IDEAL RADIOGRAPH

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Fig. 8.1: Apical end’s cut off—Failure to place the film sufficiently apically or an inadequate vertical angulation of the radiographic beam.
Fig. 8.5: Partial image of the crowns of the maxillary incisors
FIG. 6-20 Partial image caused by poor alignment of the tube head with the film rectangular collimator.
Fig. 8.12: Overlapping of the contacts; this error is usually made by improper horizontal angulation of the beam.
Fig. 8.10: Excessive curving of the posterior half of the film which is usually due to excessive digital pressure by the patient while holding the film.
Fig. 8.9: Elongation; this may be due to inadequate positive angulation of the radiographic beam or by failing to have the ala-tragus plane or occlusal plane parallel to the floor in the bisecting angle technique and then not using sufficient vertical angulation of the radiographic beam.
FIG. 4-13 Radiograph of a dried mandible revealing low contrast (A) and high contrast (B).
FIG. 6-12 A radiograph that is too light because of inadequate processing or insufficient exposure.
Fig. 23.7 Radiograph with optimum exposure time but overdeveloped (darker radiograph).
An ideal radiograph

• ‘An ideal radiograph is one which has the desired density and overall degree of darkness and which shows the part completely without distortion and with maximum details and has the right amount of contrast to make the details fully apparent.’

-H.M. Worth
Imaging characteristics of x-ray film

- Radiographic density
- Radiographic contrast
- Radiographic speed
- Film Latitude
- Radiographic noise
- Radiographic blurring
- Image quality

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Radiographic Density

• The overall degree of darkening of an exposed film is referred to as radiographic density.

• Measured as optical density of an area of the radiograph

\[ \text{optical density} = \log_{10} \frac{l_o}{l_t} \]
Characteristic curve

• Also known as H&D (Hurter and Driffield) curve.

• It is a plot of the relationship between film optical density and exposure.
FIG. 4-11. Characteristic curve of direct exposure film. The contrast (slope of the curve) is greater in the high-density region than in the low-density region.
• Gross fog or base plus fog.

• Optical density-0.2-0.3
Radiographic density is influenced by:

- Exposure
- Subject thickness
- Subject density
Exposure-

- film density is increased by-

  - increasing mA, Kvp, exposure time

  - decreasing the distance between the focal spot and film
• **Subject thickness**

Thicker the subject more beam attenuated

Exposure factors to be varied according to the size of the patient.
• Subject Density

• Greater the density of an object within the subject greater the attenuation

• Oral cavity-enamel, dentin and cementum, bone, muscle, fat and air.
Beam
differentially attenuated by these absorbers
resultant beam
recorded as light and dark areas on film

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Radiographic contrast

- It is described as the range of densities on a radiograph.

- It is defined as the difference in densities between light and dark regions on a radiograph.

- High contrast – short grey scale of contrast

- Low contrast – long grey scale of contrast
Radiographic contrast of an image is an interplay of -

- Subject contrast
- Film contrast
- Scattered radiation
• **Subject contrast** - is the range of characteristics of the subject that influence the radiographic contrast.

• **Influenced by** - subject thickness
  subject density
  atomic number

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• Also influenced by-

• Beam energy and intensity

• time and mA of the exposure
FIG. 4-14 Radiographs of a step wedge made at 40 to 100 kVp. As the kVp increases, the mA is reduced to maintain the uniform middle-step density. Note the long gray scale (low contrast) with high kVp. (Courtesy Eastman Kodak, Rochester, N.Y.)
Film contrast-describes the capacity of radiographic films to display differences in subject contrast, that is, variation in the intensity of the remnant beam.

- high contrast and low contrast films-high contrast films reveals areas of small differences in subject contrast more clearly.

-Film processing

-improper handling

-film fog

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FIG. 4-15 Characteristic curves of two films demonstrating the greater inherent contrast of film A compared with film B. The slope of film A is greater than that of film B; thus film A shows a greater change in optical density than film B for a constant change in exposure. The fact that film A is faster than film B in this figure is unrelated to film contrast.
FIG. 4-13 Radiograph of a dried mandible revealing low contrast (A) and high contrast (B).
FIG. 6-12 A radiograph that is too light because of inadequate processing or insufficient exposure.
Fig. 23.7 Radiograph with optimum exposure time but overdeveloped (darker radiograph).
• Scattered radiation
Travel in direction other than primary beam.

Causes fogging or overall darkening of the image that results in loss of radiographic contrast.

Can be avoided by-
• Using low Kvp
• Collimate the beam
• Grids in extraoral radiography
FIG. 6-16  Fogged radiograph marked by lack of image detail.
FIG. 4-20  An x-ray grid absorbs scattered x-ray photons from the primary beam and prevents them from fogging the film. In a focused grid the absorber plates are angled toward the anode; in a parallel grid the absorber plates are parallel.
Radiographic speed

• It refers to the amount of radiation required to produce an image of a standard density.

• Film speed is expressed as the reciprocal of the exposure (in roentgen) required to produce an optical density of 1 above gross fog.
• Fast films – needs lower exposure than slow films to produce a density of 1.

• Film speed controlled by silver halide grain size and their silver content

• Ultra-speed film-group D

• Kodak insight-group E and F
FIG. 4-16  Characteristic curves for InSight and Ultra-Speed film. InSight film is faster and has essentially the same contrast as Ultra-Speed film. (Courtesy Eastman Kodak, Rochester, N.Y.)
Film Latitude

• It is the range of exposures that can be recorded as distinguishable densities on a film.

• Film with wide latitude records wide range of subject contrast.
FIG. 4-17 Characteristic curves for two films demonstrating greater inherent latitude of film B compared with film A. The slope of film B is less steep than that of film A; therefore film B records a greater range of exposures within the useful density range than does film A.
Radiographic noise

- It is the appearance of uneven density of a uniformly exposed radiographic film.

- Causes: Radiographic mottle
  Radiographic artifact
FIG. 6-17 Dark spot on an x-ray film caused by film contact with the tank wall during fixation.
Fig. 23.24 Radiograph showing accidental exposure to daylight before developing (the radiograph showing exposure of the film only in the middle area at the time of unwrapping of the film after the exposure, so the area of the film exposed to daylight appears completely black).
Fig. 23.8 Black line appearing due to improper bending of the film.
• Radiographic mottle-
• Uneven density resulting from the physical structure of the film or intensifying screen.

Two important causes-

• Quantum mottle-caused by fluctuation in the no. of photons per unit of the beam cross-sectional area absorbed by the intensifying screen.

• Screen structure mottle-caused by screen phosphors.
  (Fast screens-large crystals used)
Radiographic Blurring

- Sharpness

- Resolution
  - line – pairs per mm
FIG. 4-18 Radiograph of a resolving power target consisting of groups of radiopaque lines and radiolucent spaces. Numbers at each group indicate the line pairs per millimeter represented by the group.
Radiographic blurring is caused by-

- Image receptor blurring
- Motion blurring
- Geometric blurring
Image receptor blurring

- Intra-oral films-grain size
- Intensifying screens
- Double emulsion film
FIG. 4-8 The image on the left shows a schematic of two intensifying screens (shades of gray) enclosing a film (white). The detailed view on the right shows x-ray photons entering at the top, traveling through the base, and striking phosphors in the base. The phosphors emit visible light, exposing the film. Some visible light photons may reflect off the reflecting layer of the base.
FIG. 4-19 Parallax unsharpness results when double-emulsion film is used because of the slightly greater magnification on the side of the film away from the x-ray source. Parallax unsharpness is a minor problem in clinical practice.
• Motion blurring-film

Subject

X-ray source

• Geometric blurring

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FIG. 6-19 Blurred radiograph caused by movement of the patient during exposure.
FIG. 5-2 Decreasing the angle of the target perpendicular to the long axis of the electron beam decreases the actual focal spot size and decreases heat dissipation and thereby tube life. It also decreases the effective focal spot size, thus increasing the sharpness of the image.
FIG. 5-3 Increasing the distance between the focal spot and the object results in an image with increased sharpness and less magnification of the object.
FIG. 5-4 Decreasing the distance between the object and the film increases the sharpness and results in less magnification of the object.

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Image Quality

• It describes the subjective judgement by the overall appearance of the radiograph. It combines the features of density, contrast, latitude, sharpness, resolution and other parameters.

• The Detective quantum efficiency (DQE) is a basic measure of the efficiency of an imaging system. It encompasses image contrast, blur, speed and noise.