SNS COLLEGE OF ALLIED HEALTH SCIENCES- COIMBATORE 35

DEPARTMENT : RADIOGRAPHY AND IMAGNG TECHNOLOGY

SUBJECT : GENERAL PHYSICS, RADIATION PHYSICS AND PHYSICS OF DIAGNOSTIC RADIOLOGY

PAPER : PAPER II

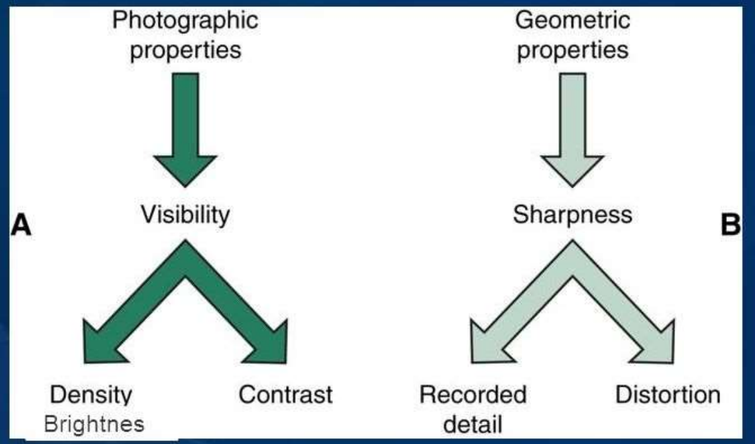
TOPIC : 3. CHARACTERISTICS OF X-ray FILM

CHARACTERISTICS X-ray FILM

CHARACTERISTICS X-RAY FILM :

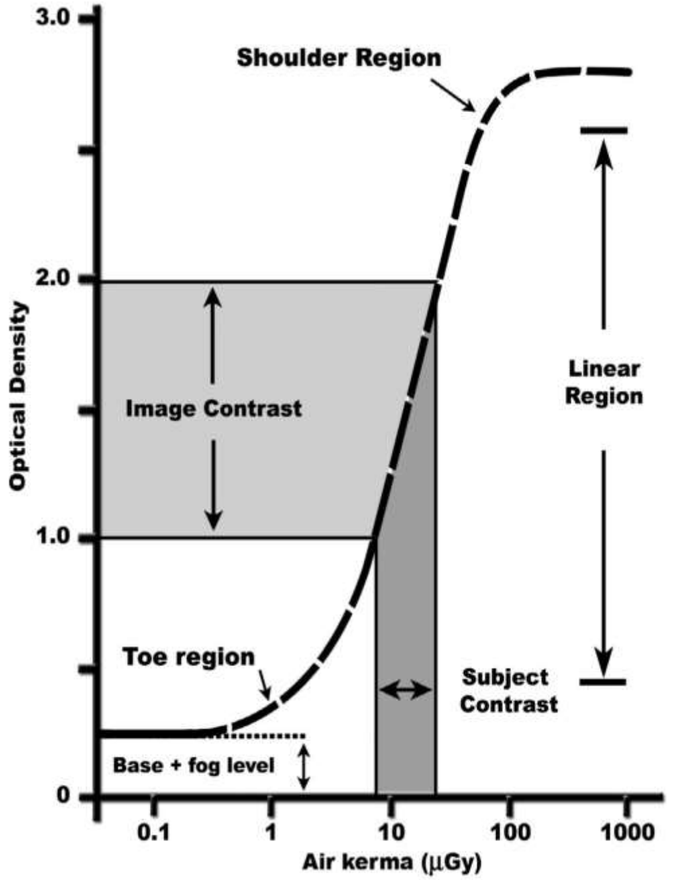
- The characteristics of X-ray film can be discussed with the following parameters.
- They are density, characteristics curve , contrast, latitude and emulsion absorption.

A primary responsibility of the radiographer is to evaluate radiographic images to determine whether sufficient information exists for a diagnosis. Evaluating radiographic quality requires the radiographer to assess the image for both its visibility of recorded detail (photographic properties) and its sharpness of recorded detail (geometric properties). Radiographic quality is the combination of both the visibility and the sharpness of recorded detail.



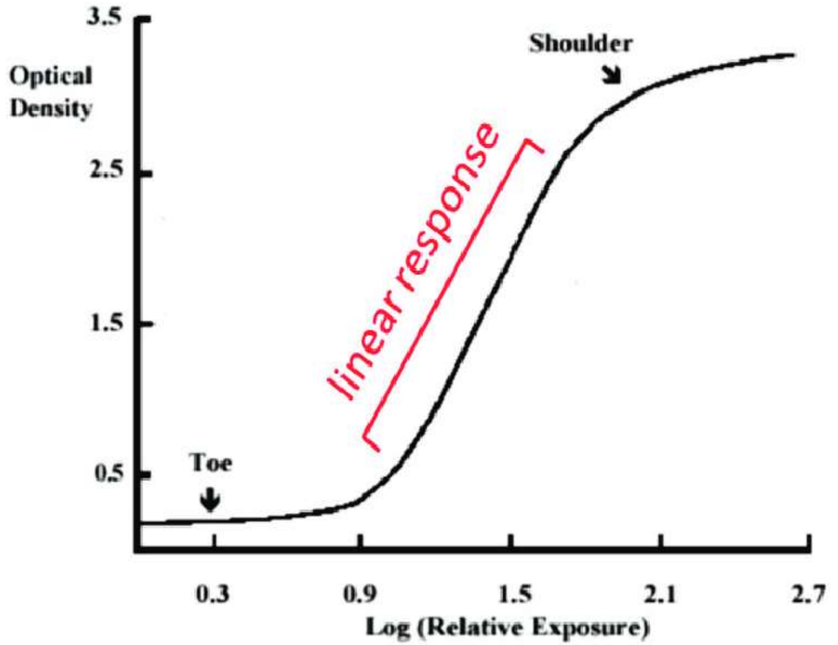
FILM DENSITY

- The term density refers to the degree of blackening on the film.
- When the X-ray film is exposed to X-rays, the metallic silver gives the blackness on the film. That's why X-ray film is said to be a negative recorder.
- The degree of blackness is directly related to the intensity of radiation exposure. It can be quantified by a term optical density (OD), which is given by the relation :
- OD = log_{10} (I_0 / I_t)
- Where, (I_0 / I_t) is the inverse of transmittance (T), which is measured by a densitometer.
- If I_0 is the light intensity measured without film and I_t is the light transmitted through the film, then T= I_0 / I_t.
- The useful range of density in diagnostic radiology is 0.25-2.0



CHARACTERISTIC CURVE

- The relation between radiation exposure and optical density is plotted as a curve, known as the characteristic curve or H and D curve, named after Hurter and Driffield, who first generated these curves in 1890.
- The film density is plotted on the vertical axis and log of exposure on the horizontal axis.
- The curve has sigmoid shape and has three portions, called Toe, Straight line and shoulder.
- The toe region is low exposure region of the curve. Base plus fog level is the film blackening in the absence of any radiation exposure and typically ranges from 0.1 to 0.2 OD units.
- It refers the background fogging and the tinting (blue) of the base.
- The maximum film density ranges from 2.5 to 3.0 OD units.



CHARACTERISTIC CURVE

- All radiographic techniques should produce a density in the straight line portion. The contrast is related to the slope of the linear portion of the curve. Higher the slope, higher the image contrast. The parameters which describes the contrast of the film is called average gradient. It is the slope of straight line, connecting two given points in the characteristic curve.
- Average gradient = (D_2 - D_1) / ($log_{10} E_2$ - $log_{10} E_1$)
- where, D_2 and D_1 are the optical densities on the straight line portions of the curve, resulting from, log of exposure E_2 and E_1.
- The average gradient value ranges from 2.5 to 3.5.
- The gradient is the mean slope between two specified densities.
- A high gradient refers higher radiographic contrast of the film.

SPEED

- The speed refers the sensitivity of the film - screen combination. Fast film requires lesser radiation exposure to achieve a given film density and slow film require more radiation exposure.
- There are 2 types of speed in use, one is the absolute speed and other is the relative speed.

ABSOLUTE SPEED

- The absolute speed of a film is defined as the reciprocal of the exposure in roentgens (1/ R) that required to produce a density of 1.0 above the base plus fog density.
- It is determined from the H and D curve and used only in performance evaluation.

SPEED

RELATIVE SPEED

- The relative speed is a measure compared with the a standard film screen combination.
- Relative speed results from comparing screen-film systems based on the amount of light produced for a given exposure.
- For example, calcium tungstate screen-film combination is called par (equal) speed and given a value of 100.
- An another combination of film-screen having twice the speed of calcium tungstate is given the speed of 200.
- In this way, the rare earth screen combinations is given speed of 400, which is used in general radiography
- Angiograms requires short exposures, may require a speed of 600.
- Bone and extremities more details or slow films.

LATITUDE

- Latitude is the range of exposure levels (mAs) that will produce acceptable range of density (0.25 – 2.0).
- The latitude is also called dynamic range, Various inversely with film contrast.
- A wide latitude film has a low gradient and low contrast, whereas higher contrast film may have lower latitude.
- Hence, a proper balance has to be made between contrast and latitude.
- A low latitude film may require number of retakes, because exact exposure techniques are difficult to decide.

FILM GAMMA

- The maximum slope of the characteristic curve of an X-ray film.
- The film gamma is a measure of the maximum change of film density for a certain change of exposure.
- This corresponds to the part of the characteristics curve with the steepest slope,
- That is at the point where the maximum derivative is found.
- **A Measurement of development of contrast.**
- **The exponent of that power law that is used to approximate the curve of output magnitude versus input magnitude over the region of interest.**
- **Contrast in photographic processes can be influenced in few ways.**
- Most specifications require film densities in the rage 1.8 to 2.5

GRAIN SIZE

PURPOSE OF FILM GRAIN

- Film grain is a recording process that intentionally adds noise to the picture
- It was first used on black and white film in order to give it an artistic look

GRAINESS IN RADIOGRAPHY

- Film graininess is the visual appearance of irregularly spaced grains of black metallic silver deposited in the finished radiograph.
- Radiographic films of all brands possess some degree of graininess.

GRAIN EFFECT IN FILM

- Film grain is an optical effect that resembles a vast field of tiny particles in images developed from celluloid film.
- Film captures images via an emulsion of light-sensitive silver halide crystals, and these particles create a grainy visual texture.

GRAIN SIZE AND DISTRIBUTION

Grain size and distribution as follows,

SPEED

- The bigger the average grain size, the higher the speed of the film.

CONTRAST

- Affected by size distribution, the more available in the film, lower the contrast.

GRAINESS

- Graininess is the apparent clumping of the crystal as seen on the radiograph.
- The bigger the crystal, the higher the graininess of the film.

GRAIN SIZE

- About 0.2 -2.0 microns.

EXPOSURE TO X-rays

Why does photographic film darken when exposed to radiation ?

- The absorption of radiation by photographic films causes photographic fog. Fog occurs when photographic materials absorb uniform levels of energy that it is part of an intended photographic exposure.
- Fog affects the light sensitive portions of films.

Non screen films

- Non screen film either have one emulsion layer or may have a double emulsion like intraoral film, but with the greater thickness than intraoral film, so a non screen film requires more exposure time than screen film so is not recommended for use in dental radiography.

EXPOSURE TO X-rays

Why does photographic film darken when exposed to radiation ?

- The sensitivity is the measure of the resolution of the image which can be obtained on a radiograph.
- the sensitivity is affected by exposure parameters (voltage, amperage, time and source-film distance)
- Subject sharpness / un sharpness, image contrast / film density, film quality and processing techniques.

X-ray Film Exposure to X-ray

- X-ray film displays the radiographic image and consists of emulsion (single or double) of silver halide (silver bromide (AgBr) being the most common at 95% while silver iodide at 5%). Which when expossed to light, produces a silver ion (Ag^{+}) and an electron.

EXPOSURE TO X-rays

Can X-rays damage film ?

- The photographic film is so sensitive to light.
- The radiation can leave what's called fog – colour striking across the film or general deterioration of image quality.

Is it safe to touch X-ray film ?

- X-ray films are non- toxic and safe handle.
- You can use them just like you would any other crafting materials.

What type of damage to film ?

- Film damage can be divided into three main categories, damage incurred in shipping, inspection, and projection
- In all cases film damage is avoidable.

INTERROGATIONS

1. Can X-rays damage film ?
2. Is it safe to touch X-ray film ?
3. What type of damage to film ?
4. X-ray Film Exposure to X-ray

REFERENCES

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2.Diagnostic Radiography – A concise practical Manual – Glenda J. Bryan (4th edn),

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THANK YOU