SAWA UNIVERSITY

RADIOGRAPHIC TECHNIQUE-1

IMAGE QUALITY IN RADIOGRAPHY

Sawa University

College of health and medical techniques

Department of Radiology Tech.

2nd Academic year

LEC.2

THEORETICAL

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M.Sc Radiology Technology

Image Quality In Radiography

- Since the discovery of X-rays in 1895, methods of acquiring and storing x-ray images have evolved.
- Conventional film-screen technology with the associated chemical processing is being replaced rapidly by digital technology.
- The study of radiographic technique and image quality includes factors that determine the accuracy with which structures that are being imaged are reproduced in the image.
- Each of these factors has a specific effect on the final image, and the technologist must strive to maximize these factors to produce the best image possible at the lowest achievable dose.

A. Analog (film) images

- Analog (film) images provide a two-dimensional image of anatomic structures.
- The image acquisition device is a film-screen system that consists of a pair of intensifying screens with a film between them.

Image Quality In Radiography

- The screens and film are housed in an X-ray cassette that protects the film from light.
- When screens receive the remnant radiation from the patient, they fluoresce(metallic silver on a polyester base); this light exposes the film, which must be chemically processed so the image can be viewed.
- Film-based images use chemical processing to visualize anatomic structures.
- Chemical processing includes several steps (developing, fixing, washing, and drying) and typically takes 60 to 90 seconds.
- The various shades of gray displayed on the image are representative of the densities and atomic numbers of the tissues being examined.

- **Exposure latitude:** the range of exposure over which a film produces an acceptable image.
- An image produced with a level of exposure outside of the exposure latitude is an unacceptable image.

Exposure Factors

Sometimes referred to as technique factors, include the following:

1. **Kilovoltage (kV):** controls the energy (penetrating power) of the x-ray beam. This can also be referred to as Kilovoltage peak (kVp).
   - **Kilovoltage peak (kVp):** the maximum electrical potential used to create the x-ray photons within the x-ray tube.
2. **Milli amperage (ma):** controls the quantity or number of X-rays produced.
3. **Exposure time (ms):** controls the duration of the exposure, usually expressed in milliseconds

Exposure Factors

Image receptors. Conventional radiographic cassette, opened and showing a sheet of x-ray film.

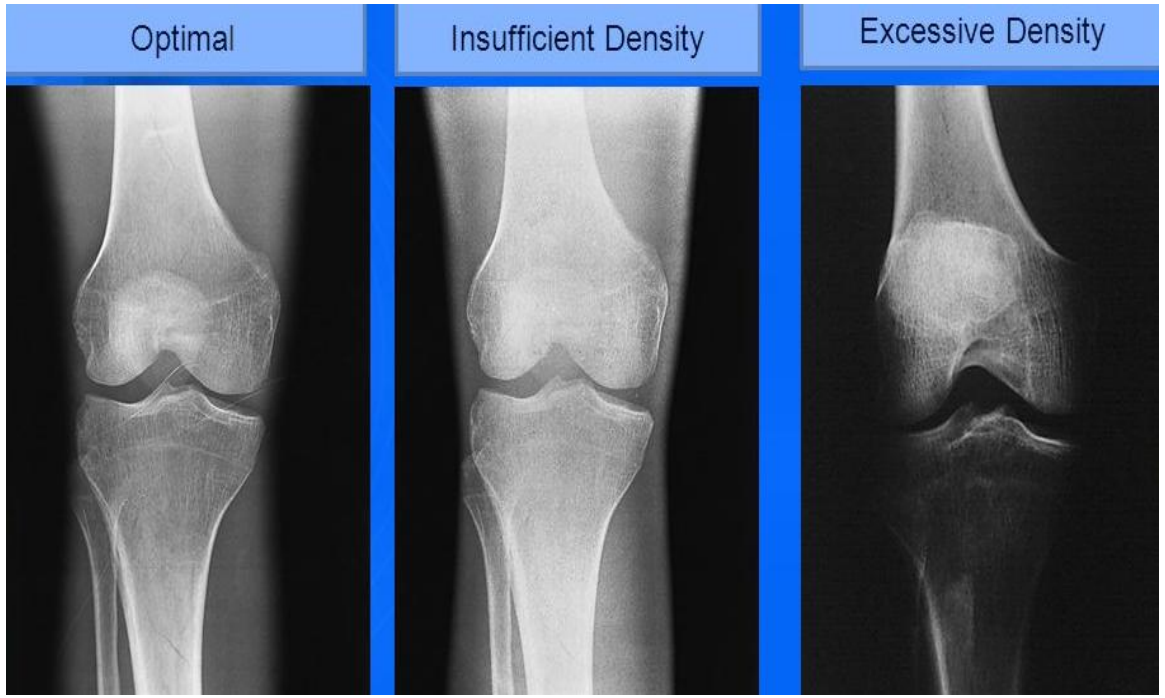
Example of radiographic console (selecting kV, mA, and mAs factors).

Image Quality Factors

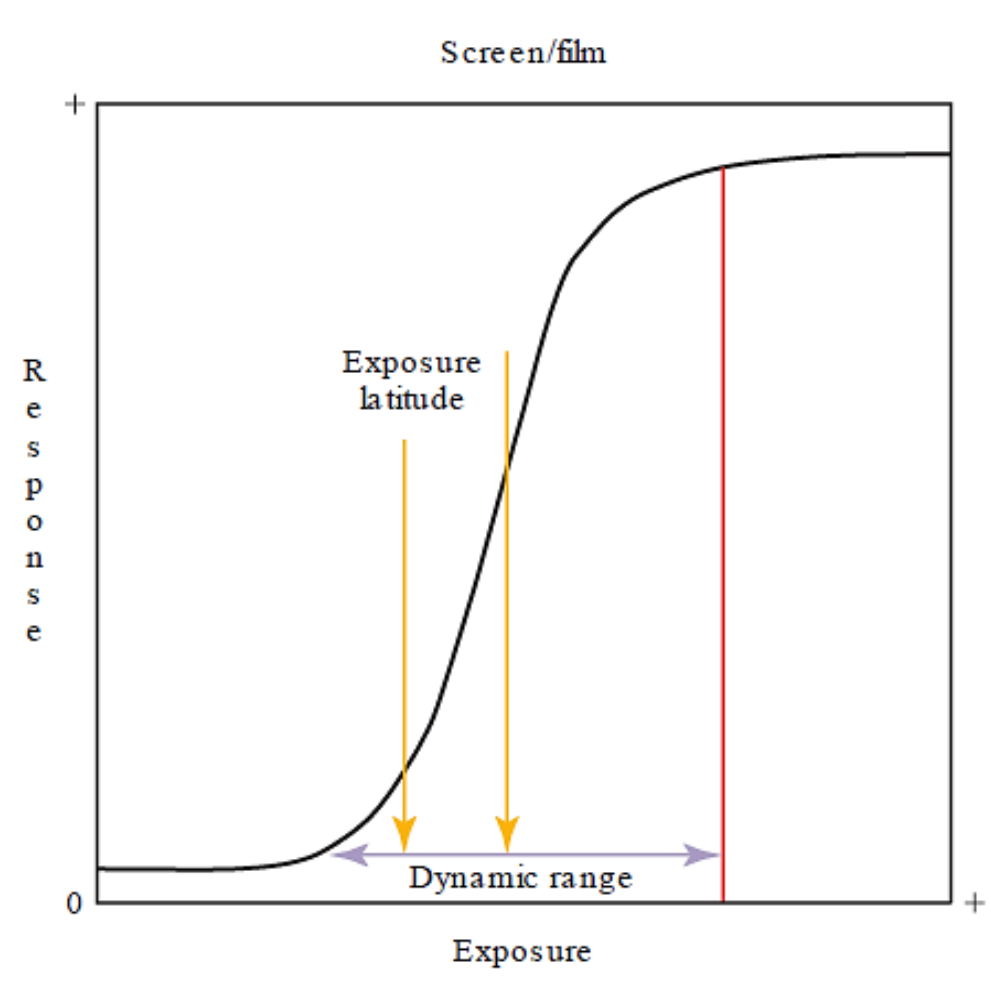
Film-based radiographic images are evaluated on the basis of four quality factors:

1. **Density:** the amount of "blackness" of the processed radiograph.
   - A radiograph with high density (less light is transmitted through the image).
   - The controlling factor for density is mAs by controlling the quantity of x-rays emitted from the x-ray tube and the duration of the exposure.
   - Too little density (underexposed) or too much density (overexposed) does not demonstrate the required structures.
2. **Contrast:** the difference in density between adjacent areas of a radiographic image.
   - When the density difference is large, the contrast is high, and when the density difference is small, the contrast is low.
   - The controlling factor for contrast is kilovoltage (kV) by controls the energy or penetrating power of the primary X-ray beam.
   - The higher the kV, the greater the energy, and the more uniformly the X-ray beam penetrates the various mass densities of all tissues.

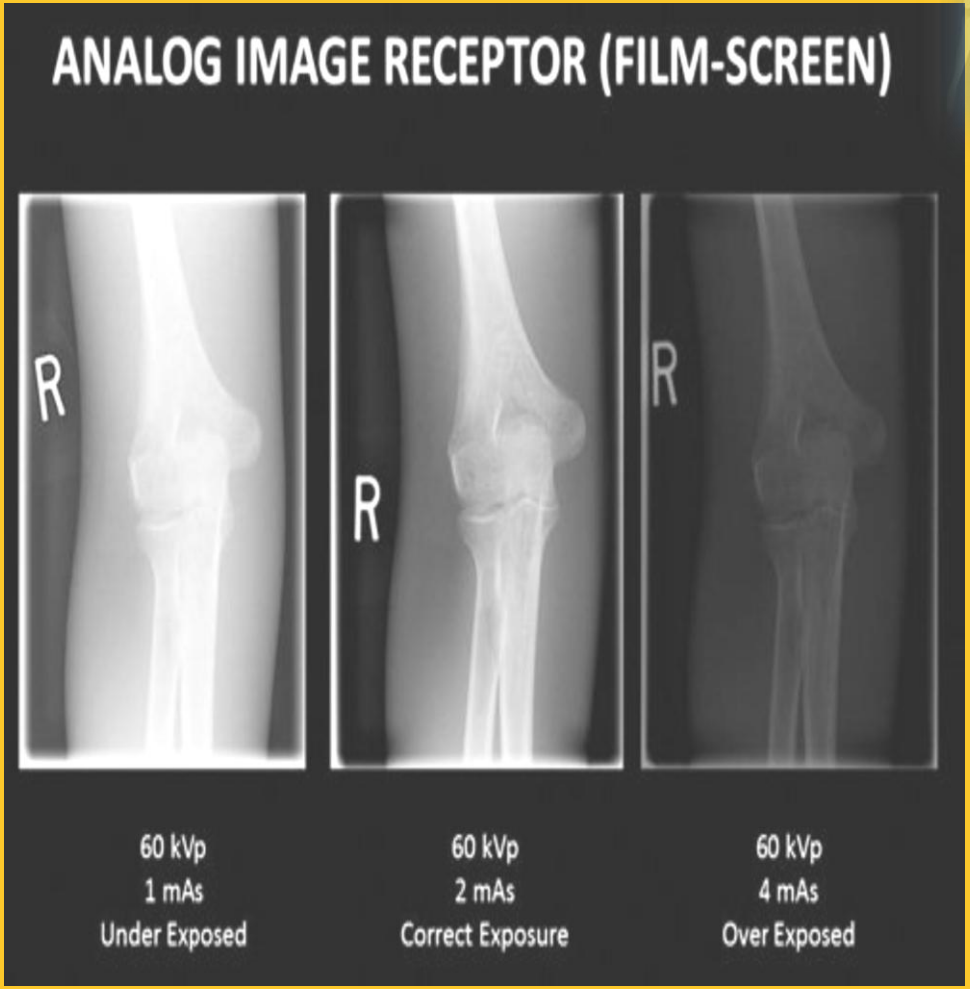
Image Quality Factors



Comparison of chest images with high and low contrast



Analog dynamic range.



Analog exposure latitude

Image Quality Factors

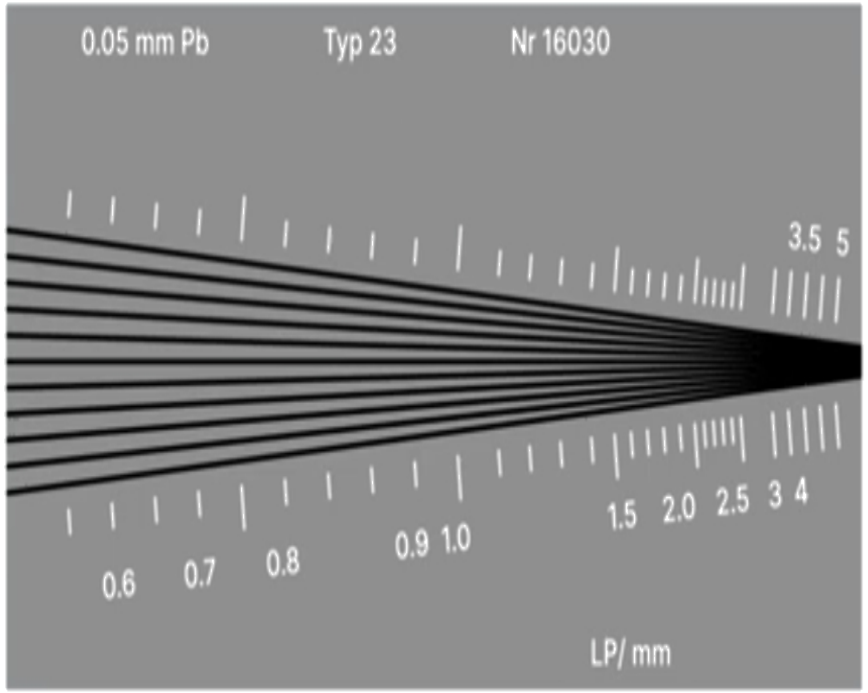
- High kv produces less variation in attenuation (differential absorption), resulting in low contrast.
- For patient radiation protection, as kv is increased, mas can be significantly reduced, resulting in absorption of less radiation by the patient.

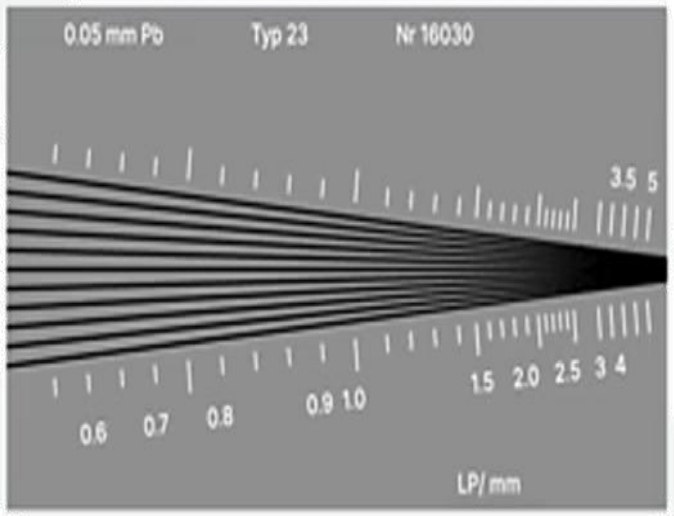
3. **Spatial resolution:** the clarity or sharpness of fine structural lines and borders of tissues or structures on the image
   - Lack of visible sharpness or resolution is known as blurring or unsharpness.
   - Resolution with film-screen imaging is controlled by (geometric factors, the film screen system, and motion).
   - Spatial resolution is measured in line pairs per millimeter (lp/mm).
   - A line pair is seen as a single line and an interspace of equal width.
   - The higher the line pair measure, the greater is the resolution.
   - (Ranging from approximately 5 to 6 lp/mm)

Image Quality Factors

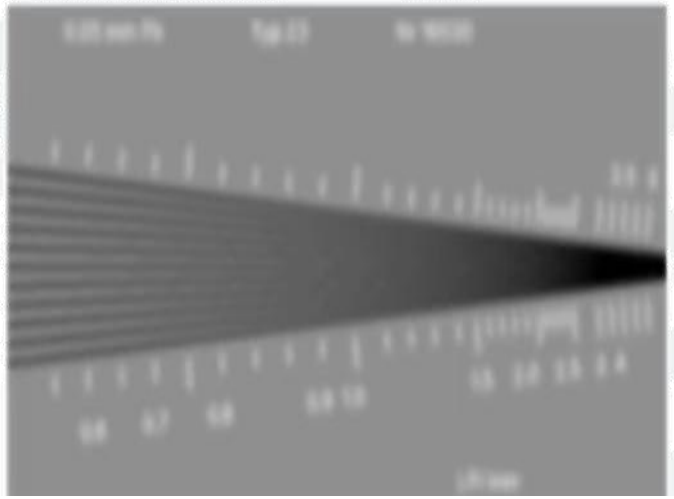
Spatial Resolution

Described with units of line-pairs per millimeter (LP/mm)





High Spatial Resolution



Low Spatial Resolution

Image Quality Factors

Spatial Resolution

Structural sharpness recorded in the radiographic image

Low Spatial Resolution

Increased Spatial Resolution

High Spatial Resolution

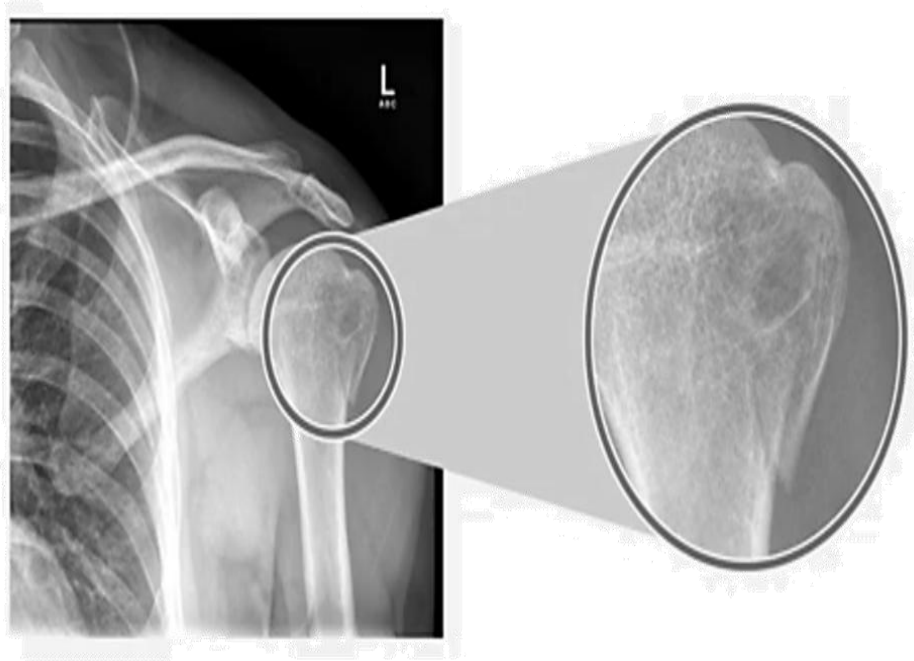
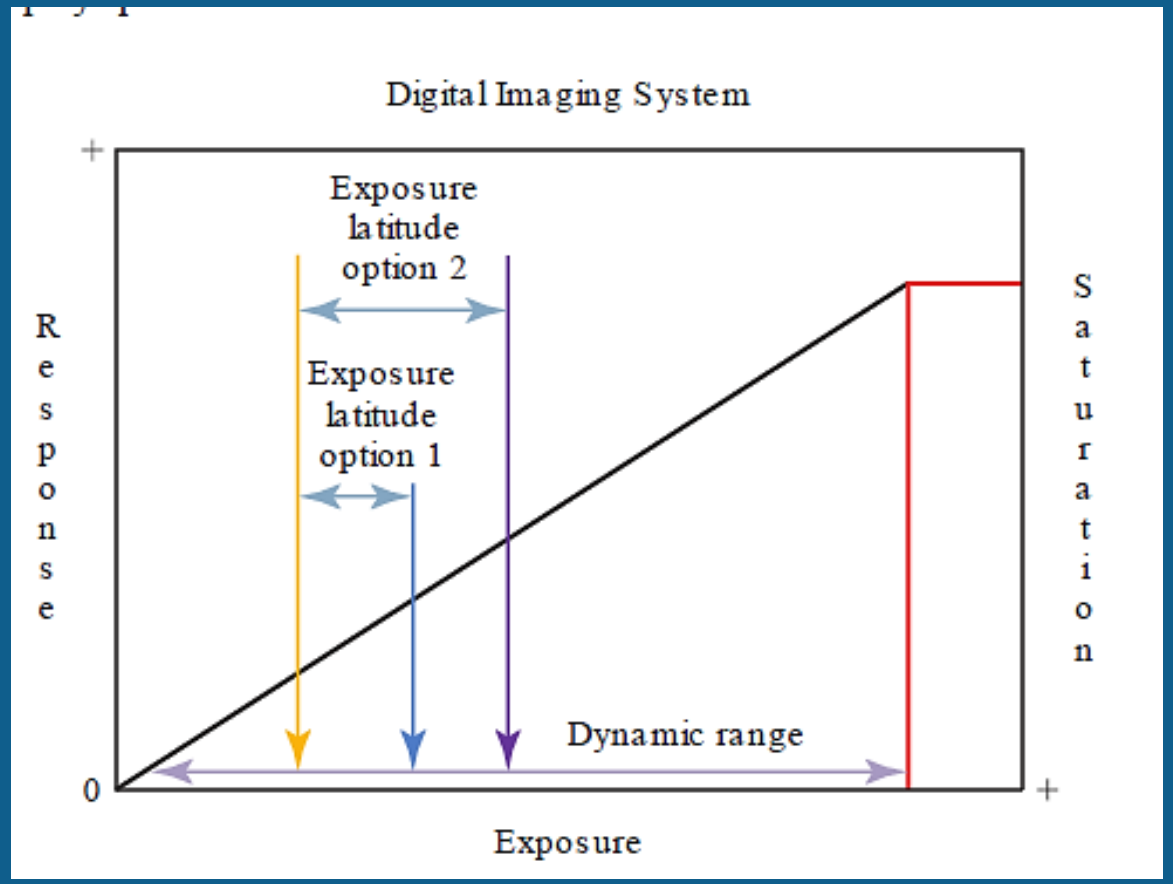


Image Quality Factors

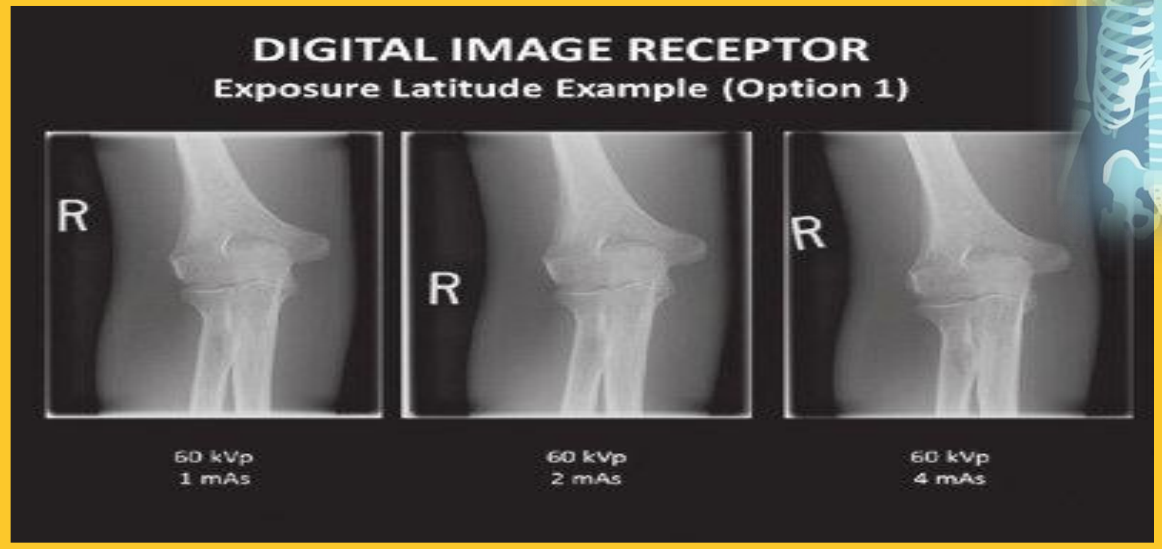
D. **Distortion:** misrepresentation of object size or shape as projected onto radiographic recording media, size distortion (magnification), and shape distortion.

B. **Digital imaging** in radiologic technology involves application of the analog-to-digital conversion theory and computer software and hardware.

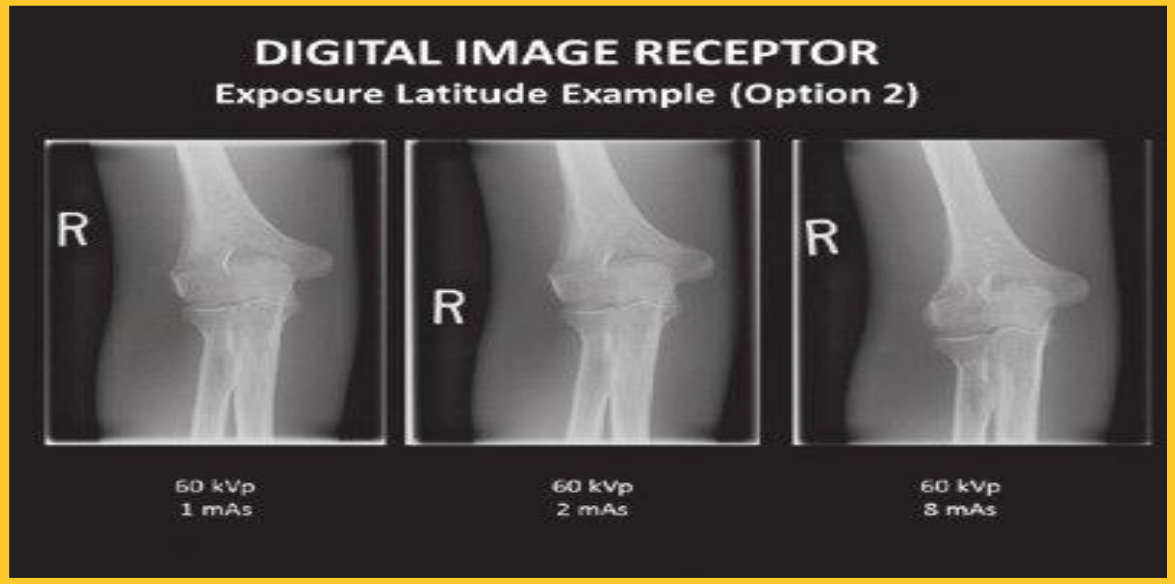
- Digital image is two dimensional and is formed by a matrix of picture elements called pixels.
- In diagnostic imaging, each pixel represents the smallest unit in the image; columns and rows of pixels make up the matrix (a sheet of graph paper).
- Digital imaging requires the use of computer hardware and software applications to view images.
- Digital imaging systems are capable of producing a radiographic image across a large range of exposure values and are described as having a wide dynamic range(exposure Latitude)



Digital imaging systems.



Digital exposure latitudes option 1.



Digital exposure latitudes option2

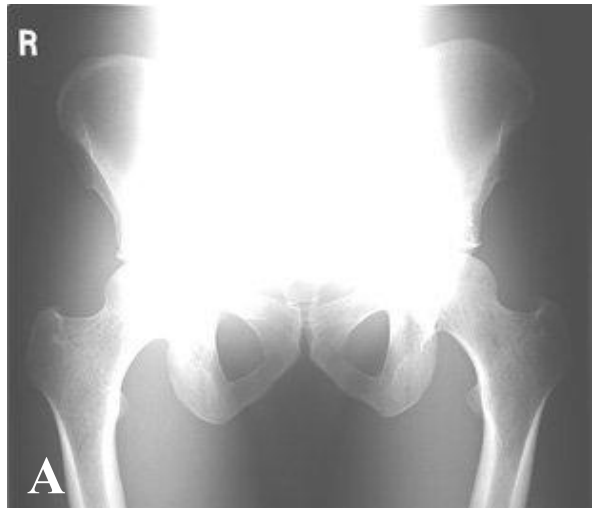
Image Quality Factors

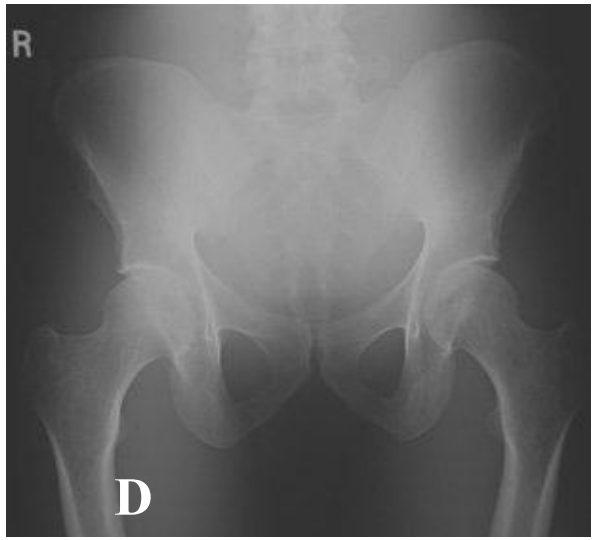
The factors used to evaluate digital image quality include the following:

1. **Brightness:** brightness is controlled by the processing software through the application of predetermined digital processing algorithms
2. **Contrast resolution**: difference in brightness between light and dark areas of image.
   - Contrast is affected by the digital processing computer through the application of predetermined algorithms.
   - The ability of the image processing software to display a desired image contrast will reduce entrance skin exposure to the patient through the use of higher kVp levels.
3. **Spatial resolution:** the recorded sharpness or detail of the structure on the image (ranging from approximately 2.5 lp/mm to 5.0 lp/mm).Measured in line pairs per millimeter.

Image Quality Factors

A. AP pelvis—high brightness (light).
B. AP pelvis—less brightness (dark).





C. AP pelvis—higher contrast.
D. AP pelvis—lower contrast.

Image Quality Factors

4. **Distortion:** defined as the misrepresentation of object size or shape as projected onto radiographic recording media.
   - The factors that affect distortion (SID, OID, and CR alignment)
   - **SID** (Source-to-Image Distance), **OID** (Object-to-Image Distance), and **CR alignment** (Central Ray alignment).
5. **Exposure indicator:** is a numeric value that is representative of the exposure that the IR has received
   - It depends on the dose of radiation that strikes the receptor.
   - It is a value that is calculated from the effect of mAs, the kV.

6. **Noise:** is defined as a random disturbance that obscures or reduces clarity.
   - In a radiographic image, this translates into a grainy or mottled appearance of the image.

Image Quality Factors

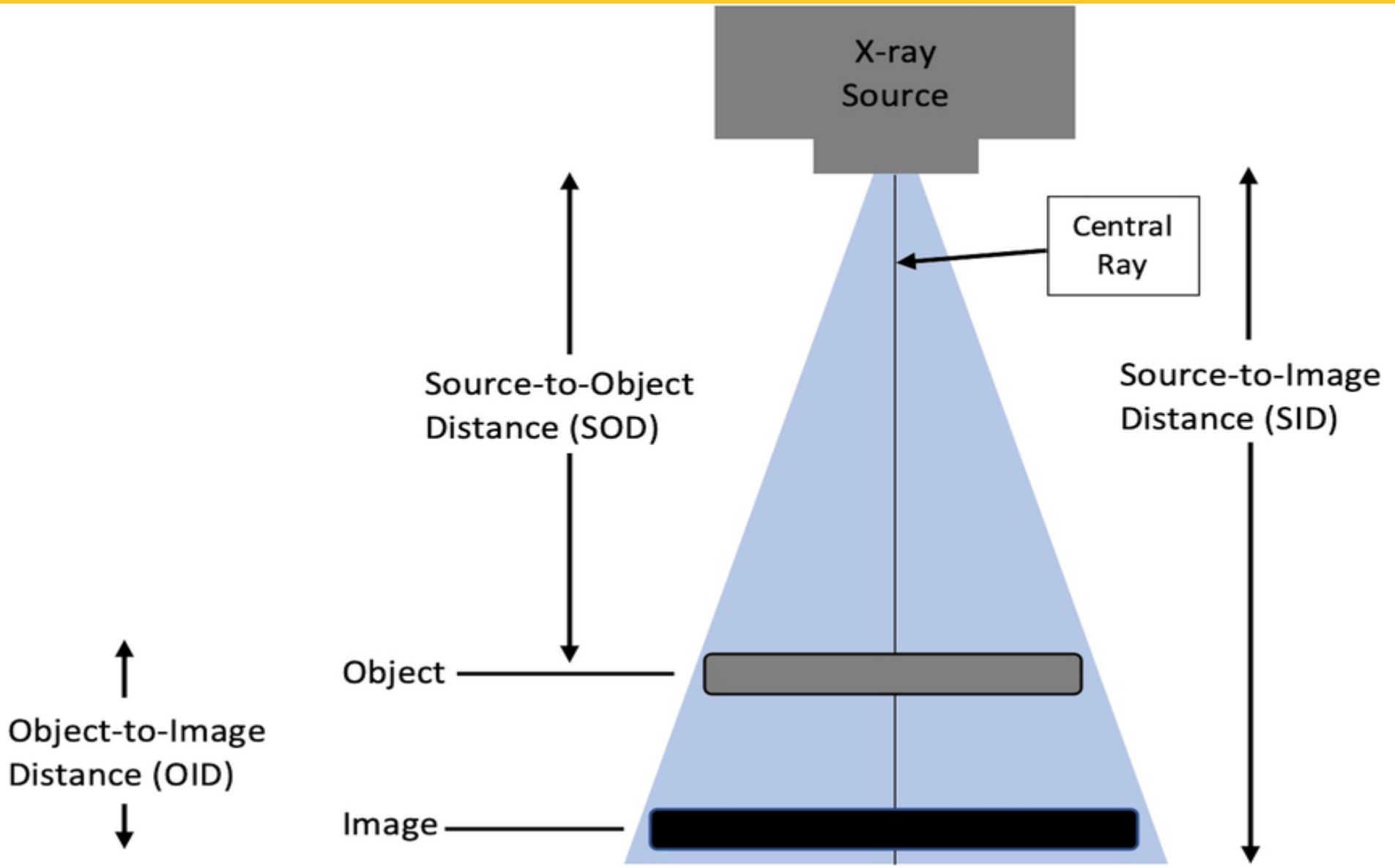


Image Quality Factors

$$Mg = \frac{SID}{SOD}$$

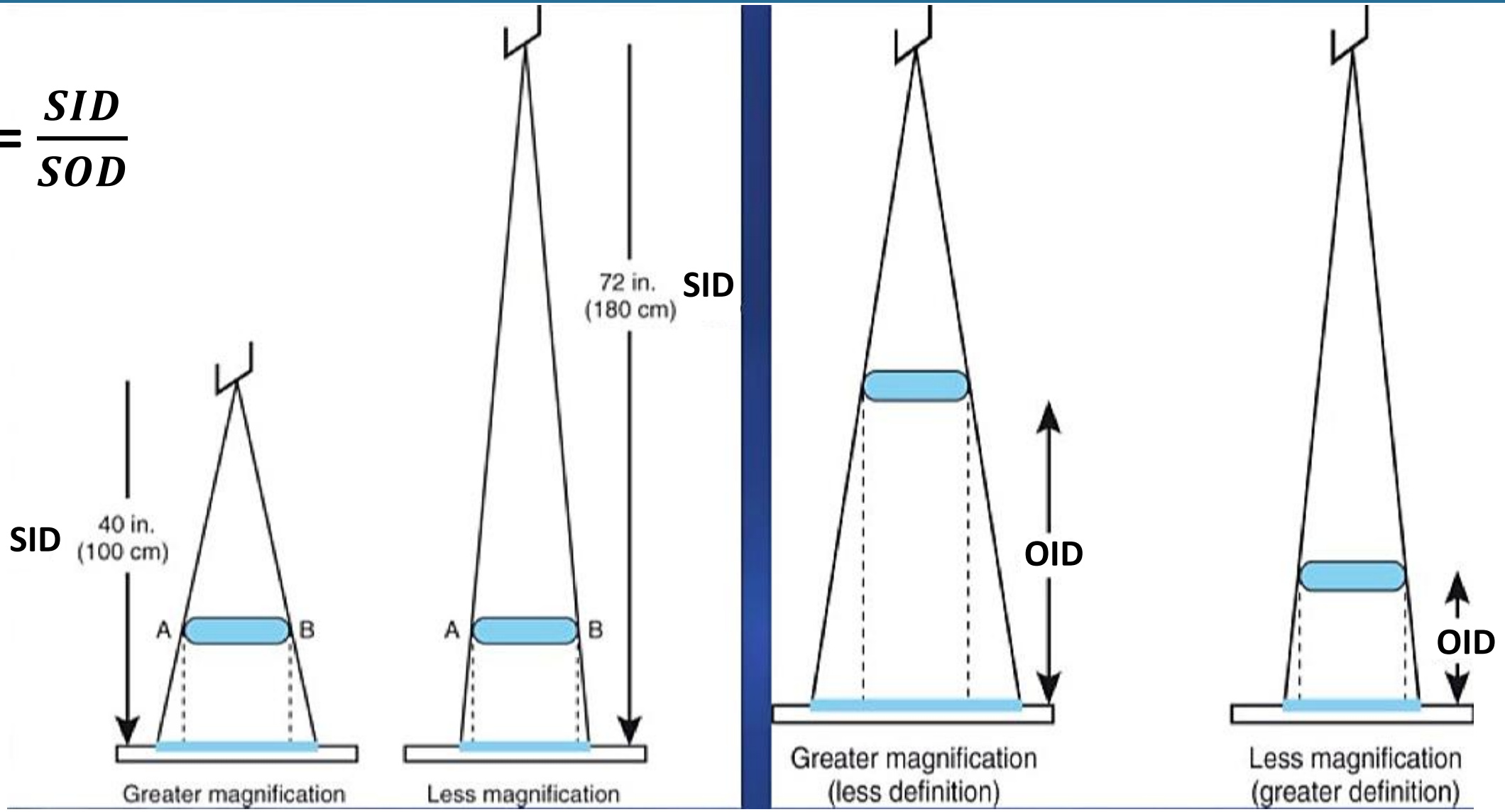
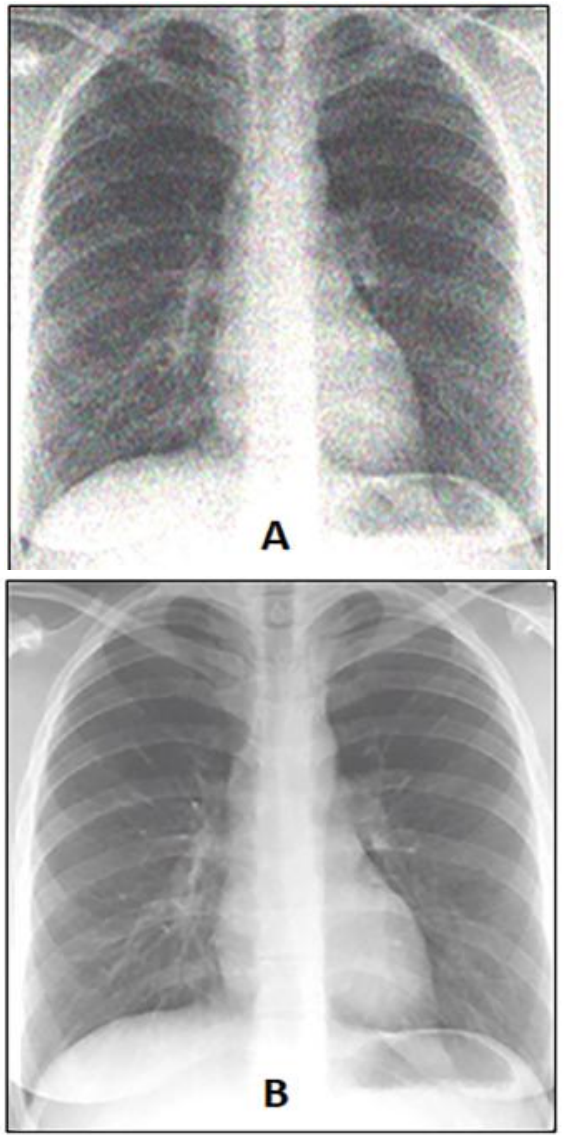


Image Quality Factors

Low exposure indicator indicates underexposure with “noisy” undesirable image.

Desirable exposure with acceptable exposure indicator.

High exposure indicator indicates overexposure.



A: Noisy image, B: Noise free image

Thanks for your attention

تذكر دائما ان النجاح لا يأتي إليك ،
بل أنت من تذهب إليه