RAD 322Radiographic Techniques 3

LECTURER:

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FLUOROSCOPY

- Credit Hours:
  - Lectures > Two hours
  - Practical > One hour
- Assessment Method:
- First written examination .....15 marks
- Second written examination .....15 marks
- Practical examination .....20 marks
- Course Work .....10 marks
- Final written examination .....40 marks

Contents of the Course

- fluoroscopy equipment
- Contrast medium in fluoroscopy
- Radiation protection during fluoroscopy
- Fluoroscopic Investigations Of The Gastrointestinal Tract
- Urinary Tract examinations
- Biliary tract

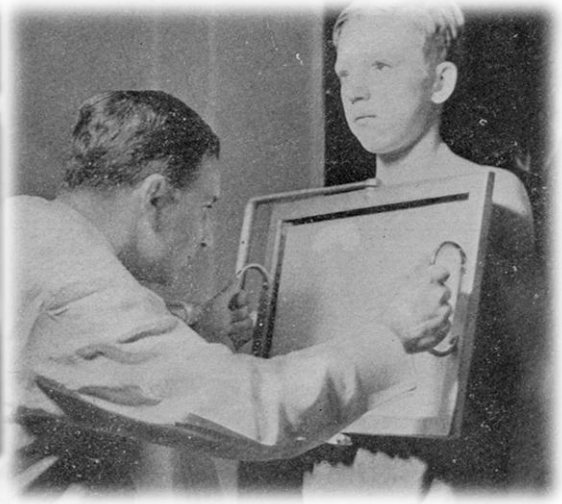
- Hysterosalpingography

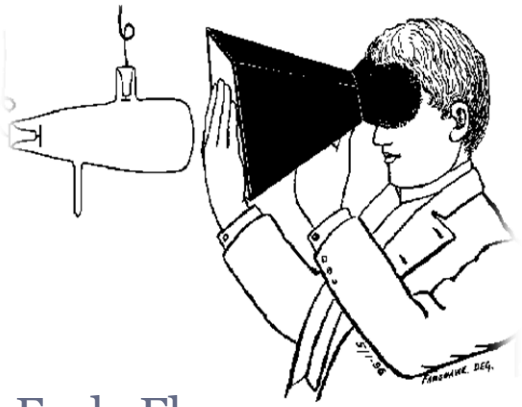
First lecture

FLUOROSCOPY EQUIPMENT

HISTORY

Conventional fluoroscopy invented by Thomas Edison in 1896





Early Fluoroscopy

Basic difference between

Conventional Radiography	Fluoroscopy
• Conventional film radiography is restricted to static patient exams.	• Fluoroscopy is a common technique used by clinical physicians to obtain real time images of moving body parts and internal structures of a patient.

Purpose of Fluoroscopy

- To perform dynamic studies,
  - If dynamic events need to be studied such as movement contrast materials through gastrointestinal tract (GIT) the image must be viewed directly using a dynamic method.
- Visualize anatomical structures in real time.
- View the motion and function of anatomic organs.

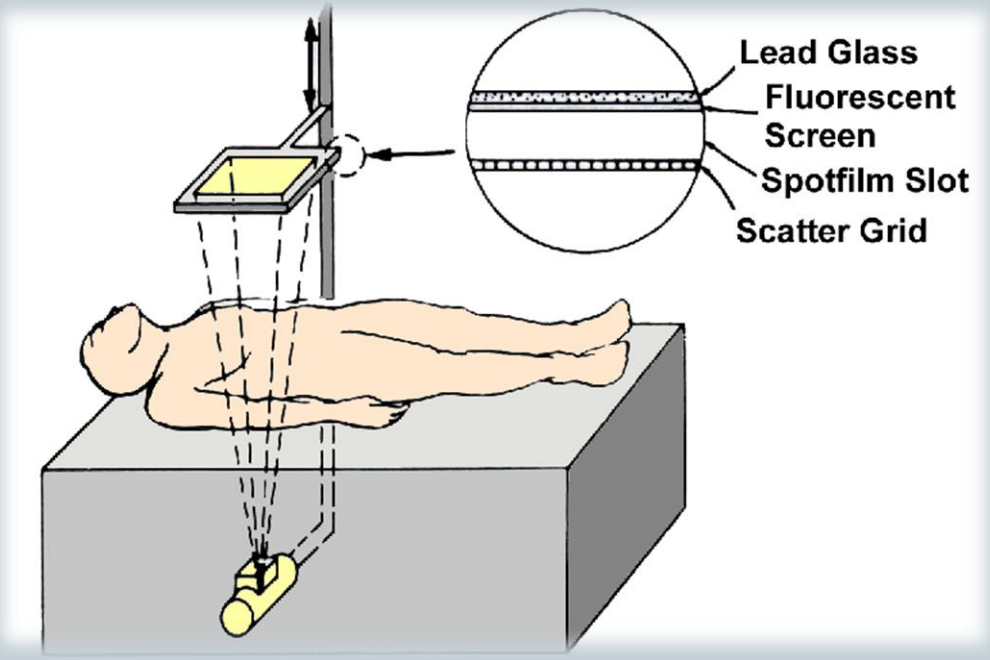
Fluorescence and Phosphorescence

- Photoluminescence :
- Chemical systems that can be excited by electromagnetic radiation and reemit radiation either of the same wavelength or of different wavelength.
- The two most common photoluminescence are:
  - Fluorescence
  - Phosphorescence.
- They differ in the lifetime of their excited states
- the fluorescence ceases immediately after irradiation is discontinued ,while phosphorescence persists for a length of time.

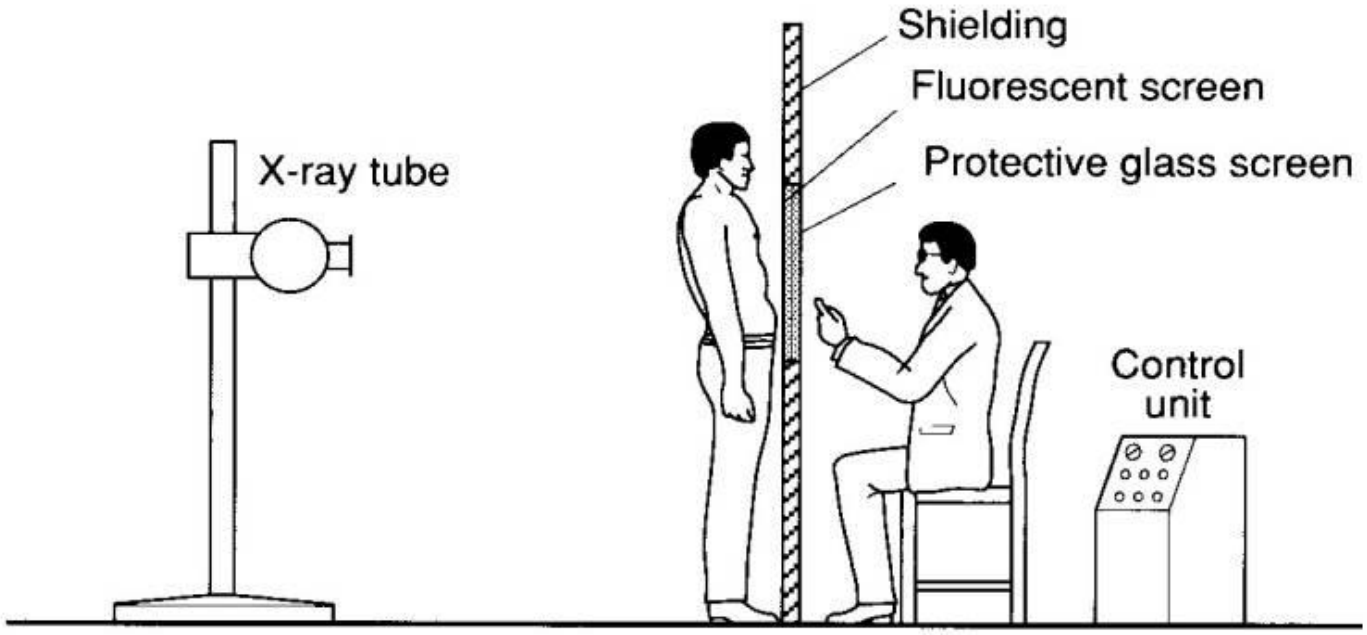
Fluoroscopic systems

Conventional fluoroscopic systems

- Earliest fluoroscopic systems used phosphor screens where the transmitted x-ray caused scintillations that were viewed directly.



Direct Fluoroscopy

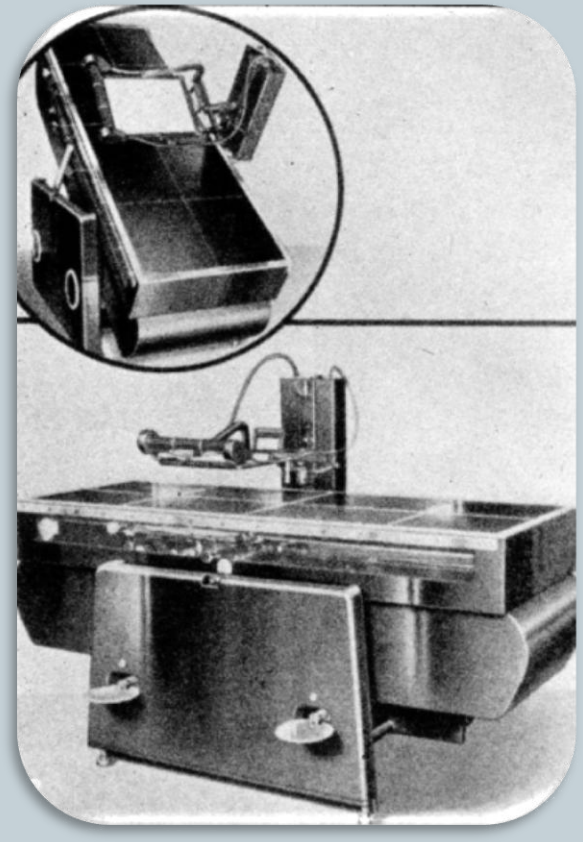


In older fluoroscopic examinations radiologist stands behind screen and view the picture.
Radiologist receives high exposure; despite protective glass, lead shielding in stand, apron and perhaps goggles.

Fluoroscopic systems

Conventional fluoroscopic systems

- The images of this type were of very poor quality for a number of reasons:-
  - Poor light output by the fluorescent screen
  - Low efficiency of the light conversion mechanism
  - Poor spatial resolution
- for that fluorescent screens are no longer used since they gave high radiation dose to the operator.



Fluoroscopic systems

Conventional fluoroscopic systems

The images of this type were of very poor quality for a number of reasons:-

- Brightness of the fluoroscopic image is dependent on anatomic structure being viewed.
- Since the patient's anatomy cannot be controlled, the increase of KVp and decrease in mA is preferred as it is in radiographic imaging.

Fluoroscopic systems

Fluoroscopic systems with image intensifiers

- Modern fluoroscopic equipment are equipped with an image intensifier with image brightness controls:
  - ABC= Automatic Brightness Control.
  - ABS= Automatic Brightness Stabilization.
  - AEC= Automatic Exposure Control.
  - AGC= Automatic Gain Control.

Fluoroscopic systems

Fluoroscopic systems with image intensifiers

What is an Image Intensifier ?

- A complex electronic imaging device that receives the remnant beam and converts it to light and increases the intensity of the light.
- The image intensifier tube is contained in a glass envelope in a vacuum and mounted in a metallic container which provides protection for the components.

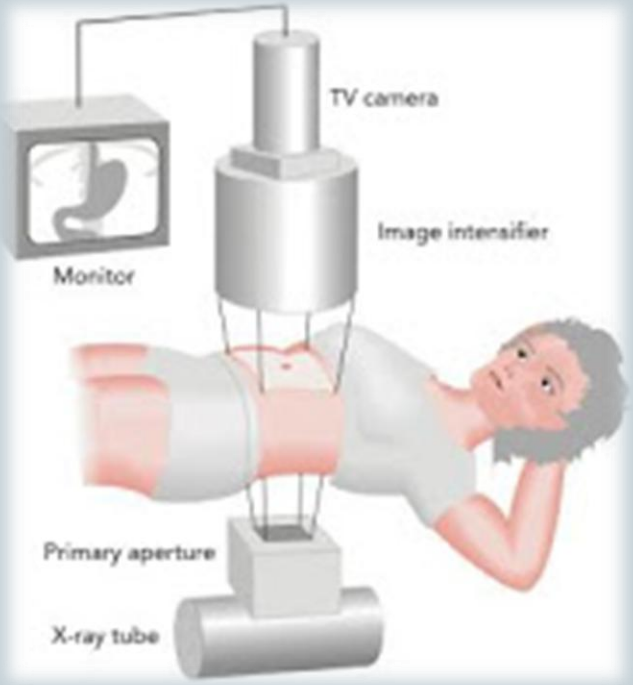
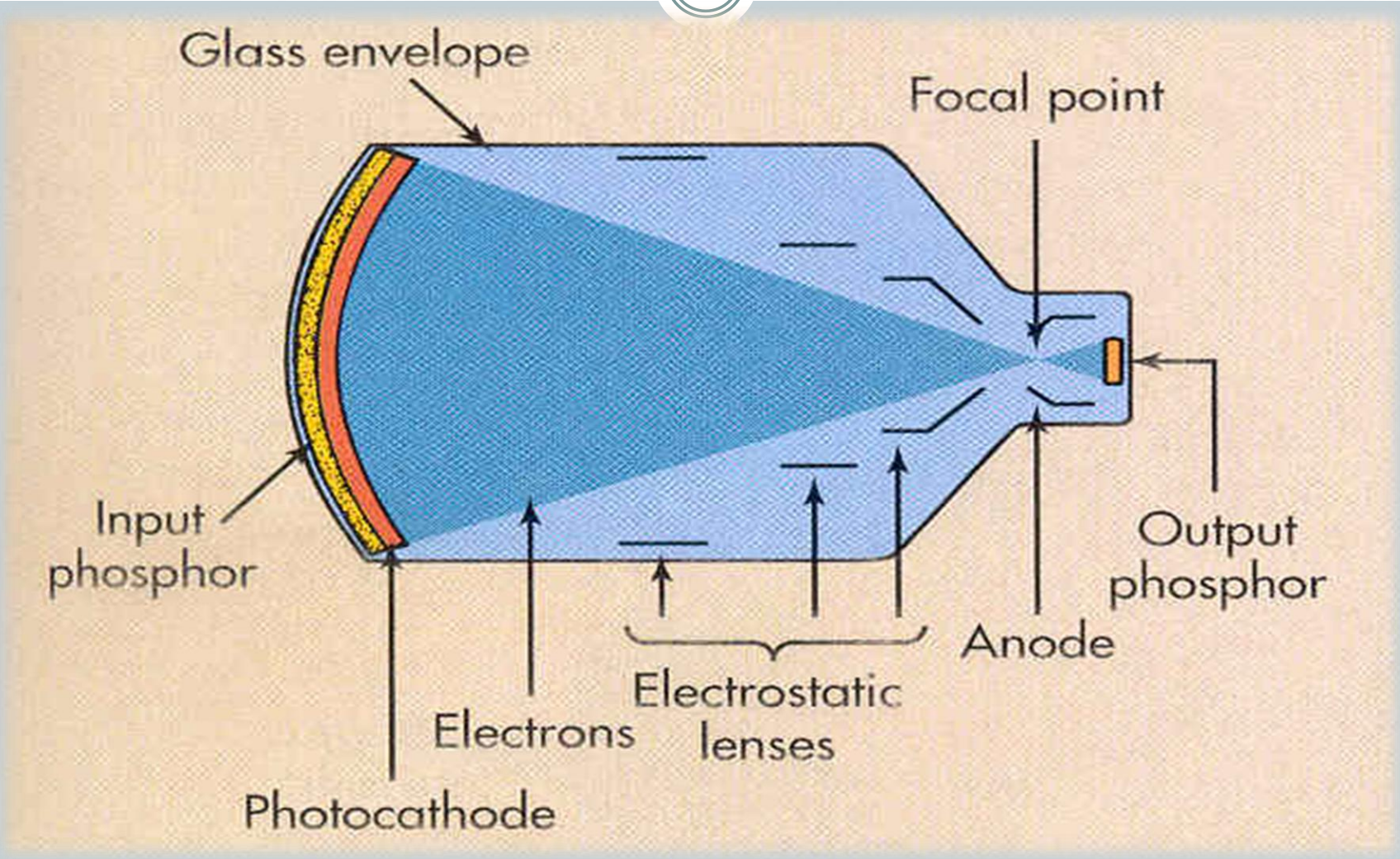
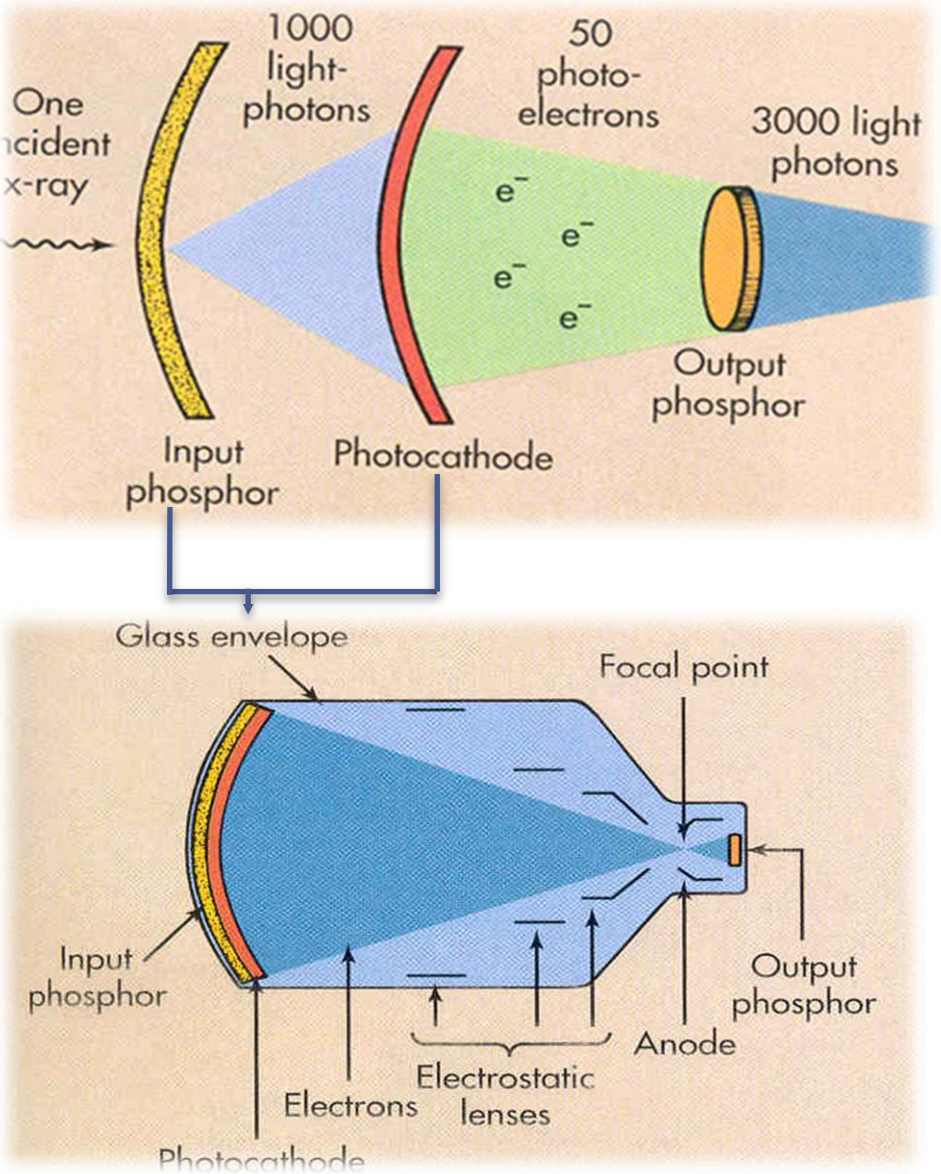


Image Intensifier Schematics



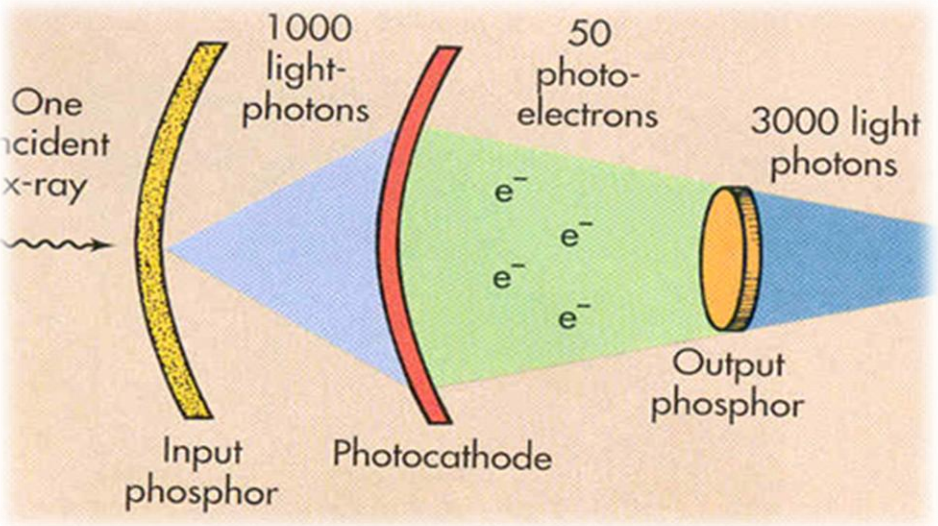
Input Phosphor

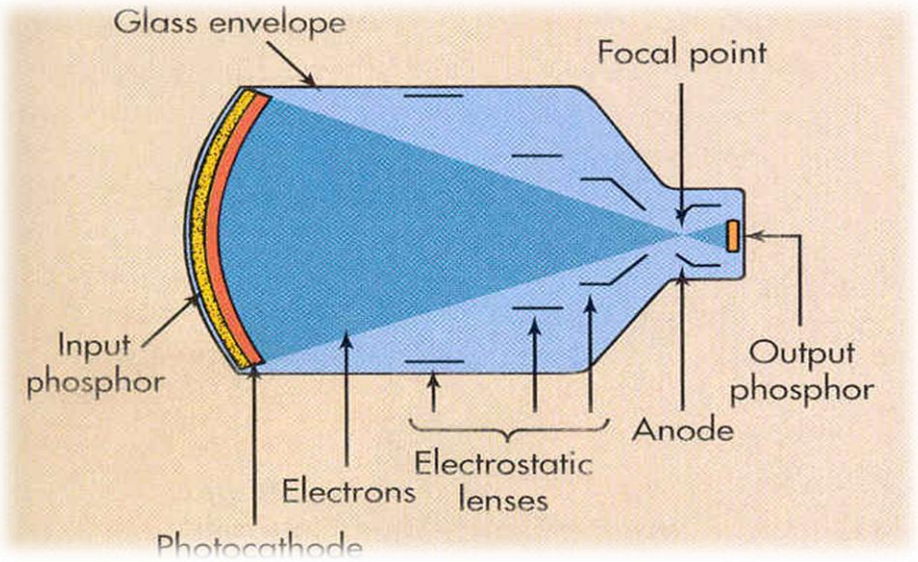
- Constructed of cesium iodide.
- Responsible for converting the incident photon's energy to a burst of visible light photon.
  - Similar to intensifying screens in cassettes.
- Standard size varies from 10 - 35 cm.



Photocathode

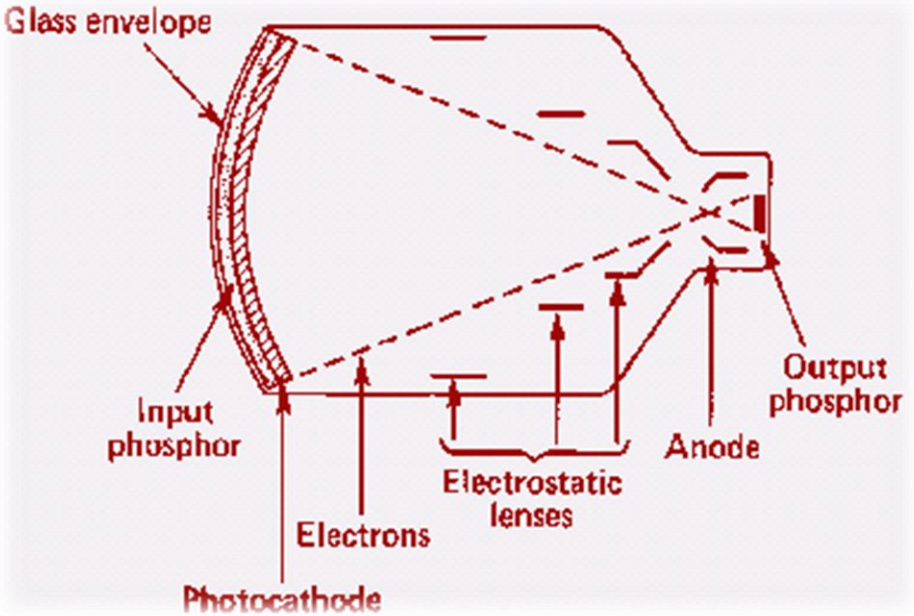
- Thin metal layer bonded directly to the input phosphor.
- Usually made of Cesium and Antimony compounds that respond to light stimulation.
- Responsible for Photoemission.
- Electron emission after light stimulation
- The number of electrons emitted is directly proportional to the light intensity of the incident x-ray photon.

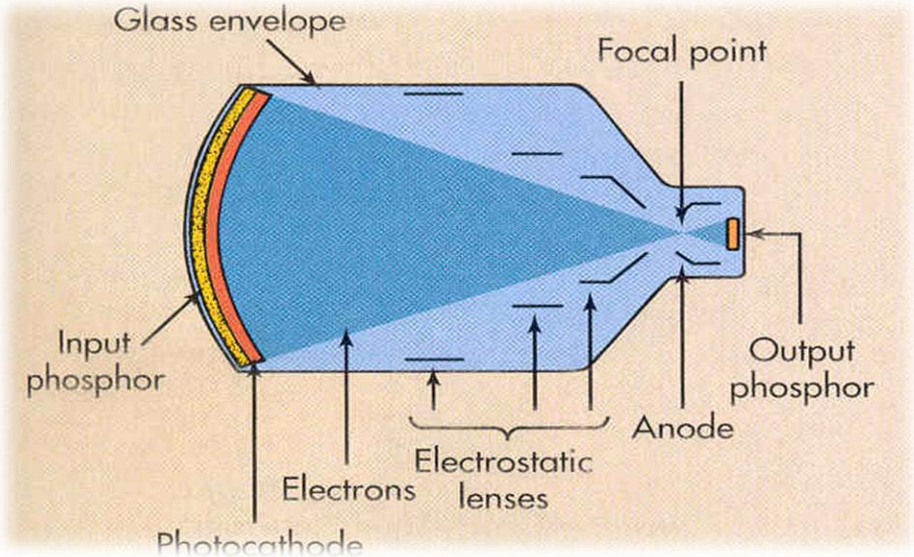




Electrostatic Focusing Lenses

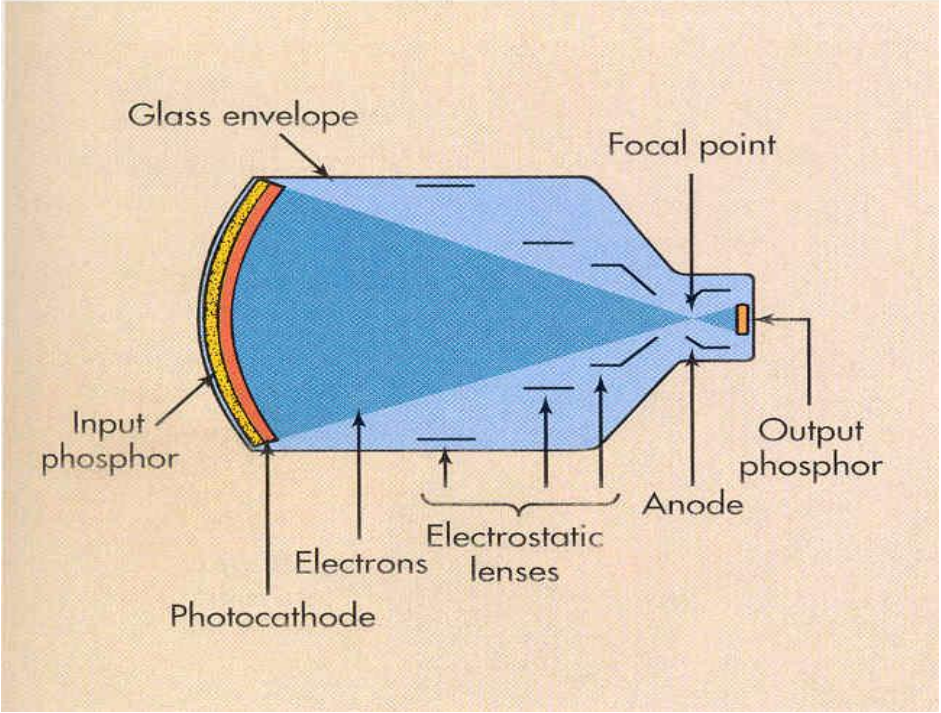
- A series of lenses inside the II tube to maintain proper focus of the photoelectrons emitted from the photocathode.
- They contain a positive charge.
- They are located along the length of the II tube.





Output Phosphor

- Usually constructed of **zinc cadmium sulfide crystals.** Serves to increase illumination of the images by converting photoelectrons to light photons.
- Upon interaction, the incident photoelectron is multiplied and converted to 50 - 75 times as many light photons.



Brightness Gain

- The ability of the II tube to increase the illumination level of the image.
  - Brightness Gain =Minification gain X Flux gain
    - Minification gain:
      - The ratio of the square of the diameter of the input phosphor to the square of the diameter of the output phosphor.
    - Flux gain:
      - The ratio of number of light photons at the output phosphor to the number at the input phosphor.

Brightness gain

Example:

What is the brightness gain for a 17cm II tube having a flux gain of 120 & a 2.5 cm output phosphor?

Brightness gain

Example:

What is the brightness gain for a 17cm II tube having a flux gain of 120 & a 2.5 cm output phosphor?

Brightness Gain = 5520

$$= \frac{17^2}{2.5^2} \times 120$$

$$= 46 \times 120$$

$$= 5520$$

Brightness gain

- Most image intensifiers have a brightness gain of 5,000 to 20,000.
- This number decreases as the tube ages.
- Because of the image intensifier, the information gathered may be stored or displayed in many ways.
  - Spot film device
  - Cine camera
  - TV monitor
  - Video recorder

Spot Film Device

- Used to make permanent images during the radiographic examination.
- Film is positioned b/w the patient and the image intensifier.
- When the film is needed, the radiologist actuates the control that brings the cassette in position. This changes the tube from fluoroscopic mA to radiographic mA.
- During fluoroscopy, the tube is operated **at less than 5 mA.**

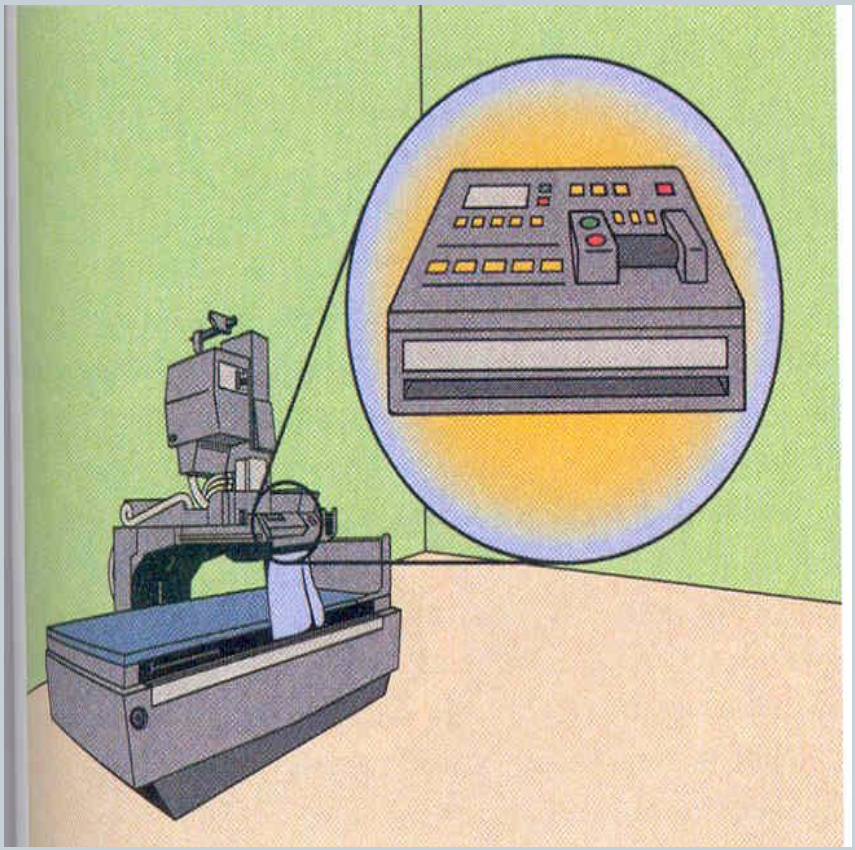


Image Magnification

- In the larger II diameter, the entire input phosphor is used to produce the image. e.g… 25 cm
- As a smaller size is used, the voltage on the focusing lenses is increased thus causing the focal point to move further from the output phosphor. e.g… 17 cm
- The end result is a magnified image that is in direct proportion to the ratio of the diameters.

TV MONITORS

- This practical and efficient viewing system was employed because of the limitations of the mirror optic viewing system.

TV monitors:

1. Enables viewing by multiple persons.
2. Monitors may be located in remote locations other than the radiographic room.
3. Image brightness and contrast can be manipulated.
4. Images may be stored on different medium for reviewing at a later time.

TV CAMERA TUBE

- When TV monitors are used to display the fluoroscopic image, TV Camera tubes are attached directly to the output phosphor of the image intensifier tube.

TV camera tubes

TV Monitor

- The video signal is amplified and transmitted to the TV monitor via a cable where it is transformed into a visible image.
- The monitor has only two controls ; contrast and brightness.

Cinefluoroscopy

- Used in Cardiac Catheterization or Angiography.
- The TV camera tube is replaced by a movie camera that records the images on film.

Fluoroscopy -Modes of operation

- **Manual Mode**
  - Allow the use to select the exact MA and KVp required
- **Automatic Exposure Control (AEC) Mode**
  - Allow the unit to drive the KVp and MA to optimize dose and image quality
- **Pulsed Digital mode**
  - Modifies the fluoroscopic output by cutting by cutting out exposure between pulses
  - With the pulsed mode, it can be set to produce less than the conventional 25 or 30 images per second. This reduces the exposure rate.

Fluoroscopy Units

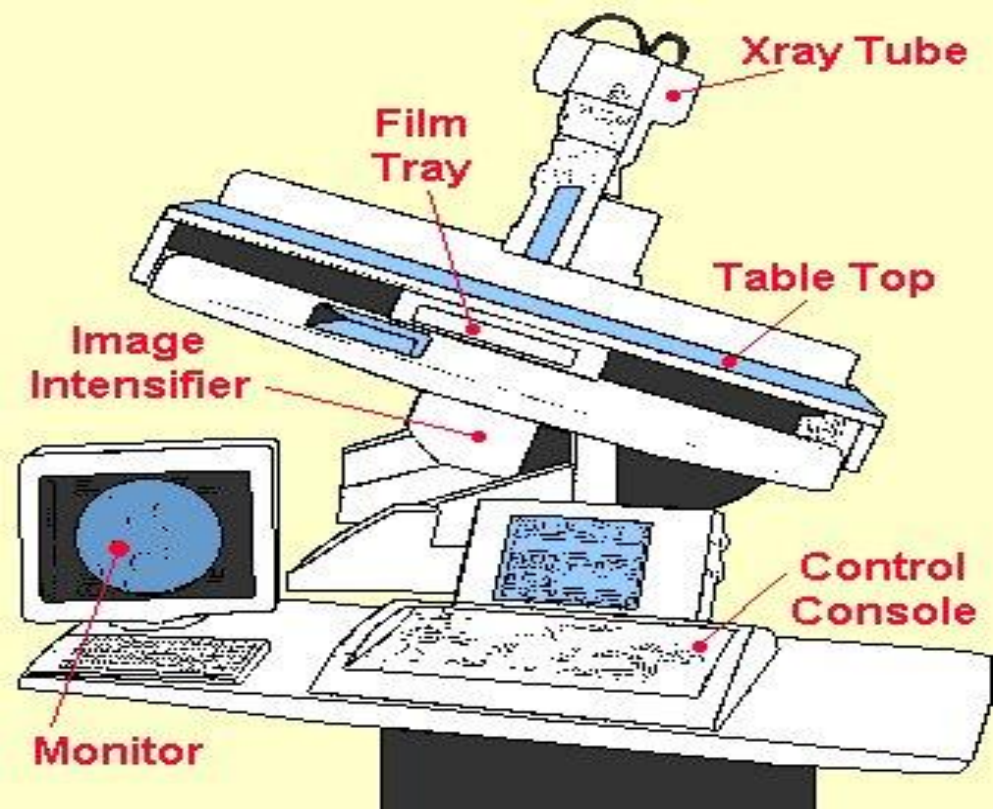
- Smaller facilities may use one fluoroscopic system for a wide variety of procedures
- Larger facilities have several units dedicated to specific applications, such as:
  - Gastrointestinal units
  - Remote fluoroscopy rooms
  - Peripheral angiography units
  - Cardiology catheterization units
  - Biplane angiography units
  - Mobile fluoroscopy – C arms units

Fluoroscopy Units

Three major radiography/fluoroscopy (R/F) designs are commonly used:

1/An over table model

Where the x-ray tube is placed above the table top, and the image intensifier under the table surface.

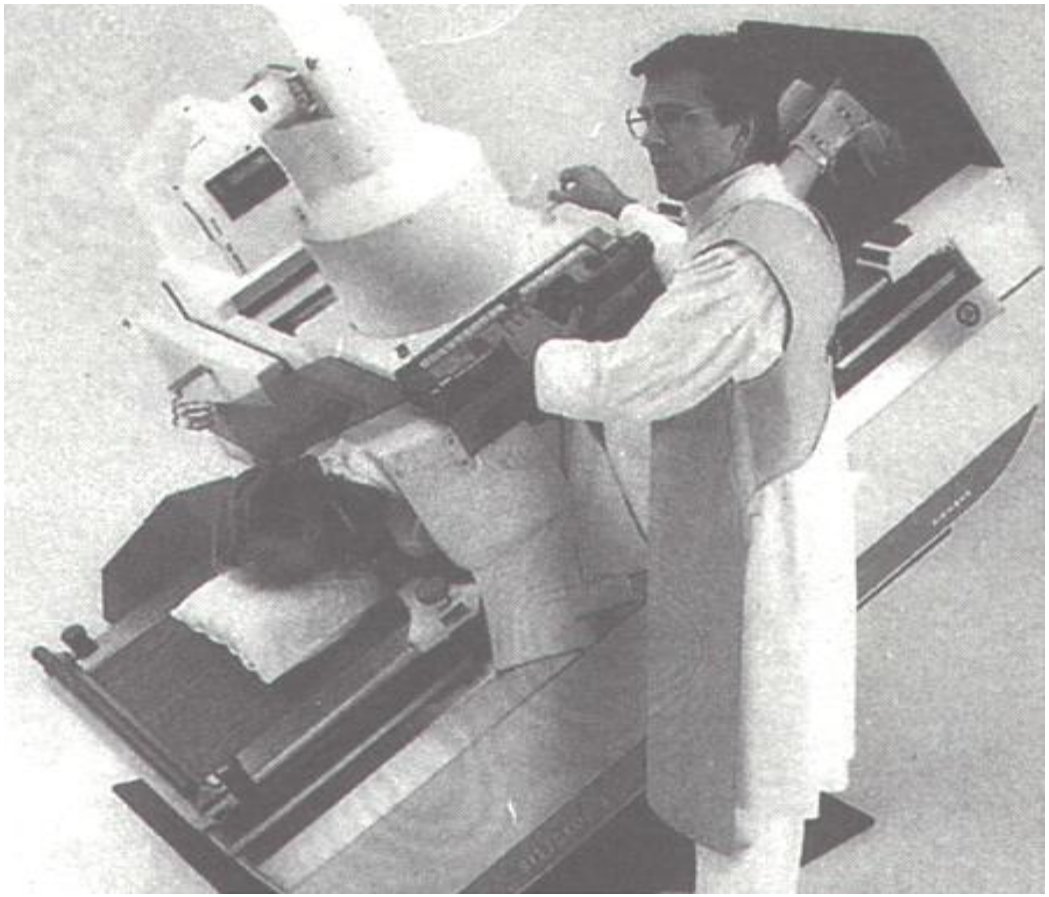



FLUOROSK

Fluoroscopy Units

2/An under table model

Where the x-ray tube is placed under the table surface , and the image intensifier over the table top.



The table have the ability to tilt from horizontal to vertical

Fluoroscopy Units

3/Single or bi-planar cine –fluoroscopy model

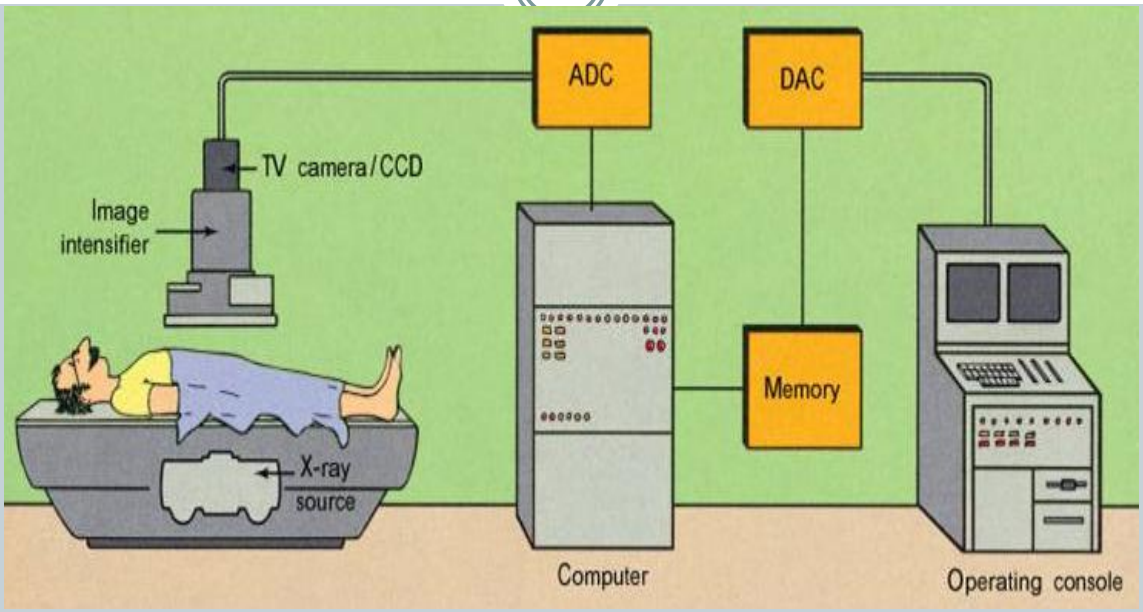
- Where the x-ray tube and image intensifier fixed to c-arms.
- Mostly used in surgical theatres.

Fluoroscopy Units

- **Remote control systems**
- Not requiring the presence of medical specialists inside the X Ray room

Digital Fluoroscopy

Digital Fluoroscopy



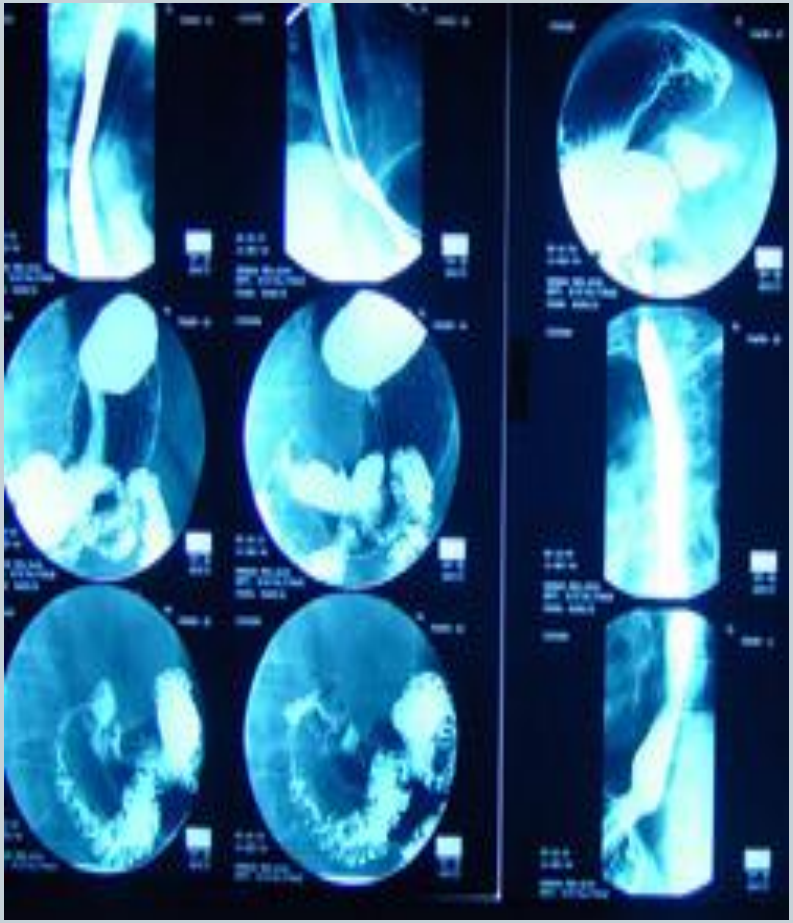
- **Digital fluoroscopy** is currently most commonly configured as a conventional **fluoroscopy** system
- This method uses **digital** detector technologies (eg, flat-panel "direct" detection of x rays and charge- coupled device technology)
- The analog video signal is converted to a **digital** format with an analog-to-**digital** converter (ADC).

Digital Image recording

- In newer fluoroscopic systems film recording replaced with digital image recording.
- Digital photo-spots acquired by recording a digitized video signal and storing it in computer memory.
- Operation fast, convenient.
- Image quality can be enhanced by application of various image processing techniques, including window-level, frame averaging, and edge enhancement.
- But, the spatial resolution of digital photo-spots is less than that of film images.

Digital spot images

- Spot images may be acquired by using the same **digital fluoroscopy** system.
- Individual frames from a **digital fluoroscopy** sequence can be stored **digital**ly and can be used instead of conventional spot film



Digital Fluoroscopy

- The **digital** image data from **digital fluoroscopy** may be processed by using many useful image processing techniques.
- These techniques may serve to decrease radiation exposure to the patient and medical imaging staff or improve visualization of anatomy.
- Processing options include last image hold, gray-scale processing, temporal frame averaging, and edge enhancement.
- Additional processing is available when **digital fluoroscopy** data are used to perform DSA.

Thank you