Training Module on  
"Training in Radiographic 
Techniques for in-service 
Radiographers"

PREPARED BY :-

DR. K.K. SABHARWAL  
Prof. & Head  
Deptt. of Radio-diagnosis  
Dr. S.N. Medical College &  
Associated group of Hospitals  
Jodhpur-342 003 (Raj.)
## Training Module On "Training in Radiographic Techniques for in Service Radiographers"

### INDEX

<table>
<thead>
<tr>
<th>Contents</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Objective of Training</td>
<td>1</td>
</tr>
<tr>
<td>Session Wise Training Schedule (for 6 days)</td>
<td>2</td>
</tr>
<tr>
<td><strong>Session-I</strong> Radiophysics</td>
<td>3 - 5</td>
</tr>
<tr>
<td><strong>Session-II</strong> X-Ray Film, Cassettes and Screens</td>
<td>6 - 8</td>
</tr>
<tr>
<td><strong>Session-III</strong> Dark Room Techniques</td>
<td>9 - 10</td>
</tr>
<tr>
<td><strong>Session-IV</strong> Radiographic Positioning of chest and related anatomy.</td>
<td>11 - 13</td>
</tr>
<tr>
<td><strong>Session-V</strong> Plain Radiography of Abdomen</td>
<td>14 - 15</td>
</tr>
<tr>
<td><strong>Session-VI</strong> Radiographic positioning of upper extremity with related radiologic anatomy</td>
<td>16 - 18</td>
</tr>
<tr>
<td><strong>Session-VII</strong> Radiographic Positioning of Lower extremity with related radiologic anatomy</td>
<td>19 - 21</td>
</tr>
<tr>
<td><strong>Session-VIII</strong> Radiographic positioning of Pelvis with related radiologic anatomy</td>
<td>22 - 24</td>
</tr>
<tr>
<td><strong>Session-IX</strong> Radiographic Positioning and related anatomy of vertebral column.</td>
<td>25 - 28</td>
</tr>
<tr>
<td><strong>Session-X</strong> Radiographic positioning and related anatomy of skull.</td>
<td>29 - 32</td>
</tr>
<tr>
<td><strong>Session-XI</strong> Radiological special investigations in Urogenital system</td>
<td>33 - 35</td>
</tr>
<tr>
<td><strong>Session - XII</strong> Radiological special investigations regarding gastrointestinal tract.</td>
<td>36 - 38</td>
</tr>
<tr>
<td><strong>Session - XIII</strong> Soft tissue radiography</td>
<td>39</td>
</tr>
</tbody>
</table>
Session - XIV High Kilovoltage radiography  40
Session - XV Introduction about radiation protection and its hazards.  41
Post Evaluation Exercise  42 - 43
Answer Sheet  44
Practical Assessment
General Objectives of Training:-

The concept of primary health care cannot be successfully implemented without the support of diagnostic services. Such services must include facilities for diagnostic radiology. Accordingly, a few years ago W.H.O. initiated the development of a "Basic Radiological system (BRS)" to provide better radiological coverage for populations at present under-served.

Apart from their general inadequacy, the existing radiodiagnostic facilities in developing countries seldom meet the real needs of the majority of the population. 90% of all X-Ray examinations are essentially simple procedures, given the lack of sophisticated equipment and the paucity of highly specialised personal. Thus, a well-structured radiological network should operate at three levels. Health centres and rural hospitals should be equipped to manage only basic radiological examinations, such as those of the chest, abdomen, and skeleton and simple (non-fluoroscopic) contrast examinations. Referral hospitals are required to solve difficult problems. The general hospital - the next level should provide general - purpose radiological examinations adding a fluoroscopy unit as well as the unmodified BRS equipment. Finally a specialized and comprehensive radiological service should be available at specialized centres and university hospitals. In doing to, it has tried to produce a module that will help the in-service radiographers to provide basic radiological coverage for population at present under-served in rural or referral hospitals of Rajasthan.

The basic aim of the training is to improve the quality of radio diagnostic services at rural, referral as well as district hospitals of Rajasthan. This training programme will develope competent radiographers to provide better radiological coverage in rural and referral hospitals. Not every radiographic positioning/procedure can be described in such a small module, more over the common radiographic positioning/procedures in our geographical area are included in this module.
Training Module on "Training in Radiographic Techniques for in-service Radiographers"

SESSION-WISE SCHEDULE (For 6 days)

<table>
<thead>
<tr>
<th>SESSIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SESSSIONS</strong></td>
</tr>
<tr>
<td><strong>Days</strong></td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
</tbody>
</table>

Note: 1. Trainees may be required to attend to emergencies under guidance during the period of training.
2. Maximum no. of trainees per batch is 10-12.
3. For inservice radiographers there is no need of training in Ultrasonography as it is done by radiologists only.
Day-1

SESSION-I

Radiophysics

Objective:-

(1) Provide information regarding production of X-rays.
(2) General properties and biological effect of X-Rays.
(3) Information regarding various parts of machine, and their function.

Method of Teaching -

(1) Live demonstration of various parts of X-Ray machine and their functions.
(2) Lecture method
(3) Black Board and chalk
(4) OHP presentation

Contents: Text

X-Ray are produced when a stream of electrons from a heated tungsten filament called the cathode, hits a target called anode, usually made of tungsten. The electrons are accelerated by applying a high voltage in the range of 70-140kv between cathode and anode, both of which are enclosed in a vacuum tube. Metal shielding around the X-Ray tube, absorbs unwanted X-Rays and allow a beam of X-Ray to emerge.

Properties of X-Ray

(a) **Photographic effect**: X-Rays are electromagnetic radiation, they expose a photographic film in the same way as light does.

(b) **Fluorescent effect**: If a suitably fluorescent substance such as calcium tungstate or barium platinocyanide is applied to cardboard and exposed to X-Rays, it will be found that the substance fluoresces, rays of a longer wave length being given off.

(c) **Penetrating Power** - The Power of penetration depends on the density of the part to be penetrated, in other words, it depends on the atomic numbers of the substance composing it. The penetrating power is directly proportional do the kilovoltage used; in other words, it depends on the wavelength of the X-ray beam.

(d) **Biological effect** - X-rays affect mainly growing and living tissues. X-radiation affects the tumors which are an example of growing tissues without causing damage to normal tissues. It has a greater effect on the growing tissues in the ovary and testis than on non-growing tissues.

(e) **Power of ionisation** - X-Ray have the power of ionising air and this power is proportional to the intensity of the radiation.
Rectilinear propagation - X-Rays travel in straight line like light rays and also travel at the speed of light.

Dual Focus tube:
A broad focus target will stand up to a heavier bombardment of electrons, but on the other hand, the disadvantage is poor detail in comparison to a fine focus if good detail is needed, a fine focus is required, but then the exposure will be limited.

The problem is dealt with by incorporating two foci, a fine and broad. Two filament current are used and a switch could operate either one or other.

Rotating anode - The anode in which the focus is set to rotate with a speed of 3600 revolutions per minute. Thus no part of the focus is subjected to an over powering bombardment of electrons.

Quality of X-Ray beam: Quality means the hardness of the ray and it is measured by the wave-length. The minimum wave length is related to the kilovoltage applied and it can be expressed as follows:-

\[ \lambda = \frac{12.35}{K_v} \]

Filtration - Filtration is the process of increasing the mean energy of polychromatic radiation by passing it through an absorption. There are three types of filters-
(a) X-Ray tube and its housing (Inherent Filtration)
(b) Metal placed in the path of beam (added filtration)
(c) Patient itself

Exposure-
When a radiographic exposure is made, X-Rays of a selected quality and quantity, determined by the kilovoltage (Kv) and milliampere seconds (mAs) are emitted from the tube. They diverge uniformly, so that the area covered is directly proportional to the square of the distance travelled. The X-Ray beam passes through the patient and is differentially attenuated by the various structure present. Secondary radiation resulting from scattering arises in the patient during the course of attenuation of the primary beam and is emitted in all directions. This may then be passed through a grid which absorbs predominantly the secondary radiation and the image is recorded when the final beam passes through a film screen combination.

Contrast - The term contrast means differences in densities of two adjacent areas on the film. This difference in density determines the contrast in photographic or radiographic image.

Latitude - When possible, exposure should be such as to make all parts of the radiograph tie on the straight line portion of the characteristic curve. The Latitude is the range of exposure over which the densities will lie in the region of correct exposure.

Grids - When X-Ray strike an object, some of the beam is scattered thus reducing the quality of the X-Ray image. To overcome this problems, a grid is
used which consist of a large number of parallel, thin stripes of lead held apart by material which allows the primary beam to pass. Unimpeded, but the obliquely scattered radiation is absorbed by the lead strips in the grids.

**Types of grids** - are (a) Parallel grids (b) Focussed grid (c) Crossed grid (e) Moving grid.

**Grid ratio** : Grid ratio is defined as the ratio between the height of the lead stripe and the distance between them.

**Bucky factor** - Bucky factor is the ratio of incident photon falling on the grids to the transmitted beam that passes through the grid. It indicates how much increased exposure is to be given while using grid.

**Collimators** - They provide many varieties of square and rectangular radiation field as per requirement, light beam marks the centre and exact configuration of the X-Ray field. Collimation of beam is extremely necessary to protect the patient from the being exposed to unwanted radiation. Thereby decreasing the scattered radiation and increasing the contrast.

**References:**

(1) Joseph Selman, The fundamental of X-ray and radium physics, six edition, Charles C Thomas Publisher U.S.A.


**Evaluation** : Question and answer Session.
Day-1

SESSION-II

X-Ray Films, Cassettes and Screens

Objectives:

(1) Provide information regarding various parts of intensifying screens and their functions.

(2) Construction of X-Ray film

(3) Various types of X-Ray films.

Method of Teaching -

(i) Live demonstration of Cassettes, films and intensifying screens.

(ii) Lecture method

(iii) Blackboard and chalk.

Content : Text

Intensifying Screens: An intensifying screen is a device that converts X-Ray photon into visible light. This visible light then interacts with the X-Ray film forming the latent image.

An intensifying screen has four layers:-

(a) Protective layer - It makes the screen resistant to abrasions and damage caused by handling, thereby giving physical protection.

(b) Phosphor layer - It is the active-layer and emits light during stimulation by X-Rays. The active substance is calcium tungstate embedded in a polymer matrix

(c) Reflective layer - Between the phosphor and the base is the reflective layer made up of shiny substance, known as titanium dioxide. This layer intercepts light headed in other directions and redirects it to the X-Ray film.

(d) Base - Serves as a support for the phosphor layer and is farthest from the film. It is made up of high grade cardboard or polyester.

Intensifying factor of a screen is the ratio of X-Ray exposure needed to produce the same density on a film with and without the screen.

A screen is said to be fast when a relatively small exposure produces a given output of light and causes certain degree of blackening of film.

Screen film contact: The cassette in which the intensifying screen is mounted must provide a good film screen contact, and most importantly the contact must be uniform.

New rare earth screens (whose phosphors are terbium activated gadolinium or lanthanum oxysulphide) are several times more efficient at converting X-Ray quanta into a light than are conventional calcium tungstate screens,
**Fluoroscopic Screens** - In fluoroscopy the visible light emitted by screens is viewed directly by the radiologist and give the corresponding X-Ray patterns. The intensity of light emitted by the screen is very low and therefore difficult to see. At these low levels of light intensity, the eye is most sensitive to green part spectrum. Therefore, the floursescent material used is Zinc cadmium sulphide.

**Construction of X-Ray Film** - Radigographic film has two parts, the base and the emulsion. Most films have emulsion coated on both sides and are therefore called double-coated film.

(i) **Base** - The base is the foundation for radiographic film. It is inert and it is of uniform lucency for viewing the radiographic clearly. Two types of basses are available cellulose triacetate and polyester. The polyester is stronger and thinner as well.

(ii) **Emulsion** - It is the material in which X-Ray or light photons from screen interact and transfer information. The emulsion consists of homogenous mixture of gelatin and silver halide crystals. The silver halide crystal is the active ingredient of the radiographic emulsion. In the typical emulsion, 75% of silver halide is silver bromide, the remainder is usually silver iodide. The light sensitive silver bromide crystals are formed by mixing silver nitrate with potassium bromide (kBr). When these bromide ions receive the exposures, the electrons from bromide ion gets released. Such positive ions are attracted to negatively charged sensitivity centres and neutralize the charge with the formation of metallic silver at the centre. This process continues till the negative charge on the sensitivity centres gets completely neutralized and metallic silver is formed. This is called latent image. It is capable of initiating development when it comes in contact with developer.

(iii) **Types of Films:**

(a) Screen films - Most often used in radiography. They are available with different speed depending on emulsion.

(b) Non-Screen films - They are about four times as fast as screen film and therefore requires only about one fourth of exposure of screen film for equal blackening.

(c) Mamography Films - is a fine grain single emulsion films designed to be exposed with a single intensifying screen.

(d) Duplicating Film - is a single emulsion that is exposed to ultra-violet light through the existing radiograph to produce a copy.

(e) Subtraction film - is sometimes employed in angiography. It is a single emulsion film.

(f) Dental films - are double emulsion films, they are exposed without screens.

(g) Medical imaging films - They are sued for recording images in CT, MRI, USG and digital radiography.
References

(1) Joseph Selman, The fundamental of X-ray and radium physics, six edition, Charles C thomas Publisher U.S.A.


Evaluation: Question and answer session.
Day-1

SESSION-III

Dark Room Techniques

Objectives:
1. Provide information regarding film processing.
2. Various ingredients of developer and fixer, and their functions.
3. Information about automatic film processing.
4. Various dark room precautions.

Method of Teaching-
1. Live demonstration of X-Ray film processing in dark room.
2. Demonstration of automatic film processing.
3. Lecture method.

Contents: Text

The radiographic image in the X-Ray Film in most of the medical radiography is produced mainly by the light. The X-Ray film in the Cassette is sandwiched between two sheets of a substance which has fluorescent properties and can change the X-Rays into visible light. These sheets are known as intensifying screens. The exposure of light to film, causes reduction of silver halide ions to metallic silver which produces latent image.

Many chemicals are capable of reducing silver halide to metallic silver but most of them are useless, as they reduce both exposed and unexposed grains simultaneously. However certain chemicals are used for this purpose. These chemical substances which are used to complete the process of reduction of exposed silver grains are known as "developing agent". and these together with contain other chemicals necessary for their work are known as "Developer". The process of chemical reduction is known as "development".

In practice, developer contains the following-
(a) Developing Agent (metol and hydroquinone)
(b) Accelerator, (alkali)
(c) Preservative (Sodium Sulphite)
(d) Restrainer (Potassium bromide)
(e) water

The radiographic film after development is thoroughly rinsed in water, to wash out the developer to prevent further action of light on the film. The unaffected silver halide is to be dissolved out by the action of certain chemicals. The solution of these chemical substances is known as "Fixer" and the process is known as "Fixation".

Fixer consists of following constituents-
(a) **Fixing agent** - Sodium thiosulphate, also known as HYPO is used.
(b) **Preservative**: to stop, development both rapidly and uniformly, an acid is included into fixer so that the alkaline developer in the film gelatin is rapidly neutralized. Sodium bisulphite is commonly used.

(c) **Hardener** - Common hardeners are "alum's" which possess the property of taming gelatin.

(d) **Acid** - Acetic acid serves two purpose - neutralised the alkali still remaining on the film and provides an optimum medium for fixer and hardener.

After fixation is complete, the film is thoroughly washed in water, to remove all traces of dissolved (unaffected) silver halide grains and the chemical substances remaining after fixation. The film is than finally dried in a duct free atmosphere.

The complete process which includes development, rinsing, fixation and washing is done in a dark room and is known as "Processing."

**Automatic Film Processing** - In modern diagnostic centres where work load is high, automatic film processing is very helpful in the sense that it can process much larger number of films in a short time, thereby accelerating the pace of work. The basic principles of an automatic film processor is a series of rollers which helps films pass through various compartments. The transportation of the films should be at a constant speed. Precise temperature control is of permanent importance. The temperature of developer should be maintained at 95°F. A circulation system, continuously pumps the developer and fixer, thereby causing, agitation of the chemicals. To ensure best results, constant and uniform thickness of base and emulsion in a X-Ray film must be ensured otherwise it may hamper smooth passage of the X-Ray films through the rollers leading to jamming of the films.

**Dark room precautions** - Following dark room precautions need to be observed to get a good quality X-Ray:

- Never switch on the white light while the film are being processed.
- Never open the door, until the entire processing upto fixing is completed.
- After loading the film in cassette, first close the box of unexposed film before locking the X-Ray Cassette.
- Do not use the finger nails while taking the film out of cassette.
- Do not ever bend the X-ray film nor touch it with fingernails.
- Keep the films in a cool and dry place.
- Intensifying screens are very sensitive and expensive as well.
- Dark room must be clean and dry all the time.

**References**


**Evaluation** : Question and answer sessions.

Practical Assessment
Day-2

SESSION - IV

Radiographic positioning of Chest and related anatomy.

Objectives

(1) Provide information regarding various radiographic positions of chest with their exposure factors.

(2) Related radiological anatomy of lungs, heart, great vessels, diaphragms etc.

Method of Teaching

(i). By live demonstration of various radiographic position of chest on X-ray table.

(ii). Study the related radiological anatomy of lungs, heart, mediastinal and diaphragmatic shadows on X-ray films.

(iii). Lecture method

(iv). Black Board and chalk.

Contents - Text

Radiography of chest is the commonest examination performed in department of radiology. It is required to demonstrate pulmonary, pleural, pericardial, cardiac, mediastinum and diaphragmatic pathologies

The following guidelines must be kept in mind, for X-ray chest,

- Care should be taken to ensure that no radio opaque objects are left on under the cotton gown.
- X-ray must always be taken on arrested respiration.
- Chest radiograph must be taken on full inspiration.
- Care must be taken in positioning the patient so that there is no rotation of the patient.
- Normally the centering point is 4th or 5th dorsal vertebra.
- To minimise or reduce magnification of heart shadow a long focus films distance (5-6 feet) is need. In supine view the longest focus film distance does not exceed 4 feet (120 cm.)

Positions:

(1) Posterior anterior (PA View)

Patient is erect with chest against the film. Chin is raised and placed on the top of cassette. The top of the cassette should be 2 inches (5.0 cm) above the level of shoulders. The elbows are flexed, the back of the hands placed on the hips and elbows are pushed forward, till both shoulders touch the film.
Exposure factors:

Distance : 150-180 cm
KV : 65
mAs : 10-15
Grid : No

(2) **Antero-posterior (AP view)**: Patient stands erect facing the tube with his back in contact with the cassette. Care should be taken to see that the film is high enough to include the apices of the lung i.e. top of the film should not be more than 1 inch (2.5 cm) below the occipital protuberance. The shoulders should be brought forwards with hands on hips.

Central ray 1 inch (2.5 cm) below the suprasternal notch at right angle to the film.

Exposure factors : Same as P.A. view

(3) **Lateral** : From the P.A. position, the patient is rotated 90° such that the affected side is in contact with the film in true lateral position. Both the arms are folded and raised above the head and the axilla is placed against the cassette. Centre through axilla at the level of 5th thoracic vertebra at right angle to the film.

Exposure factors
Distance : 120-150 cm
KV : 80
mAs : 30
Grid : No

(4) **Lateral decubitus** - This position is used when the patient is too ill to stand erect. The patient lies on the affected side to demonstrate fluid in the pleural cavity or on the unaffected side to demonstrate air in the pleural cavity. The patient lies on true lateral position with both arms straight above head. The cassette is placed vertically behind or infront of the patient. Centre to the Cassette wing a horizontal beam.

Exposure factors : Same as P.A. view of chest

(5) **Right anterior oblique** - Patient is erect facing the cassette. Commence with the chest against cassette in postero-anterior position. Then rotate the patient so that the right shoulder in contact with the film. The angle of rotation of patient should be 65° i.e. coronal plane of body is at an angle of 65° with the cassette. Right arm is kept behind patient's back or at the side and the left arm is raised forwards and upwards. Centre over left scapula at the level of 5th dorsal vertebra, at right angle to the film.

Exposure factors
Distance : 180 cm
KV : 70-75
mAs : 20
Grid : No
(6) **Left anterior oblique** - Patient faces the cassette in erect posture. Then rotate the patient with left shoulder in contact with the film and right shoulder away from the film till the coronal plane of the body is at angle of 75° with cassette. Left arm is kept behind patient's back or at side and right arm is raised forwards and upwards with hand resting on head.

  Exposure factors
  Distance : 180 cm
  KV : 70 - 75
  mAs : 20
  Grid : No

**References**

(1) Sandore Meschan, Radiographic positioning and Related Anatomy, W.B. Saunders Company.

(2) K.C. Clark, Positioning in Radiography, 9th edition, ILFORD LIMITED

(3) PES Palmer and W.P. Cockshott, WHO manual of Radiographic interpretation for general practitioners.

**Evaluation** : Question and answer session.

  Practical Assessment
Plain Radiography of Abdomen.

Objectives:

(1) Provide information regarding various radiographic positioning for plain radiography of abdomen with their clinical importance.

(2) Relevant radiological anatomy of abdomen

Method of Teaching

(i). Live demonstration of various radiographic positioning of abdomen on X-ray table.

(ii). Lecture method

(iii). Black Board and chalk.

Contents: Text

Plain radiography of abdomen is valuable in perforation, infection and obstruction of the intestinal tract. Films should be taken in erect posture (to demonstrate fluid levels) and in supine position (to show gas filled bowel loops).

Radiograph of abdomen must include both domes of diaphragm and pubic symphysis. The kidney outlines. Psoas muscle shadows and soft tissues should all be clearly demonstrated. No radiological examination of the abdomen is complete without a film taken to demonstrate the lung fields as cardiac condition or pulmonary consolidations may mimic an acute abdomen.

(1) Antero Posterior (Supine) view -

The patient lies supine on X-Ray table, with the knees flexed over a small pillow for comfort. The cassette is so positioned that its lower border is 1 inch (2.5 cm) below the public Symphysis. Centre through umbilicus at right angle to the film on full expiration during exposure.

Exposure factors:

Distance : 90 cm
KV : 70-75
mAs : 80-100
Grid : Yes

(2) Antero-posterior (Erect) view -

The patient stands erect, with his back against the bucky. The cassette should be so positioned that its upper border is 2 inches (5.0 cm) above Xiphisternum, to include the diaphragm.

Central ray in the middle of cassette, just above umblicus, at right angle to the film.

Multiple air fluid levels are very well seen on erect A.P. view suggesting acute intestinal obstruction.
Exposure factors
Distance : 90 cm
KV : 80 - 85
mAs : 80
Grid : Yes

(3) Antero-Posterior (K.U.B.)

Patient lies supine with centre of the body in line of centre of table. The lower border of cassette should be 2.5 cm below public symphysis. The centre of the cassette should be at about the level of (lower costal margin in mild axillary line and upper edge of cassette is at the level of xiphisternum. Central ray is directed vertically to the centre of the film.

Distance : 90 cm
KV : 70-75
mAs : 80
Grid : yes

References:
(1) Sandore Meschan, Radiographic positioning and Related Anatomy, W.B. Saunders Company.
(2) K.C. Clark, Positioning in Radiography, 9th edition, ILFORD LIMITED
(3) PES Palmer and W.P. Cockshott, WHO manual of Radiographic interpretation for general practitioners.

Evaluation : Question and answer session.
Practical Assessment
Day-2

SESSION -VI

Radiographic positioning of upper extremity with related radiologic anatomy.

Objectives:

(1) Provide information regarding various radiographic positions of upper extremity with exposure factors.

(2) Related radiological anatomy of shoulder, arm, forearm and hand.

Method of Teaching

(i) Liver demonstration of various radiographic positioning of upper extremity with their exposure factors on x-ray table.

(ii) Study the related radiographic anatomy on view box

(iii) Lecture method

Content : Text

(1) **Postero-anterior view of hand:**

Patient sits besides the X-ray table on a stool. Elbow is flexed and hand is placed prone on the film, i.e. whole palm in contact with the film. The fingers are slightly separated. Sand bag may be placed on forearm to steady the hand. Centre over the head of 3rd metacarpal (middle finger) at right angle to the film.

Exposure factor-

<table>
<thead>
<tr>
<th>Distance</th>
<th>90 cm.</th>
</tr>
</thead>
<tbody>
<tr>
<td>KV</td>
<td>50</td>
</tr>
<tr>
<td>mAs</td>
<td>10 - 20</td>
</tr>
<tr>
<td>Grid</td>
<td>No</td>
</tr>
</tbody>
</table>

(2) **Oblique View of hand** - from the P.A. position, hand is rotated to an angle of 45° with the film, the little finger being in contact with the film. Centre over the head of 5th metacarpal at right angle to the film.

Exposure factor - same as P.A. view

(3) **Postero-anterior or P.A. view of wrist joint** : Patient seated with the forearm resting on the table, palm downwards. Sand bag is put over forearm. Centre midway between ulnar and radial styloid processes at right angle to the film.

Exposure factor : same as in hand.

(4) **Lateral view of wrist joint** - from the P.A. position, rotate the hand 90° to the table with thumb upwards. The little finger and medial side of forearm should be on the table centre through radial styloid process at right angle to the film.

Exposure factors - same as in hand.
(5) **Antero-posterior view of forearm** -
Patient seated with forearm resting on the film and the elbow in the A.P. position. Hand is supinated and the dorsum of hand rests firmly on the film. Sand bag is put over hand, centre through the middle of forearm at right angle to the film.

Exposure factors:
- Distance : 90 cm
- KV : 60
- mAs : 10 -15
- Grid : No.

(6) **Lateral view of forearm** - Elbow and wrist in true lateral position with upper and lower arms resting on the table.

Centre over middle of forearm at right angle to the film.

Exposure factors same as A.P. view of forearm.

(7) **Lateral view elbow joint** - Patient is seated by the side of table with elbow and wrist in the lateral position. The elbow is flexed at 90°. The shoulder should be low at the level of table.

Central ray through the lateral epicondyle at right angle to the film.

Exposure factors:
- Distance : 90 cm
- KV : 55 - 60
- mAs : 10 - 15
- Grid : No

(8) **Antero posterior view of elbow** -
Patient is seated at the end of the table, with the arm extended and rotated so that the whole arm and back of the hand lie flat on the table in a straight line. Central ray 2cm below the mid point of epicondyles of the humerus.

exposure factor same as lateral view of elbow.

(9) **Antero-Posteroior view of arm**-
The film should be large enough to include both shoulders and elbow joints. The patient is placed supine or erect, humerus and forearm extended and supinated so that the humerus can rest wholly on the film.

Central ray over middle of humerus at right angle to the film

Exposure factors:
- Distance : 90 cm
- KV : 60
- mAs : 15
- Grid : No
(10) **Lateral view of arm** - Patient supine on table or erect in position. Arm is rotated inwards through an angle of 90° from A.P. position. Elbow joint is flexed. Central ray over mid point of Humerus at right angle to the film.

Exposure factors: As on A.P. view.

(11) **Antero-posterior view of shoulder joint**

Patient supine or erect and slightly rotated to bring the scapula of the affected side parallel to the film. Centre over the head of humerus at right angle to the film.

Exposure factors:
- Distance: 90 cm
- KV: 60
- maAs: 15 - 20
- Grid: No

**References**

(1) Sandore Meschan, Radiographic positioning and Related Anatomy, W.B. Saunders Company.

(2) K.C. Clark, Positioning in Radiography, 9th edition, ILFORD LIMITED

(3) PES Palmer and W.P. Cockshott, WHO manual of Radiographic interpretation for general practitioners.

**Evaluation**

- Questions and answer session.
- Practical Assessment
Day-3

SESSION-VII

Radiographic positioning of lower extremity with relates radiologic anatomy

Objectives

(1) Provide information regarding various radiographic views of lower extremity with exposure factors.

(2) Related radiologic anatomy of pelvis, thigh, leg and foot.

Method of Teaching

(i) Live demonstration of various radiographic positioning of lower extremity with their exposure factors on x-ray table.

(ii) Study the related radiologic anatomy on view box

(iii) Lecture method

Contents : Text

(1) Antero-posterior view of foot

Patient supine or seated on table with foot resting flat on the film knee is leaving slightly towards midline of body. Central ray over base of 3rd metarsal at an angle of about 15-20° towards ankle.

Exposure factors

Distance : 90 cm
KV : 55 - 60
mAs : 20 - 30
Grid : No

(2) Antero-posterior oblique view of foot - From the A.P. position, the leg is allowed to lean medially until the sole of the foot is at an angle of 45° to the film.

Centre through medial border of foot at the level of navicular with 15° tilt towards ankle.

Exposure factors : As in A.P. view of foot

(3) Antero-posterior view of Ankle -

Patient supine on table with ankle resting on film. The foot should be as near vertical as possible to avoid super imposition of calcaneum over ankle joint. Foot is turned inwards until both malleoli are equidistant from the film.

Central ray over mid point between malloeoli at right angle to the film.

Exposure factors

Distance : 90 cm
KV : 60
mAs : 8 - 10
Grid : No
(4) Lateral view of Ankle - Patient lies on the injured or affected side with lateral border of foot on the film. Knee is slightly flexed and rests on a sand bag or pad.

Centre over medial malleolus at right angle to the film.

Exposure factors
Distance : 90 cm
KV : 50 - 55
mAs : 6 - 8
Grid : No

(5) Antero-posterior view of Leg

Patient supine on table with leg fully extended are equidistant from the film. Care should be taken that either the knee or ankle joint is included in the film, preferably both.

Central ray over middle of tibia (leg) at right angle to the film.

Exposure factors
Distance : 90 cm
KV : 50
mAs : 20
Grid : No

(6) Lateral view of Leg - 

Patient lying on affected side, the knee is flexed with lateral border of foot on the table. In this position the malleoli should super impose on each other. Centre over middle of tibia at right angle to the film.

Exposure factors : Same as in A.P. View

(7) Antero-posterior view of knee-Joint

Patient sitting or lying on table, leg fully extended and rotated slightly inwards so that the patella is centralized over the femur.

Central ray 1.5cm below the lower border of patella at right angle to the film.

Exposure factors
Distance : 90 cm
KV : 55
mAs : 20
Grid : no.

(8) Lateral view of knee joint-

Patient lying on affected side with knee slightly flexed. Heel is slightly raised from the table and the knee should be in contact with the film.

Centre 2.5 cm below and 2.5 cm. behind the lower border of patella.

Exposure factors : Same as in A.P. view
(9) **Axial view of patella** -

Patient prone on table with affected knee flexed as much as possible. Tibia and fibula should be steadied either by bandage or held by hand.

Central ray over patella at an angle of 15° to the lower leg.

Exposure factors
- Distance : 90 cm
- KV : 55
- mAs : 20
- Grid : No

(10) **Antero-posterior view of thigh** -

Patient is supine on table with leg fully extended. The foot is rotated a little inwards or medially so that the patella is parallel with the table.

Central ray over middle of thigh at right angle to the film.

Exposure factors
- Distance : 90 cm
- KV : 60
- mAs : 20
- Grid : no.

(11) **Lateral view of thigh**

Patient lying on affected side with tibia and fibula in true lateral position and lateral border of foot on the table. Sand bag is placed over leg.

Central ray over the middle of thigh at right angle to the film.

Exposure factors : same as A.P. View

References
2. K.C. Clark, Positioning in Radiography, 9th edition, ILFORD LIMITED

**Evaluation**  - Questions and answer session.
  - Practical Assessment
Day-3

SESSION-VIII

Radiographic positioning of pelvis with related radiologic anatomy.

Objectives:

Provide information regarding various radiographic views of pelvis and its radiologic anatomy.

Method of Teaching

(i) Live demonstration of various radiographic views of pelvis on x-ray table with their exposure factors
(ii) Study the related radiologic anatomy on view box
(iii) Lecture method

Contents : Text

(1) Antero-posterior view of pelvis-

Patient supine on table with legs extended. The heels are slightly separated with big toes touching each other. The pelvis must be positioned symmetrically, with anterior superior iliac spines equidistant from the film.

Central ray 2 inches below the mid point of a line joining the anterior superior iliac spines at right angle to the film.

Exposure factors
- Distance : 90 cm
- KV : 70
- mAs : 120-160
- Grid : yes

(2) Lateral view of pelvis-

For a lateral view of whole pelvis, patient lies in lateral position with the legs extended and a small pad between the knees.

Centre to the upper border of femoral head.

Exposure factors : Same as in A.P. view.

(3) Antero-posterior view of hip joint-

Patient is supine on table, leg extended and the foot slightly rotated inwards so that both malleoli are equidistant from the film. Central ray 1 inch below mid point of a line joining anterior superior iliac spine and upper border of pubis at right angle to the film.

Exposure factors
- Distance : 90 cm
- KV : 60 - 70
- mAs : 100
- Grid : Yes
(4) **Lateral view of hip Joint**

The patient lies supine with the pelvis raised on foam pads and the injured limb extended. The foot is slightly rotated medially, if possible, to avoid foreshortening of femoral neck. The normal knee is flexed and the foot is placed on a stool, out of the way of beam. The film and grid are positioned vertically against the injured hip, and adjusted so that the film is parallel with neck of femur.

Centre to the neck of femur, using a horizontal beam at right angle to the film.

Exposure Factors: Same as A.P. of hip.

(5) **Antero-posterior view of Sacrum**

Patient supine on table and knees flexed over a small pillow. The cassette is positioned such that its upper border is at the level of iliac crests.

Centre 2 inches (5.0 cm) above symphysis pubis in mid line with central ray directed 15° to the head.

<table>
<thead>
<tr>
<th>Exposure factors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>90 cm</td>
</tr>
<tr>
<td>KV</td>
<td>70</td>
</tr>
<tr>
<td>mAs</td>
<td>160 no.</td>
</tr>
<tr>
<td>Grid</td>
<td>yes</td>
</tr>
</tbody>
</table>

(6) **Lateral view of Sacrum** - The patient is rotated in true lateral position so that the sacrum is approximately over the centre of table. The knees are flexed a little. Central ray 2 inches (5.0 cm) anterior to and at the level of posterior superior iliac spine perpendicular to the film.

<table>
<thead>
<tr>
<th>Exposure factors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>90 cm</td>
</tr>
<tr>
<td>KV</td>
<td>90</td>
</tr>
<tr>
<td>mAs</td>
<td>200</td>
</tr>
<tr>
<td>Grid</td>
<td>yes</td>
</tr>
</tbody>
</table>

(7) **Antero-posterior view of Coccyx** -

Patient is supine on table. Both knees are slightly flexed and supported by sand bag.

Central ray over midline of body at the level of upper border of symphysis pubis at an angle of 10-15° towards feet.

<table>
<thead>
<tr>
<th>Exposure factors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>90 cm</td>
</tr>
<tr>
<td>KV</td>
<td>70</td>
</tr>
<tr>
<td>mAs</td>
<td>120</td>
</tr>
<tr>
<td>Grid</td>
<td>yes</td>
</tr>
</tbody>
</table>
(8) **Lateral view of Coccyx** - Patient lying on side in the true lateral position with knee flexed. A non radio opaque pad should be placed under mid lumbar region to keep the patient in position.

Central ray at the level of upper border of symphysis pubis over the patient's buttock at right angle to the film.

**Exposure factors**
- Distance : 90 cm
- KV : 90
- mAs : 200
- Grid : yes

(9) **Antero-posterior view for sacro-iliac joints**

Patient lies supine on table with knee touching each other and slightly flexed. Pelvis is positioned symmetrically.

Central ray (2 inches) above pubic symphysis in mid line at an angle of 15° towards head.

**Exposure factors**
- Distance : 90 cm
- KV : 70
- mAs : 160
- Grid : yes

**References**
2. K.C. Clark, Positioning in Radiography, 9th edition, ILFORD LIMITED

**Evaluation**
- Questions and answer session.
- Practical Assessment
Day-3

SESSION IX

Radiographic positioning and related anatomy of vertebral column

Objective:

Provide information regarding various radiographic view of vertebral column with their related radiologic anatomy.

Method of Teaching

(i) Live demonstration of various radiographic views of vertebral column on x-ray table.

(ii) Study the related radiologic anatomy on view box

(iii) Lecture method

Contents: Text

The vertebral column consists of 33 vertebra (7 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 4 coccygeal). The sacral segments are fused together to form sacrum bone.

(1) **Antero-posterior (C1-C3) "Open mouth" View**

Patient supine on table or erect facing the tube, with medial sagittal plane perpendicular to the film.

The chin is raised slightly until the radiographic base line or orbito-meatal line (a line joining the outer canthus of eye and external auditory meatus) is tilted up to 10-12° from the perpendicular.

Central ray through a widely open mouth at right angle to the film midway between the jaws.

Exposure factors

<table>
<thead>
<tr>
<th>Distance</th>
<th>90 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>KV</td>
<td>60</td>
</tr>
<tr>
<td>mAs</td>
<td>100</td>
</tr>
<tr>
<td>Grid</td>
<td>yes</td>
</tr>
</tbody>
</table>

(2) **Antero-posterior (C3-C7) View of cervical vertebra.**

Patient supine on table. Chin is raised so that lower jaw is at right angle to the table. Central ray in midline at level of angle of mandible with tube tilted 10° to the head or central ray over midline of body of 2 inches above suprasternal notch at right angle to the film.

Exposure factors

<table>
<thead>
<tr>
<th>Distance</th>
<th>90 cm</th>
</tr>
</thead>
<tbody>
<tr>
<td>KV</td>
<td>60</td>
</tr>
<tr>
<td>mAs</td>
<td>80</td>
</tr>
<tr>
<td>Grid</td>
<td>yes</td>
</tr>
</tbody>
</table>
(3) **Lateral view of cervical vertebra** (C1-C7)

Patient standing or sitting in true lateral position with one shoulder against the cassette. Both the shoulders should be pulled down as much as possible by asking the patient to hold one sand bag in each hand.

The chin is raised so that the angle of mandible does not obscure upper cervical vertebrae. Head should be kept steady. The lower border of film must be at the level of shoulder and upper border at the level of top of pinna of ear.

Central ray just behind the angle of mandible at right angle to the films.

<table>
<thead>
<tr>
<th>Exposure factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance         : 150</td>
</tr>
<tr>
<td>KV               : 70</td>
</tr>
<tr>
<td>mAs              : 50</td>
</tr>
<tr>
<td>Grid             : no</td>
</tr>
</tbody>
</table>

(4) **Antero-posterior view of thoracic spine**.

Patient lies supine on X-ray table with knees flexed and arms by the side. Patient should lie as straight as possible on the table. Upper border of Cassette should be just above the spinous process of 7th cervical vertebra.

Central ray over mid point between suprasternal notch and xiphoid process. at right angle to the film.

<table>
<thead>
<tr>
<th>Exposure factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance         : 90 cm</td>
</tr>
<tr>
<td>KV               : 70</td>
</tr>
<tr>
<td>mAs              : 100-120</td>
</tr>
<tr>
<td>Grid             : yes</td>
</tr>
</tbody>
</table>

(5) **Lateral view of Thoracic spine**

Patient lies on his side in true lateral position with knees flexed and hands above head, or in front of face.

Central ray over 5th dorsal vertebra or through the axilla at right angle to the film.

<table>
<thead>
<tr>
<th>Exposure factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance         : 90 cm</td>
</tr>
<tr>
<td>KV               : 70</td>
</tr>
<tr>
<td>mAs              : 120</td>
</tr>
<tr>
<td>Grid             : yes</td>
</tr>
</tbody>
</table>

(6) **Antero posterior View of dorso-lumber vertebra.**

The patient lies supine with knees and hips flexed. Centre to the midline at the level of first lumber vertebra, perpendicular to the film.

<table>
<thead>
<tr>
<th>Exposure factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance         : 90 cm</td>
</tr>
<tr>
<td>KV               : 70</td>
</tr>
<tr>
<td>mAs              : 120</td>
</tr>
<tr>
<td>Grid             : yes</td>
</tr>
</tbody>
</table>
Distance : 90 cm  
KV : 70  
mAs : 100-120  
Grid : yes

(7) **Lateral view of dorso lumber vertebra**-  
The patient lies on his side with knees flexed. Small pads are placed under the wrist and shoulder to maintain spine parallel with the table centre 3 inches (7.5cm) anterior to spinous process at the level of first lumber vertebra at right angle to the film.

Exposure factors  
Distance : 90 cm  
KV : 90  
mAs : 120  
Grid : yes

(8) **Antero-posterior view of lumber vertebra**-  
Patient supine on table with knees and hips flexed. Soles of feet must rest on the table to reduce lumber lordosis. The patient should be lying in mid line as straight as possible.

Central ray at the level of sub-coastal margin (over 3rd lumber vertebra) at right angle to the film  

Exposure factors  
Distance : 90 cm  
KV : 70-75  
mAs : 160  
Grid : yes

(9) **Lateral view of Lumber vertebra**  
Patient lying in lateral position, knees flexed and both hands above head or in front of face. Care should be taken to see that the patient is in true lateral position and the body is as far as possible parallel to the table. Centre to the level of lower costal margin, 2-3 inches anterior to 3rd lumber spinous process at right angle to the film.

Exposure factors  
Distance : 90 cm  
KV : 90-95  
mAs : 160  
Grid : yes

(10) **Antero-posteriro view of Lumbo sacral vertebra**-  
Patient supine as for A.P. lumber spine. Centre in the midline, at the level of anterior superior iliac spines with tube angled 15-20° towards head.
Exposure factors

Distance : 90 cm  
KV : 75  
mAs : 160  
Grid : yes

(11) **Lateral view of Lumbo Sacral vertebra**

Patient lying in true lateral position as for lumber spine.

Centre 3 inches (7.5 cm) anterior to spinous process of L5 Vertebra, at right angle to the film.

Exposure factors

Distance : 90 cm  
KV : 95  
mAs : 200  
Grid : yes

**References**

(1) Sandore Meschan, Radiographic positioning and Related Anatomy, W.B. Saunders Company.

(2) K.C. Clark, Positioning in Radiography, 9th edition, ILFORD LIMITED

(3) PES Palmer and W.P. Cockshott, WHO manual of Radiographic interpretation for general practitioners.

**Evaluation**  
- Questions and answer session.
- Practical Assessment
Day-4

SESSION - X

Radiographic positioning and related anatomy of skull

Objectives

Provide information regarding various radiographic views of skull with related radiologic anatomy.

Method of Teaching

(i) Live demonstration of various radiographic positioning of skull on x-ray table.
(ii) Study the related radiologic anatomy on view box
(iii) Lecture Method

Contents - Text

- Radiographic base line or orbito-meatal line
  This line joins the outer canthus of the eye and the external auditory meatus.

- Median sagittal plane
  This is the plane which divides the skull symmetrically between two equal halves in the midline from the back to front.

- Inter pupillary line this line joins the centre of the two orbits or two pupils when looking straight ahead.

- Anthropological base line - this line joins the external auditory meatus and inferior or lower orbital margin.

  In skull radiography, a high powered unit should be used which may be capable of delivering a high milliampere combined with a short exposure time preferably with a five focus tube.

(1) Postero-anterior (Occipito - frontal) View

Patient prone on table with orbito meatal line at right angle to the film. Median sagittal plane should be perpendicular to the film. Centre through the external occipital protuberance at right angle to the film.

<table>
<thead>
<tr>
<th>Exposure factors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>90 cm</td>
</tr>
<tr>
<td>KV</td>
<td>80</td>
</tr>
<tr>
<td>mAs</td>
<td>70-80</td>
</tr>
<tr>
<td>Grid</td>
<td>yes</td>
</tr>
</tbody>
</table>

(2) 20° occipito frontal (Caldwell view)

Patient prone on table with head in true P.A. position. Median sagittal plane and orbito meatal line (radiographic base line) are perpendicular to the film. Centre in the midline to the inter-orbital or inter pupillary line with central ray angled 20° to the feet.

<table>
<thead>
<tr>
<th>Exposure factors</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>same as in P.A. view</td>
</tr>
</tbody>
</table>
(3) **Antero-posterior or Fronto occiptal View** -
Patient supine on table, chin is tilted slightly downwards towards chest so as to make orbito-meatal line perpendicular to the film. Central ray over forehead, 2 inches above nasion or bridge of nose at right angle to the film.

Exposure factors: Same as in P.A. view

(4) **Lateral view skull** -
Patient prone on table, head is rotated to either side so that median sagittal plane is parallel with the table and inter orbital line is at right angle to the table. Raise shoulder of side towards which the head has been rotated and support with sand bag. Central ray 1 inch (2.5 cm) above and 1 inch infront of meatus at right angle to the film.

Exposure factors
- Distance: 90 cm
- KV: 70
- mAs: 60
- Grid: yes

(5) **Antero-posterior View with 30° tube tilt (Towne’s View)**
Patient supine on table with chin well down towards the chest so that orbitomeatal or radiographic base line is at right angle to film. Arms and shoulders should be pulled downwards as much as possible. The median sagittal plane must be at right angle to the film.

Central ray passes through a point 2 inches (4.0 cm) above glabella or bridge of nose with tube tilted 30° towards feet.

Exposure factors
- Distance: 90 cm
- KV: 85
- mAs: 80
- Grid: yes

(6) **Submento-vertical (Base of Skull)**
Patient supine on table with chin and neck extended as much as possible so that the head hangs backwards. To achieve this position a pillow or sand bag should be put below the shoulder to facilitate for hanging head position. Orbitomeatal and interpupillary lines are parallel to film. Median sagittal plane should be perpendicular to the film.

Central ray through midpoint of a line joining the angle of mandible, at right angle to the film.

Exposure factors
- Distance: 90 cm
- KV: 90
- mAs: 80-90
- Grid: yes
(7) Occipito - mental (Water's View)

Patient prone on table or sitting up with the chin and tip of nose in contact with the film, so that the orbito-meatal line is at an angle of 45° to the film. The median sagittal plane should be perpendicular to film.

Central rays 1 inch (2.5 cm) above the occipital protuberance at right angle to the film.

Exposure factors
Distance : 90 cm
KV : 85
mAs : 70
Grid : yes

(8) Postero-anterior oblique (Stenver's view) - for mastoid air cells.

Commence with patient's forehead against the film. Orbito-meatal line is at right angle to the film. Then rotate the head 39° to each side in turn. Central ray over mastoid process nearest the film at an angle of 12° towards head.

Exposure factors
Distance : 90 cm
KV : 80
mAs : 70
Grid : yes

(9) Lateral oblique view for mastoid air cells

Head is in true lateral position with median sagittal plane parallel to the film, and inter-orbital line perpendicular to the film. Then rotate the head slightly forwards and downwards until the chin and cheek are in contact with the film. Central ray over mastoid nearer the film (2 inch above and 2 inches behind the external auditory meatus of side away from the film) at an angle of 30° towards feet.

Exposure factors - same as P.A. oblique view for mastoid air cells.

(10) Lateral view for nasal bone -

Patient prone on table. Head is rotated to either right or left side so that median sagittal plane is parallel with the table and interorbital line is at right angle to film. Raise shoulder of the side towards which the head has been rotated, and supported with sand bag. The film should be parallel with line of nasal septum.

Centre over root of nose at right angle to film.

Exposure factors
Distance : 90 cm
KV : 45
mAs : 6-8
Grid : no
(11) **Lateral oblique view for mandible**

Patient is prone on table. The head is rotated to either right or left side so that the median line is parallel with the table. Inter orbital line is perpendicular to the film.

Centre 2 inches (5 cm) below the angle of mandible farthest from the film at an angle of 30° towards the head.

**Exposure factors**

- Distance : 90 cm
- KV : 75
- mAs : 60
- Grid : yes

(12) **Lateral view of mandible**

Head is in true lateral position with median sagittal plane parallel with the table and inter orbital line at right angle to the film. Centre midway between the external auditory meatus and the symphysis menti, at right angle to the film.

**Exposure factors** - same as in lateral oblique view

(13) **Postero-anterior view of mandible.**

Patient is prone on table, or sitting up with forehead is contact with the film. Orbitomeatal line is at right angle to the film and inter pupillary line parallel with the film.

Centre in midline, between angle of mandible and passing. through lips, perpendicular to the films.

**Exposure factors**

- Distance : 90 cm
- KV : 75
- mAs : 60
- Grid : yes

**References**

2. K.C. Clark, Positioning in Radiography, 9th edition, ILFORD LIMITED

**Evaluation**  - Questions and answer session.
  - Practical Assessment
Day-4

SESSION XI

Radiological special investigations in Urogenital system

Objectives:

(1) Provide basic information regarding excretory urography, retrograde pyeloureterography, micturating cysto-urethrography and ascending urethrography.

(2) Information regarding various radiographic views taken in these above mentioned special investigations.

Method of Teaching

(i) Live demonstration of various radiographic positioning for excretory urethrography, retrograde pyelo urethrography, micturating cystourethrography and ascending urethrography

(ii) Lecture method

Content: Text

(1) Excretory Urography

(a) Indication - Suspected renal / Urinary tract pathology

(b) Contra indications-

(i) Renal failure

(ii) multiple myeloma

(iii) Infancy

(c) Contrast media - Low osmolar contrast media is used.

(d) Preliminary films

- supine, full-length AP view of abdomen in inspiration.

(e) Technical procedure - After examining the plain film, contrast media (LOCM) is injected intravenously. The normal adult dose is between 40-100ml. for children aged between 2 and 15 years, the dose is upto 1 ml per kg of body weight. inject the full dose rapidly. Take the first film as soon as the injection is finished, this must be within 5 min of starting. Take the next film 10 min. after the injection started. Kidneys, ureters and bladder is visualised, if any part of urinary tract is not well visualised, take an additional prone film after 15 min., then add the film of bladder

(f) films

(i) Immediate films - AP view of renal areas, taken 10-14S after injection

(ii) 5 min. film - AP view of renal area.

(iii) 15 min film - AP view of renal area.

(iv) Release film - supine AP abdomen.

(v) After micturition film.
(2) Retrograde Pyeloureterography -
(a) Indications (i) demonstration of site, length, if possible, the nature of obstructive lesion in ureter.
(ii) demonstration of PCS after unsatisfactory excretory urogram.
(b) Contrast medium - LOCM 150-200, 10 ml
(c) Preliminary film - Full length supine AP view of abdomen.
(d) Technical procedure - about 3-5 ml of contrast media is administered through ureteric catheter which was placed in situ and films taken as
- supine PA of kidney
- both 35° anterior oblique of the kidney
if films are satisfactory, then the catheter is withdrawn, first 10cm below the renal pelvis and then to lie just above the ureteric orifice. About 2 ml of contrast is administered at each of these levels and films taken.
- Supine PA view of ureter
- both 35° anterior obliques of ureter.

(3) Micturating Cystourethrography -
(a) indications - (1) vesicoureteric reflux.
(2) Study of urethra during micturation
(3) abnormality of bladder
(4) VVF
(b) Contrast media - HOCM or LOCM
(c) Technical procedure - The patient lies supine on the X-Ray table; using aseptic technique 0.05% in glycerine, residual urine is drained from urinary bladder. Older children and adult are given a urine receives but smaller children should be allowed to micturate on to absorbent pads. The bladder filling is observed by intermittent fluoroscopy. Spot films are taken during micturation and any reflux recorded. The lower ureter is best seen in anterior oblique position of that side. Finally a full-length view of the abdomen is taken to demonstrate any reflux of contrast medium.

(4) Ascending Urethrography in male -
(a) indications
(i). stricture urethra
(ii). urethral tears
(iii). congenital abnormalities
(iv). Fistula or false passages
(b) Contrast media - HOCM or LOCM 200-300 20 ml.
(c) Technical procedure -
After aseptic technique, the tip of catheter is inserted so that the ballon lies in the fossa navicularis and its ballon is inflated with 1-2 ml of water. Contrast is injected under fluroscopic control and films are taken in the following positions

(i). 30° LAO  
(ii). Supine PA view  
(iii). 30° RAO  

Ascending Urethrography should be followed by Micturating cystourethrography to demonstrate the proximal urethra.

References


Evaluation  - Questions and answer session.  
- Practical Assessment
Day-4

SESSION - XII -

Radiological special investigations regarding gastrointestinal tract.

Objective -

(1) Provide information regarding Barium, Swallow, Barium meal, Barium meal follow through and Barium enema study.

(2) Information regarding various radiographic views taken in these above mentioned special investigations.

Method of Teaching

(i) Live demonstration of various radiographic positioning for Barium swallow, Barium meal, meal follow through and Barium enema examination on IITV.

(ii) Study the related radiologic anatomy on IITV.

(iii) Lecture method.

Content - text

(1) Barium Swallow

Indications

(i). Dysphagia

(ii). Pain

(iii). Assessment of tracheo oesophageal fistula

Contrast media - Barium 150% w/v 100 ml

Technical procedure - The patient is in the erect RAO position, an ample mouthful of barium is swallowed and spot films of the upper and lower oesophagus are taken.

(2) Barium meal

Indications -

(i). Dyspepsia

(ii). weight loss

(iii). upper abdominal mass

(iv). Gastrointestinal haemorrhage.

(v). Assessment of site of perforation

Contrast media - Barium 250% w/v, 125 ml

Films - After administration of barium per orally, spot films of stomach are taken as follows

(i). RAO - to demonstrate antrum and greater curve

(ii). Supine - to demonstrate antrum and body

(iii). LAO - to demonstrate lesser curve enface.

(iv). Left lateral tilted, head up 45° - to demonstrate fundus.
Spot films of the duodenal Cap. - are taken as follows
(i). Prone
(ii). RAO
(iii). Supine
(iv). LAO
• Spot film of duodenal loop is taken as follows
• Prone the patient lies on a compression pad.
• an additional view to demonstrate the anterior wall of the duodenal loop may be taken in an RAO position
• Additional views of the fundus in an erect position may be taken.

(3) Barium meal and follow through -
Indications
(i). Pain
(ii). Diarrhoea
(iii). Bleeding
(iv). Partial obstruction
(v). Abdominal mass.

Contrast media - Barium 100% w/v 300 ml (150 ml if performed immediately after a barium meal)

Technical procedure - The aim is to deliver single column of barium into small bowel. This is achieved by lying the patient on his right-side after barium has been ingested.
Films - are taken as follows
(i). Prone PA film of the abdomen are taken every 20 minutes during first hour, and subsequently every 30 minutes until the colon is reached. The prone position is used because the pressure on the abdomen helps to separate the loops of small bowel.
(ii). Spot films of terminal ilium are taken supine.

(4) Barium Enema
indications
(i). Change in bowel habit
(ii). Pain
(iii). Mass
(iv). Melaena
(v). Obstruction

Contrast media - Barium 125% w/v 500 ml

Technical procedure - Thin solution of barium is administered per rectally.
The infusion is terminated when the barium reaches the hepatic flexure. The column of barium within the sigmoid colon is run back out by either lowering the infusion bag to the floor or tilting the table erect.

Air is gently pumped into the bowel, forcing the column of barium round towards the caecum and providing the double contrast effect.

Films - There is great variation in views recommended and the following is only the scheme used.

(I) Spot films of the rectum and sigmoid colon (Lying)
   (i). RAO
   (ii). Prone
   (iii). LPO
   (iv). Left lateral of the rectum

(II) Spot films of the hepatic flexure, splenic flexure and rectum (erect)
   (i). LAO to open out the splenic flexure
   (ii). RAO to open out the hepatic flexure
   (iii). Right lateral view of the rectum

(III) Spot film of the caecum (Lying)
   Positioning of the patient supine, lying slightly on the right side and with a slight head down tilt will usually give a double contrast effect in the caecum.

(IV) Over couch films to demonstrate all of the large bowel (Lying)
   (i). supine
   (ii). prone
   (iii). left lateral decubitus
   (iv). right lateral decubitus

(5) "Instant" Barium enema

Indications : To show the extent and severity of mucosal lesions in active ulcerative coilitis

This is performed without any bowel preparation.

Preliminary Films - Plain abdominal film to exclude toxic megacolon

Technique - As for normal barium enema

Films - only three films are required
   (i). Prone
   (ii). Left Lateral decubitus
   (iii). Erect.
Day-5

SESSION-XIII

Soft Tissue radiography

Objective
Provide information regarding low kv and soft tissue radiography and its various indications.

Method of Teaching
(i) Live demonstration on x-ray table
(ii) Lecture method

Content: Text
The individual tissues, such as muscles and fat comprise soft tissues which have a low intrinsic density and there is very little difference in density (contrast) between adjacent structures.

The usual conventional radiographic method is to use the lowest kilovoltage that would penetrate the part adequately. Normally the kv chosen is 15-20 less than that required for bony details of same part. Care should be taken to see the tube is not over heated by giving repeated exposures at low kv and high mAs.

The use of low kv technique greatly increases the radiation dose to the patient, so care must be taken to protect gonads.

Indications of low kv technique
(1) Mammography
(2) To demonstrate
   (a) Low density foreign bodies
   (b) Larynx and soft tissue structures of neck in lateral view
   (c) Calcification in tendons and arteries
   (d) Soft tissue ulceration
   (e) Soft tissue signs following dislocation or subluxation of the acromio-clavicular joint.

References:

Evaluation: Question and Answer session.
Day-5
SESSION XIV

High Kilovoltage radiograph

Objective
Provide information regarding high kv radiography and its various indications

.Method of Teaching
(i) Live demonstration on x-ray table.
(ii) Lecture method

Content : Text

Contrast in a radiography is the difference in density between adjacent or super imposed shadows and this is produced by the difference in attenuation of X-rays by different tissues. The attenuation of x-radiation in matter is a function of incident energy electron density and atomic number, therefore it varies in different types of tissue with increase in kv.

The output of an x-ray tube is considerably increased at high kv. The light energy from intensifying screen also increases with increase in kv, thereby reducing the mAS.

Advantages of high kv technique

• Wide range of tissues can be visualised on a single film
• Radiation dose to the patient is reduced.
• The use of lower mAS, allows more frequent use of fine focus.
• Reduction in mAS allows a shorter time factor, thereby reducing the chances of movement blurr.
• Exposure latitude is greater.
• High kv technique is particularly useful in rapid serial radiography, where heating of x-ray tube is increase at high kv.

Indications of high kv technique

(1) Obstetric radiography due to reduction in dose to mother and films
(2) Hystero salpingography, because of reduction in gonodal dose
(3) Lateral view of Lumbo - sacral spine, because of visible greater range of densities.
(4) Barium studies and rapid serial examinations, because of shorter exposure time with reduced heating of tube

References:


Evaluation : Question and Answer session.
Day-5

SESSION : XV

Introduction about radiation protection and its hazards

Objective -

To provide information regarding radiation (the risk of harm from X-rays) and information regarding methods of radiation protection.

Method of Teaching

Lecture method to demonstrate the various hazards of radiation and its protection.

Content - Text

X-Ray are only dangerous if we are careless. We can not feel to see them but repeated exposure to X-Rays, even those that are scattered off the patient or the X-Ray equipment, and even in small doses can cause permanent damage to the health of X-Ray operator or any one else. We must never make an X-Ray exposure When we are anywhere near x-ray tube. We must always be behind the control panel. We must not allow any one except the patient to be in the x-ray room, unless the patient needs to be supported or a child needs to be held.

Following rules for X-Ray protection are adopted.

(a) Stand behind the control panel when the X-ray exposure is made.
(b) Make sure that lead aprons and lead gloves are worn.
(c) if possible, do not allow any one else in X-Ray room.

When supplied, wear film badge always and have it checked regularly.

Never take an x-ray unless ordered by a doctor or other qualified medical person.

There is no danger if we are careful.

References


Evaluation - Questions and answer session.
Q.1. X-Rays are produced when a stream of electrons hits a target, called anode, usually made up of
(a) Aluminium (b) Tungsten (c) Lead (d) Flouride

Q.2. In mammography, the target is made up of-
(a) Aluminium (b) Lead (c) Molybdenum (d) Tungsten

Q.3. The ratio between the height of lead strips and the distance between them is known as-
(a) Grid ratio (b) Grid Pattern (c) Bucky factor (d) Intensification factor

Q.4. The original phosphor used in X-ray intensifying screen was
(a) Titanium dioxide (TiO₂) (b) Crystalline Calcium tungstate (CaWO₄)
(c) Cadmium Oxide (d) Magnesium sulphate

Q.5. The speed of intensifying screen is increased by all except
(a) Using thicker phosphor layer (b) Using thinner phosphor layer
(c) Using higher conversion efficiency phosphor (d) Using higher absorption phosphor.

Q.6. In computed radiography (CR), phosphostimulable phosphor is
(a) europium-activated barium fluorohalide (b) Terbium activated gadolinium oxysulfide
(c) Calcium tungstate (d) Lanthanum oxysulphide

Q.7. Photographically acive or radiation sensitive part of a X-ray film is
(a) film base (b) super coat (c) emulsion (d) Gelatin

Q.8. Modern developing solution contains
(a) Hydroquinone plus phenidone or metol. (b) an alkali (c) a preservative (d) all of them

Q.9. The common fixing agent or Hypo is
(a) hydroquinone (b) metol (c) sodium sulfite (d) Thiosulphate of sodium or ammonium salt.

Q.10. In chest PA view, the centering point is at-
(a) 2nd dorsal vertebra (b) 5th dorsal vertebra
(c) C7 cervical vertebra (d) C1 Cervical vertebra

Q.11. In which view of chest, a film should be taken is full expiration in addition to the routine exposure in full inspiration-
(a) AP view (b) Lateral View (c) Apicogram (d) Posterio-anterior lordotic view

Q.12. All of the following are true for posterior anterior view of hand except
(a) Distance 90 cm (b) KV - 50 (c) mAS : 10-20 (d) Grid - Yes

Q.13. All of the following are true for Antero-posterior view of shoulder Joint, except
(a) Patient lies supine or erect and slightly rotated to bring the affected side parallel to the film
(b) Centre over mid shaft of humerus  (c) Distance 90 cm  (d) KV - 60

Q.14. All of the following are true of Antero-posterior view of knee joint, except
(a) Patient sitting or lying on table with leg fully extended
(b) Central ray 1.5cm below the lower border  (c) Grid is used  (d) KV-55, mAs - 20 of patella

Q.15. All of the following are true for skyline view of Patella, except
(a) Patient lies supine on table with affected knee flexed as much as possible
(b) Centre over patella at an angled of (c) Distance - 90 cm  (d) KV-55, mAS - 20 15° to the lower leg.

Q.16. "Open-mouth" view is for
(a) C1-C3  (b) C3 - C5  (c) C4 - C6  (d) C6 - C7 vertebra

Q.17. The line joining the external auditory meatus and inferior or lower orbital margin is called.
(a) Radiographic base line  (b) orbito meatal line
(c) Anthropological base line  (d) inter pupillary line.

Q.18. Towne's or half axial view is known as
(a) Antero-posterior view  (b) AP view with 30° tube tilt towards feet.
(c) 20° Occipito-frontal view  (d) Lateral view of Skull

Q.19. All of the following are correct for submento-vertical view for base of skull, except.
(a) Patient lies supine on table with chin and neck extended as much possible.
(b) Centre through mid point of a line joining the angles of mandibles at right angle to the film.
(c) KV - 90, mAS - 80-90  (d) Grid - No

Q.20. Stenver's View for mastoid air cells is
(a) Lateral oblique  (b) Postero anterior oblique
(c) Lateral view  (d) Antero posterior oblique
## Answer Sheet

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1 | b |   | 11 | d |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 2 | c |   | 12 | d |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 3 | a |   | 13 | b |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 4 | b |   | 14 | c |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 5 | b |   | 15 | a |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 6 | a |   | 16 | a |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 7 | c |   | 17 | c |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 8 | d |   | 18 | b |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 9 | d |   | 19 | d |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|10 | b |   | 20 | b |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |