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# Chest X-ray Taking Procedures Training for X-ray technicians/Radiographer

## “Radiographic Positioning Techniques”

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# Content



Radiographic Positioning Of The Chest



Body Planes



Radiographic Projections



Body Habitus



Patient Preparation



Positioning Technique

# Radiographic Positioning Of The Chest

# Radiographic Positioning Of The Chest

- **Radiographic positioning** - the study of patient positioning performed for visualization of specific body parts on image receptors (IRs)
- **Anatomic position** - is an erect position with arms abducted slightly (down), palms forward, and head and feet directed straight ahead



**Anatomic position**

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano.

# Body Planes

# Four Common Planes

## Sagittal plane

- Divides the body into right and left parts

## Coronal plane

- Divides the body into anterior and posterior parts

## Horizontal plane (Axial)

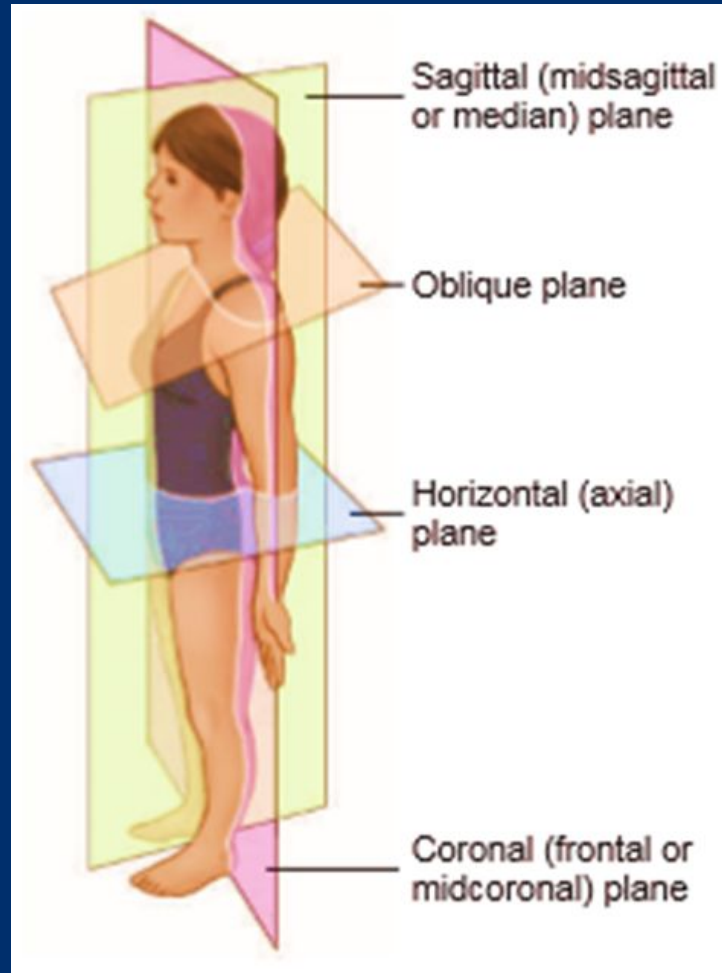
- Divides the body into superior and inferior portions

## Oblique plane

- Longitudinal or transverse plane that is at an angle or slant and is not parallel to the sagittal, coronal, or horizontal plane

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano.

# Four Common Planes – Cont.



## Body Planes

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano.

# Radiographic Projections



# Radiographic Projections



## 1) Posteroanterior (PA) projection

- A projection of the CR from posterior to anterior
- CR enters at the posterior surface
- Exits at the anterior surface



## 2) Anteroposterior (AP) projection

- A projection of CR from anterior to posterior
- CR enters at an anterior surface.



## 3) AP axial projection - lordotic position

- A specific AP chest projection
- to demonstrate the apices of the lung

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano.

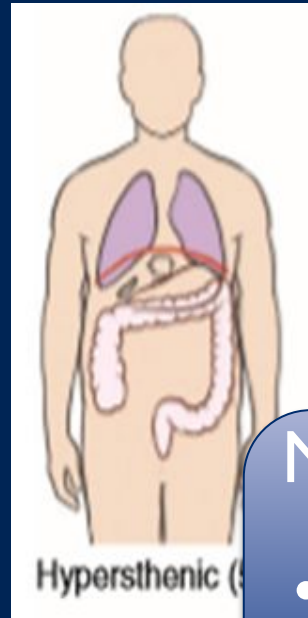
# Body Habitus

# Body Habitus

## Hypersthenic

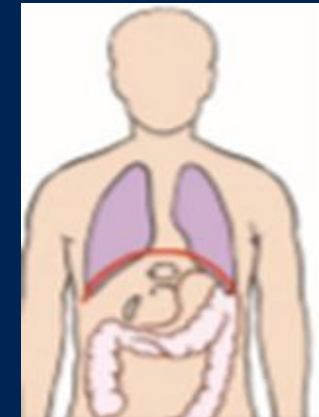
5% of population

1. Massive build
2. Thorax is broad and deep
3. Ribs are almost horizontal
4. Thoracic cavity is shallow
5. Lungs are short
6. Heart is short and wide
7. Diaphragm is high



## Sthenic

50% of population



### Note:

- IR placed crosswise to costophrenic angles in PA chest radiograph.

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano.

# Body Habitus – Cont.

## Hyposthenic

35% of population



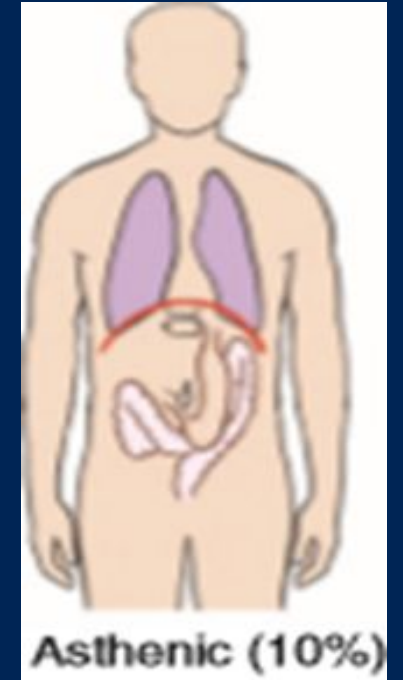
### Note:

- vertical collimation for the costophrenic angles are not cut off on the lower margin.

## Asthenic

10% of population

1. Slender build
2. Thorax is narrow and shallow
3. Ribs slope sharply downward
4. Thoracic cavity is long
5. Lungs are long, broader
6. Heart is long and narrow
7. Diaphragm is low



### Note:

- IR is long enough to include both the upper apex areas, which extend well above the clavicles, and the lower costophrenic angles.

# Patient preparation

# Patient Preparation

Patient preparation for chest radiography includes the removal of all opaque objects



To ensure that all opaque objects are removed from the chest region (all clothing, including bra, necklaces, or other objects around the neck)



The patient then puts on a hospital gown, which commonly has the opening in the back

Long hair braided or tied together in bunches with rubber bands



Oxygen lines or electrocardiogram (ECG) monitor leads should be moved carefully to the side of the chest if possible



The patient then puts on a hospital gown, which commonly has the opening in the back

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano.

# Positioning Techniques

# Why Erect Chest Radiographs

All chest radiographs should be taken in an erect position if the patient's condition allow:

1. The diaphragm is allowed to move down farther
2. Air and fluid levels in the chest may be visualize
3. Engorgement and hyperemia of pulmonary vessels may be prevented

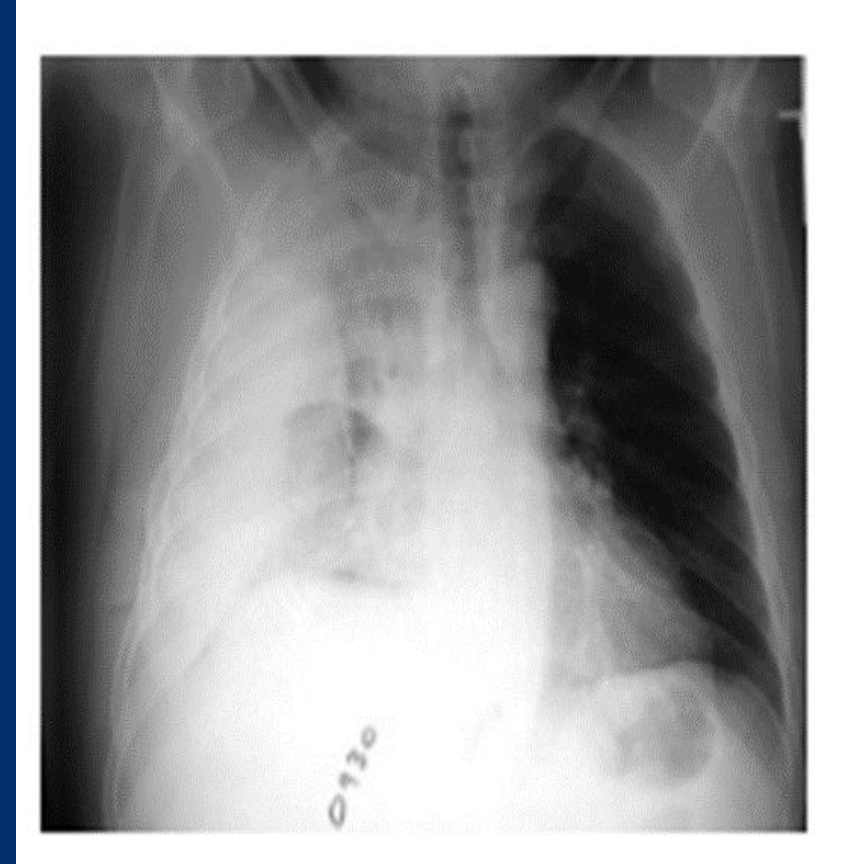
Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano



# Erect Chest Radiographs – Cont.



**PA erect, some fluid evident in left lower lung  
(Note flat line appearance near diaphragm)**



**Supine AP chest (fluid in right lung)**

# I) PA Projection (Chest)

## Clinical Indications:

- Pleural effusions, pneumothorax, atelectasis, and signs of infection

## Technical Factors:

- Minimum SID - 72 inches (183 cm)
- IR size - 35 × 43 cm (14 × 17 inches), lengthwise or crosswise
- Grid
- Analog and digital systems - 110 to 125 kV range

## Shielding:

- Shield radiosensitive tissues outside region of interest to reduce the radiation dose

# I) PA Projection (Chest) – Cont.

Top of IR is approximately 1 to 2 inches [4 to 5 cm] above shoulders

## *Patient Position:*

- Patient erect, feet spread slightly, weight equally distributed on both feet
- Chin raised, resting against IR
- Hands on lower hips, palms out, elbows partially flexed
- Shoulders rotated forward against IR
- Shoulders depressed

## *Part Position:*

- Align midsagittal plane with CR and with midline of IR with equal margins between lateral thorax and sides of IR
- Ensure no rotation of thorax by placing the midcoronal plane parallel to the IR
- Raise or lower CR and IR as needed to the level of T7 for an average patient

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

# I) PA Projection (Chest) – Cont.

## CR:

CR perpendicular to IR and centered to midsagittal plane at **level of T7** (7 to 8 inches [18 to 20 cm] below vertebra prominence, or to the inferior angle of scapula)

## Recommended Collimation:

Collimate on four sides to area of lung fields

Top border - level of vertebra prominence  
Lateral border - to outer skin margins

## Respiration:

Exposure is made at end of **second full inspiration**

# PA Projection (Chest) – Cont.



**Inspiration chest. (Courtesy Llori Lundh, RT.)**

Note the number of ribs visible above the diaphragm, indicating the degree of inspiration (10 posterior ribs)



**Expiration chest. (Courtesy Llori Lundh, RT.)**

Note the number of ribs demonstrated above the diaphragm on the expiration projection (8 posterior ribs).

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

# I) PA Projection (Chest) – Cont.



## PA Chest

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

# Evaluation Criteria (PA Projection - Chest)

## Anatomy Demonstrated

Included are both lungs from apices to costophrenic angles and the air-filled trachea from T1 down  
Hilum region markings, heart, great vessels, and bony thorax

## Position:

Chin sufficiently elevated to prevent superimposing apices  
Sufficient forward shoulder rotation to prevent superimposition of scapulae over lung fields  
Larger breast shadows (if present) primarily lateral to lung fields

## No Rotation:

Both sternoclavicular joints the same distance from centre line of spine  
Distance from lateral rib margins to vertebral column the same on each side from upper to lower rib cage

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

# Evaluation Criteria (PA Projection - Chest) – Cont.

## Collimation margins:

Near equal on to and bottom with center of collimation field (CR) to T7 region

## Full inspiration:

no motion

\*Visualizes a minimum of 10 posterior ribs above diaphragm (11 on many patients)

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano



# Evaluation Criteria (PA Projection - Chest) – Cont.

- **Exposure:**
  - No motion evident by sharp outlines of rib margins, diaphragm, and heart borders as well as sharp lung markings in hilar region and throughout lungs
  - Sufficient long-scale contrast for visualization of fine vascular markings within lungs
  - Faint outlines of at least midthoracic and upper thoracic vertebrae and posterior ribs visible through heart and mediastinal structures

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

## 2) Lateral Projection (Chest)

### Clinical Indications:

- Pathology situated posterior to the heart, great vessels, and sternum.

### Technical Factors:

- Minimum SID—72 inches (183 cm)
- IR size - 14 × 17 inches, lengthwise
- Grid
- Analog and digital systems - 110 to

125 kV range

### Shielding:

- Shield radiosensitive tissues outside region of interest to reduce the radiation dose

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

## 2) Lateral Projection – Cont.

### Patient Position:

Patient erect, left side against IR  
Weight evenly distributed on both feet  
Arms raised above head, chin up

### Part Position:

Center patient to CR and to IR anteriorly and posteriorly  
Position in a true lateral position (coronal plane is perpendicular and sagittal plane is parallel to IR)

### CR:

CR perpendicular, directed to mid-thorax at **level of T7** (3 to 4 inches [7.5 to 10 cm] below level of jugular notch)

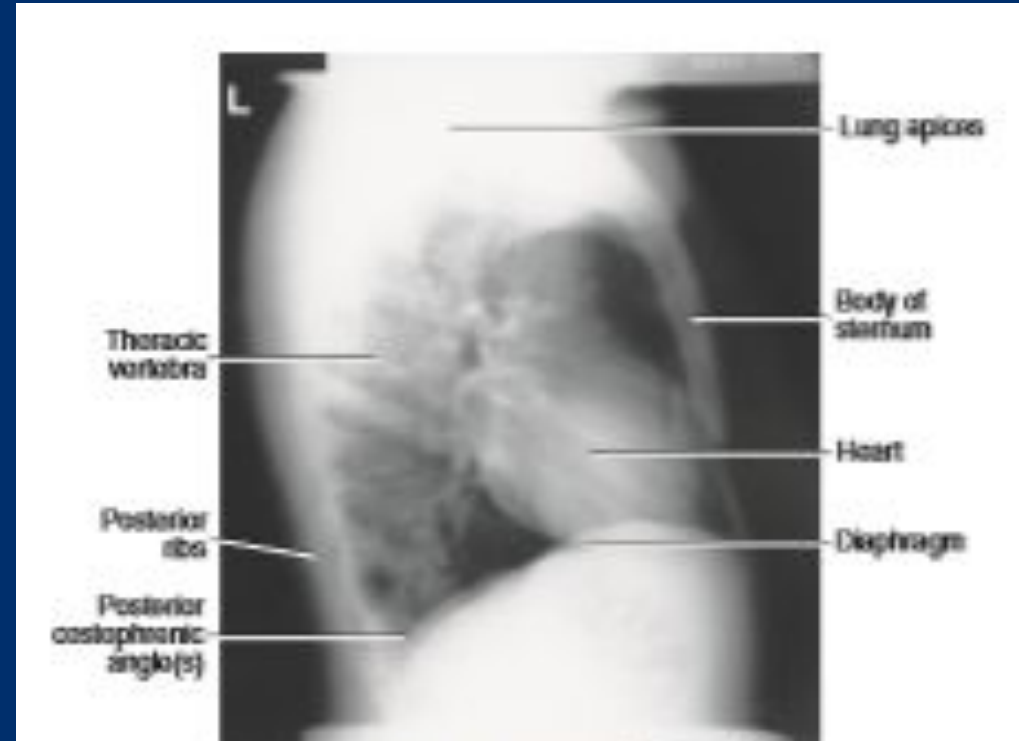
Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

## 2) Lateral Projection – Cont.

- ***Recommended Collimation:***
  - Collimate on four sides to area of lung fields (top border of light field to level of vertebra prominence)
- ***Respiration:***
  - Make exposure at end of second full inspiration

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

## 2) Lateral Projection – Cont.



### Lateral Chest

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

# Evaluation Criteria (Lateral Projection)

## Anatomy

**Demonstrated:**  
The entire lungs from apices to the costophrenic angles and from the sternum anteriorly to the posterior ribs and thorax posteriorly

## Position :

Chin and arms elevated sufficiently to prevent excessive soft tissues from superimposing apices

## No rotation:

Posterior ribs and costophrenic angle on side away from IR projected slightly 4 to 12 inch [or about 1 cm] posterior because of divergent rays)  
The hilar region should be in the approximate center of the IR.

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

## Evaluation Criteria (Lateral Projection) – Cont.

- *Exposure:*
  - No motion evident by sharp outlines of the diaphragm and lung markings
  - Should have sufficient exposure and long-scale contrast for visualization of rib outlines and lung markings through the heart shadow and upper lung areas without overexposing other regions of the lungs

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

# 3) AP Projection

## Clinical Indications:

- The lungs, diaphragm, and mediastinum pathology
- Determining air-fluid levels (pleural effusion)

## Technical Factors:

- Minimum SID—72 inches (183 cm)
- IR size - 14 × 17 inches, lengthwise
- Grid
- Analog and digital systems -110 to 125 kV range

## Shielding:

- Shield radiosensitive tissues outside region of interest to reduce the radiation dose

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 6th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano



### 3) AP Projection – Cont.

#### Patient Position:

Patient is supine on table; if possible, the head end of the cart or bed should be raised into a semierect position  
Roll patient's shoulders forward by rotating arms medially or internally

#### Part Position:

Place IR under or behind patient; align center of IR to CR (top of IR about 1/12 inches [4 to 5 cm] above shoulders)

#### CR:

CR to level of T7, 3 to 4 inches (8 to 10 cm) below jugular notch

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

### 3) AP Projection – Cont.

- ***Recommended Collimation:***
  - Collimate on four sides to area of lung fields (top border of light field to level of vertebra prominense)
- ***Respiration:***
  - Make exposure at end of second full inspiration

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

# Evaluation Criteria (AP Projection)

1. The heart appears larger as a result of increased magnification from a shorter SID and increased OID of the heart

2. Possible pleural effusion for this type of patient often obscures vascular lung markings compared with a fully erect PA chest projection

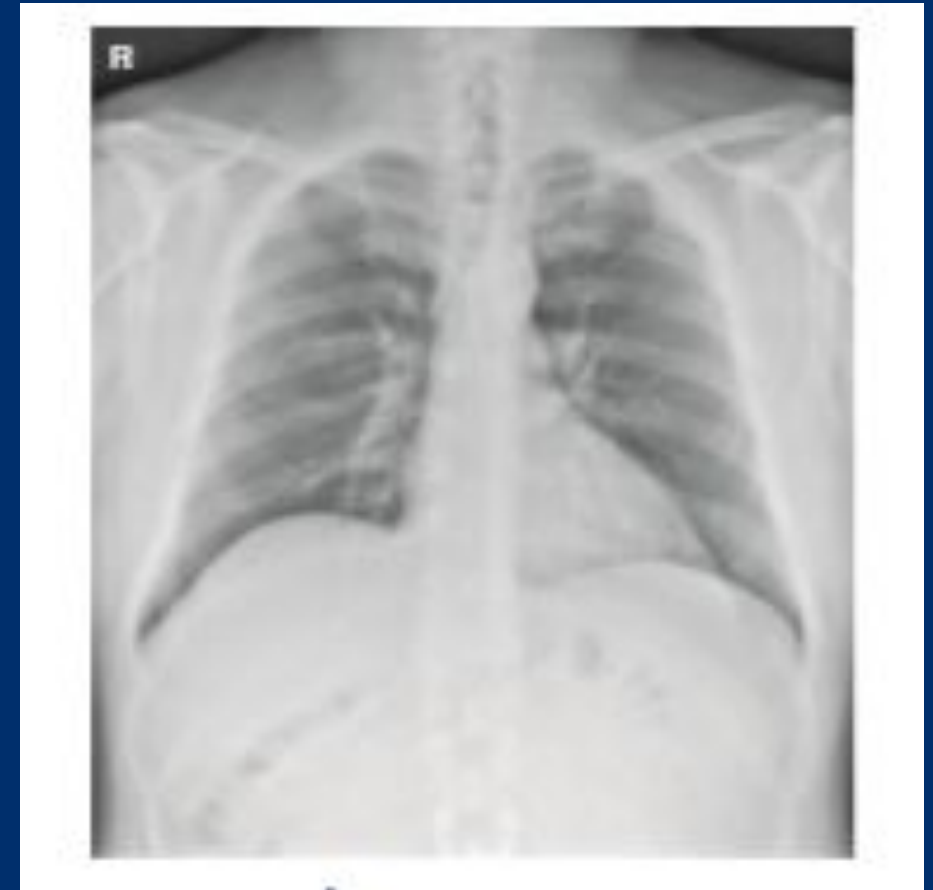
Without a horizontal beam, fluid levels may not be demonstrated

3. Usually, inspiration is not as full, and only eight or nine posterior ribs are visualized above the diaphragm

The lungs appear denser because they are not as fully aerated

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

### 3) AP Projection – Cont.



**AP Chest**

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# Differences between CXR AP and PA

AP	PA
Scapula shadow seen in the lung fields	Scapula drawn away from the lung fields
Clavicle above lung apices	Clavicle projects over lung zones
Heart is magnified	Heart is not magnified

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

# Differences between CXR AP and PA

AP	PA
Ribs are more parallel	Ribs are more oblique
Vertebrae visible through the heart shadow	Vertebrae is less dense
Diaphragm highest level	Diaphragm lowest level

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

## 4) AP Lordotic Projection

### Clinical Indications:

- Rule out calcifications and masses beneath the clavicles

### Technical Factors:

- Minimum SID—72 inches (183 cm)
- IR size - 14 × 17 inches, lengthwise
- Grid
- Analog and digital systems -110 to 125 kV range

### Shielding:

- Shield radiosensitive tissues outside region of interest to reduce the radiation dose

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano

## 4) AP Lordotic Projection – Cont.

### Patient Position:

Patient standing about foot (30 cm) away from IR and leaning back with shoulders, neck, and back of head against IR

Both patient's hands on hips, palms out; shoulders rolled forward

### Part Position:

Center midsagittal plane to CR and to centerline of IR

Center cassette to CR  
(Top of IR should be about 3 inches [7 to 8 cm] above shoulders on an average patient.)

Reference: The Textbook of Radiographic Positioning & Related Anatomy, 8th Edition (ISBN 978-0-323-08388-1). Authors Kenneth L. Bontrager and John P. Lampignano



## 4) AP Lordotic Projection – Cont.

### CR:

CR perpendicular to IR, centered to midsternum (3 to 4 inches [9 cm] below jugular notch)

### Collimation:

Collimate on four sides to area of lung fields (top border of light field to level of vertebra prominence)

### Respiration:

Make exposure at end of second full inspiration

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# Evaluation Criteria (AP Lordotic Projection)

## Anatomy :

- Entire lung fields and clavicles should be included

## Position:

- Clavicles should appear nearly horizontal and above or superior to apices, with medial aspects of clavicles superimposed by first ribs
- Ribs appear distorted, with posterior ribs appearing nearly horizontal and superimposing anterior ribs

## Centre of collimation field (CR):

- Should be midsternum with collimation visible on top and bottom.

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# Evaluation Criteria (AP Lordotic Projection) – Cont.

**No  
rotation:**

- Sternal ends of the clavicles should be the same distance from the vertebral column on each side
- The lateral borders of the ribs on both sides should appear to be at nearly equal distances from the vertebral column

**No  
motion:**

- Diaphragm, heart, and rib outlines should appear sharp
- Optimal contrast scale and exposure should allow visualization of the faint vascular markings of lungs, especially in area of the apices and upper lungs

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# Evaluation Criteria (AP Lordotic Projection) – Cont.



**AP lordotic**

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**THANK YOU !**