

Syed Tubail Jan

(15371)

BS-Radiology

Q NO # 1:-

Digital Fluoroscopy Imaging System

↳ It is a form of X-rays that allows us to view deep structures of the body in real time.

It is a type of Medical imaging that shows a continuous X-ray image on a monitor much like an X-ray movie.

And Unlike a regular X-ray which records the image to film,

Digital Fluoroscopy record a series of images to a computer.

Parts of Digital Fluoroscopy Imaging System:-

- * X-ray tube
- * Spectral shaping filters
- * A field restriction device (aka collimator)

- * An anti-scatter grid
- * An image receptor
- * An image processing computer
- * A display device
- * A High Voltage Generator
- * A patient support device (Table or couch)
- * Hardware.

* Functions:-

* High Voltage generator And X-ray tube:-

The High voltage generator and x-ray tube used in most Fluoroscopy systems is similar in design and construction to tubes used in general radiographic applications.

* Spectral Shaping Filters:-

It is common for Fluoroscopic imaging systems to be equipped with beam filters between the x-ray tube exit port and collimator. And it is used for the high contrast in the anatomy of interest.

And this filtration may be user-selectable providing the operator with the flexibility to switch between low and higher dose modes as conditions dictate during a fluoroscopic procedure.

* Collimator:-

Collimator are shutters that limits the geometric extent of the x-ray field that are present in all x-ray equipments. And it matches the shape of the image receptors.

* Anti-scatter Grid:-

Anti-scatter grids are standards components in fluoroscopic systems, which don't allow high level scattering of the rays. And allows to get clear images.

* Image Receptor:-

The image receptor is the x-ray image intensifier which is an electronic device that converts the x-ray beam intensity pattern in a visible image.

* Image Processing Computer:-

It allows more flexibility in movement and patient positioning.

* Display Device:-

It allows the users to appreciate fine details and subtle contrast differences in anatomy of interest.

* Patient Support Device (Table or Couch):-

They must provide strength to support patients.

It avoids shadows, loss of signal and loss of contrast in images.

QNO# 2:-

Exposure Factors:-

↳ The Factors that influence the quantity and quality of x-radiations to which the patient is exposed are called exposure factors.

Four Prime Exposure Factors:-

- ① Kilovolt Peak (kVp)
- ② Current (mA)
- ③ Exposure time (s)
- ④ Source-to-image receptor distance (SID)

① Kilovolt Peak (kVp):-

The kVp has more effect than any other factor on image receptor exposure. As kVp increases, there is less differential absorption will occur. Thus, High kVp results in reduced image contrasts.

(2) Current (mA):-

The mA selected determines the number of x-rays produced and therefore the radiation quantity.

As more electrons flows through the x-ray tube, more x-ray are produced.

With a constant exposure time, mA controls the x-ray quantity and therefore the patient radiation dose.

x-ray quality remain same with a change in mA.

(3) Exposure time:-

Radiographic exposure time usually are kept as short as possible.

Short exposure time reduces motion blur that can occur because of patient motion.

(4) Distance (SID):-

Affects exposure of IR because of the inverse square law. SID largely determines the intensity of photons at the IR. Distance has no effects on the quality.

QNO3#

Four Image Quality Factors:-

The factors that influences the characteristics of a radiograph is called Quality Factors.

There are four main quality factors.

- ① Contrast.
- ② Noise
- ③ Artifacts
- ④ Distortion

The influence of these quality Factors on the characteristics of Radiograph:-

① Contrast:-

Contrast is the ability to distinguish structures that lie close and may have same appearances.

An object in an image will be clearly visible if it has sufficient physical contrast relative to the surrounding tissues. And it make easy the study of radiographic images.

② Noise:-

Image noise sometimes refers to as image mottle, gives an image a textured or grainy appearance.

Lower noise results in a better radiographic image because it improves contrast resolution. And help in a clear radiographic image.

③ Artifacts:-

Most Methods can create image features that do not represent a body structure or object, these are image artifacts.

Artifacts can obscure a part of an image or may be interpreted as an anatomical feature.

And by removing artifacts we can get a clear radiographic image.

④ Distortion:-

A medical image should not only give internal body objects visible, but should also give an accurate impression of the size, shape and position.

An imaging procedure can however introduce Distortion of these three factors.

QNO#4:-

Image Intensifier:-

It is an electronic vacuum tube that converts the remnant beam to light, then to electrons, then back to light increasing the light intensity in the process.

Image intensifier are utilized to convert low energy x-radiations into visible light images.

Components of Image Intensifier:-

- * Glass envelope
- * Input Phosphor
- * Photocathode
- * Electrostatic Focusing lenses
- * Output Phosphor.

Glass envelope:-

Maintains tube vacuum to allow control of electron flow. Has no functional part in image formation.

Input Phosphor:-

X-rays that exit the patient and are incident on the image intensifier tube are transmitted through the glass envelope and interact with the input phosphor, which is cesium iodide. When X-rays interact with the input phosphor, its energy is converted into a burst of visible photons.

Photocathode:-

It is bonded directly to the input phosphor with a thin, transparent, adhesive layer. It responds to stimulation by light with the emission of electrons.

Electrostatic focusing lenses:-

Located along the length of the tube, responsible for focusing the electrons across the tube from input to output phosphor.

Output Phosphor:-

It is usually made of zinc cadmium sulfide crystals. The electron that arrive here results in approximately 50-70 times.

QNO# 5(a):-

Advantages of Using Flat Panel Image receptor:-

- ↳ Flat panels are being used for Medical Imaging but also been used in several extra oral imaging devices
- ↳ Allows direct digital imaging of large areas of the body.
- ↳ Large Matrix areas with pixel size less than $100\mu\text{m}$.
- ↳ Their sensitivity allows a lower dose of radiation for a given picture quality than film.
- ↳ They are lighter
- ↳ They are more durable
- ↳ They are smaller
- ↳ They are more accurate.
- ↳ And they can be produced with large areas.

QNO#5(b)

Properties of charged-coupled devices:-

- ↳ It is basically a computer chip that function as an electronic camera.
- ↳ It consists of a 2-D array of highly efficient light detectors, that count incoming photons.
- ↳ A charged couple device can either be an area array (square) or linear array.
- ↳ charged coupled devices chips are small for example $40-60\text{mm}^2$.
- ↳ CCD detectors consists of a serial chain of single components such as phosphors, fiber optics or lenses.
- ↳ They also help to convert the X-ray energy into light or electrons.

Uses of charged coupled devices:-

- ↳ They are used in digital radiography for the indirect conversion of x-ray photons into an electric charge.
- ↳ They are used in medical Fluoroscopy
- ↳ They are used as light sensing devices
- ↳ They are used as signal processing devices
- ↳ And may be used as sensors and actuators.