Radiology

Film imaging

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X – Ray Films Radiograph: Is the image of an object made with use of X- ray instead of light.

Dental x- ray film: Is a recording media on which image of the object was made by exposing this film to X- ray.

Types of X- ray film

a- Intra oral X- ray film.

b- Extra oral X- ray film.

a- Intra oral X- ray film

Chemical composition of X- ray film:

It consists of a sensitized emulsion present on both sides of transparent base.

The base is the foundation of the radiographic film, made from cellulose acetate. Its primary purpose is to provide a rigid structure onto which the emulsion can be coated. Its flexible and fracture resistant to allow easy handling but rigid enough to be placed on the viewer.

The emulsion is the heart of the x-ray film, it's the material with which the x-ray or light photons interact and forming the image. It consists of homogenous mixture of silver halides crystals (mainly silver bromides) suspended in gelatin. The silver bromide crystals are sensitive to both light and X- ray photons.

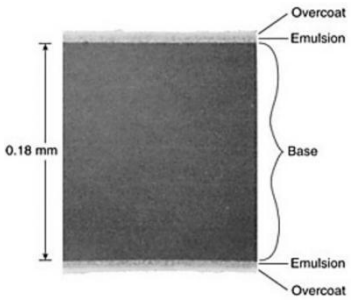


Fig. 1: Diagram showing the cross-sectional structure of radiographic film.

The intra oral film is wrapped by opaque material to prevent light from reaching the film because light photons can activate the silver halides crystals. Also a thin sheet of (Lead foil) is usually placed behind the film to prevent most of secondary radiation that originated in the tissue of the patient behind the film from reaching it. Therefore this lead foil reduces secondary radiation and minimizes film fog. In addition the lead foil absorbs X- ray that have passed through the object and the film so it reduce the exposure of the tissue behind the film. This foil has a design of (herring bone pattern).

Fig. 2: The contents of a film packet.

Intra oral film types

Classified on numerical basis into:

A - Type I

Called **periapical** film used to examine the apical area of the tooth and the surrounding structures (record the crowns, roots, and surrounding bone).

Film packs come in three sizes

•Size 0 for small children (22 mm × 35 mm)

•Size 1, which is relatively narrow and used for views of the anterior teeth (24 mm × 40 mm)

•Size 2, the standard film size used for adults (30.5 mm 40.5×mm)

So the available sizes are (1.0, 1.1 and 1.2)

B – Type II

Is called **bitewing** film it used to detect the inter proximal caries and the height of alveolar bone between 2 adjacent teeth. Bite-wing films often have a paper tab projecting from the middle of the film on which the patient bites to support the film. Size 2 film is normally used in adults; the smaller size 1 is preferred in children. In small children, size 0 may be used. A relatively long size 3 is also available. So the size include (2.0, 2.1, 2.2 and 2.3)

C – Type III

Is called **occlusal** film that used to demonstrate area larger in dimension than area appearing in periapical film. the size is (3.4) only.

Fig 4: types of x-ray films (manual and self-developing)

Intra oral film speed

Speed means the sensitivity of X- ray film silver bromide crystals (Ag Br) to X- ray photon.

There is direct relation between the speed of the film and the size of the crystals, the larger crystal size the faster film speed. the faster mean it need less amount of radiation to produce radiographic image so less radiation dose absorbed by patient.

The classification of film speed based on alphabetical basis so from A to F, film speed A is the slowest while speed F is the faster one. Only films with a D or faster speed rating are appropriate for intraoral radiography.

E/F-speed film is preferred because it requires approximately half the exposure time and thus half the radiation dose of Dspeed film. In the United States the most widely used films are ULTRA-speed (Dspeed) and INSIGHT (E/F speed).

b- Extra oral film

The purpose of using such film is to make a radiographic image able to examine an area in and around the jaw that can't be seen by intra oral film, such as panoramic , cephalometric and other skull radiograph

Types of extra oral film

1. Screen
2. Non screen

❖ Non screen film

1. Film emulsion is more sensitive to X- ray than to light.
2. The film has double emulsion like intra oral film but the emulsion is thicker.
3. Increased thickness of emulsion make the non screen film need less amount of radiation so it need less exposure time.
4. The size of the film used include: 5×7 and 8×10 inches.

❖ Screen film

1. Film emulsion is more sensitive to visible light and more specifically to blue light in the visible light spectrum.
2. The size include: - 5×7, 8×10 and 10×12 inches.

❖ The screen film placed between 2 fluorescent screen in cassette. These 2 fluorescent screen made from (tiny calcium tungestate crystals). When these crystals exposed to X- Ray , the result of this exposure is a creation of light , this light in turn exposes the screen film to produce the image.

Fig4: screen film

Film properties

These include density, contrast and details or definition.

A. **Density**:

Is the degree of blackness present in the processed film it measures in terms of light transmission on a percentage or logarithmic scale.

Film density used in diagnostic radiograph is ranged from 0.25 to 2. The more film exposure to X- ray the blacker it becomes when processed.

The optical density OD of unexposed film are due to base density and fog density (background fog density).

The base density is the OD inherent in the film base and its due to the composition of the base and the tint added to it to make the radiograph more pleasing to eye (it's about 0.1), while fog density is related to the development of silver grains that contain no useful information, it results from exposure of film during storage, undesirable chemical contamination, improper processing (should not exceed 0.2).

Factors affect film density

1. Exposure time: increase exposure time increases the film density.
2. Milliampere: increase milliampere value (mA) which is usually ranged from 10–15mA, cause increasing film density.
3. Kiolvoltage: increase Kilovoltage value (kV) cause increasing film density.
4. Developing time: developing time usually range from 4 – 5 minutes. increase developing time cause increasing film density.
5. Distance: increase the distance between x- ray tube and the film during exposure cause decrease film density.

B. Contrast:

It means the graduation of differences in film density at different areas of a radiograph.

Type of contrast:

1. Long – scale or low contrast:- when many different film densities can be seen between totally clear and totally black areas of the radiograph.
2. Short – scale or high contrast:- when few different film densities can be seen between totally clear and totally black areas of the radiograph.

The stepwedge or penetrometer: Is an object used to show the radiographic contrast .it's usually made of aluminum and is constructed so that there is a constant increase in thickness of aluminum between the X- ray tube and the film.

❖ **Factors affect contrast**

1. Kilovoltage: increase kilovoltage cause increase the contrast scale

2. Processing solution temperature: increase the temperature cause decrease of contrast scale.

C. **Details or definition**:

Is the ability to reproduce sharp outlines of the object.

Factors affect details

1. Focal spot size: size of focal spot must be as small as possible in order to produce sharp image.

2. Film grain size (film crystals): increase the size of film grain produce less sharp image.

3. Movement of patient head or X- ray tube or the film during exposure causes unsharp image.

4. Target object distance: which should be as great as possible, otherwise the image will be unsharp.

5. Object film distance: should be as small as possible to produce sharp image.

6. Screen – film contacts: poor contact cause un sharp image.

• **What will happen during exposure of X- ray film exposure to radiation?**

x- ray photons interact with electrons of the atoms of the chemical emulsion in the Xray film so the result is analog image, analog means the image appears identical to the original.

Latent image formation

The Ag Br crystals in the film emulsion are changed whenever they absorb X- ray photons, the result of absorption is precipitation of speck of silver in each exposed Ag Br crystal to X- ray, collectively these specks are called Latent image which is invisible and in order to convert to visible image X- ray film must be processed.

Film processing

Its either manual or automatic processing.

Processing cycle include: Developing, rising, fixing, washing and drying.

• **Developing:** is the stage of processing during which the latent image is converted to a visible image. X- ray film is placed in alkaline developer solution ,the action of developing agents are on exposed Ag Br crystals to continue the process of precipitating the specks of silver until all silver is deposit at the site of crystal and the bromine is released into the developing solution causing softening of the X- ray film emulsion .

• **Rinsing:** by water for 30s to terminates the developer action and remove chemicals from emulsion.

• **Fixing:** by using a fixer solution .its action is:

1. Re harden the film emulsion
2. Removed all the unexposed or undeveloped crystals.

After fixing the film washed in running water & finally drying.

Dark Room

The darkroom or processing room is a place where the necessary handling and processing of radiographic films can be carried out safely and efficiently without hazard of producing film fog by accidental exposure to light or x-ray. It may exclude all outside light and provides the artificial safelight only.

Size and location of darkroom

Whenever possible oral radiography darkroom should be designed when the dental office is planned and should be convenient and easy to work with.

The **size** of the darkroom depends on the followings:

1.Type & amount of the films to be processed , the greater workload need larger darkroom . Large films need large processing tanks , so it takes more space in the darkroom.

2.Extra space must be provided if more than one person works with ,9sq.ft. for one person is enough but it is advisable to have at least 20 sq. ft. of floor space for average dental office.

While for the **location** of darkroom, many requirements should be taken in

consideration:

1. It can be conveniently reached from the rooms where the films exposed & examined.

2.Darkroom should be located where room temperature fluctuates as little as possible because the temperature of the processing solution must kept constant .It should be located in cool part of the clinic .

3. Humidity retards drying of the processed films and damages unused films stored in opened films boxes.

4. The darkroom should be accessible to plumbing & power lines.

5. The darkroom must also be well ventilated to provide a comfortable working environment

- **Illumination of dark room**

1. A ceiling light to provide ordinary illumination in the darkroom , its switch must be placed high enough on the wall to prevent the operator from accidentally turning it on during processing .

2. Safelight , it consist of a filtered light beam .this light is safe only when the correct watt-bulb is used and the fixture is placed at or beyond the recommended distance from the work area.

3. Red warning light which is placed outside the entrance to the room , it should be wired so that it is illuminated whenever the safelight is turned on

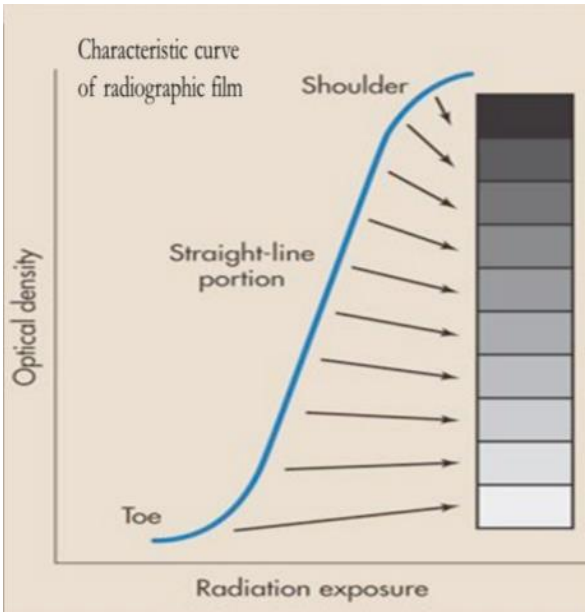
Film storage

1.Film must be stored away from excessive heat and humidity.

2.Chemicals must not be allowed to come in contact with stored films.

3.Objects should not be placed on top of stored films because pressure can cause film artifacts.

4.The boxes of stored films should be lead lined or made of steel to prevent stray radiation from fogging the films.



.Fig. 5: characteristic curve of radiographic film is the graphic relationship between optical density (OD) and exposure.