Radiology

Lec. 4 Factors relating to the production of radiograph د. اريج

Radiation Quantity: is the number of x-ray photons in the useful beam. The factors affecting x-ray quantity are :

1. mAs: x-ray quantity is directly proportional to milliamper-seconds.
2. kVp: x-ray quantity is directly proportional to the square of kilovolt Peak.
3. Distance: x-ray quantity varies inversely with distance.
4. Filtration: x-ray quantity is reduced by filtration, which absorb the low- energy photon of the beam.

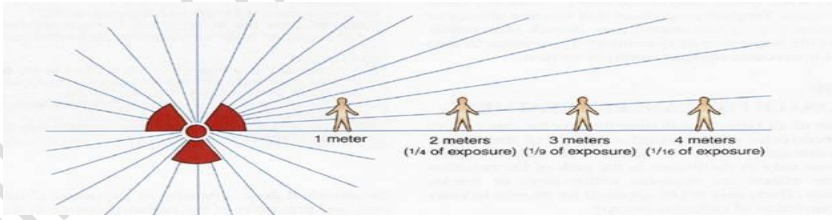
Radiation Quality: is the penetrating power of the x-ray beam, which is quantified by HVL.
The factors affecting x-ray quality are:

1. kVp: x-ray penetrability is increased as kVp is increased.
2. Filtration: x-ray penetrability is increased when filters added to the beam.

- **Inverse square law**:- the low stated that ((the intensity of radiation inversely proportional with the square of distance measured from the source of radiation to the point of measuring the radiation intensity.

I: intensity $I \times \frac{(D_2)^2}{(D_1)^2}$

D: Distance



Factors relating to the production of radiograph

A/ Factors relating to the radiation beam.

B/ Factors relating to the object.

C/ Factors relating to the X- ray film.

A/ Factors relating to the radiation beam.

1. Exposure time: It's the interval during which X- rays are being produced. exposure time is directly related to the total photon production thus increase exposure time cause increase in the quantity of X- radiation that's why exposure time has direct effect on film density.

2. Milliamperage: Its related to amount of electricity pass through the filament circuit. So it's directly control the rates of X- ray photon production thus it has direct effect on film density.

3. Kilovoltage: kV it refers to the potential difference between cathode and anode in the x- ray tube the higher kVp the greater is the potential difference and the greater is the energy of X- ray photons.

4. Tube – film distance: this distance consist of (tube – object distance) and (object – film distance), now the tube – film distance affect the intensity of radiation (according to inverse square law), while the tube – film distance affect the exposure time directly so the distance proportional directly with the exposure time but the distance proportion inversely with the intensity of radiation. also the distance affect the dose of radiation because decrease the tube – film distance make the X- ray beam more diverge behind the skin area and more tissue is irradiated. While increase the distance makes the beam less diverge and reduce the amount of tissue irradiated.

5. Focal spot size: the focal spot or called the source of radiation must be as small as possible to get best image quality. So any movement in the head of X- ray machine affect the focal spot size.

6. Collimation: a basic rule of radiation stated that the diameter of circular X- ray beam should be not greater than 2.75 inches while the rectangular beam dimension is 1 ½×2 inches , collimator used to control the size and shape of the beam.

Effect of collimation:

- Reduce the amount of tissue irradiated
- Minimize the production of secondary radiation fog.

* Fog: - is the unwanted film density (blackening) and thus reduce radiographic contrast.

7. Filtration: the effect of filtration is the absorption of long wave length X- ray photons that have low penetrating power (can't penetrate the hard calcified tissue). The result of filtration of X- ray beam is hardened beam (more short wave-length photon with high penetration power) so increase the half – value layer, also increase filtration affect the contrast and density but in different way, the contrast is decreased (long scale) like the effect of increase kV. While the density is decreased because when filtration increase the result is the absorption of not only long wave length photons but even some of short wave length photons so the number of X- ray photons or the quantity of radiation is reduced so the density is reduced.

8. Equipment efficiency: dental X- ray machine differ in construction and efficiency so the quality and quantity of X- ray beam vary from machine to another.

B – Factors relating to the object:

The object is basically an absorbing X- ray medium, so 2 points important about the object during exposure to X- ray:

1. Thickness of the object: Thick object required more radiation to make a radiographic image so it's often advisable to increase kV or mA and /or exposure time in order to increase the amount of X- ray photons.

2. Density of the object: density refers to weight per unit volume of the object . In dental radiography enamel of the tooth has highest density of all body tissues. increase the density of the object increase its ability to absorb X- radiation. So hard tissue like enamel absorb great amount of radiation when compared with absorption of soft tissue like pulp because of object density.

C – Factors relating to the X- ray film:

1. **Reduction of secondary radiation:**

secondary radiation include scattered, stray leakage or any other radiation that not belong to primary X- ray . Secondary radiation is un desirable because it reaches all parts of the film and produces film fog. Several ways to minimizing this radiation like:-

- Using as small beam of radiation as possible.
- Proper collimation.
- In intra oral film a sheet of lead foil is placed behind the film in the film packet.
- In extra oral film a grid is placed between the object and the film. The grid is an extremely effective device for reducing the amount of scattered radiation that exiting an object and reaching the film. Its composed of alternating strips of a radiopaque material (usually lead) and strips of radiolucent material (often plastic). so the grid transmit only those x-rays whose direction is on straight line from the source to the film (image receptor) and absorb the remnant scattered radiation.

2. **Film and film storage:**

X- ray film must stored in light - tight containers because the Ag Br Crystals in the emulsion are sensitive to light as well as to X- ray. Also film must stored in lead - lined box to keep the films away from the stray radiation, also stored in place away from excessive temperature or humidity and we should used it before the expiration.

3. Intensifying screen:

is a device that convert the energy of x-ray beam into visible light, which interact with x-ray film and forming the latent image.

Intensifying screen used in extra oral film to reduce patient dose by converting the x-ray to light so one x-ray photon give rise to many light photons, the number of x-rays required to produce the same density on the film is markedly reduced.

4. Film processing:

The latent image is formed when silver halide grains are exposed to x-ray, then only the exposed grain will form the visible image by development. while the unexposed grains removed from emulsion by fixing and make a permanent image.

As mentioned in previous lecture, its either automatic or manual steps, the automatic processing is preferred because it faster and resulted in better image quality.

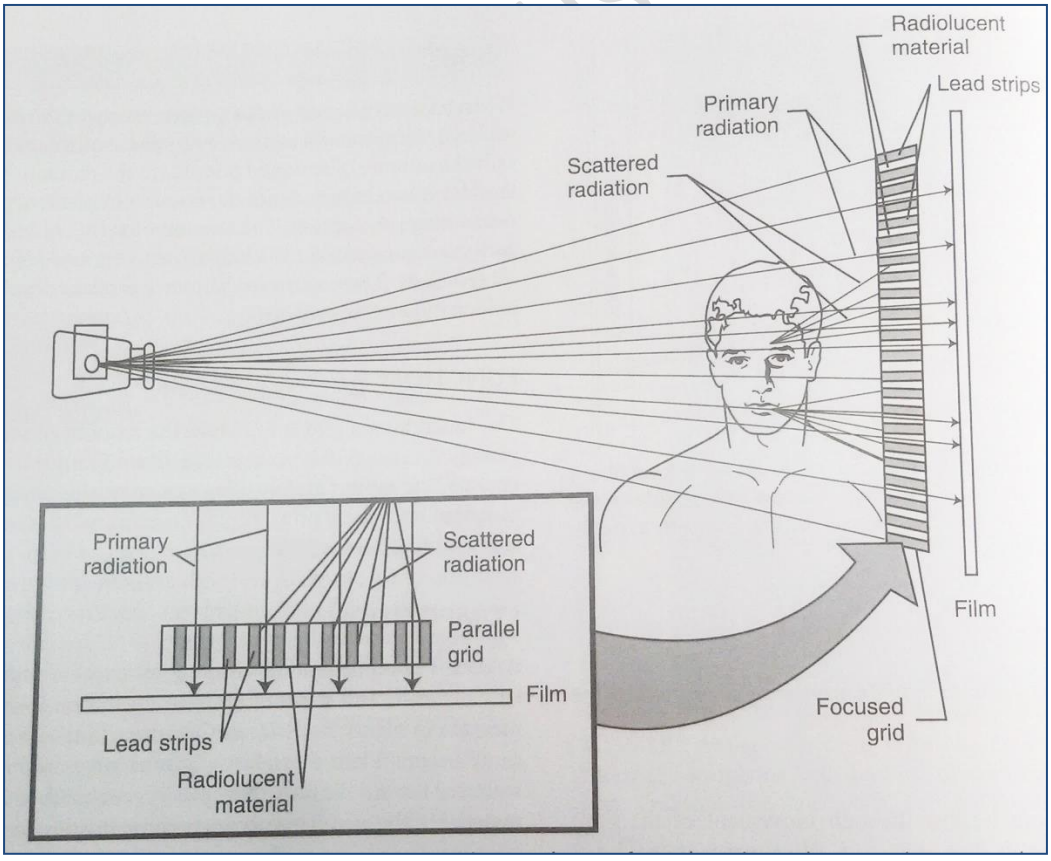


Fig. 1: extra oral grid demonstrating the lead strips and the scattered radiation elimination.