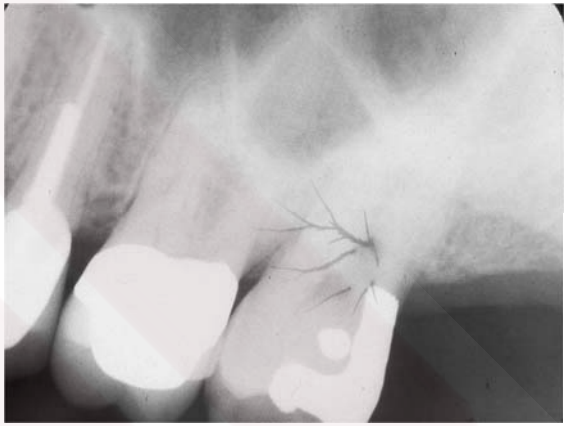
XV. Inappropriate film handling

Film crimping/ bending.

XV. Inappropriate film handling

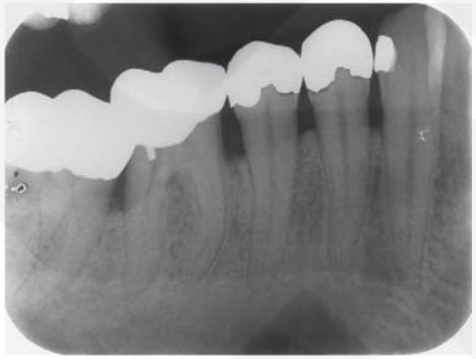
Writing the patient's name on the unwrapped film.

XV. Inappropriate film handling



Static electricity. Humidify the darkroom with a humidifier or a large open container of water.

XVI. Fogging film

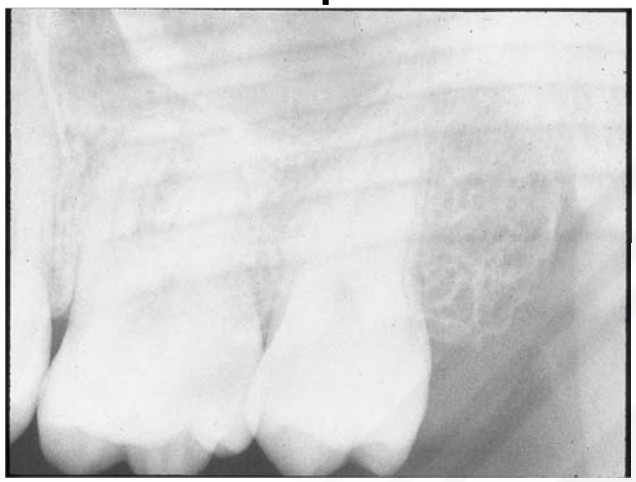


- Use of outdated film.
- Film storage in a warm place.
- Exposure of film to scatter radiation.
- Light leaks in the darkroom.
- Unsafe safelight.

XVII. Automatic processor errors

Two films were stuck together in the processor.

XVII. Automatic processor errors



Dirty rollers

THE END