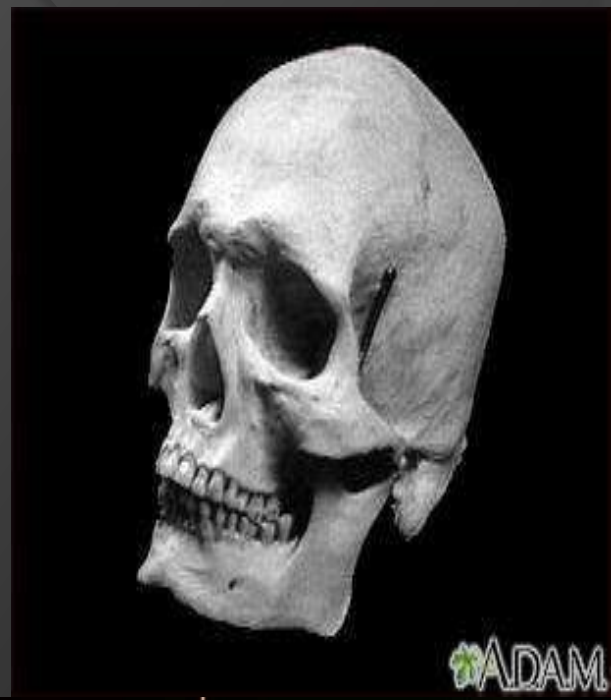
THE SKULL

The skull is a very complex structure, composed of more than 20 different bones.

The importance of plain radiography of the skull has diminished in recent years due to the widespread availability of advanced imaging modalities such as computed tomography (CT) and magnetic resonance imaging (MRI).

In order to produce high-quality images of the cranium and minimize risk for the patient, the radiographer must have a good understanding of the relevant anatomy, positioning landmarks and equipment used for imaging.



Anatomical terminology

All radiography of the skull is undertaken with reference to a series of palpable landmarks and recognized lines or planes of the skull.

It is vital that the radiographer possesses a good understanding of these before undertaking any positioning.

Landmarks

• Outer canthus of the eye: the point where the upper and lower eyelids meet laterally.

• Infra-orbital margin/point: the inferior rim of the orbit, with the point being located at its lowest point.

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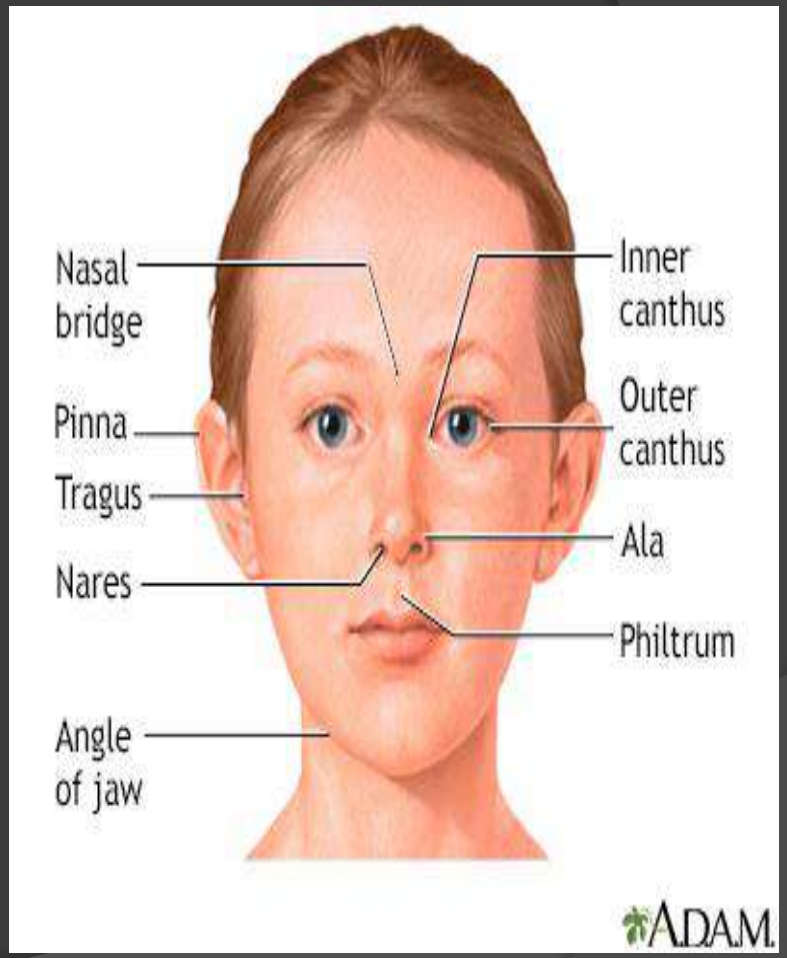
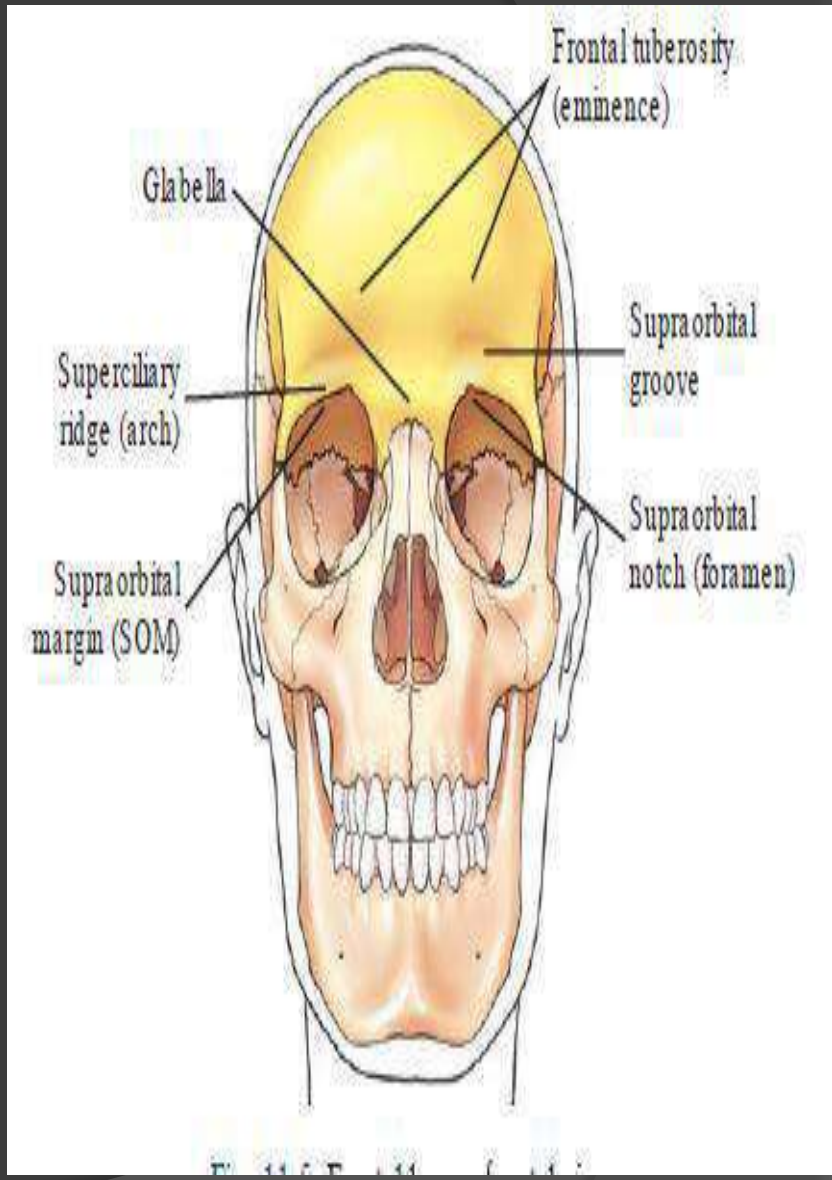
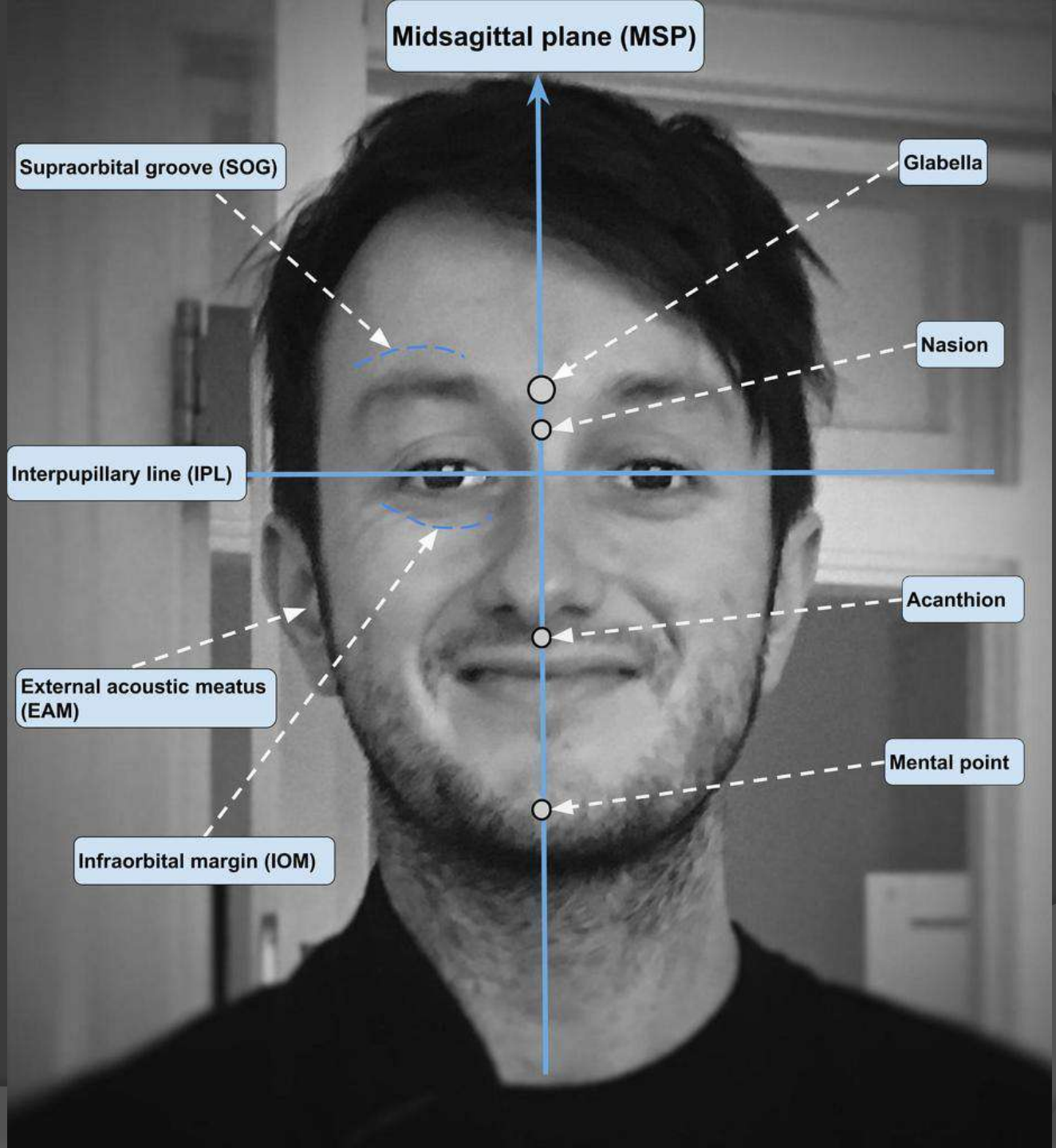


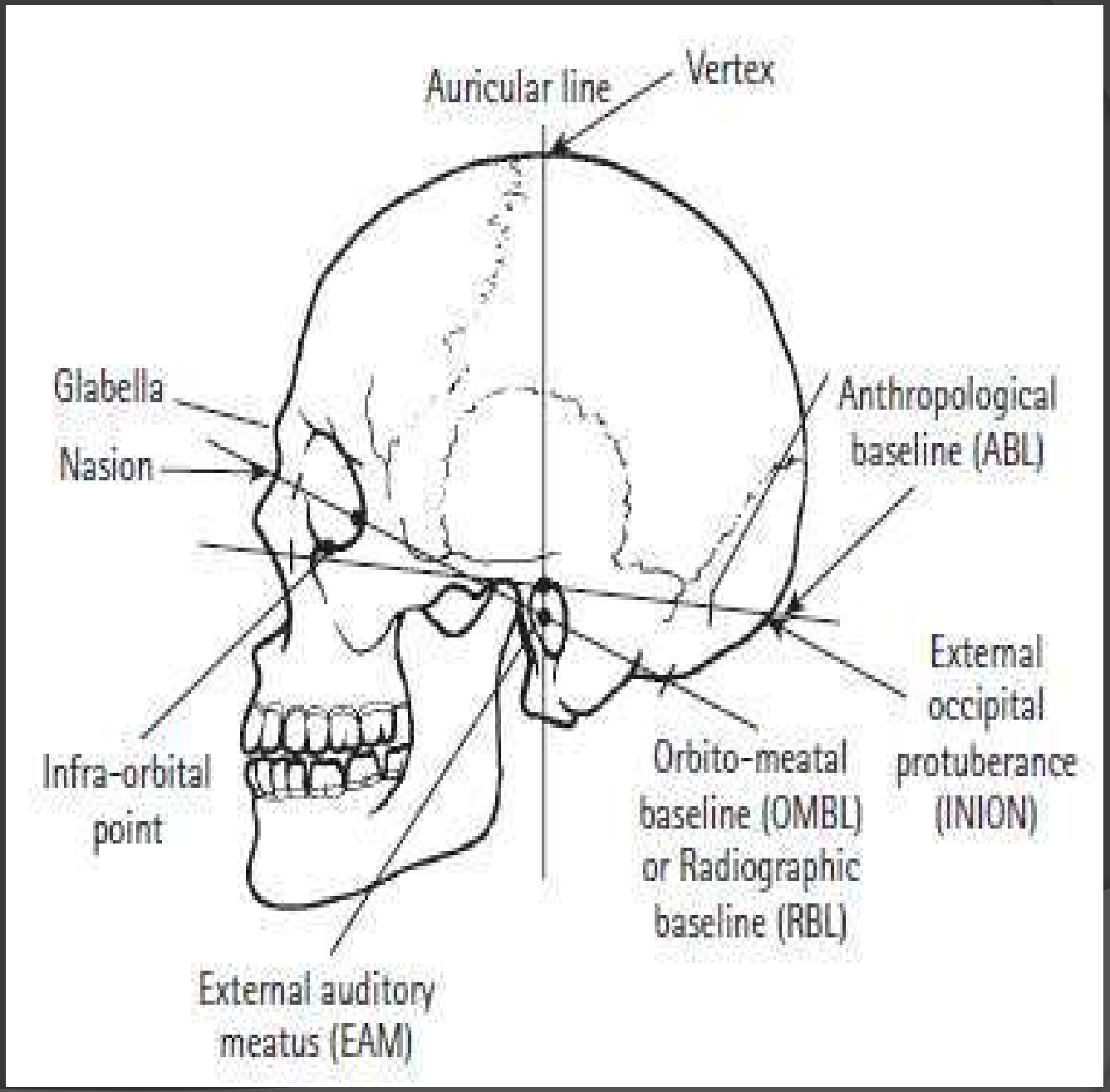
Nasion: the articulation between the nasal and frontal bones.

Glabella: a bony prominence found on the frontal bone immediately superior to the nasion.

Vertex: the highest point of the skull in the median sagittal plane. •




Midsagittal plane (MSP)
Supraorbital groove (SOG)
Glabella
Nasion
Interpupillary line (IPL)
Acanthion
External acoustic meatus (EAM)
Mental point
Infraorbital margin (IOM)

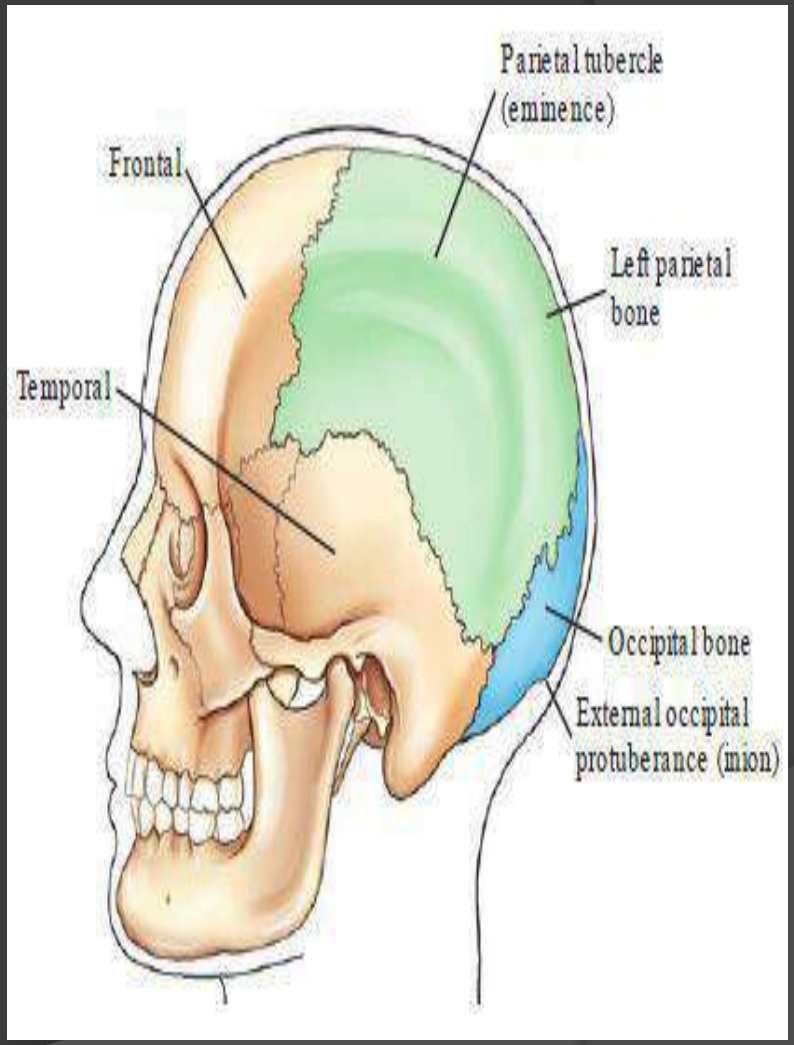

Auricular line
Vertex
Glabella
Nasion
Anthropological baseline (ABL)
External occipital protuberance (INION)
Infra-orbital point
Orbito-meatal baseline (OMBL) or Radiographic baseline (RBL)
External auditory meatus (EAM)

External occipital protuberance (inion):

a bony prominence found on the occipital bone,

usually coincident with the median sagittal plane.

External auditory meatus: the opening within the ear that leads into the external auditory canal .



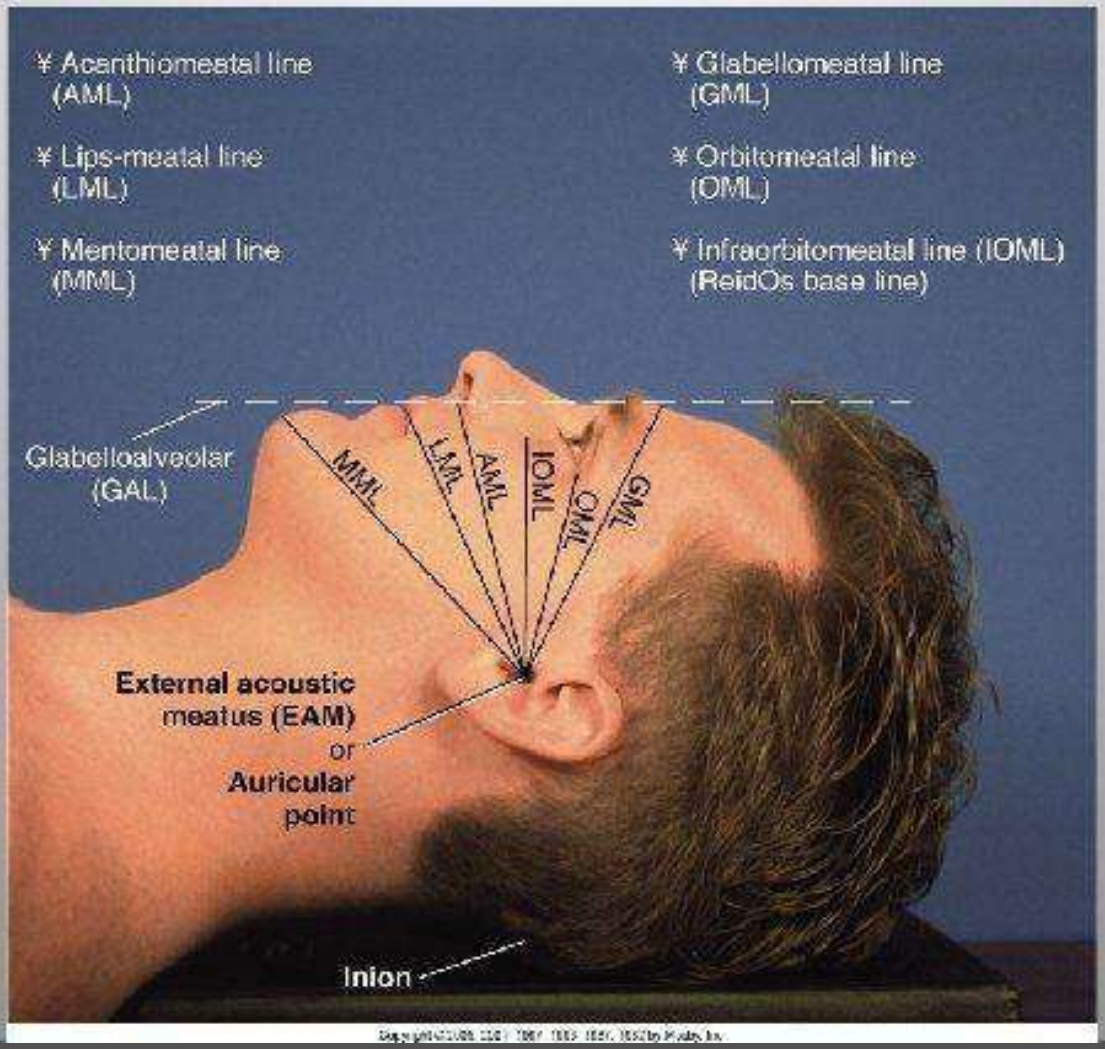
Skull positioning lines

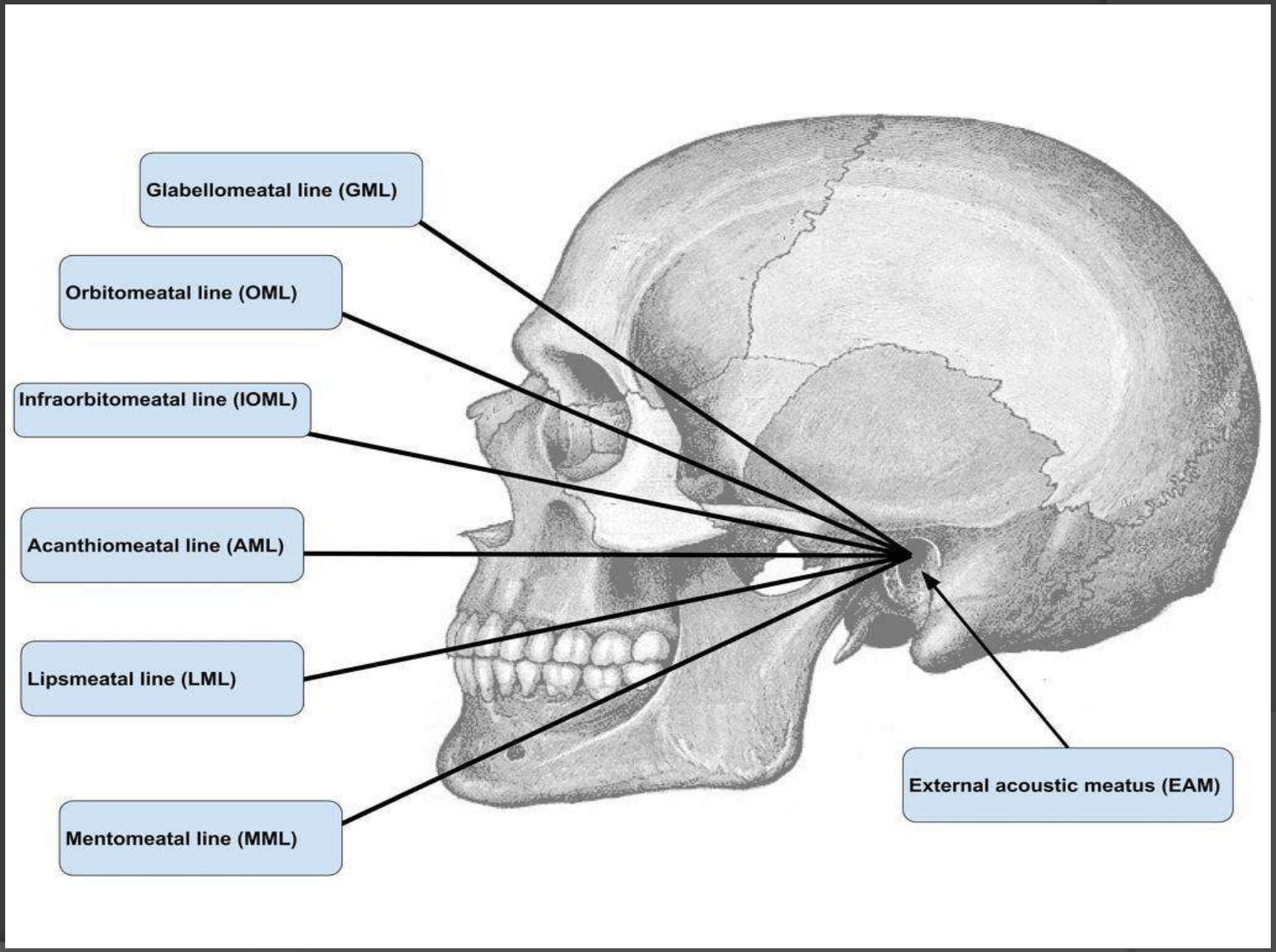
glabellomeatal line (GML)
orbitomeatal line (OML)
infraorbitomeatal line (IOML)
acanthiomeatal line (AML)
lipsmeatal line (LML)
mentomeatal line (MML)

Orbito-meatal base line (radiographic baseline): extends from the outer canthus of the eye to the centre of the external auditory meatus. This line is angled approximately 10 degrees to the anthropological baseline.

Anthropological baseline: passes from the infra-orbital point to the upper border of the external auditory meatus (also known as the Frankfurter line).

Skull Positioning Lines




Glabellomeatal line (GML)
Orbitomeatal line (OML)
Infraorbitomeatal line (IOML)
Acanthiomeatal line (AML)
Lipsmeatal line (LML)
Mentomeatal line (MML)
External acoustic meatus (EAM)

Planes

- Median sagittal plane: divides the skull into right and left halves.

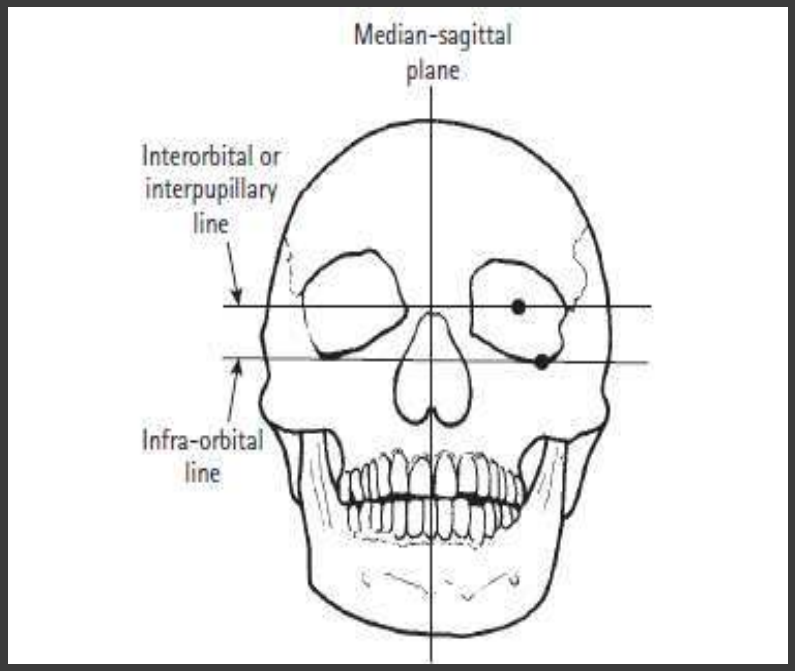
Landmarks on this plane are the nasion anteriorly and the external occipital protuberance (inion) posteriorly.

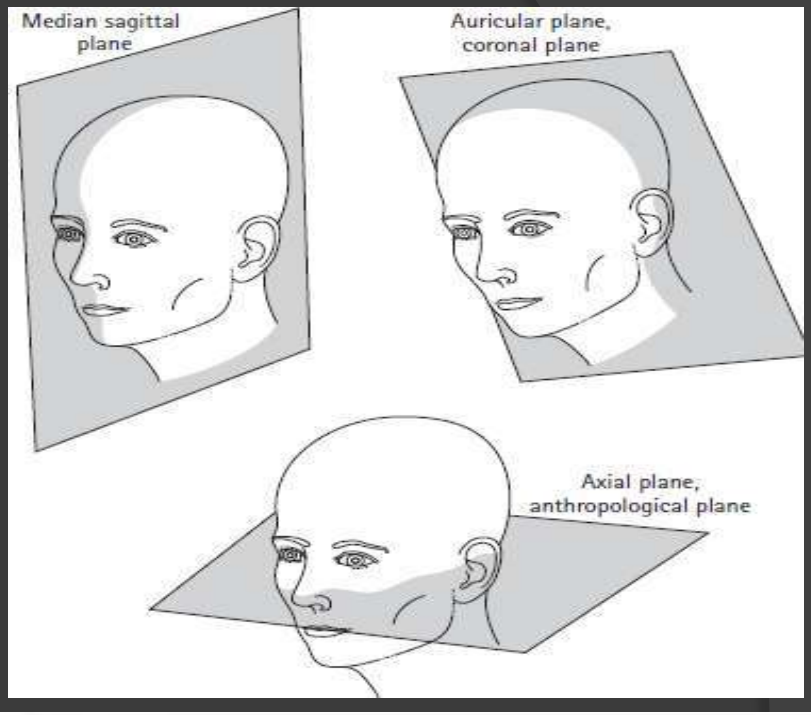
- Coronal planes: these are at right-angles to the median sagittal plane and divide the head into anterior and posterior parts.
- Anthropological plane: a horizontal plane containing the two anthropological baselines and the infra-orbital line. It is an example of an axial plane.

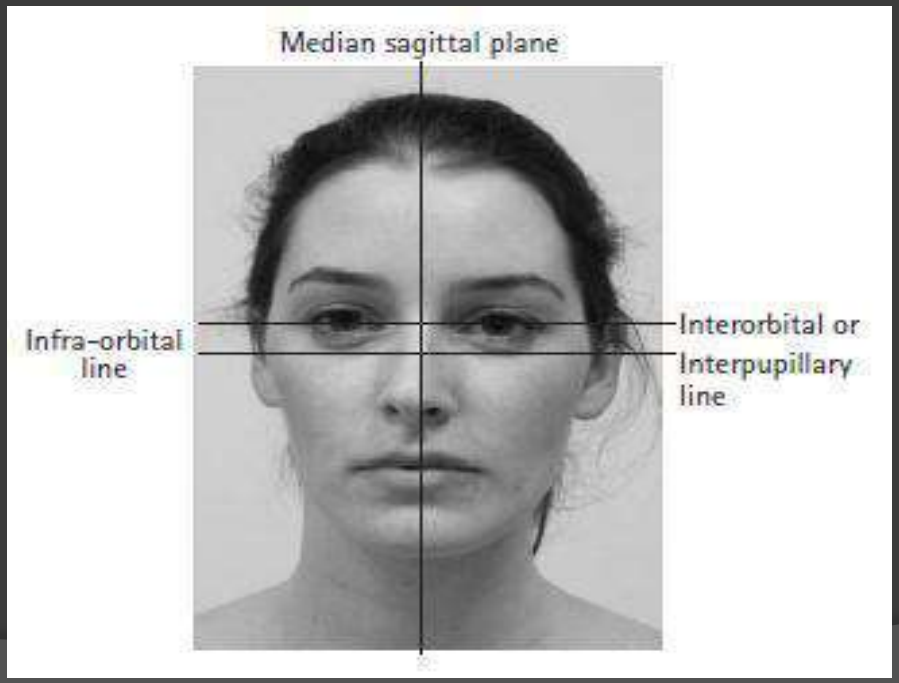
Axial planes are parallel with this plane.

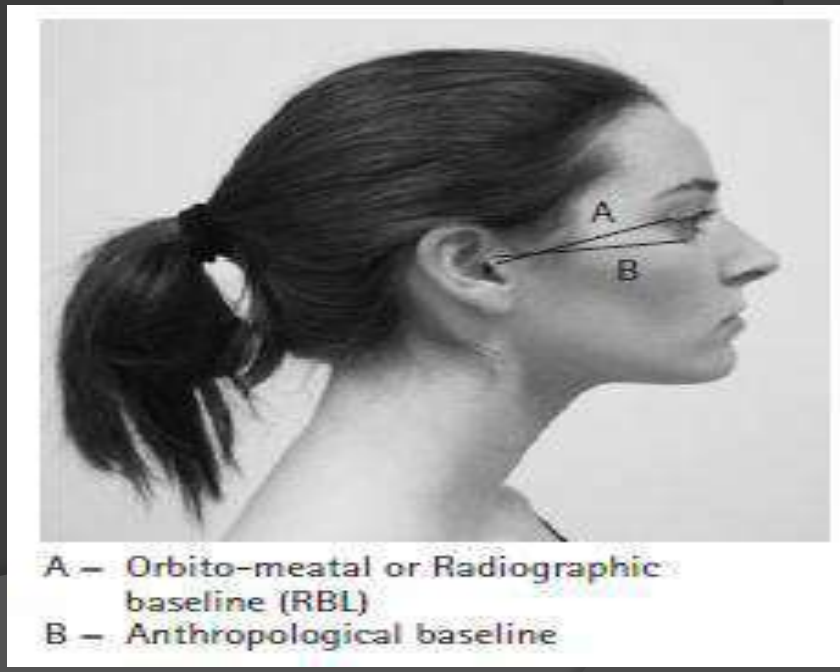
- Auricular plane: perpendicular to the anthropological plane. Passes through the centre of the two external auditory meatuses. It is an example of a coronal plane.

The median sagittal, anthropological and coronal planes are mutually at right-angles.


Median-sagittal plane
Interorbital or interpupillary line
Infra-orbital line


Median sagittal plane
Auricular plane, coronal plane
Axial plane, anthropological plane


Median sagittal plane
Infra-orbital line
Interorbital or
Interpupillary line


A
B
A – Orbito-meatal or Radiographic baseline (RBL)
B – Anthropological baseline

Positioning terminology

To describe a skull projection, it is necessary to state the relative positions of the skull planes to the image receptor and the central ray relative to skull planes/image receptor and to give a centering point or area to be included within the beam.

The **standard projections are:**

1. The *lateral view.*
2. The *PA views.*
3. The *AP Towne's view* obtained by tilting the central ray 30° caudally and centring.
4. The *basal view* obtained by placing the patient's head in the `hanging head' position with the anatomical baseline horizontal. and centering vertical to it and between the angles of the mandible

LATERAL POSITION—RIGHT OR LEFT LATERAL

Patient Position

Erect or prone position

Part Position

Place the head in a true lateral position, with the side of interest closest to IR.

For the lateral projection, the central ray passes along a coronal plane at right-angles to the median sagittal plane.

It is named according to the side of the head nearer to the image receptor.

The *lateral view,* with the side of the suspected lesion against the film.

In the example the beam enters the head on the left side, passes along a coronal plane, and exits the head on the right side, where the image receptor is located. This is, therefore, a right lateral.

• The centring is point is over the pituitary.Center to a point (5 cm) superior to external auditory meatus (EAM).

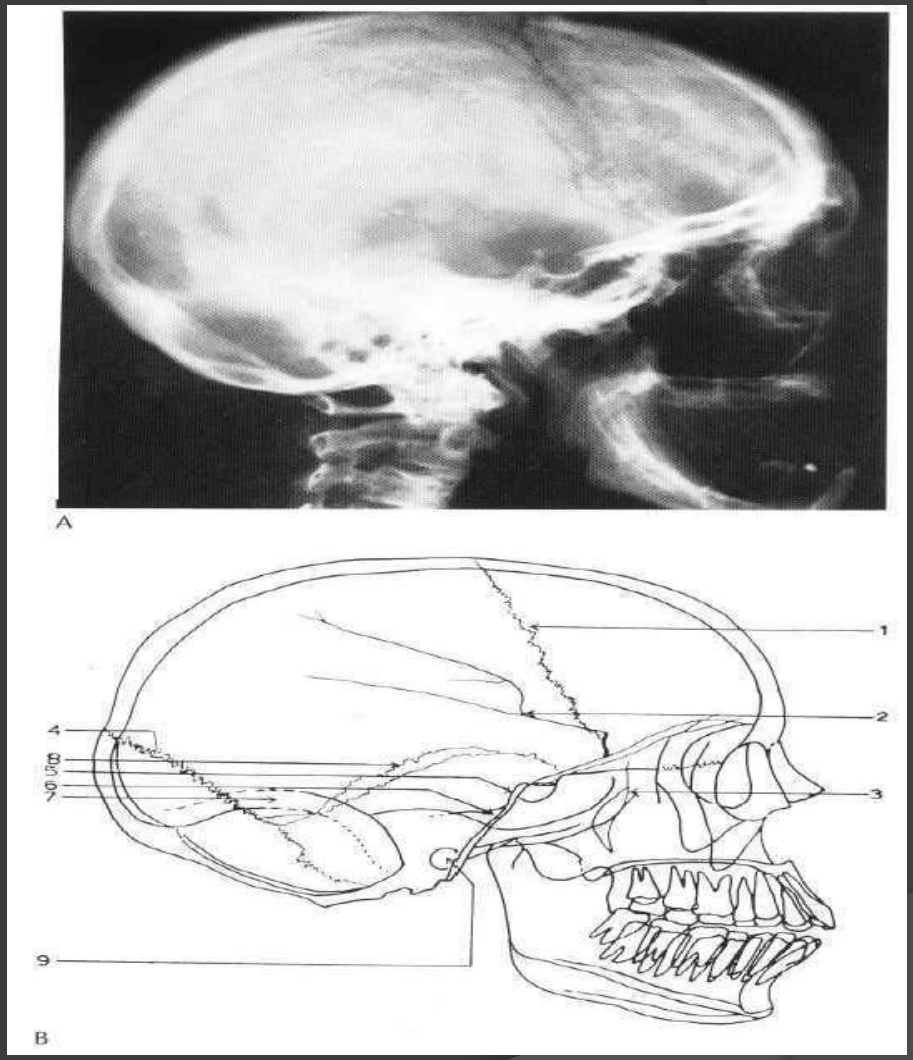


Fig. 53.2 (A) X-ray film of skull taken in standard lateral projection. (B) Diagram to illustrate the standard lateral view. 1 = coronal suture; 2 = meningeal vascular marking, anterior branch; 3 = anterior border of middle fossa; 4 = lambdoid suture; 5 = dorsum sellae; 6 = clivus; 7 = lateral sinus; 8 = squamoparietal suture; 9 = external auditory meatus.

AP axial (TOWNE method)

Clinical Indications

- Skull fractures
- neoplastic processes

Patient Position

Erect or supine position

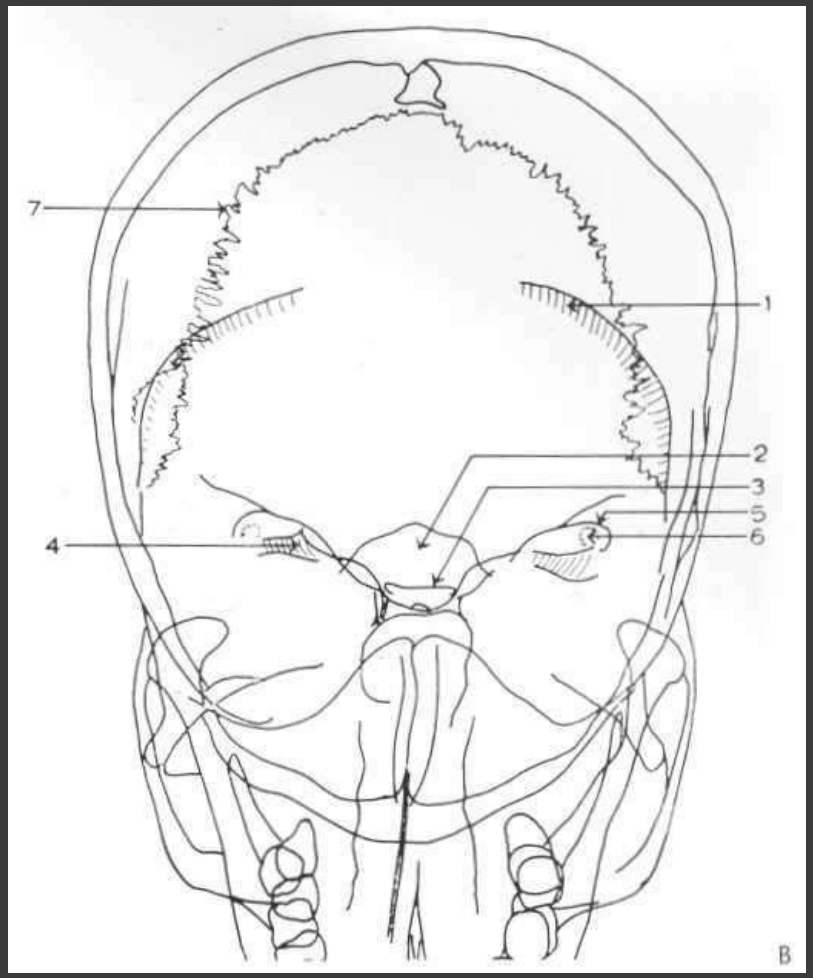
Part Position

Depress chin, bringing OML perpendicular to IR.

Align MSP to CR

Ensure that no head rotation nor tilt exists.

MSP=mid sagittal plane , IR=image receptor , CR = central ray .



X-ray film taken in standard Towne's projection. (B) Diagram to illustrate (A) 1 = lateral sinus; 2 = foramen magnum; 3 = dorsum sellae; 4 = internal auditory meatus; 5 = acuate eminence; 6 = superior semicircular canal; 7 = lambdoid suture.

PA (Occipito-frontal projections) : CALDWELL METHOD

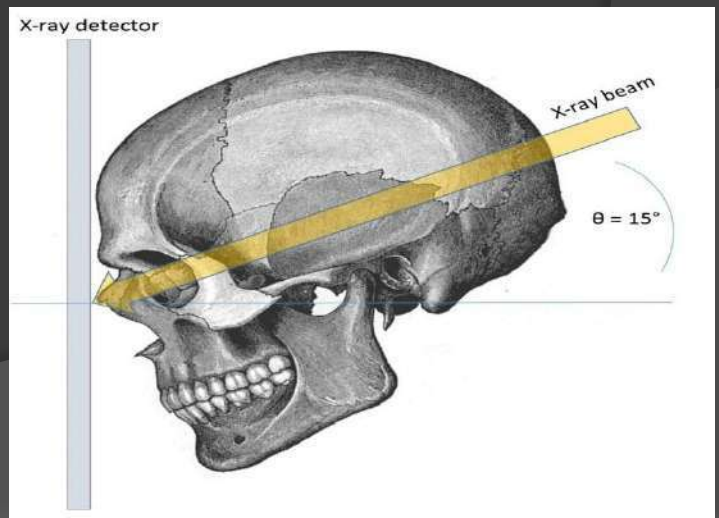
Part Position

. Rest patient's nose and forehead against table.

• Flex neck as needed to align OML perpendicular to IR.

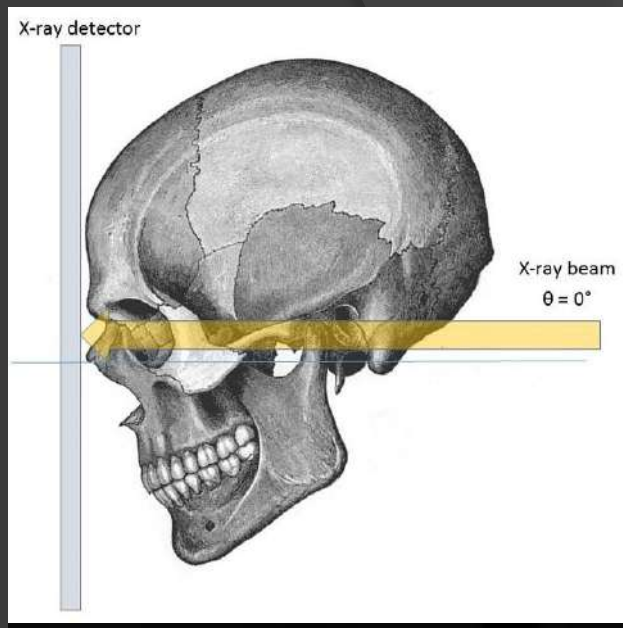
• Align MSP perpendicular to midline CR.

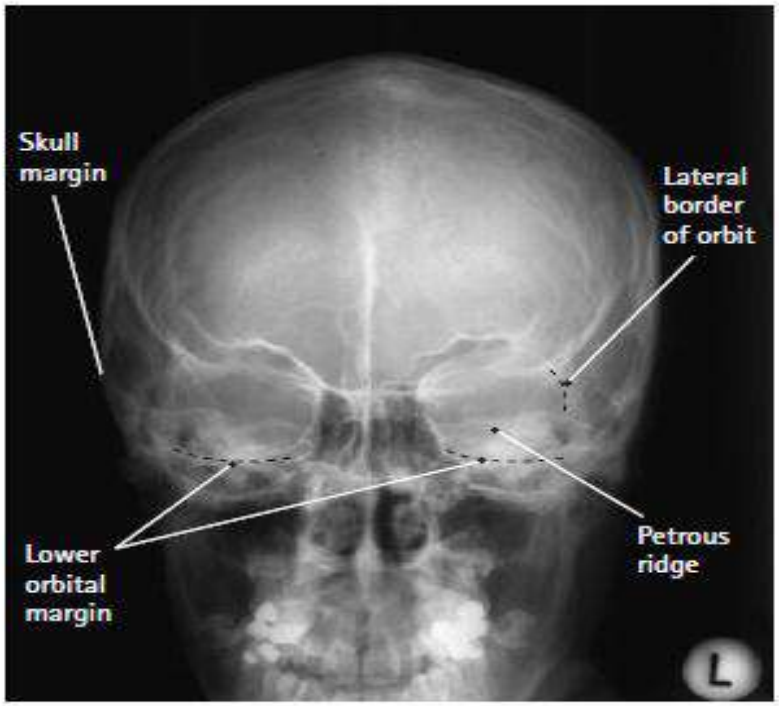
• Angle CR 15° caudad, the central ray centred on the inion in order to project the dense petrous bones clear of the orbits .

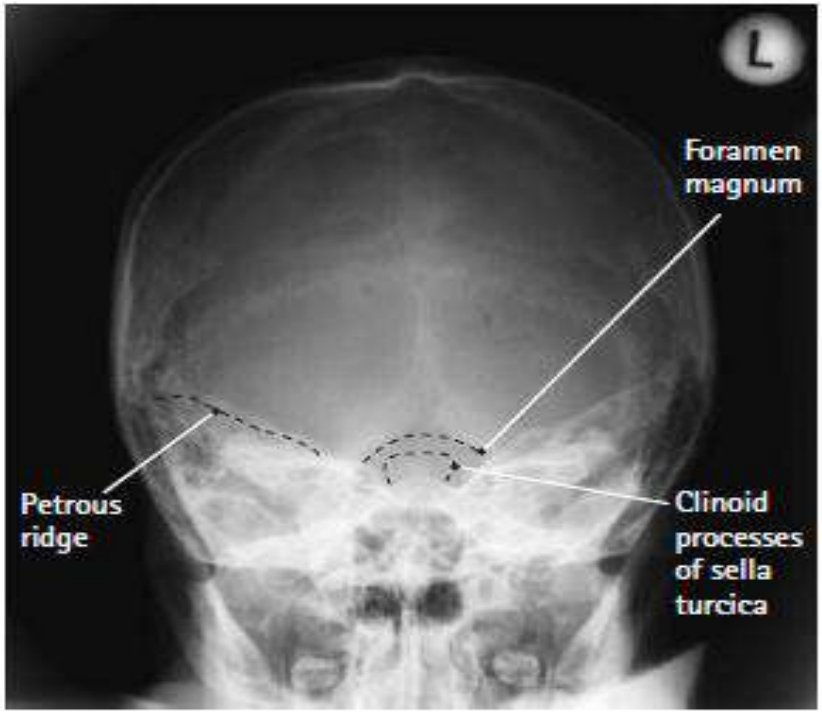


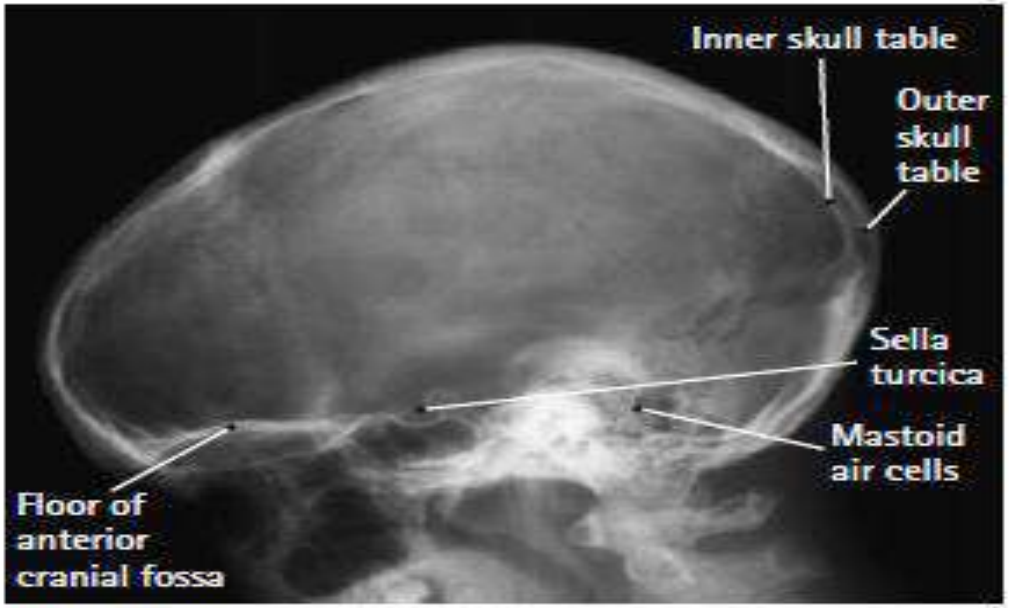
The skull posteroanterior (PA) view

This should be taken with the orbitomeatal line vertical and center to exit at nasion.




Skull margin
Lateral border of orbit
Lower orbital margin
Petrous ridge
L


L
Foramen magnum
Petrous ridge
Clinoid processes of sella turcica


Inner skull table
Outer skull table
Sella turcica
Mastoid air cells
Floor of anterior cranial fossa

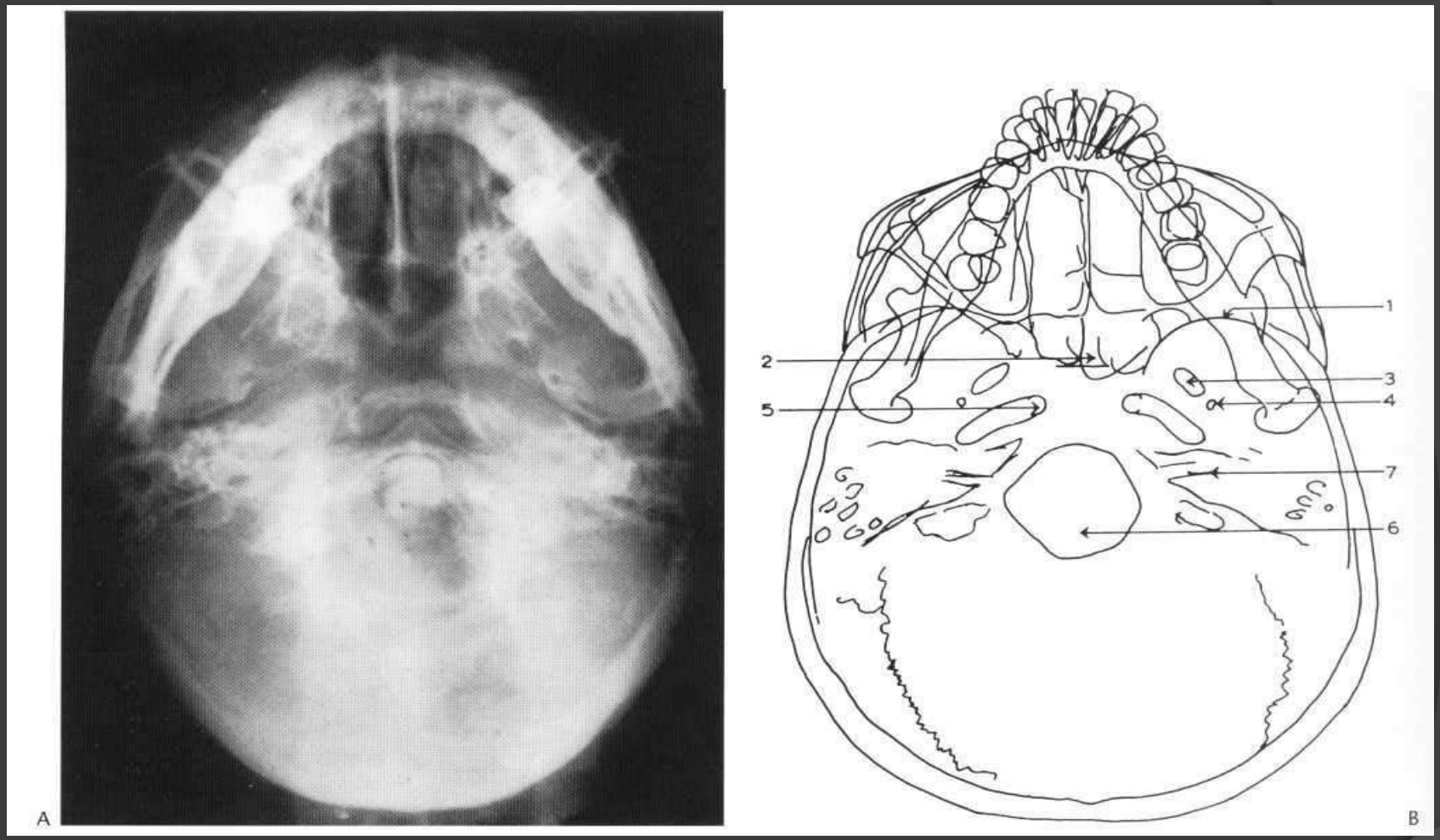
The basal view

Submento-vertical

Obtained by placing the patient's head in the

`hanging head' position with the anatomical baseline horizontal.

and centering vertical to it and between the angles of the mandible .



(A) X-ray film taken in standard basal view.
(B) Diagram to illustrate (A) 1 = greater sphenoidal wing; 2 = sphenoidal sinus;
3 = foramen ovale; 4 = foramen spinosum; 5 = foramen lacerum medium; 6 = foramen magnum; 7 = internal auditory meatus.

Facial bones and sinuses

RADIOGRAPHIC ANATOMY FOR POSITIONING :

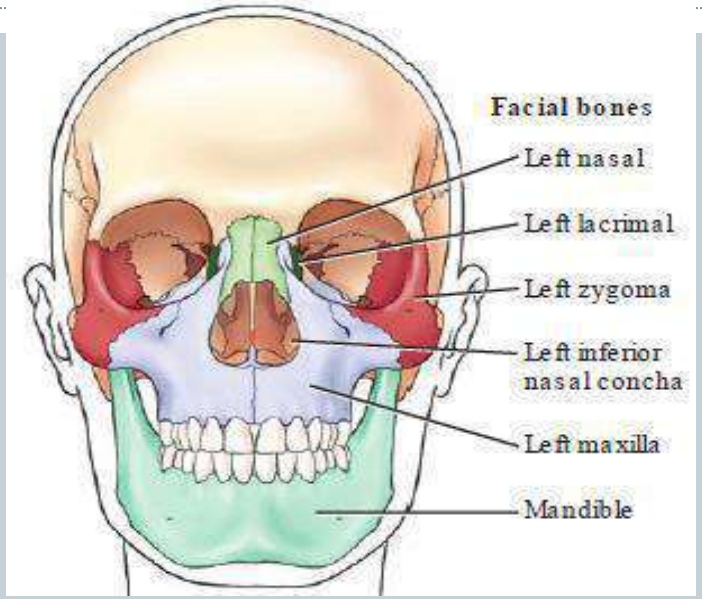
- THE FACIAL BONES ARE A SERIES OF IRREGULAR BONES THAT ARE ATTACHED COLLECTIVELY TO THE ANTRO-INFERIOR ASPECT OF THE SKULL. WITHIN THESE BONES, AND SOME OF THE BONES FORMING THE CRANIUM, ARE A SERIES OF AIR-FILLED CAVITIES KNOWN AS THE PARANASAL

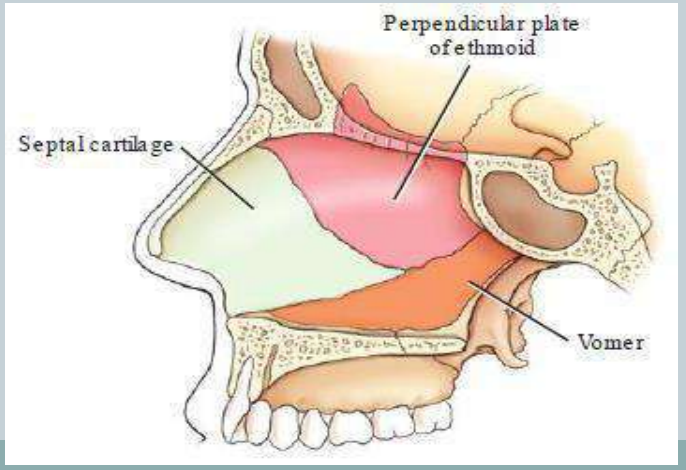
- THE 14 FACIAL BONES CONTRIBUTE TO THE SHAPE AND FORM OF A PERSON'S FACE. IN ADDITION, THE CAVITIES OF THE ORBITS, NOSE, AND MOUTH.

Only 2 are single bones.

The remaining 12 consist of six pairs of bones:

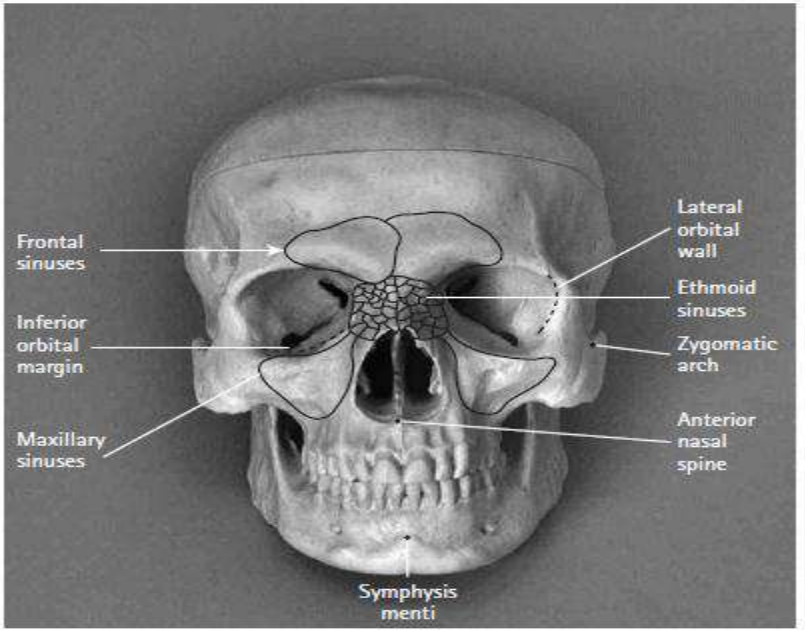
- 2 Maxillae (upper jaw),
- 2 Zygomatic bones
- 2 Lacrimal bones
- 2 Nasal bones
- 2 Inferior nasal conchae
- 2 Palatine bones
- 1 Vomer
- 1 Mandible (lower jaw)

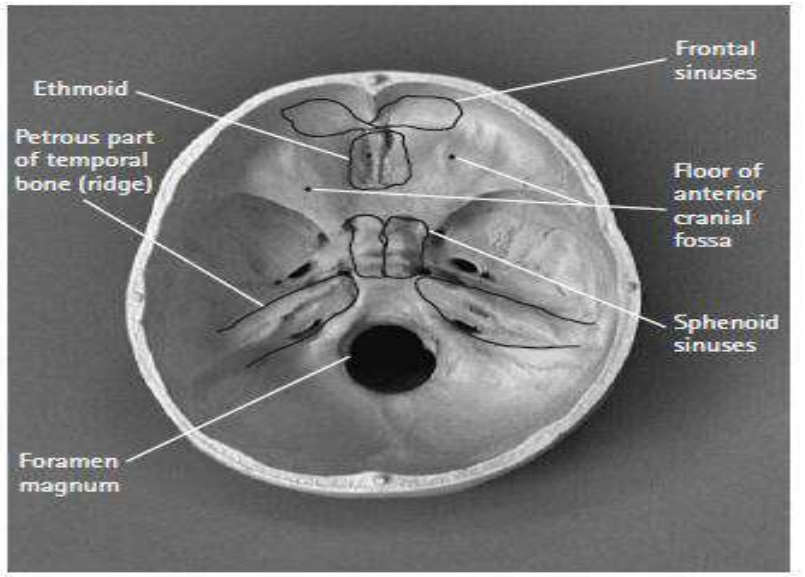




The following are the paranasal air sinuses:

- **Maxillary sinuses (maxillary antra): paired, pyramidal shaped** structures located within the maxillary bone either side of the nasal cavity. They are the largest of the sinuses.
- **Frontal sinuses: paired structures located within the frontal** bone adjacent to the fronto-nasal articulation. They are very variable in size, and in some individuals they may be absent.
- **Sphenoid sinuses: structures that lie immediately beneath** the sella turcica and posterior to the ethmoid sinuses.
- **Ethmoid sinuses: small air spaces that collectively** form part of the medial wall of the orbit and the upper lateral walls of the nasal cavity.



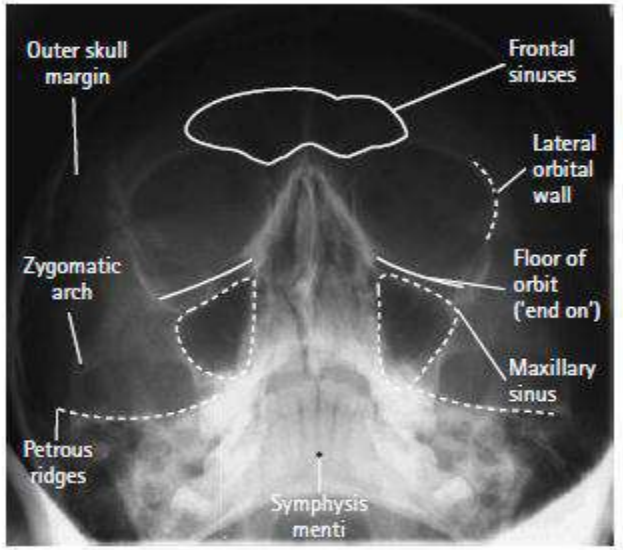


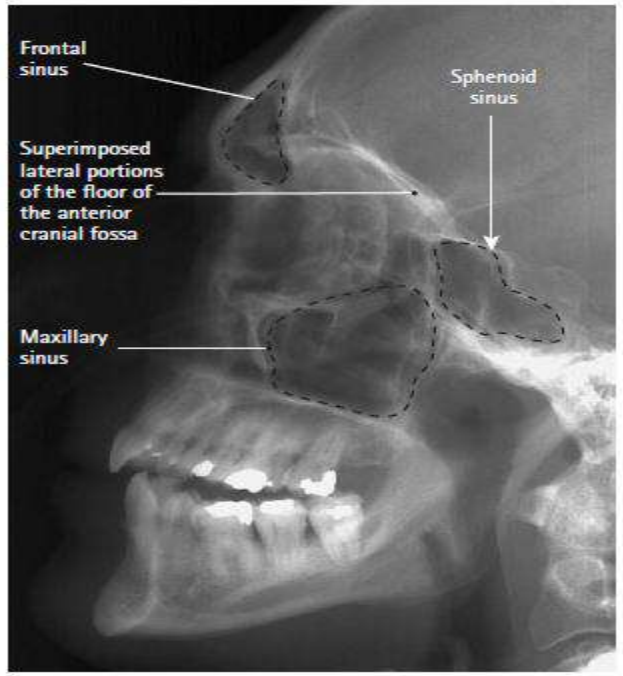
Radiological considerations

- The facial bones and sinuses are complicated structures, and the radiographer must be aware of their location and radiographic appearances in order to assess the diagnostic suitability of an image.
- Facial projections must demonstrate clearly the likely sites of facial fracture, especially in the mid-facial area.

These include the orbital floor, lateral orbital wall and zygomatico-frontal suture, lateral antral wall, and zygomatic arch.

- The signs of fracture in these areas may be subtle.
- Facial fractures may be bilateral and symmetrical.





Facial bones Recommended projections

Indications : Trauma and pathology

-Occipito-mental , Occipito-mental 30°↓ ,(Basic series).

-Modified mento-occipital.

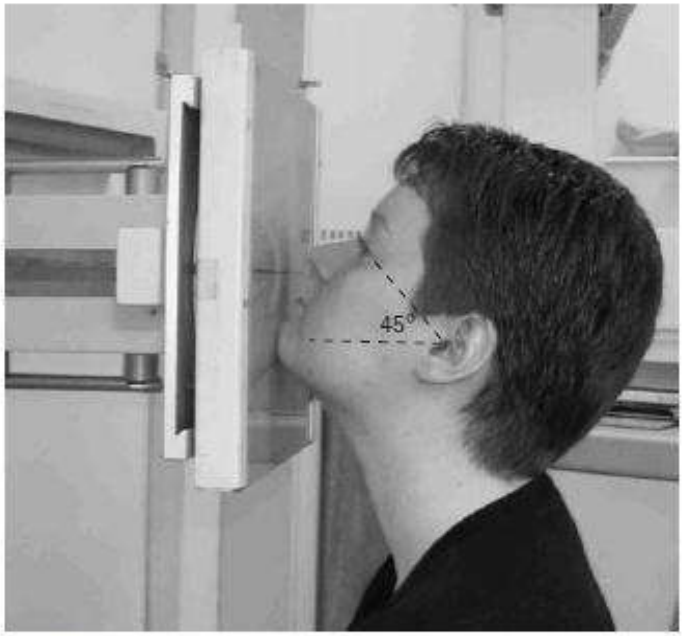
-lateral .

Occipito-mental

This projection shows the floor of the orbits in profile, the nasal region, the maxillae, the Inferior parts of the frontal bone and the zygomatic bone.

Position of patient and cassette

- The projection is best performed with the patient seated facing the cassette holder or vertical Bucky.
- The head is then adjusted to bring the orbito-meatal baseline to a 45-degree angle to the cassette holder.



Occipito-mental projection using skull unit

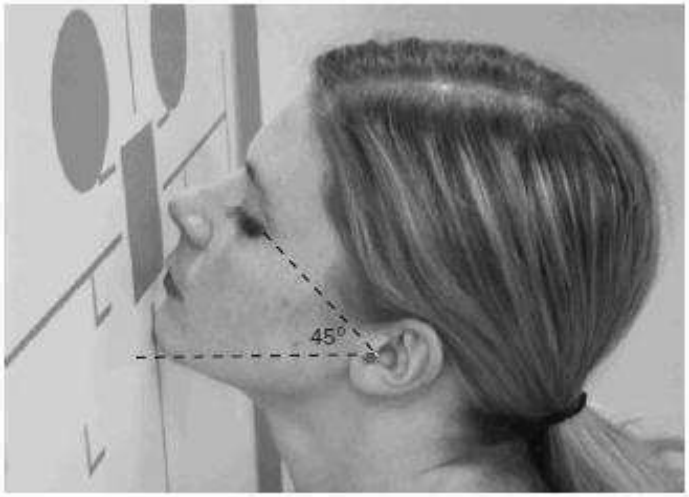
Direction and centring of the X-ray beam

- The central ray should be perpendicular to the cassette holder. it will be centered to the middle of the cassette holder.
- There should be no rotation. This can be checked by ensuring

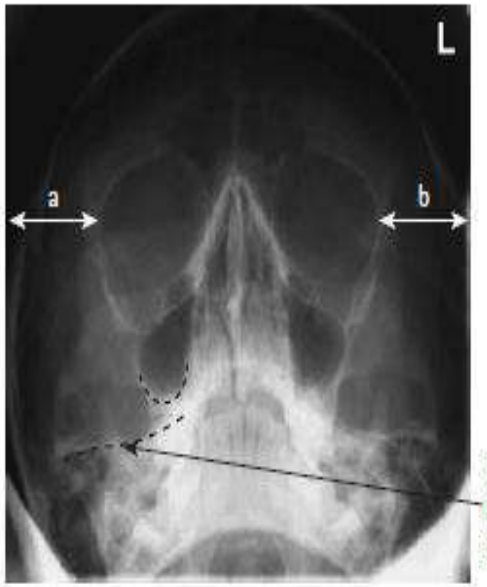
that the distance from the lateral orbital wall to the outer

skull margins is equidistant on both sides (marked a and b on

the image opposite).



Occipito-mental projection using a vertical Bucky



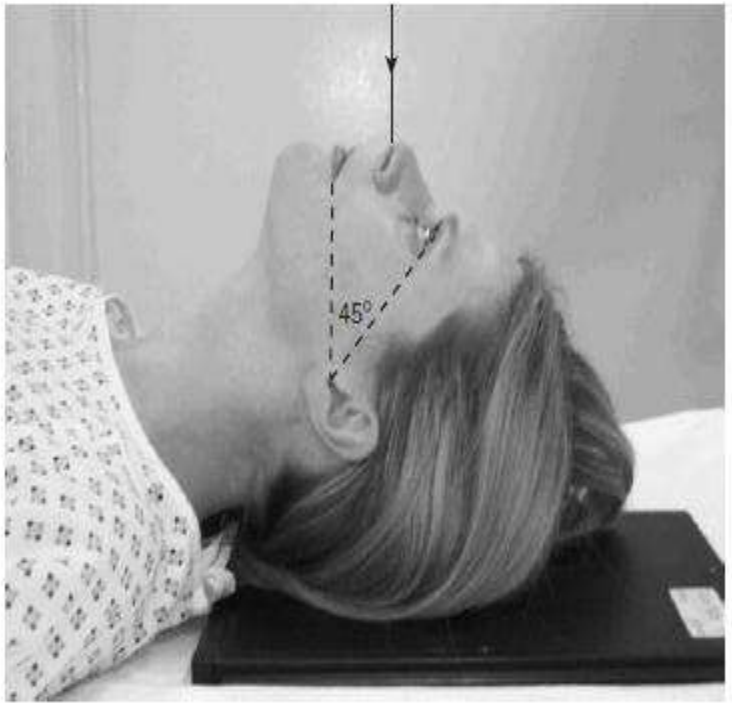
Petrous ridges just below inferior margin of maxillary sinus

Modified mento-occipital

Position of patient and cassette

• The patient will be supine on the trolley and should not be moved. If it is possible to place a cassette and grid under the patient's head without moving the neck, then this should be undertaken. If this is not possible, then place the cassette and grid in the cassette tray under the patient.

The centring point remains the same.

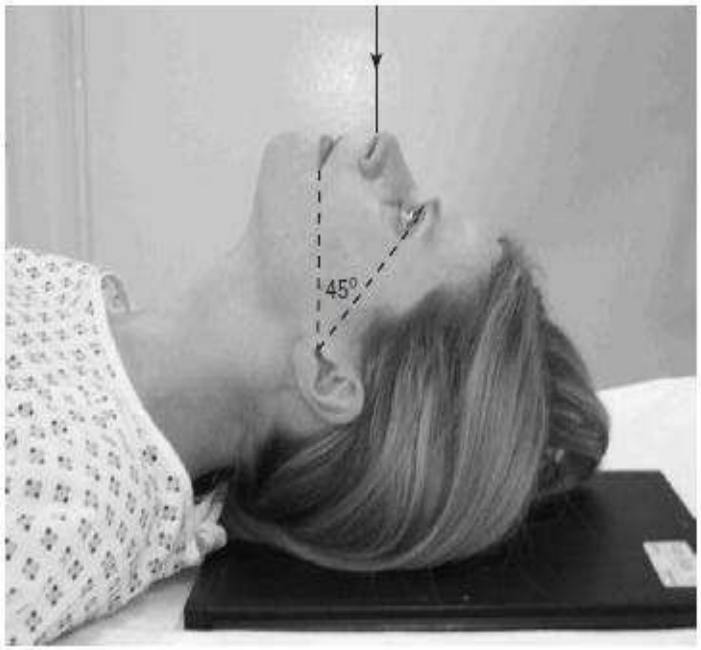


Patient imaged supine with 45-degree baseline

Direction and centring of the X-ray beam

- If the baseline makes an angle of 45 degrees back from the vertical (chin raised), then a perpendicular beam can be employed centred to the midline at the level of the lower orbital margins.

The centring point remains the same.



Patient imaged supine with 45-degree baseline

Lateral

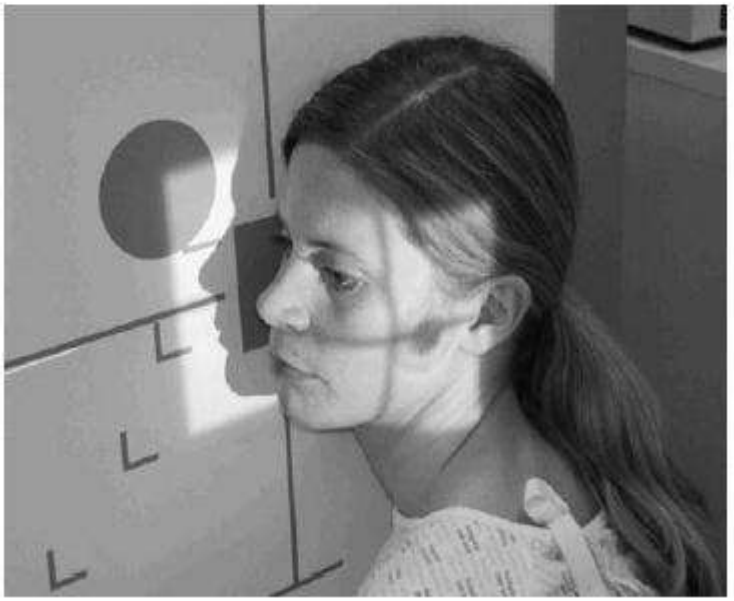
Position of patient and cassette

• The patient may be positioned erect or supine

Erect

• The patient sits facing the vertical Bucky or cassette holder .

The Bucky height is altered, such that its centre is 2.5 cm inferior to the outer canthus of the eye.



Supine

• The patient lies on the trolley, with the arms extended by the sides and the median sagittal plane vertical to the trolley top.

The the centre of the cassette is 2.5cm inferior to the outer canthus of the eye.

Direction and centering of the X-ray beam

• Centre the horizontal central ray to a point 2.5 cm inferior to the outer canthus of the eye.

Lateral facial bones showing foreign body

Nasal bones:

CLINICAL INDICATIONS :
NASAL BONE INJURIES

LATERAL

- **PATIENT POSITION IS RECUMBENT PRONE OR ERECT.**
- THE PATIENT SITS FACING A CASSETTE SUPPORTED IN THE CASSETTE STAND OF A VERTICAL BUCKY.
- THE HEAD IS TURNED SO THAT THE MEDIAN SAGITTAL PLANE IS PARALLEL WITH THE CASSETTE AND THE INTER-PUPILLARY LINE IS PERPENDICULAR TO THE CASSETTE .
- THE NOSE SHOULD BE ROUGHLY WITH THE CENTRE OF THE CASSETTE.

Direction and centering of the X-ray beam

- A horizontal central ray is directed through the centre of the nasal bones inferior to nasion and collimated to include the nose.
- A high-resolution cassette may be used if detail is required.

Paranasal sinuses

Recommended projections

projections will vary according to local needs

-Occipito-mental (with open mouth)

-Parietoacanthial (Modified Waters Method)

-(Lateral)

Occipito-mental (with open mouth) Waters view.

Position of patient and cassette

- The projection is best performed with the patient seated facing the cassette holder or vertical Bucky.
- The patient's nose and chin are placed in contact with the midline of the cassette holder.

The head is then adjusted to bring the orbito-meatal baseline to a 45-degree angle to the cassette holder.

The patient should open the mouth as wide as possible before exposure. This will allow the posterior part of the sphenoid sinuses to be projected through the mouth.

Direction and centring of the X-ray beam

- The central ray of the skull unit should be perpendicular to the cassette holder and by design will be centred to the middle of the image receptor

OM radiograph for sinuses demonstrating a polyp in the right maxillary sinus

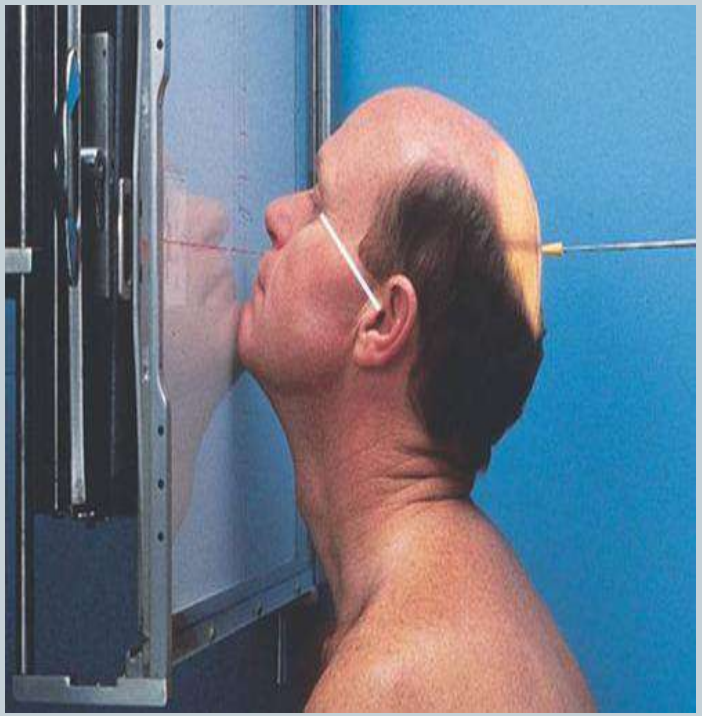
PARIETOACANTHIAL PROJECTION (Modified Waters Method)

Patient position is erect or prone (erect is preferred if patient's condition allows).

☐ **Part Position**

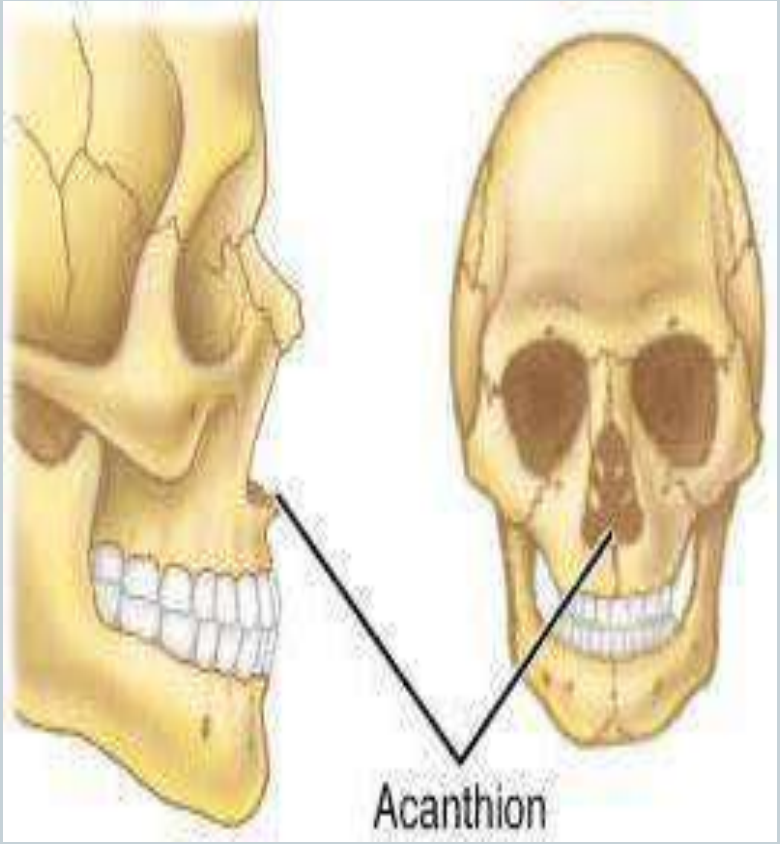
☐ Extend neck, resting chin against table

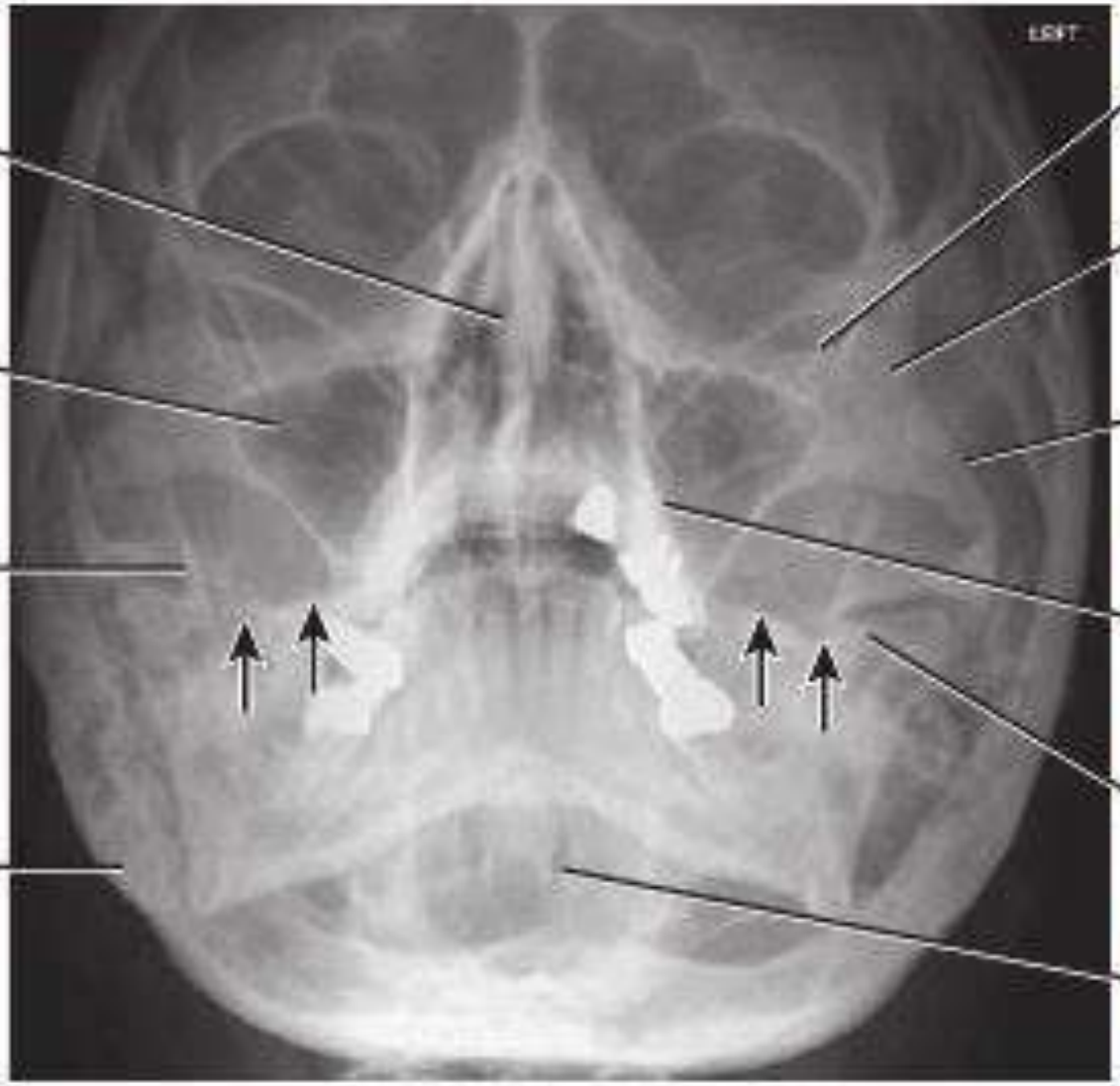
☐ Adjust head until MML is perpendicular to plane of IR. OML forms a 37° angle with the table.



CR

• Align CR perpendicular to IR, to exit at acanthion.




Bony nasal septum
Maxillary sinus
Coronoid process
Mastoid process
Inferior orbital rim
Zygomatic bone
Zygomatic arch
Maxillary alveolar process
Petrous ridge
Dens within foramen magnum

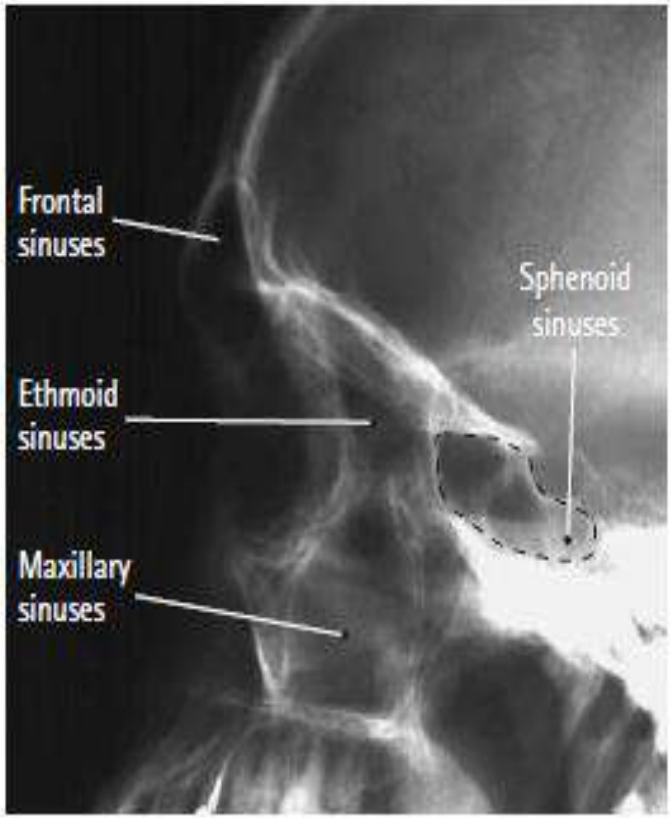
Lateral

Position of patient and cassette

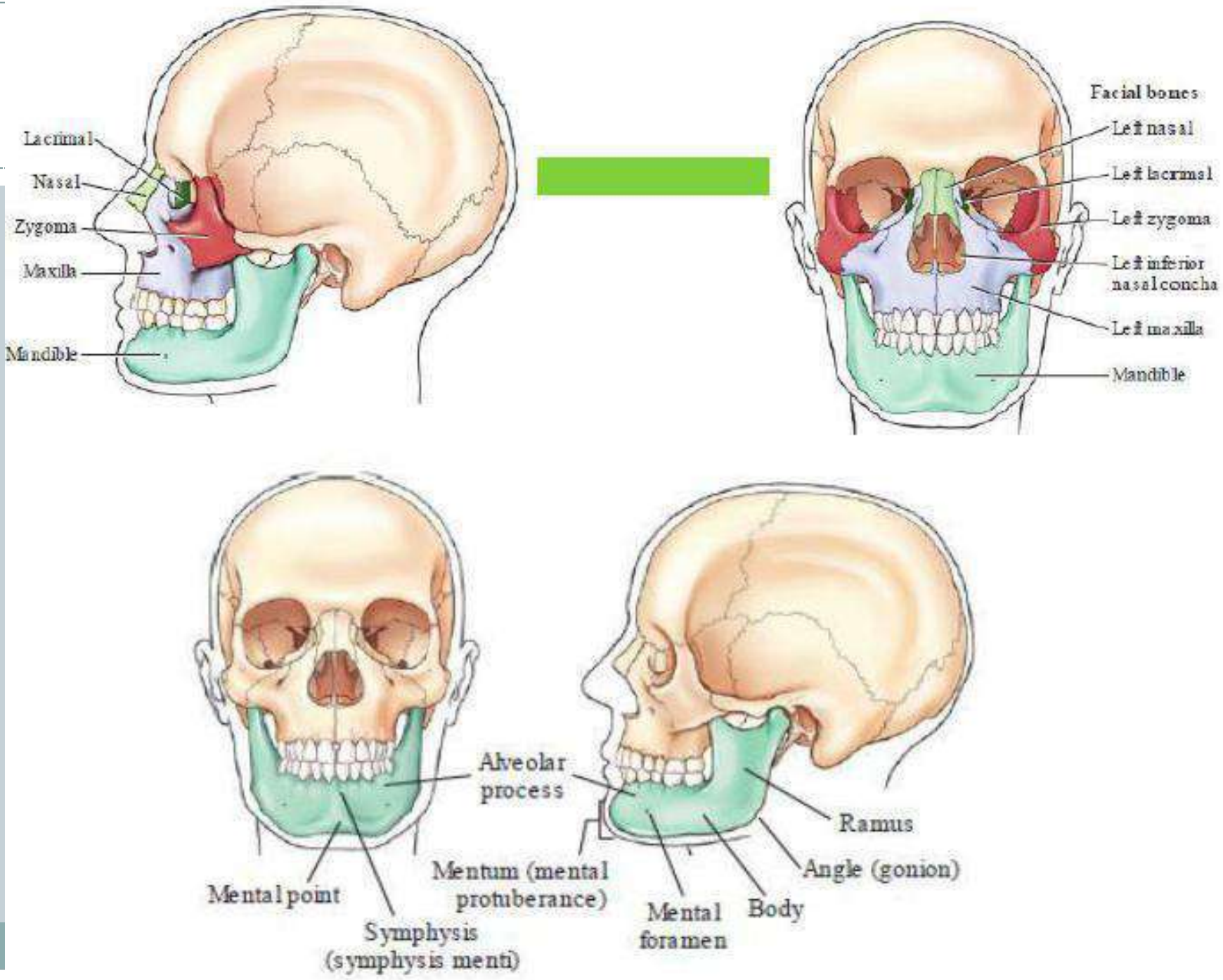
- The patient sits facing the vertical Bucky or cassette holder. The head is then rotated, such that the median sagittal plane is parallel to the Bucky and the inter-orbital line is perpendicular to the Bucky.
- The shoulders may be rotated slightly to allow the correct position to be attained. The patient may grip the Bucky for stability.
- The head and Bucky heights are adjusted so that the centre of the Bucky is 2.5 cm along the orbito-meatal line from the outer canthus of the eye.

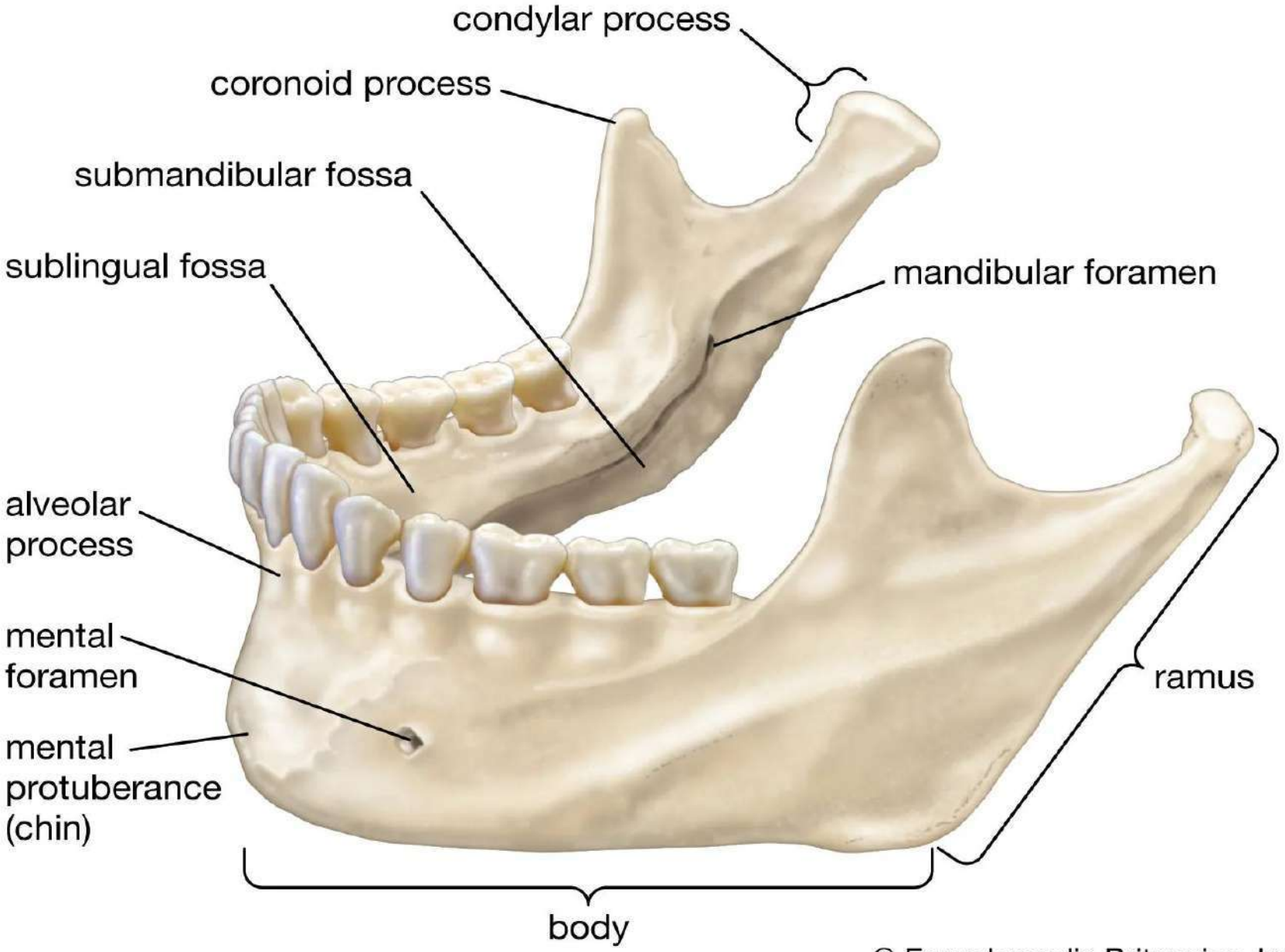
Direction and centring of the X-ray beam

- A horizontal central ray should be employed to demonstrate fluid levels.
- The tube should have been centred previously to the Bucky, such that the central ray will now be centred to a point 2.5cm posterior to the outer canthus of the eye.



Mandible


Lacrimal
Nasal
Zygoma
Maxilla
Mandible
Facial bones
Left nasal
Left lacrimal
Left zygoma
Left inferior nasal concha
Left maxilla
Mandible
Alveolar process
Ramus
Mentum (mental protuberance)
Angle (gonion)
Mental point
Symphysis (symphysis menti)
Mental foramen
Body


condylar process
coronoid process
submandibular fossa
sublingual fossa
mandibular foramen
alveolar process
mental foramen
mental protuberance (chin)
ramus
body
© Encyclopædia Britannica, Inc.

Projections

- postero-anterior (PA)
- oblique (postero-anterior)
- lateral 30 degrees cephalad

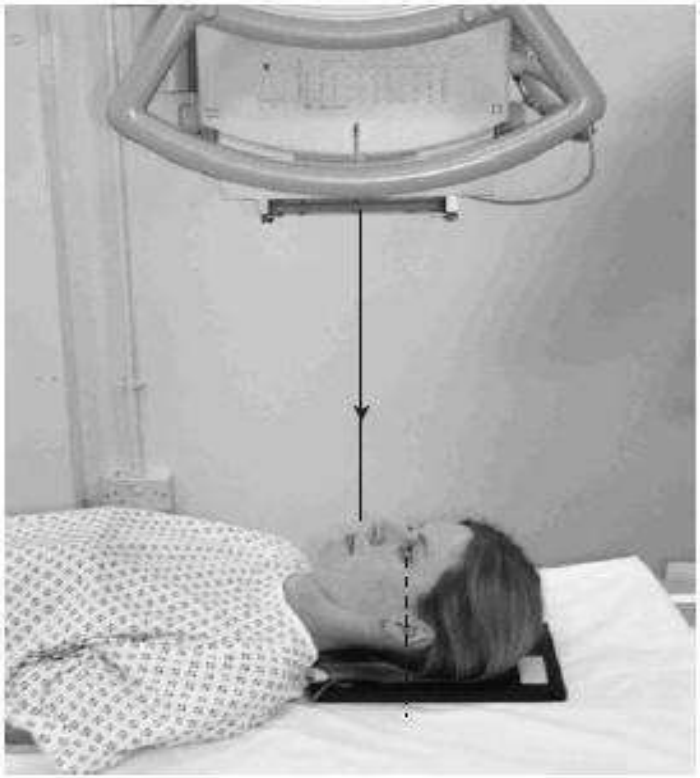
Clinical Indications

- Fractures
- Neoplastic or other focal lesions .

Position of patient and cassette

- The patient sits facing the vertical Bucky cassette holder.

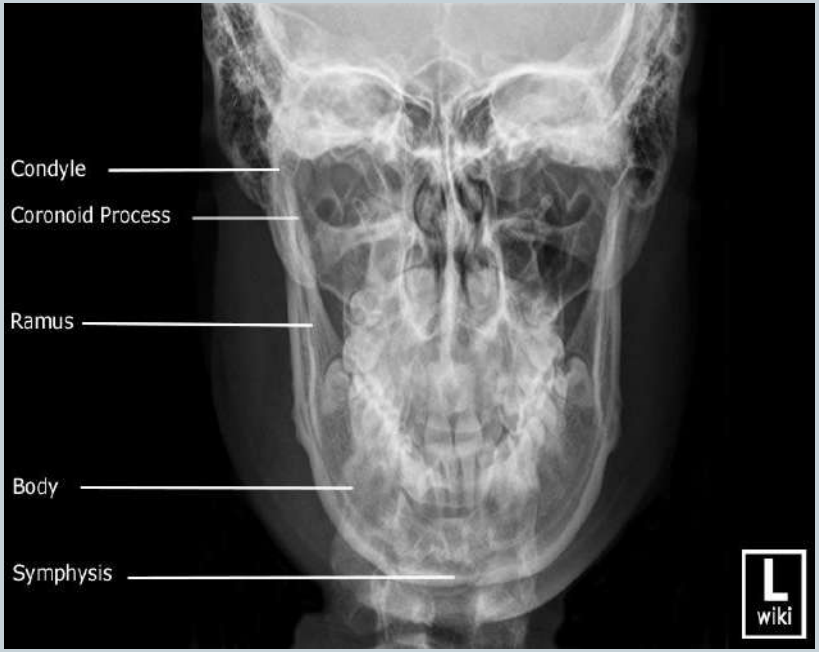
Alternatively, in the case of trauma, the projection may be supine on a trolley, giving an antero-posterior projection.



The patient's median sagittal plane should be coincident with the midline of the Bucky or cassette holder. The head is then adjusted to bring the orbito-meatal baseline perpendicular to the Bucky or cassette holder.

The median sagittal plane should be perpendicular to the cassette.

Check that the external auditory meatuses are equidistant from the cassette.



Direction and centring of the X-ray beam

• The central ray is directed perpendicular to the cassette and centred in the midline at the levels of the angles of the mandible.

oblique

This projection demonstrates the region of the symphysis menti.

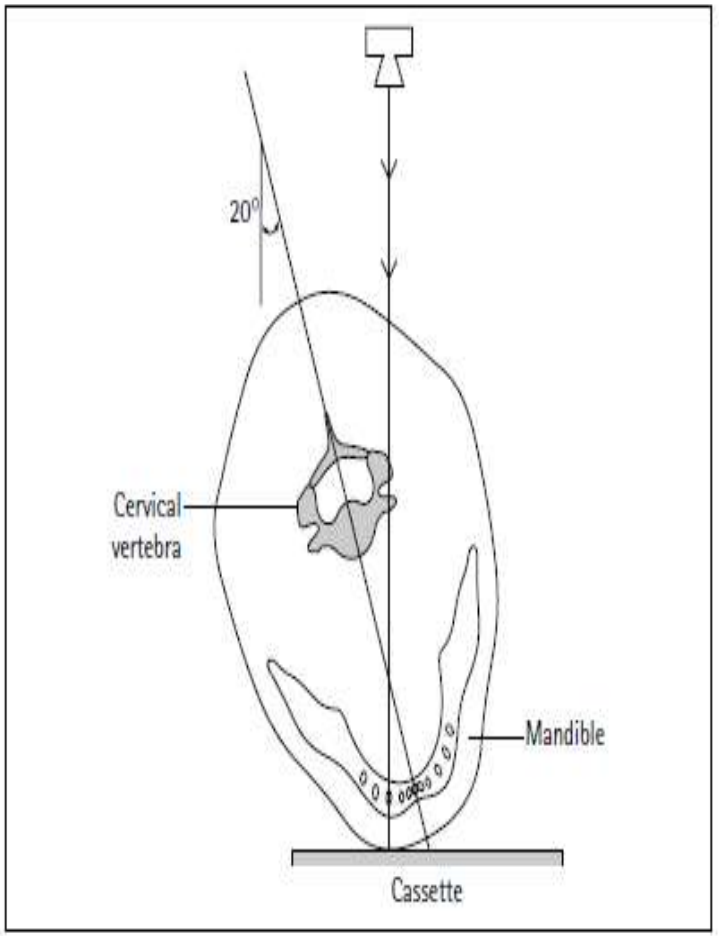
Position of patient and cassette

• The patient sits facing the vertical Bucky or skull unit cassette holder.

Alternatively, in the case of trauma, the projection may be supine on a trolley, giving an antero-posterior projection.

The patient's median sagittal plane should be coincident with the midline of the Bucky or cassette holder. The head is then adjusted to bring the orbito-meatal baseline perpendicular to the Bucky.

• From a position with the median sagittal plane perpendicular to the cassette, the head is rotated 20 degrees to either side, so that the cervical vertebra will be projected clear of the symphysis menti.



- The head is now repositioned so the region of the symphysis menti is coincident with the middle of the cassette

Direction and centring of the X-ray beam

• The central ray is directed perpendicular to the cassette and centered 5 cm from the midline, away from the side being examined, at the level of the angles of the mandible.

lateral 30 degrees cephalad

Position of patient and cassette

• The patient lies in the supine position. The trunk is rotated slightly and then supported with pads to allow the side of the face being examined to come into contact with the cassette, which will be lying on the tabletop.

The median sagittal plane should be parallel with the cassette and the inter-pupillary line perpendicular.

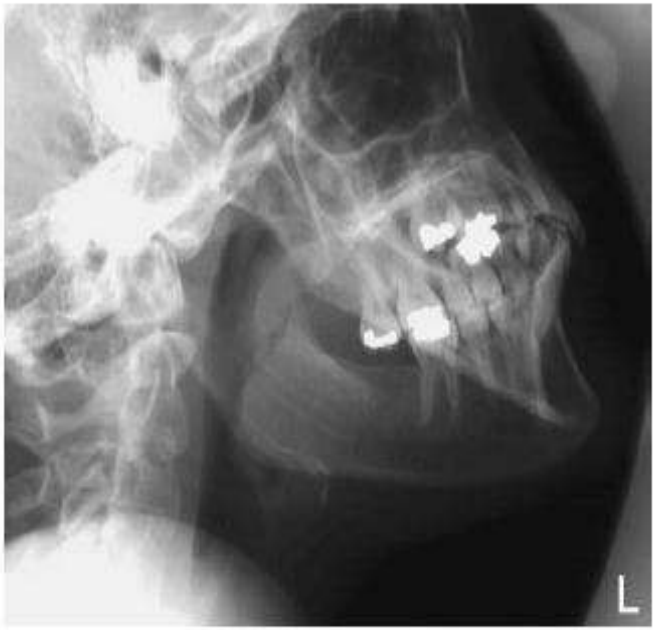
The projection may also be performed with a horizontal beam in trauma cases when the patient cannot be moved.

• In this case, the patient will be supine with the median sagittal plane at right-angles to the tabletop.

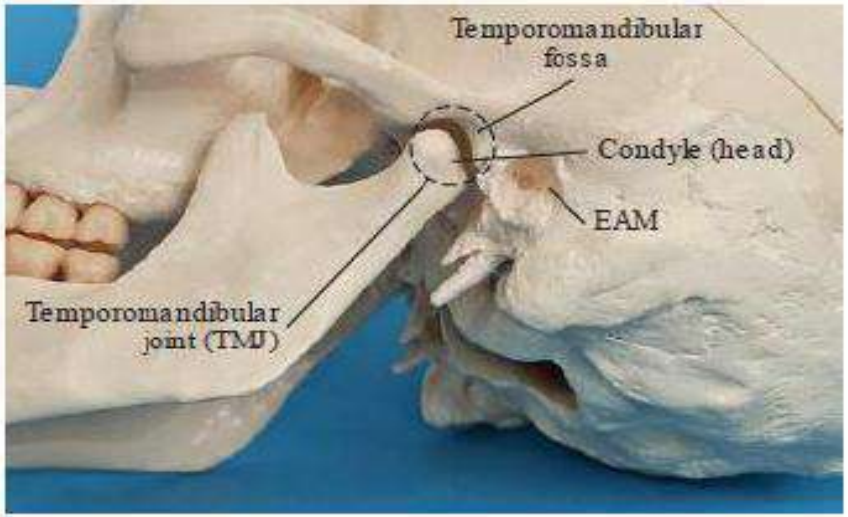
The cassette is supported vertically against the side under examination.

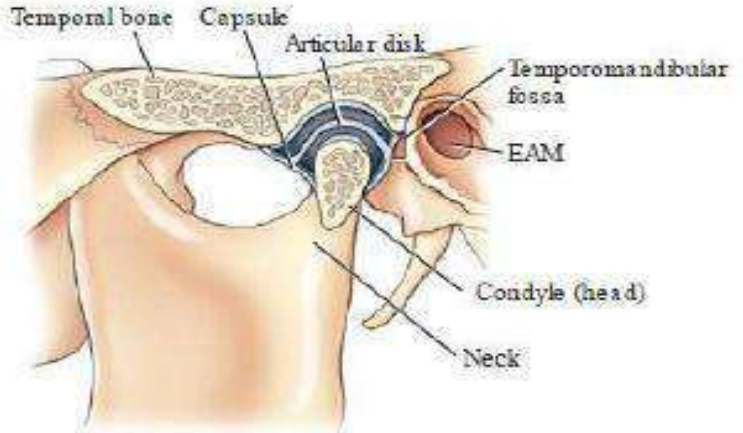
Direction and centering of the X-ray beam

• The central ray is angled 30 degrees cranially at an angle and is centred 5 cm inferior to the angle of the mandible remote from the cassette.



Temporal-mandibular joints





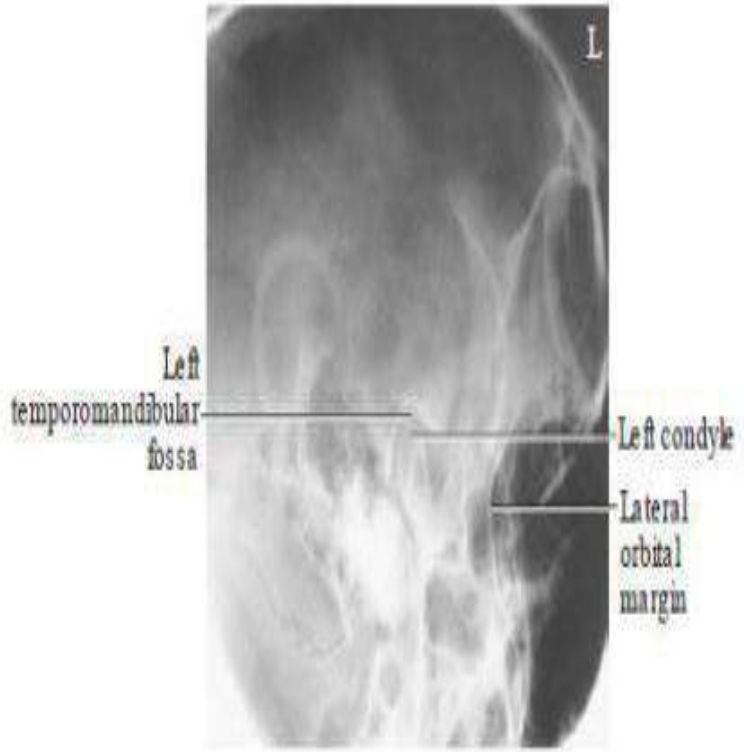


Fig. 11.184 Closed mouth.

lateral (axiolateral) 25-30 degrees caudad

It is usual to examine both temporal-mandibular joints. For each side, a projection is obtained with the mouth open as far as possible and then another projection with the mouth closed.

Clinical indication

TMJ images are useful in assessing joint dysfunction by demonstrating erosive and degenerative changes.

Open- and closed mouth projections can be very helpful in assessing whether normal anterior gliding movement of the mandibular condyle occurs on jaw opening.

MRI is now used for detailed study of the TMJ

Position of patient and cassette

- The patient sits facing the vertical Bucky, the head is rotated to bring the side of the head under examination in contact with the table..
- The head and Bucky or cassette holder level is adjusted so the centre cross-lines are positioned to coincide with a point 1 cm along the orbito-meatal baseline anterior to the external auditory meatus.
- The median sagittal plane is brought parallel to the cassette by ensuring that the inter-pupillary line is at right-angles to the table top and the nasion and external occipital protuberance are equidistant from it.

Axiolateral TMJs (Schuller)

Fig. 20-160. Axiolateral TMJ with mouth open.

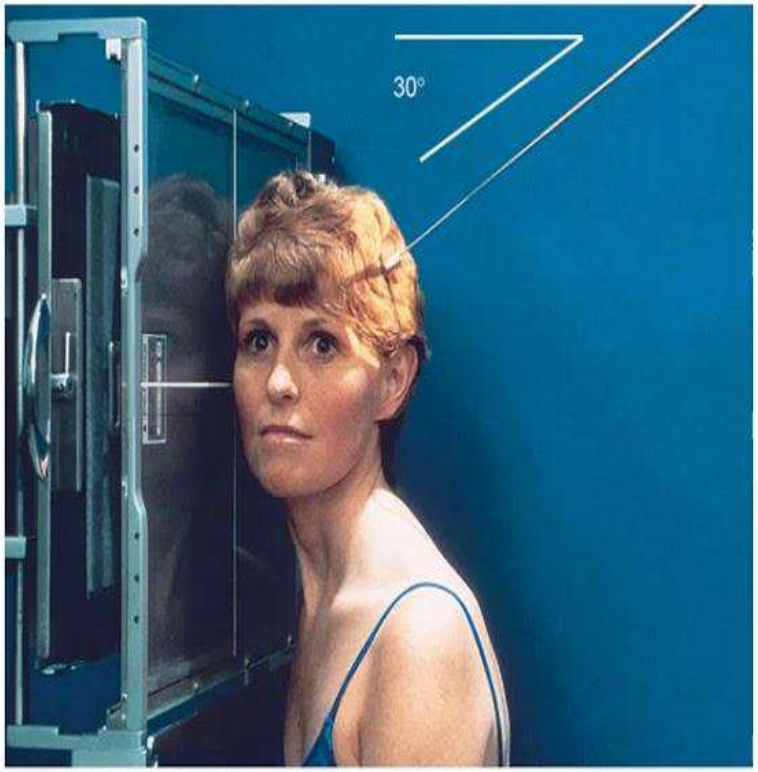


Fig. 20-157. Axiolateral TMJ: mouth closed.

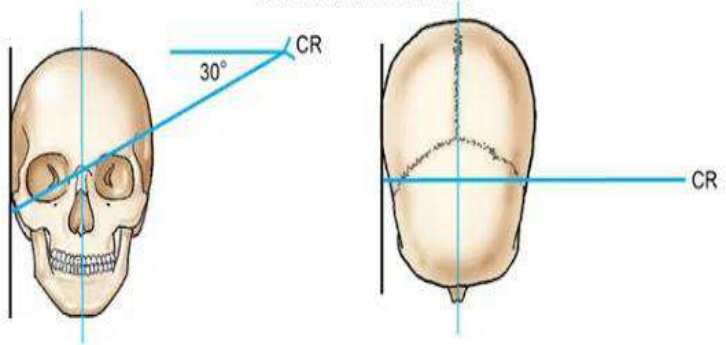
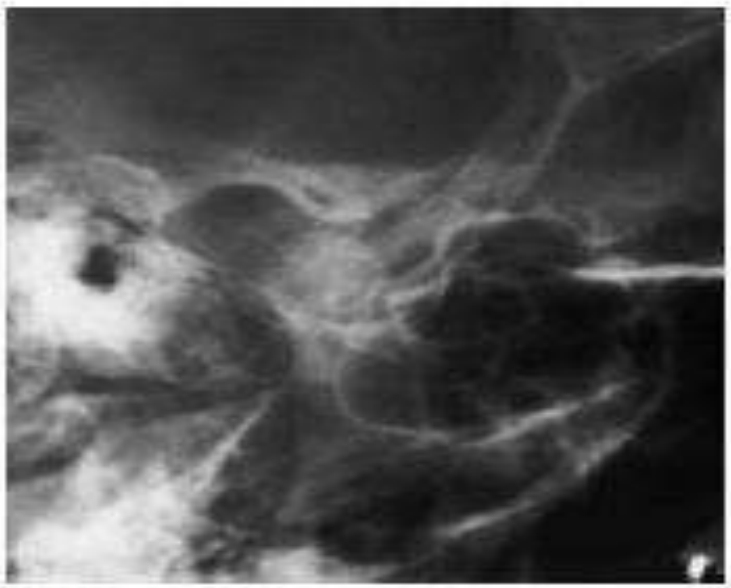


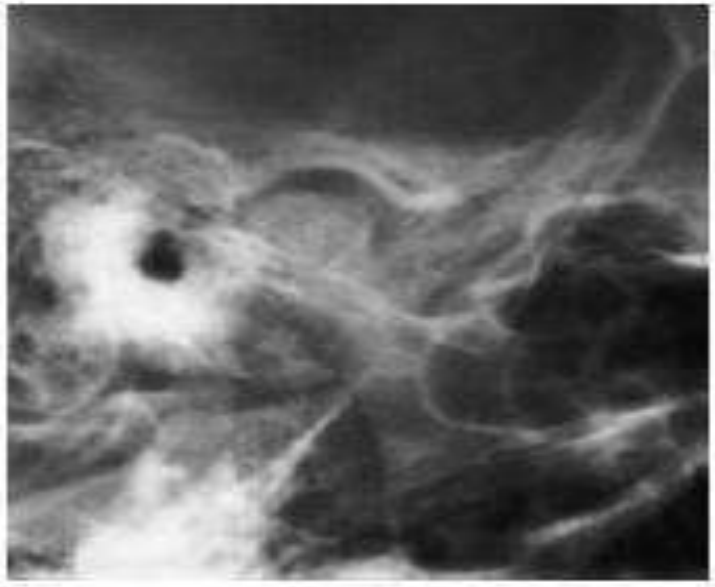
Fig. 20-158. Upright radiography diagram: axiolateral TMJ.

Direction and centring of the X-ray beam

• Using a well-collimated beam or an extension cone, the central ray is angled 25-30 degrees caudally and will be centred to a point 5 cm superior to the joint remote from the cassette (5 cm) superior to EAM) so the central ray passes through the joint nearer the cassette.



Mouth open



Mouth closed

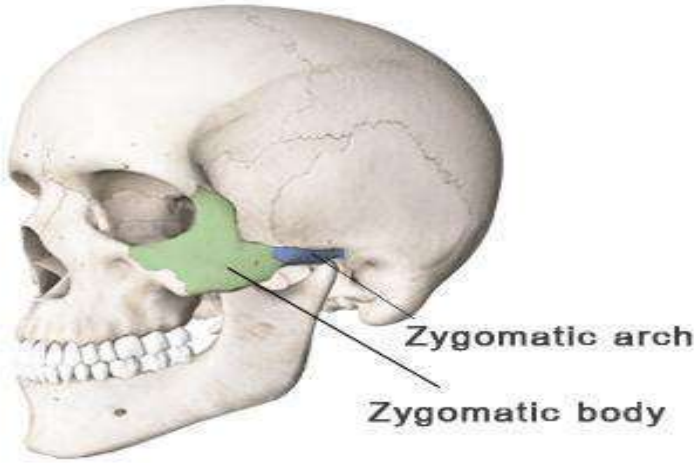
Zygomatic arches

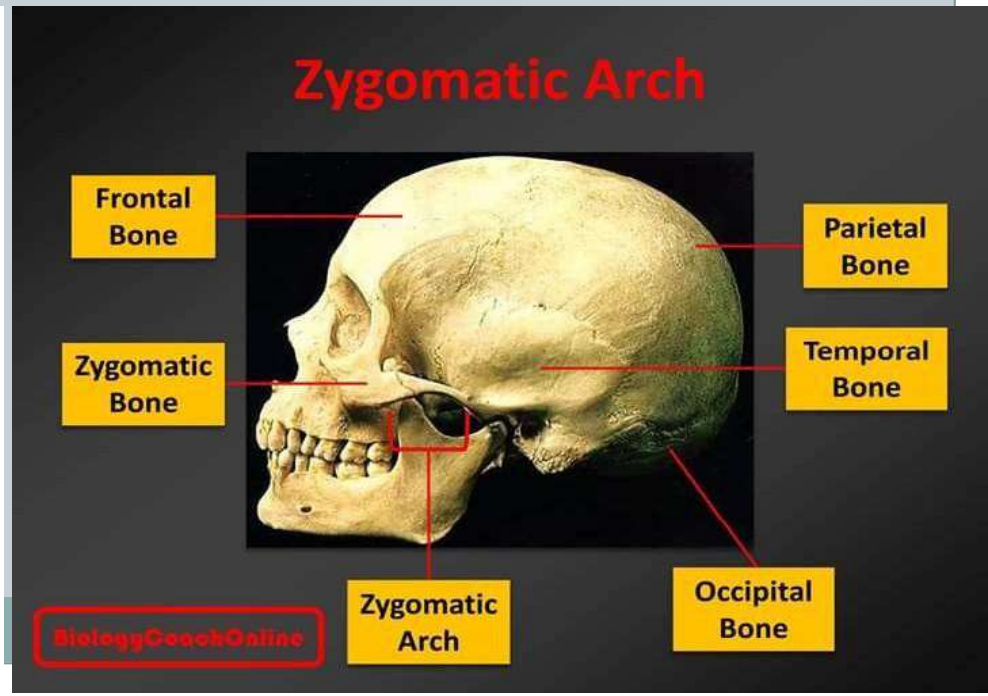
Projections

-(SMV) projection for both sides .

-Obligue infero-superior projection :

This projection is essentially a modified submento-vertical (SMV) projection.



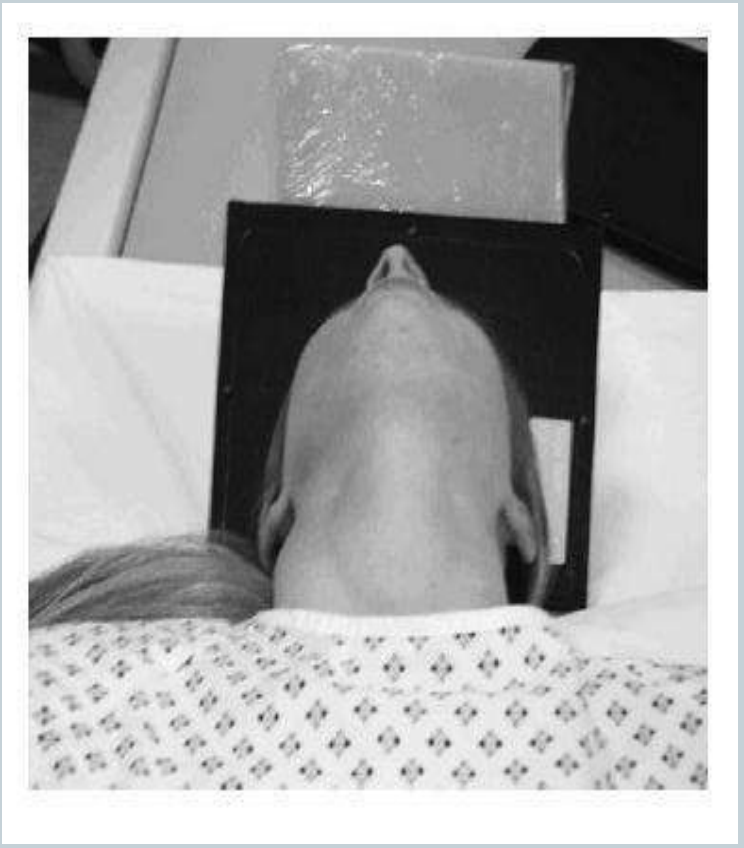


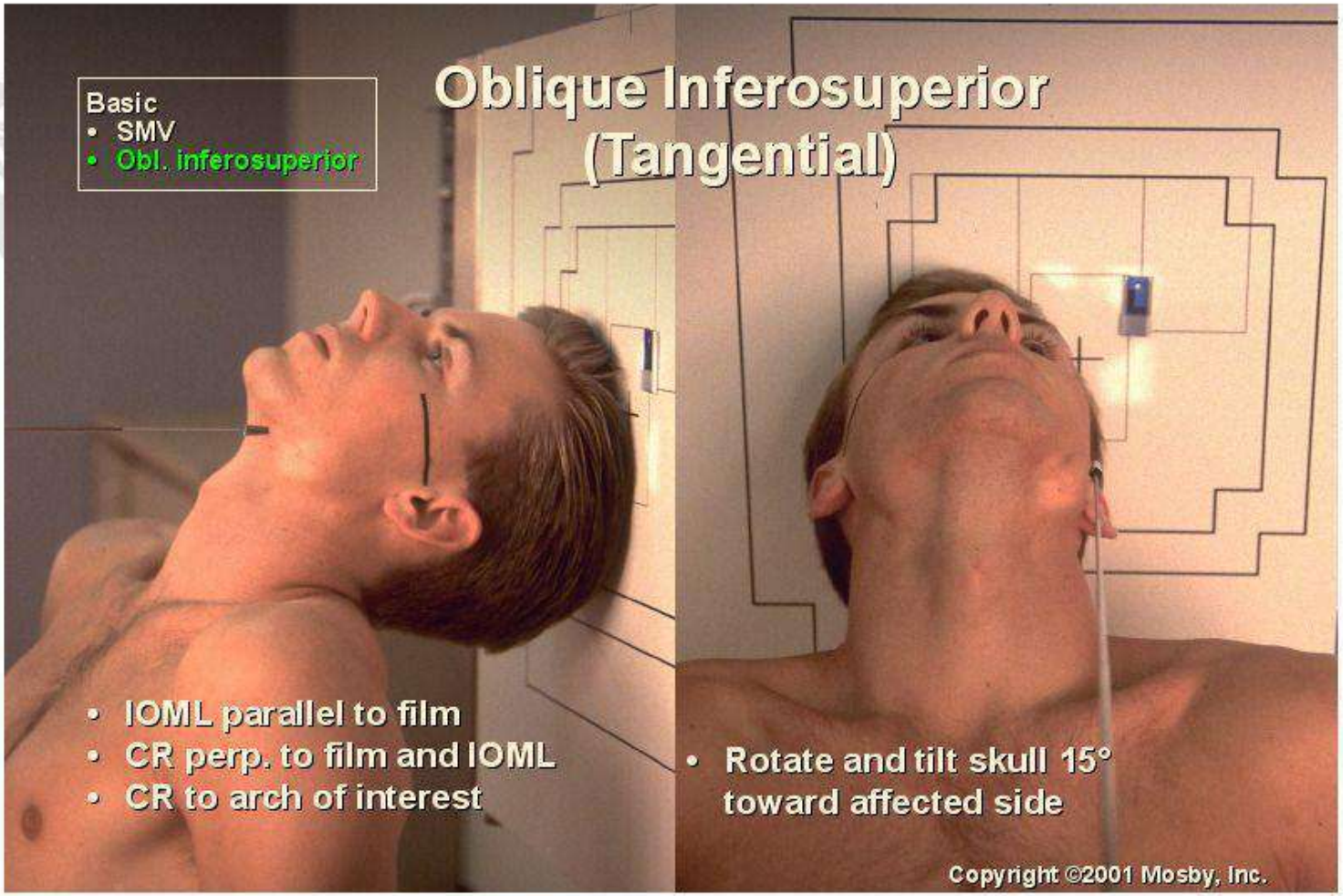
Position of patient and cassette

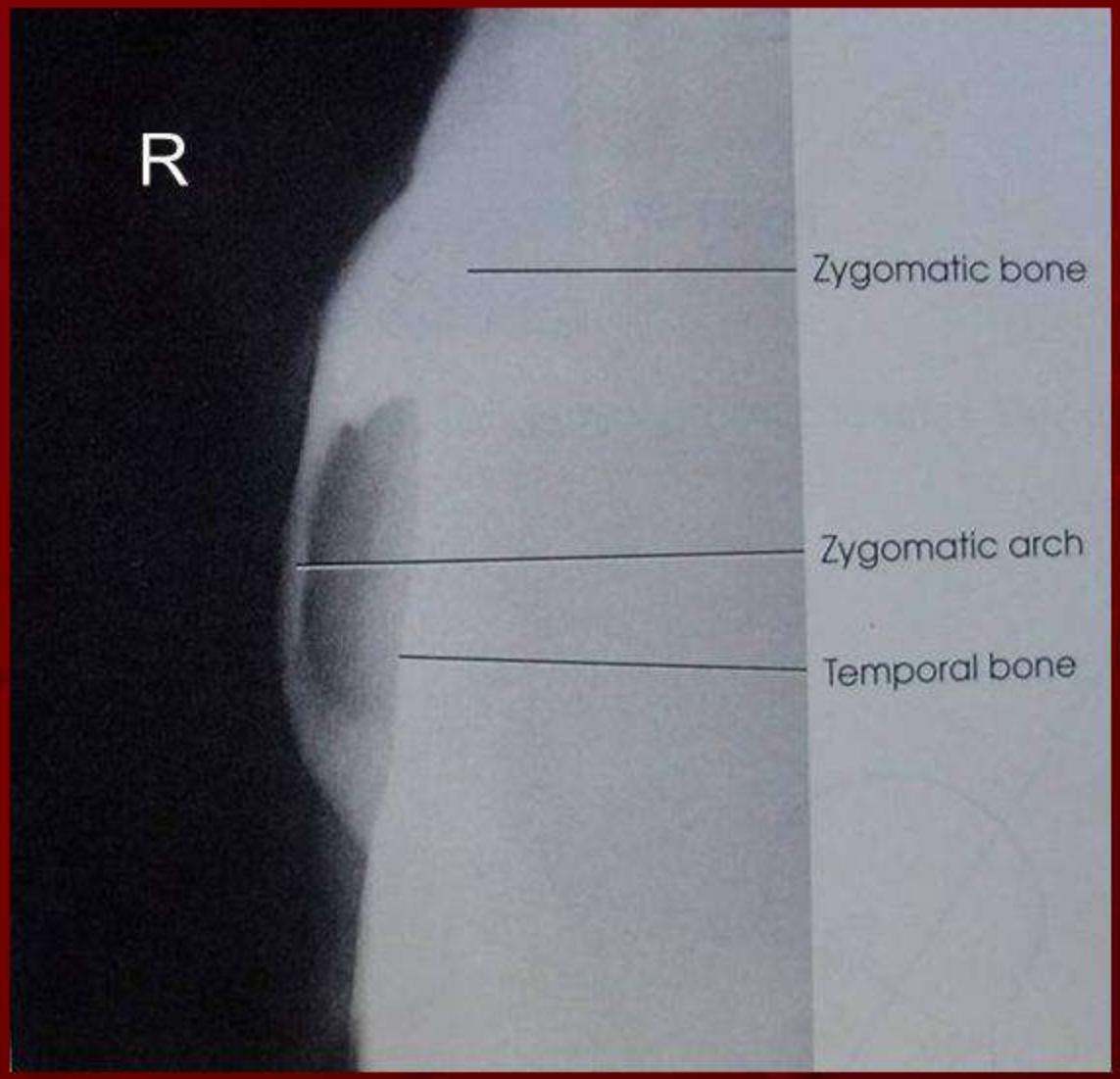
- The patient lies supine, with one or two pillows under the shoulders to allow the neck to be extended fully.
- A cassette is placed against the vertex of the skull, such that its long axis is parallel with the axial plane of the body. It should be supported in this position with foam pads and sandbags.
- The flexion of the neck is now adjusted to bring the long axis of the zygomatic arch parallel to the cassette.
- The head in now tilted 5 to 15 degrees toward the side under examination. This allows the zygomatic arch under examination to be projected on to the film without superimposition of the skull vault or facial bones.

Direction and centring of the X-ray beam

- The central ray should be perpendicular to the cassette and long axis of the zygomatic arch.
- A centring point should be located such that the central ray passes through the space between the midpoint of the zygomatic arch and the lateral border of the facial bones.
- Tight collimation can be applied to reduce scatter and to avoid irradiating the eyes.




Basic
• SMV
• Obl. inferosuperior
Oblique Inferosuperior (Tangential)
• IOML parallel to film
• CR perp. to film and IOML
• CR to arch of interest
• Rotate and tilt skull 15° toward affected side
Copyright ©2001 Mosby, Inc.



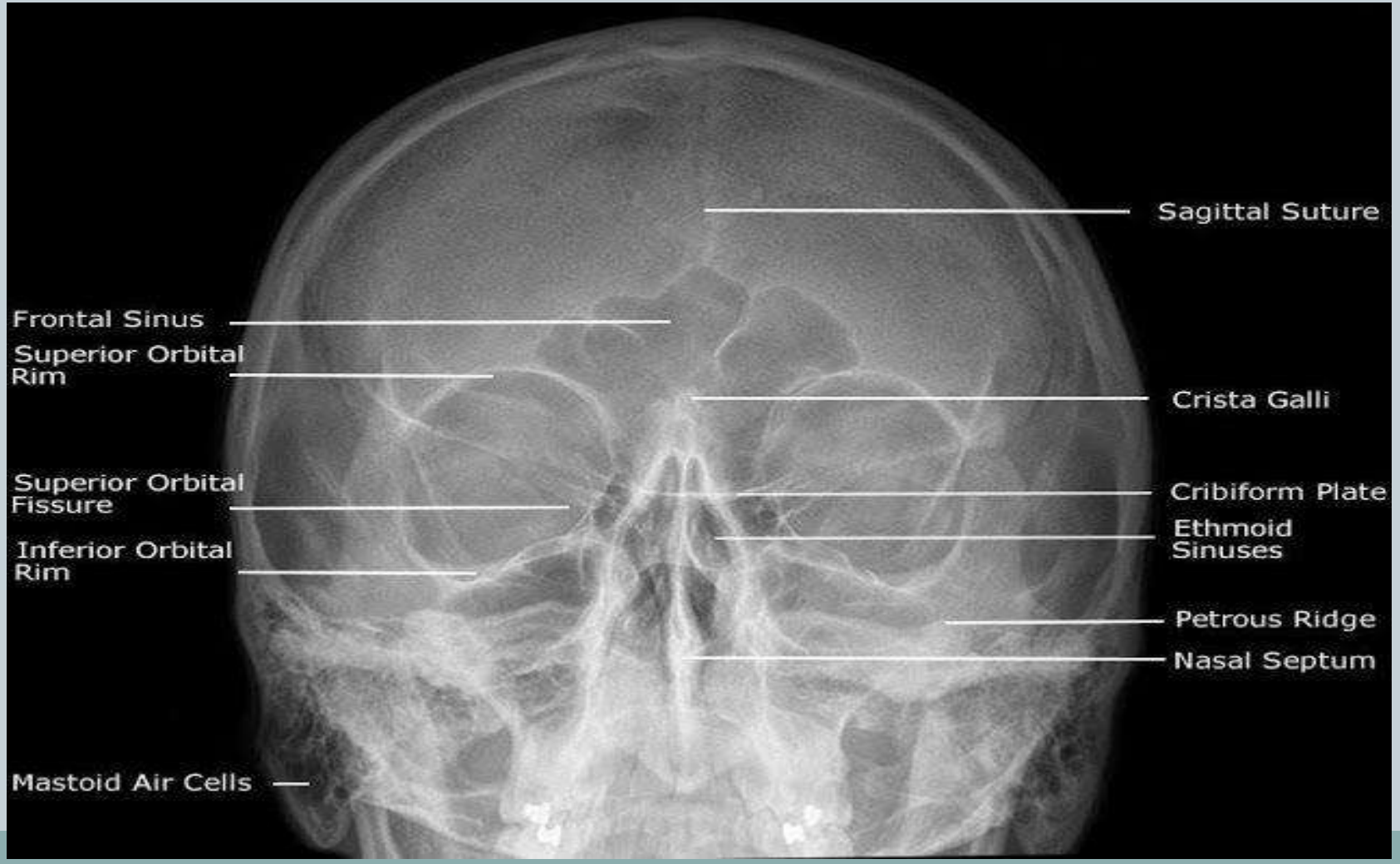
Single

Zygomatic Arch –

tangential

projection

Orbits


Sagittal Suture
Frontal Sinus
Superior Orbital Rim
Crista Galli
Superior Orbital Fissure
Cribiform Plate
Ethmoid Sinuses
Inferior Orbital Rim
Petrous Ridge
Nasal Septum
Mastoid Air Cells

Occipito-mental (modified)

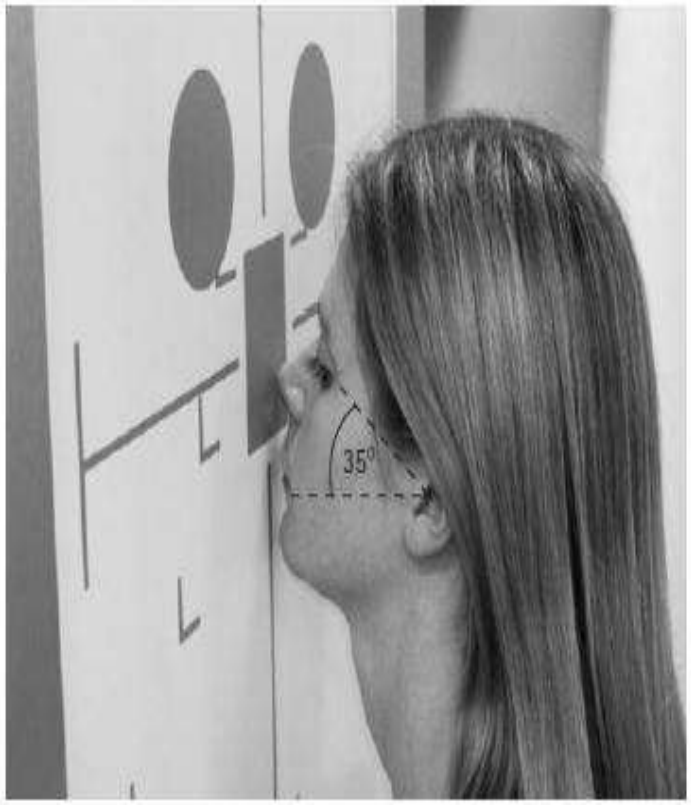
CLINICAL INDICATION

-THIS IS A FREQUENTLY USED TO ASSESS INJURIES TO THE ORBITAL REGION (E.G. BLOW-OUT FRACTURE OF THE ORBITAL FLOOR)

-TO EXCLUDE THE PRESENCE OF METALLIC FOREIGN BODIES IN THE EYES

Position of patient and cassette

- The projection is best performed with the patient seated facing the skull unit cassette holder or vertical Bucky.
- The patient's nose and chin are placed in contact with the midline of the cassette holder. The head is then adjusted to bring the orbito-meatal baseline to a 35-degree angle to the cassette holder.
- The horizontal central line of the vertical Bucky or cassette holder should be at the level of the midpoint of the orbits.



Direction and centering of the X-ray beam

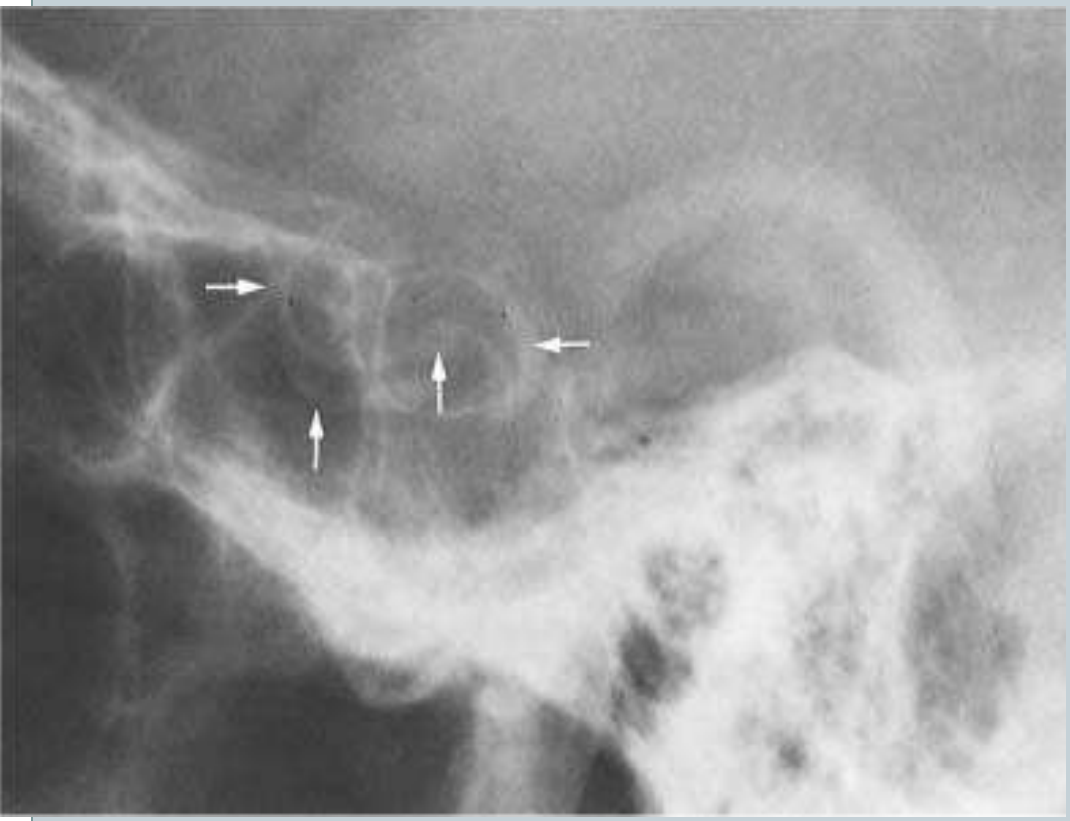
• The central ray of the skull unit should be perpendicular to the cassette holder and will be centred to the middle of the image receptor. If the above positioning is performed accurately, then the beam will already be centred.

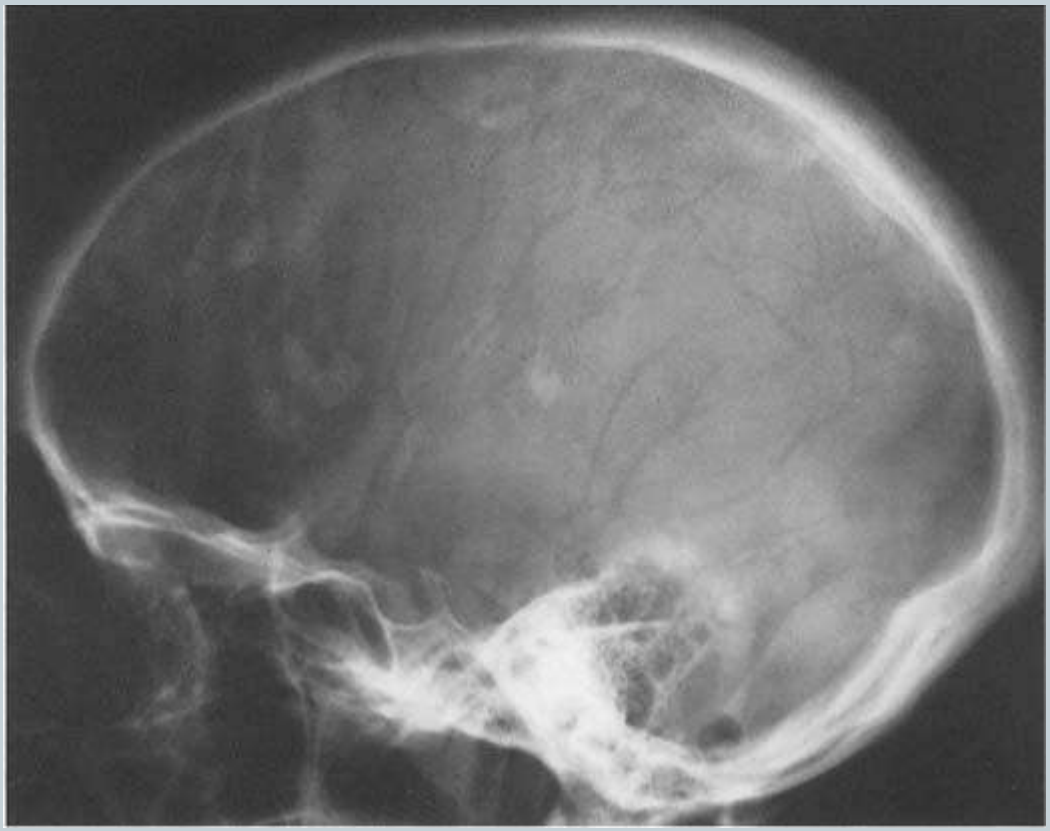
Cases for skull and facial bones

Main skull pathology, image interpretation of special cases

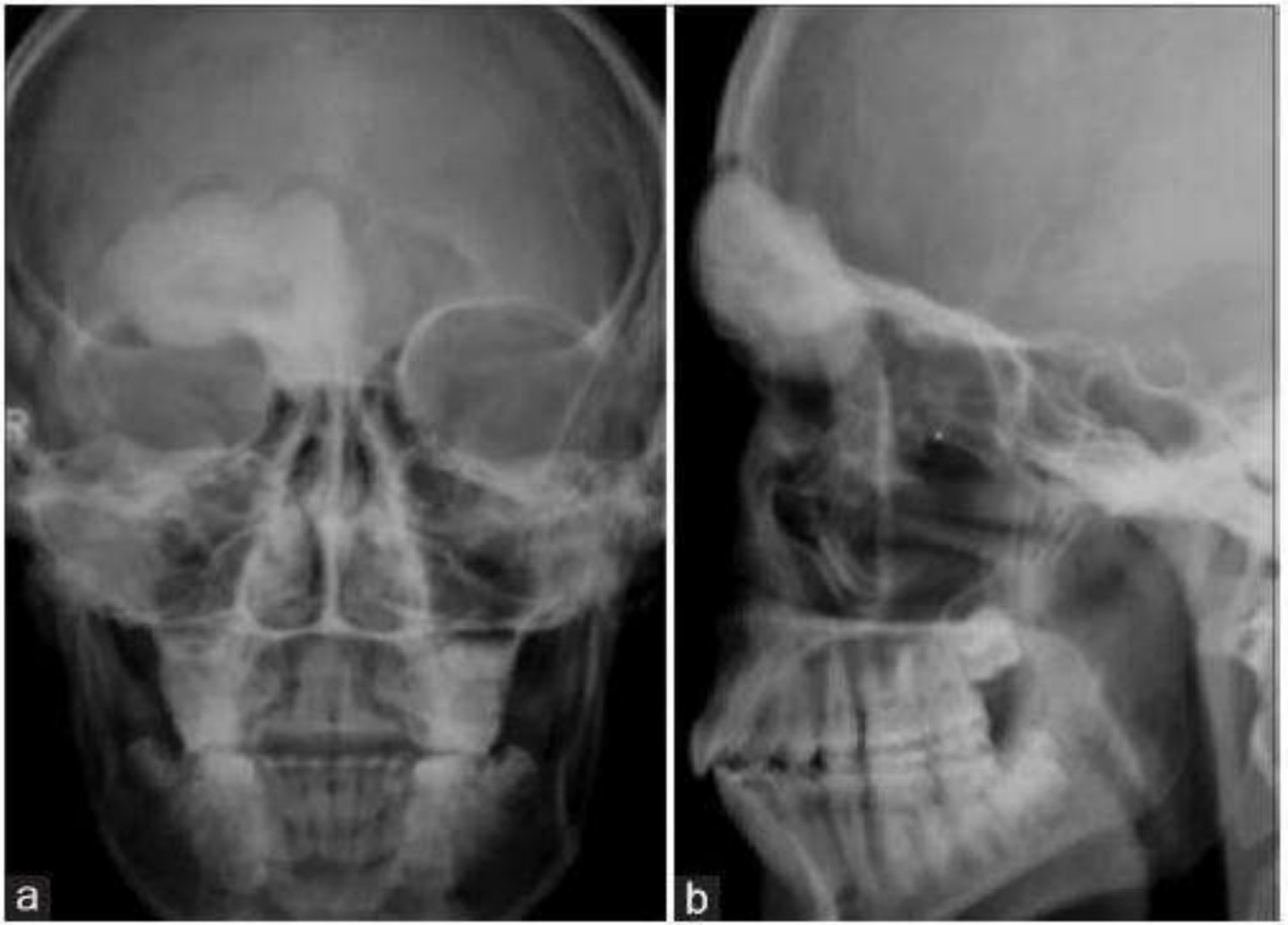
Normal intracranial calcifications

1. Pineal body.
2. Choroid plexuses
3. Dura (falx) , Ligaments
4. Basal ganglia and dentate nuclei
5. Pituitary gland
6. Lens
7. Internal carotid artery (cavernous portion)





Osteoma of the right frontal sinus



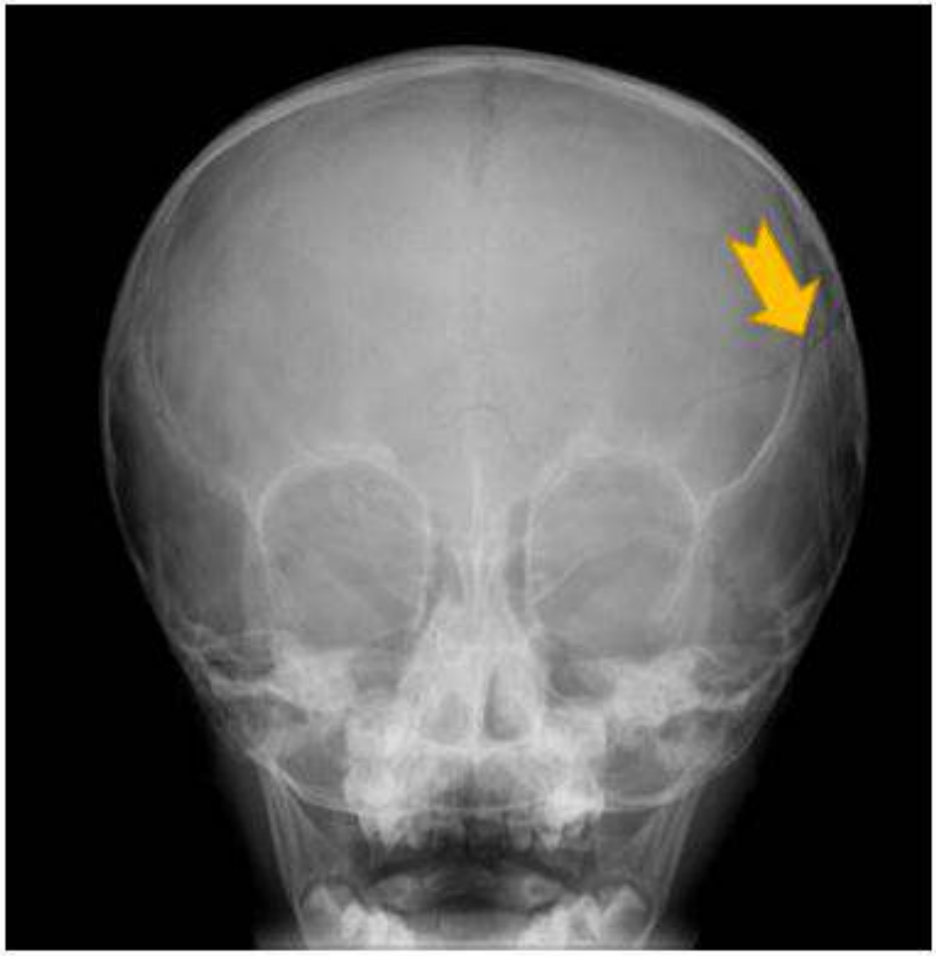
Skull fractures : linear and depressed

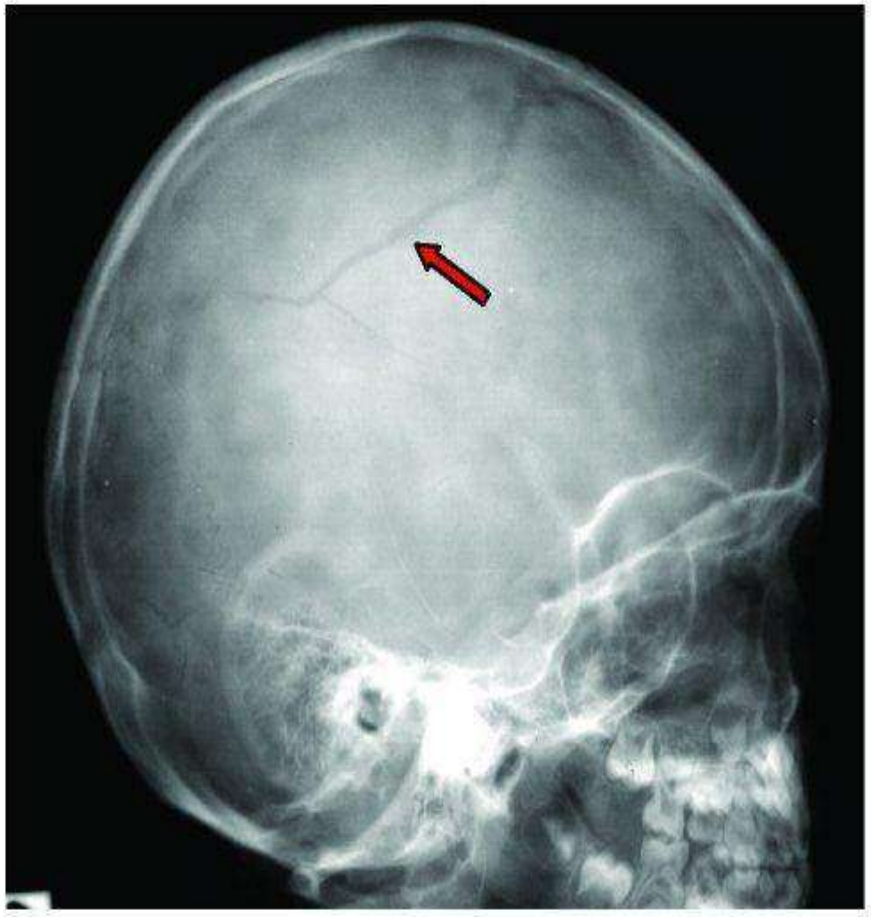
Linear skull fracture

Linear skull fracture

Linear skull fracture vs suture line (on Xray)		
Feature	Linear skull fracture	Suture line
Density	Dark black	Grey
Course	Straight	Follows course of suture line
Branching	None	Joins other suture line
Width	Very thin	Jagged, wide

Linear skull fracture



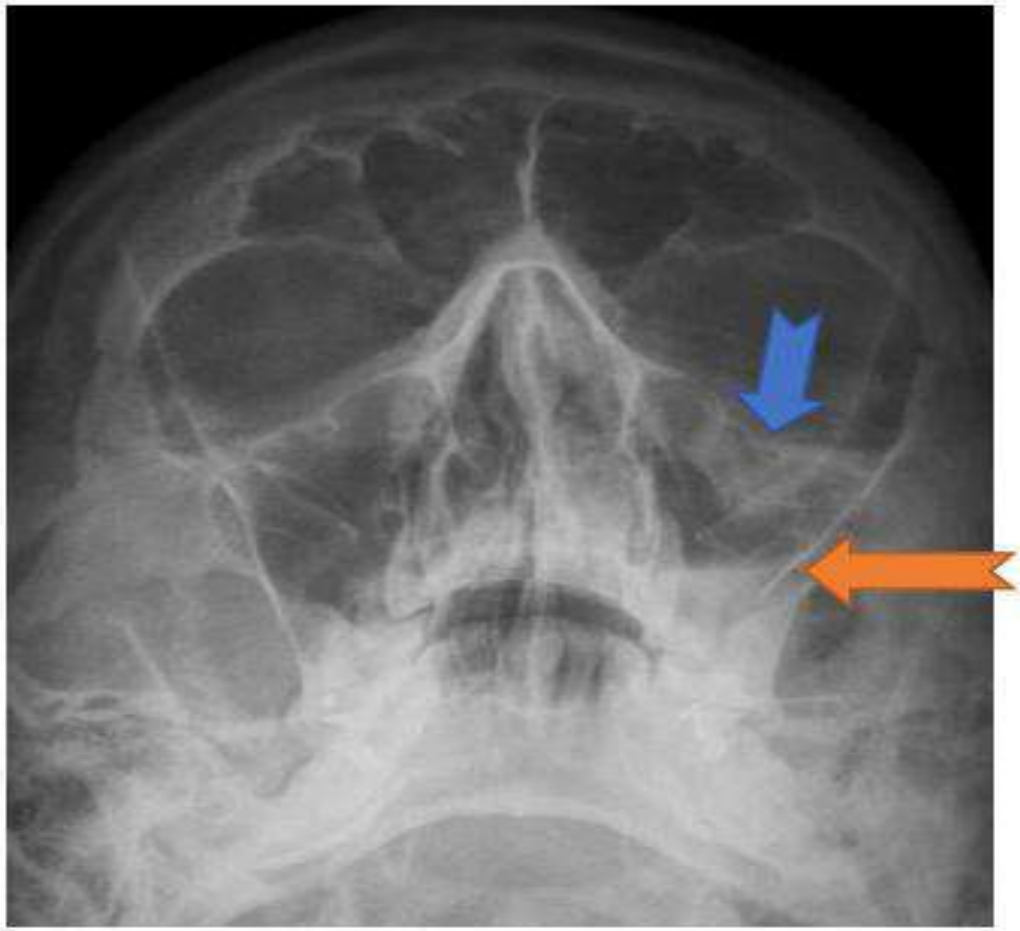


Skull X-ray showing a multiple linear, depressed skull fractures of the vertex

Skull X-ray showing a depressed skull fracture of frontal bone

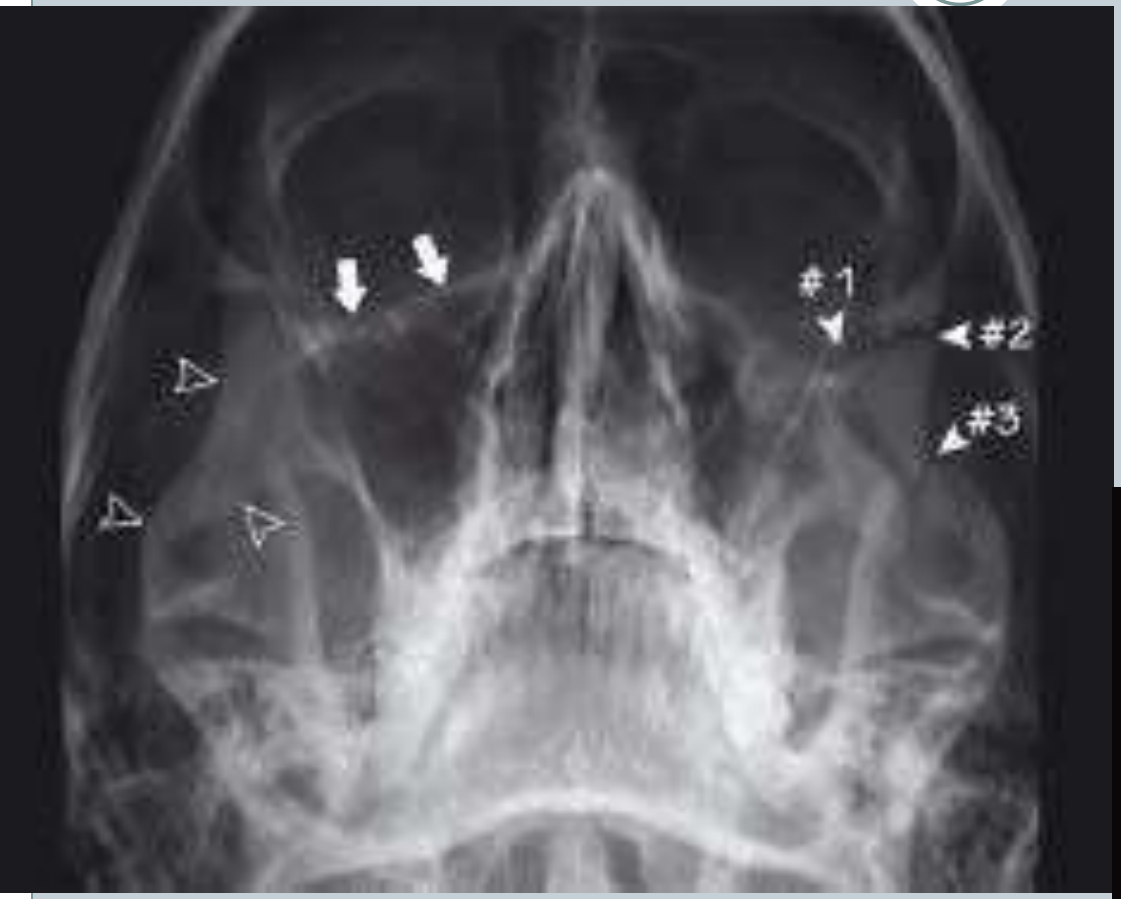
Blow out fracture of the left orbital floor **OM view**

- Air fluid level of left maxillary sinus

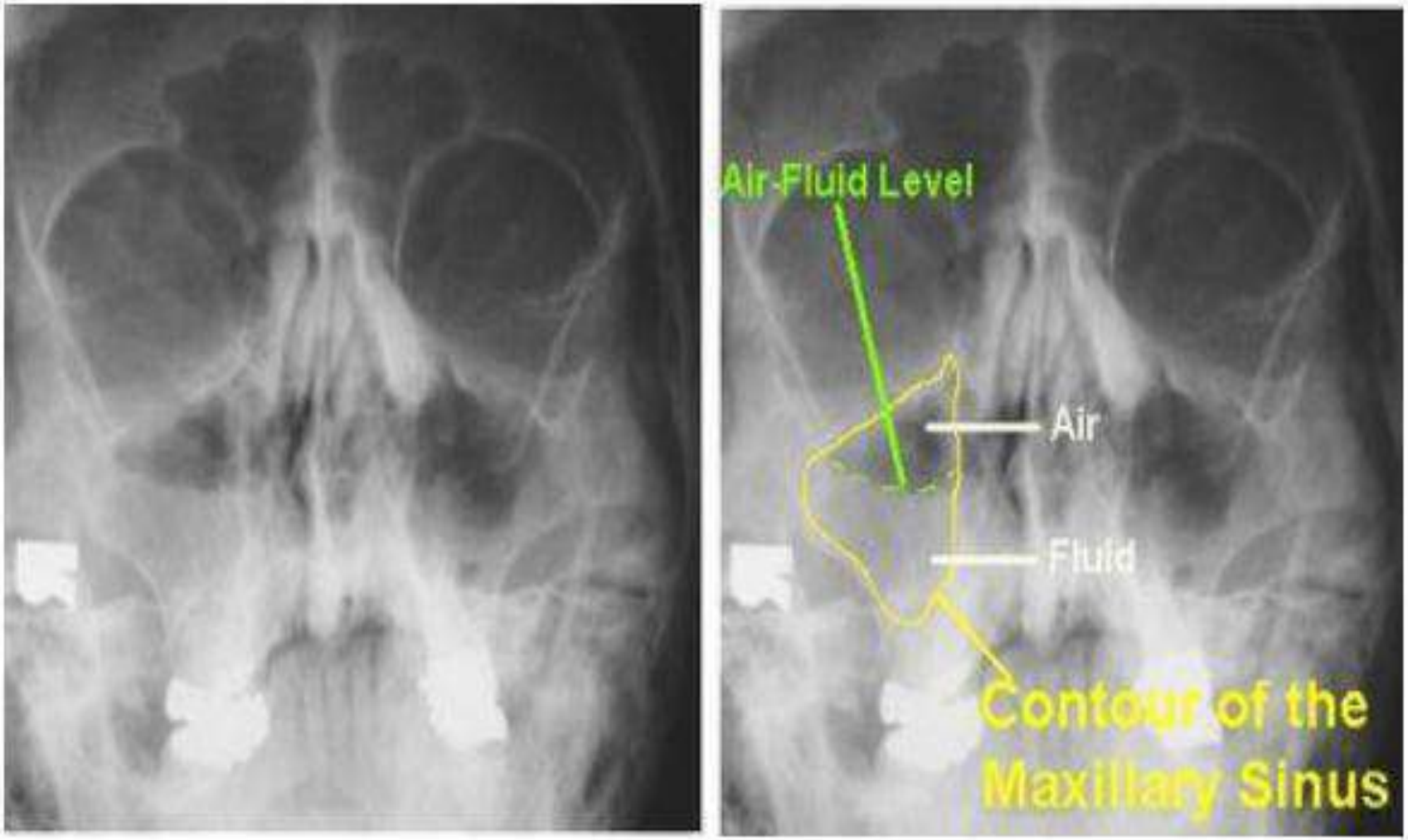


Zygomatic arch demonstrating double fracture

Tripod fracture: OM view There are fractures of the LT maxillary bone including floor and lateral wall of the orbit , zygomatic arch.



Mandible fracture: PA mandible view


Air-Fluid Level
Air
Fluid
Contour of the
Maxillary Sinus

Bilateral maxillary sinusitis

Multiple lucent areas of different sizes
Multiple myeloma Vs metastasis

Thalassemia

Thickening of the skull vault with hair on end appearance

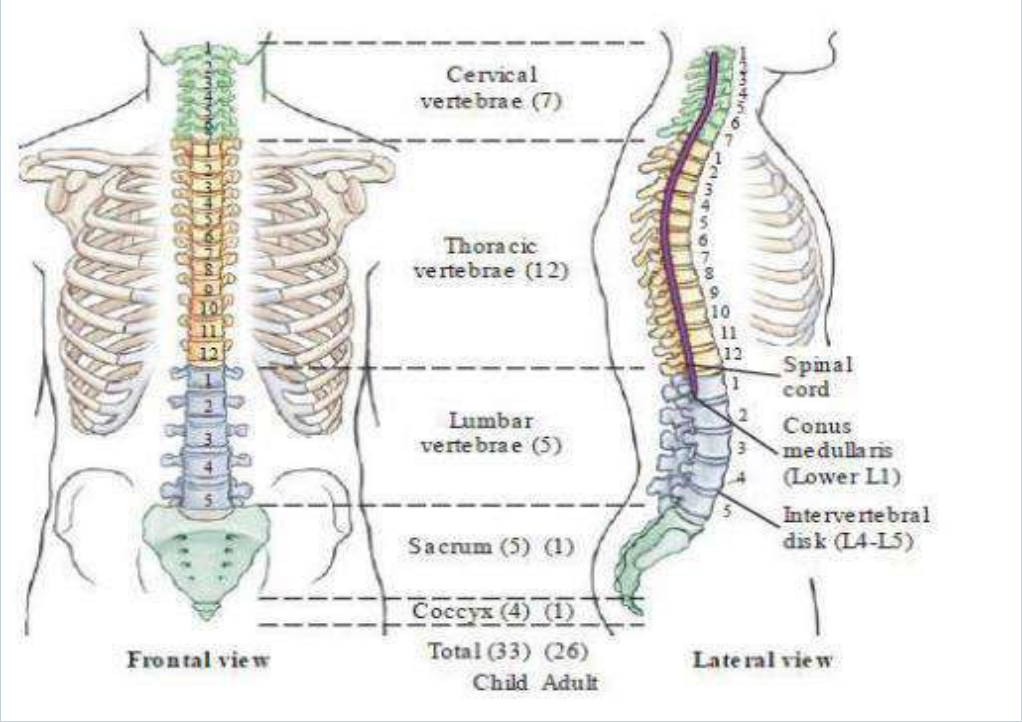
Pituitary adenoma
Ballooning of the sella

VERTEBRAL COLUMN

The vertebral column is divided into five areas in each of these areas the vertebrae have distinctive characteristics.

These areas are

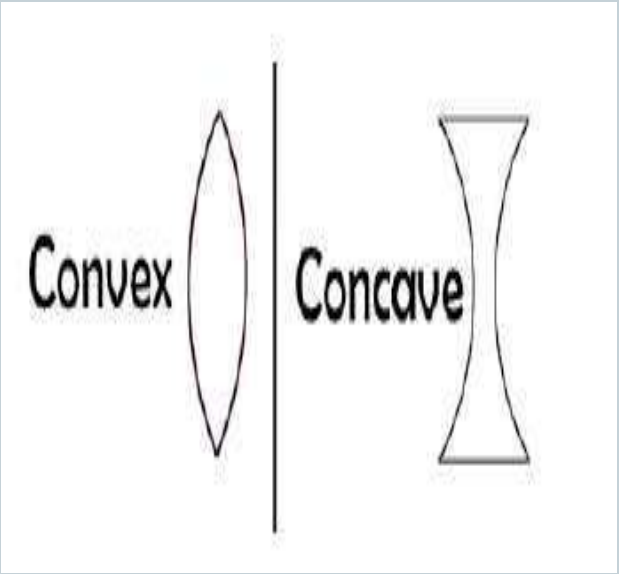
- ☐ ***Cervical***
- ☐ ***thoracic***
- ☐ ***lumbar***
- ☐ ***Sacrum***
- ☐ ***Coccyx***

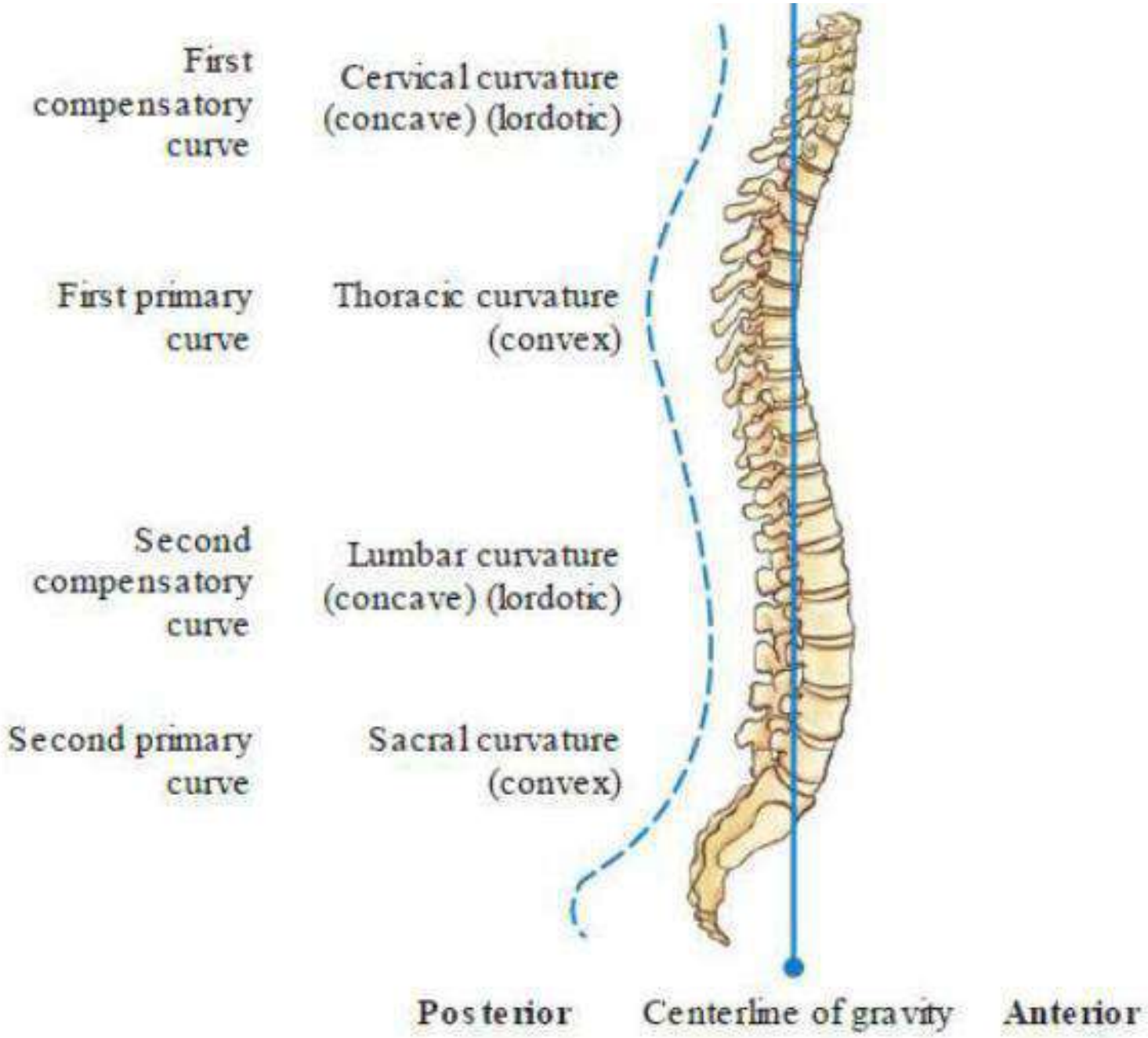


Vertebral curves

The cervical and lumbar regions have concave curvatures and are described as ***Lordotic.***

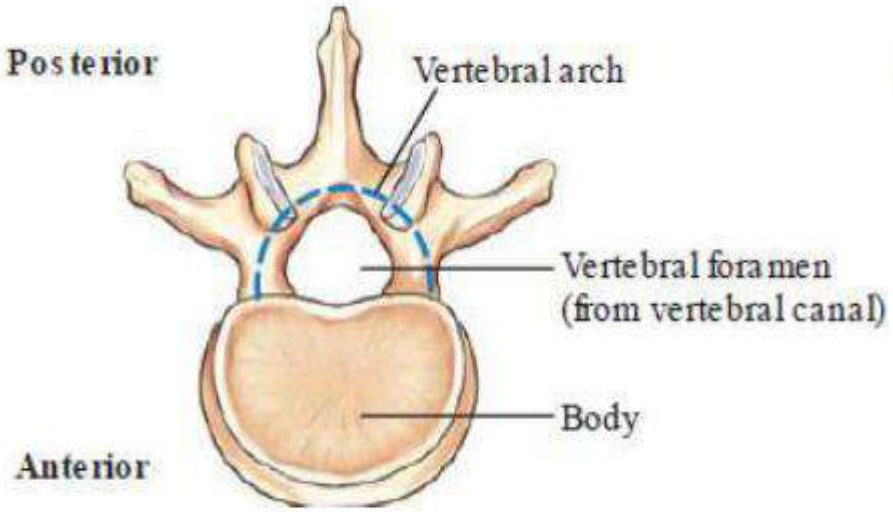
The thoracic and sacral regions have convex curvatures ***kyphotic..***

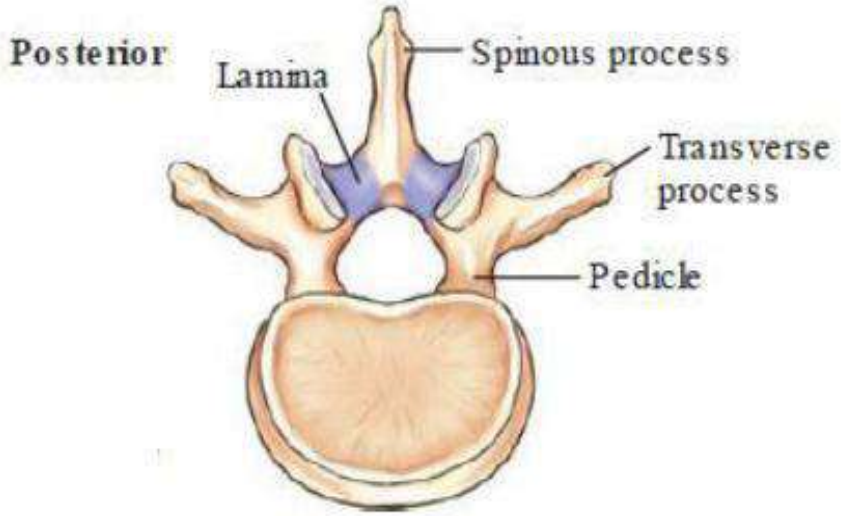


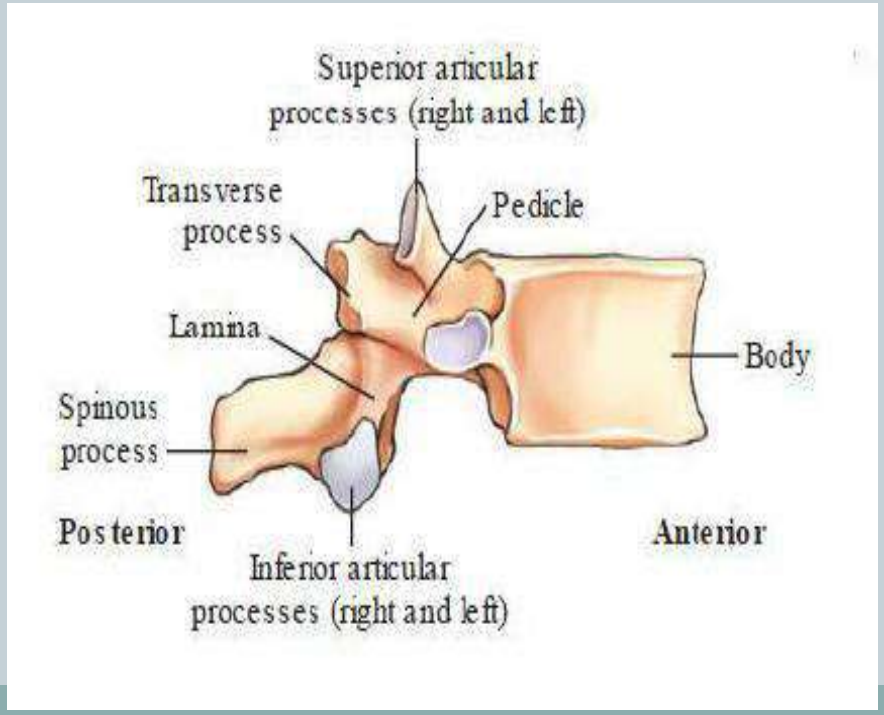

First compensatory curve
Cervical curvature (concave) (lordotic)
First primary curve
Thoracic curvature (convex)
Second compensatory curve
Lumbar curvature (concave) (lordotic)
Second primary curve
Sacral curvature (convex)
Posterior
Centerline of gravity
Anterior

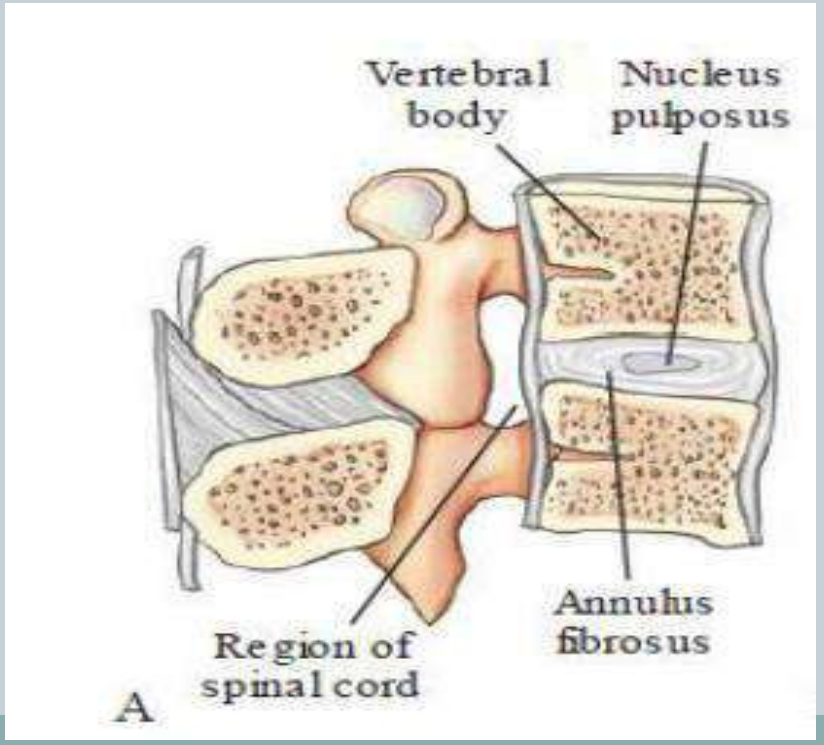
Important considerations in spinal radiography

- Ideally, the vertebral bodies will not be superimposed over one another and will be separated on the image.
- Disc spaces should be demonstrated clearly, without superimposition of vertebral bodies.
- The curves are variable along the area of interest, thus making it impossible to achieve separation of individual vertebra .In this instance, it may be worth considering individual exposures, with the beam angled to achieve the required degree of separation.


Posterior
Vertebral arch
Vertebral foramen
(from vertebral canal)
Body
Anterior

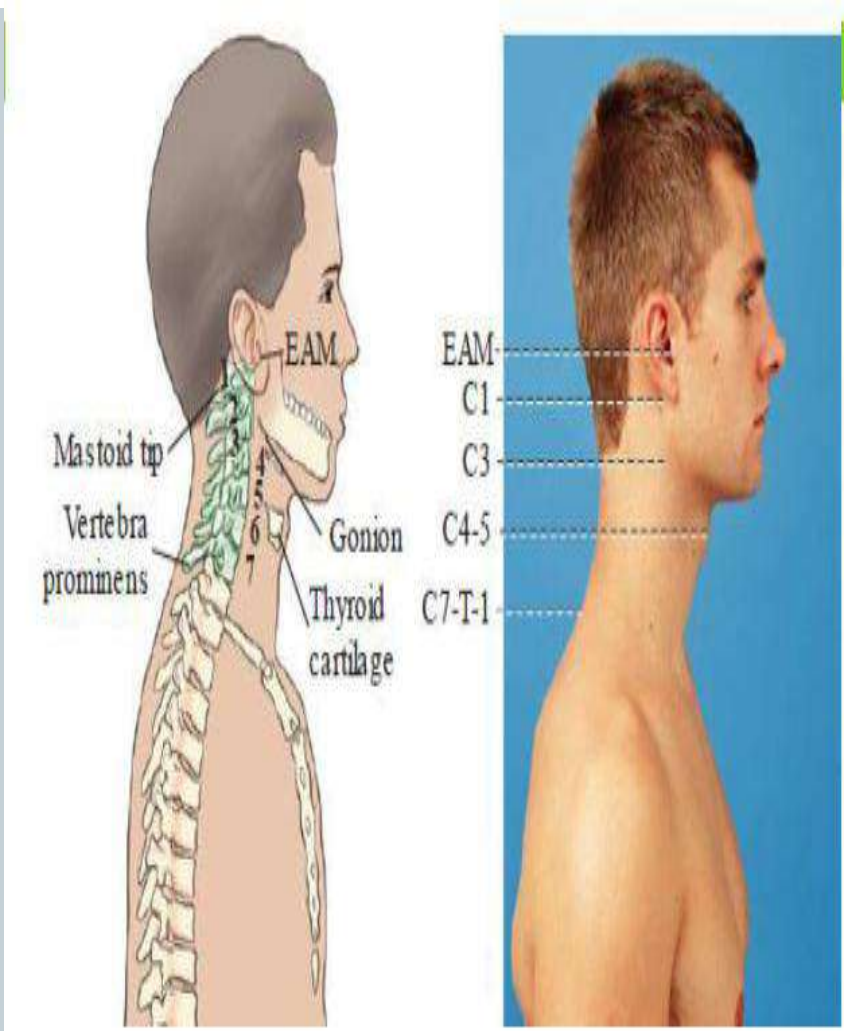

Posterior
Lamina
Spinous process
Transverse
process
Pedicle


Superior articular
processes (right and left)
Transverse
process
Pedicle
Lamina
Body
Spinous
process
Posterior
Anterior
Inferior articular
processes (right and left)


Vertebral
body
Nucleus
pulposus
Region of
spinal cord
Annulus
fibrosus
A

Useful landmarks

- The easily palpated tip of the mastoid process indicates the level of C1.
- The spinous process of C7 produces a visible protuberance on the posterior aspect of the inferior part of the neck. Below this, the spinous process of the thoracic spine can be palpated.
- The inferior angle of the scapula indicates the level of T7 when the arms are placed by the side.
- The sternal notch lies at the junction between T2 and T3.
- T4 is indicated by the sternal angle with T9 corresponding to the xiphisternal joint, although the size of this structure is variable.



• The lower costal margin indicates L3 and is located easily.

This is a very useful aid to positioning in spinal radiography.

• A line joining the most superior parts of the iliac crests indicates the level of L4, whilst the tubercle of the iliac crest discloses the location of L5.

• The anterior and posterior iliac spines lie at the level of the second sacral vertebra.

• The coccyx can be palpated between the buttocks and lies at the level of the symphysis pubis

Cervical spine

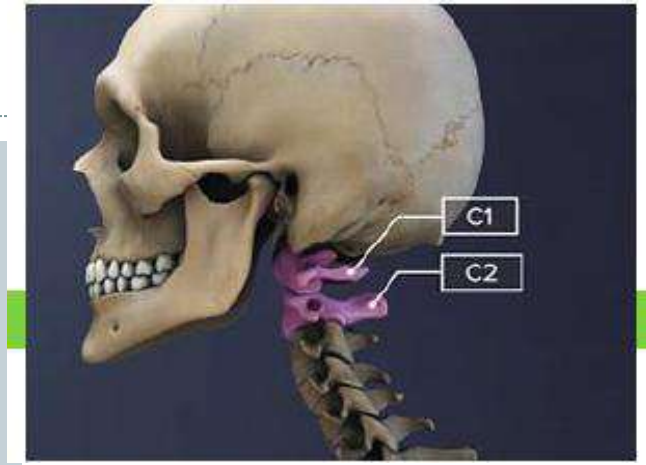
C1 (the atlas)

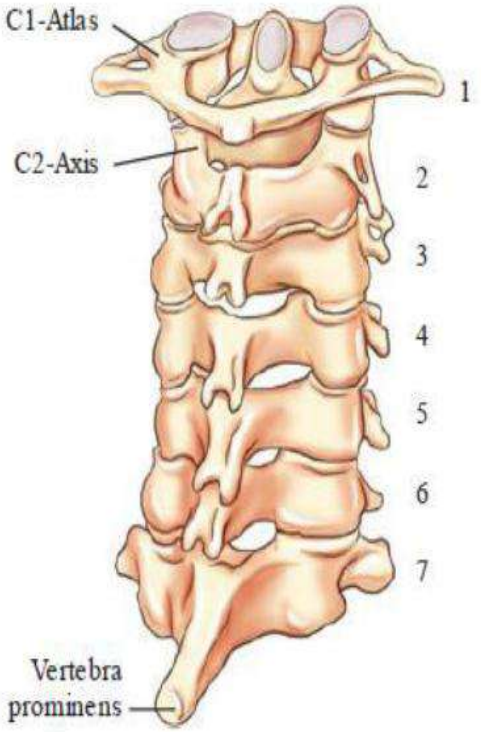
C2 (the axis) are different

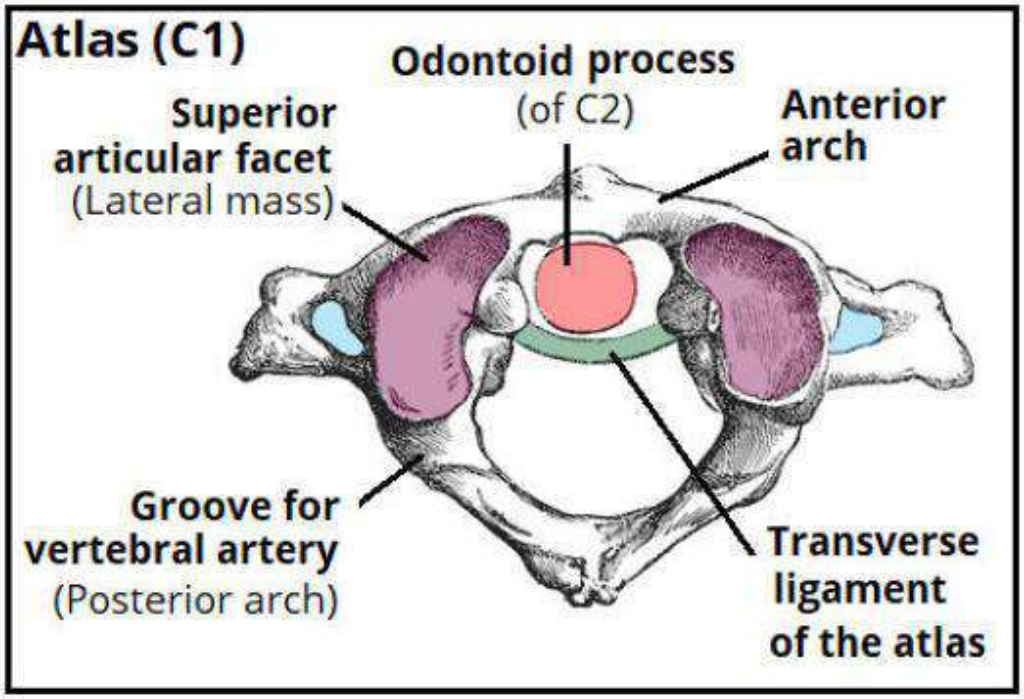
The C3-C6 are typical cervical vertebrae.

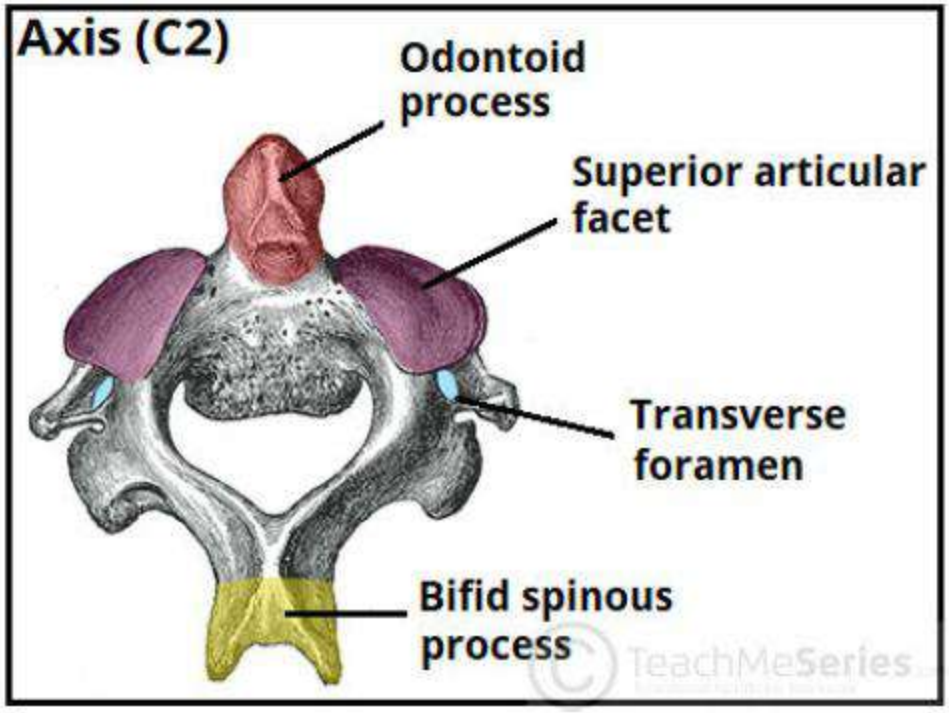
The C7 has many features of thoracic vertebrae.

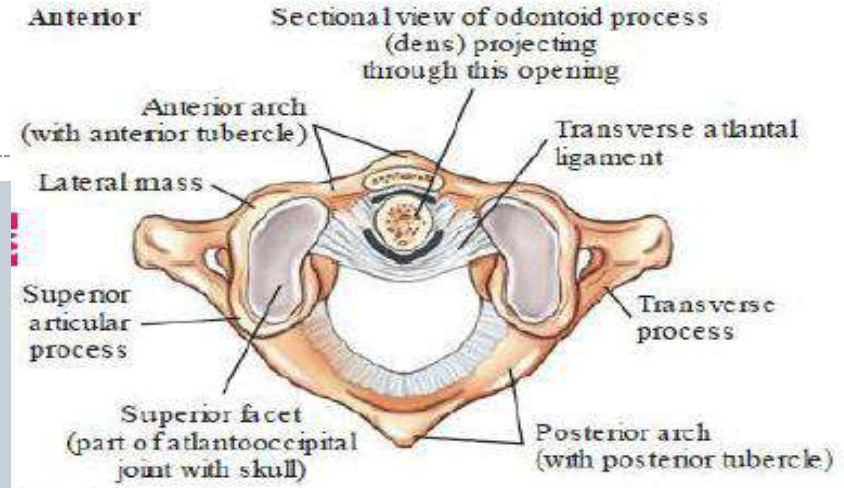
(***extra long and more horizontal spinous process)***






Atlas (C1)
Odontoid process
(of C2)
Superior
articular facet
(Lateral mass)
Anterior
arch
Groove for
vertebral artery
(Posterior arch)
Transverse
ligament
of the atlas


Axis (C2)
Odontoid
process
Superior articular
facet
Transverse
foramen
Bifid spinous
process



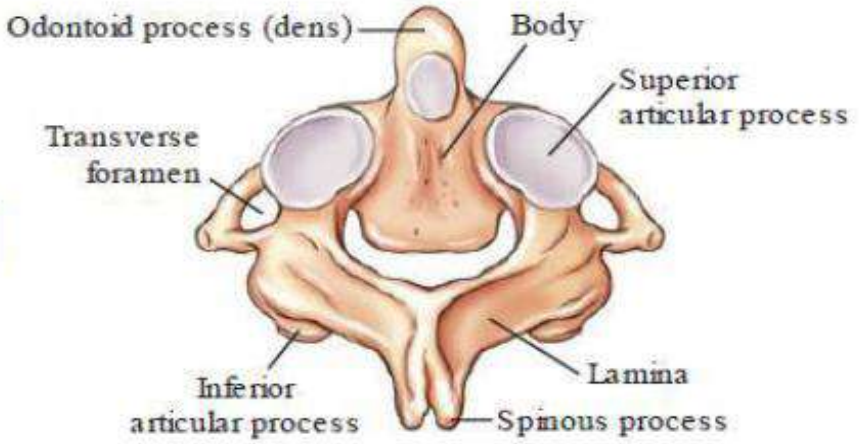


Fig. 8.15 Atlas (C1)—superior view.

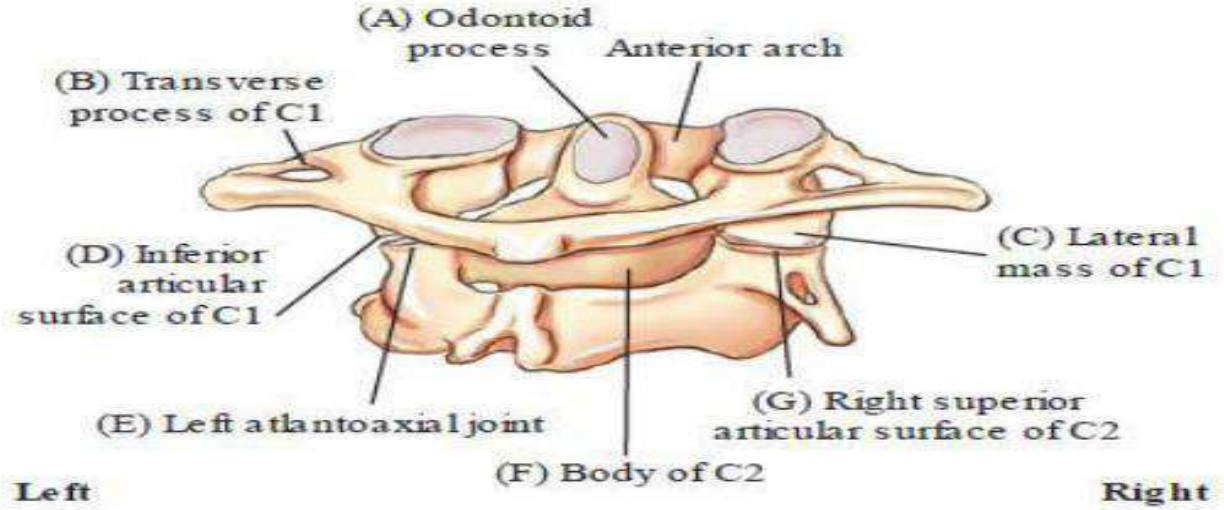


Fig. 8.17 C1 and C2—posterior oblique view.

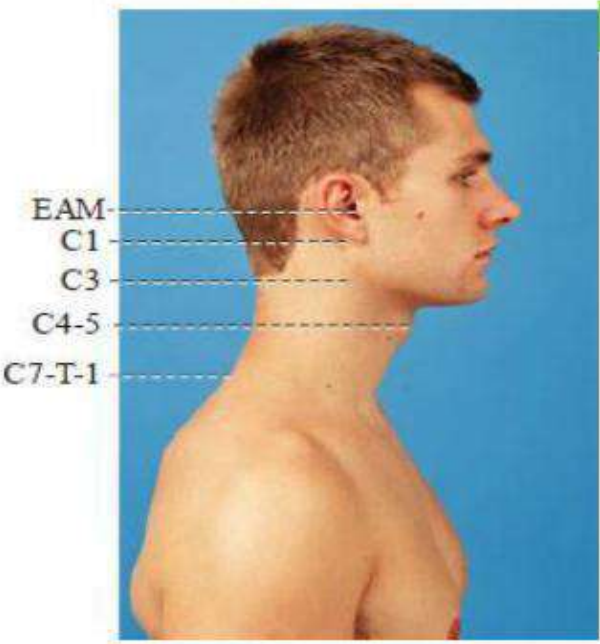
Cervical landmarks

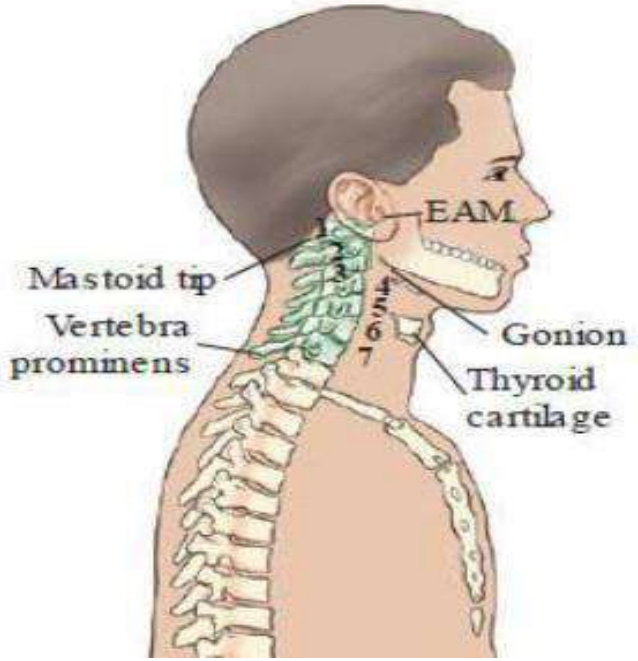
1/ The mastoid process corresponds to the level of C1. (2.5 cm) below the level EAM.

2/ the angle of the jaw, or gonion, is at the same level as C3.

3/ The most prominent part of the thyroid cartilage, or Adam's apple, is at the approximate level of C4-5.

4/ The spinous process of the last cervical vertebra, C7 vertebra prominence, is at about the same level as the body of T1





Basic projections

Many centers perform

Antero-posterior and a **lateral projection**,

with the addition of a further image to demonstrate the **AP C1/2** region if the patient has a history of trauma.

Antero-posterior 3rd to 7th vertebrae

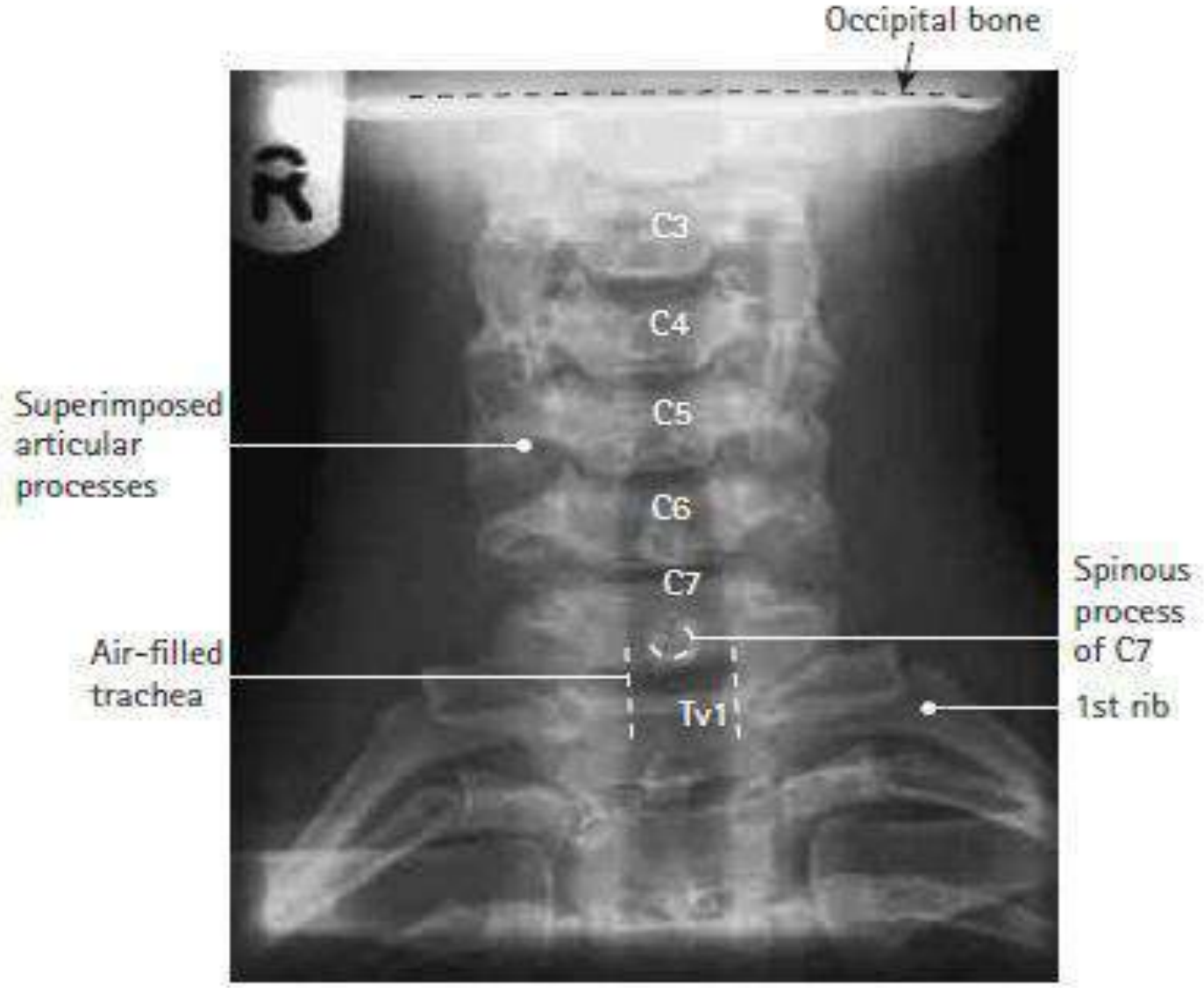
Position of patient and cassette

- The patient lies supine on the Bucky table or, if erect positioning is preferred, sits or stands with the posterior aspect of the head and shoulders against the vertical Bucky.
- The median sagittal plane is adjusted to be at right-angles to the cassette and to coincide with the midline of the table or Bucky.
- The neck is extended (if the patient's condition will allow) so that the lower part of the jaw is cleared from the upper cervical vertebra.
- The cassette is positioned in the Bucky to coincide with the central ray.

Direction and centering of the X-ray beam

• A 5–15-degree cranial angulation is employed, such that the inferior border of the symphysis menti is superimposed over the occipital bone.

• The beam is centered in the midline towards a point just below the prominence of the thyroid cartilage through the fifth cervical vertebra.


Occipital bone
C3
C4
C5
C6
C7
Tv1
Superimposed articular processes
Air-filled trachea
Spinous process of C7
1st rib

Lateral erect

Position of patient and cassette

- The patient stands or sits with either shoulder against the cassette.
- The median sagittal plane should be adjusted such that it is parallel with the cassette.
- The head should be flexed or extended such that the angle of the mandible is not superimposed over the upper anterior cervical vertebra or the occipital bone does not obscure the posterior arch of the atlas..

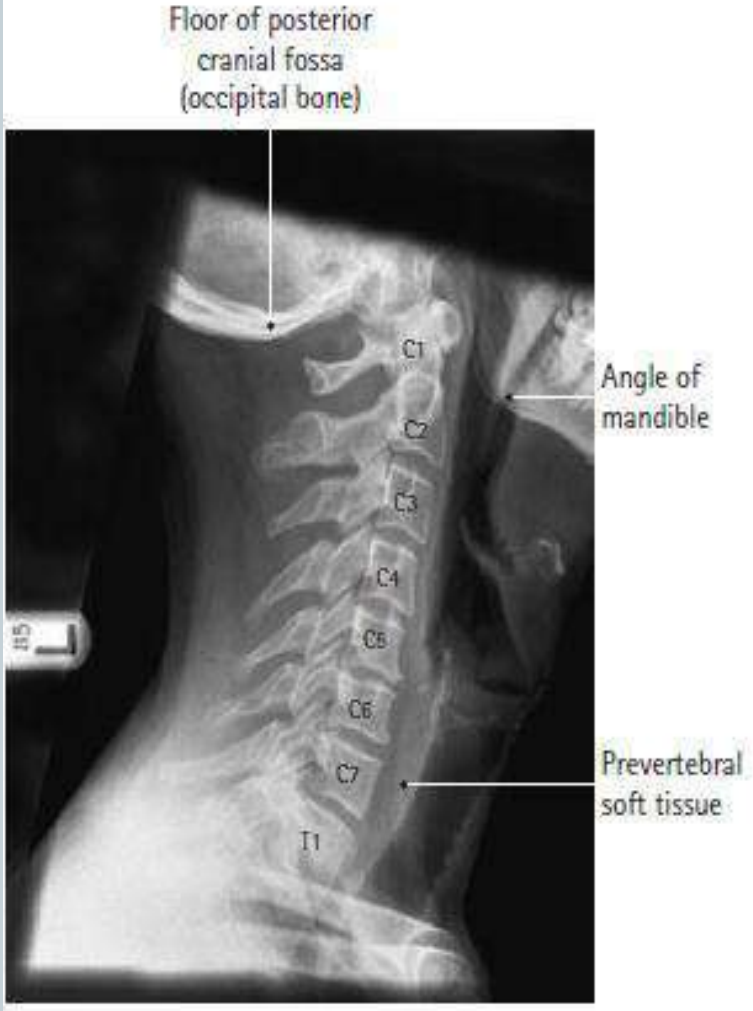
Shoulders depressed

• In order to demonstrate the lower cervical vertebra, the shoulders should be depressed, as shown in the photograph.

This can be achieved by asking the patient to relax their shoulders downwards. The process can be aided by asking the patient to hold a weight in each hand

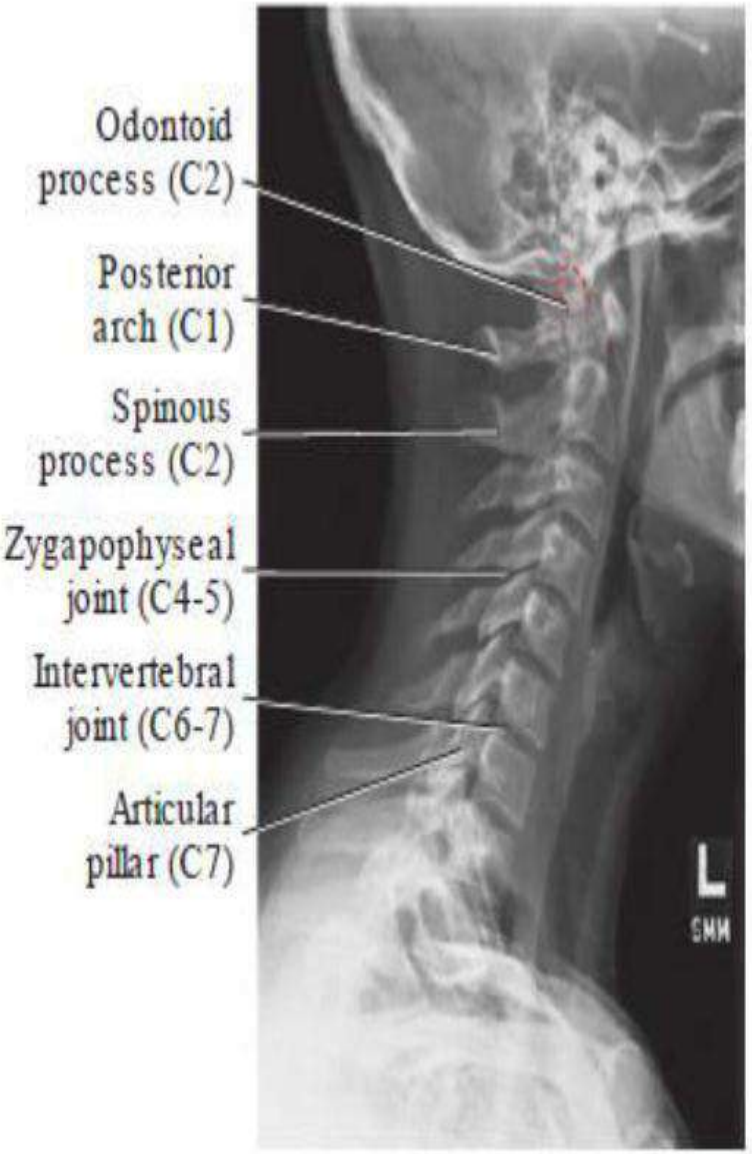
Direction and centering of the X-ray beam

• The horizontal central ray is centred to a point vertically below the mastoid process at the level of the prominence of the thyroid cartilage.



Essential image characteristics

- The whole of the cervical spine should be included, from the atlanto-occipital joints to the top of the first thoracic vertebra.
- The mandible or occipital bone does not obscure any part of the upper vertebra.
- Angles of the mandible and the lateral portions of the floor of the posterior cranial fossa should be superimposed.



Lateral supine

For trauma cases, the patient's condition usually requires the examination to be performed on a casualty trolley.

The lateral cervical spine projection is taken first, without moving the patient.

Position of patient and cassette

- The patient will normally arrive in the supine position.
- It is vitally important for the patient to depress the shoulders (assuming no other injuries to the arms).
- The cassette can be either supported vertically or placed in the erect cassette holder, with the top of the cassette at the same level as the top of the ear.

Positioning for lateral supine projection

Antero-posterior – first and second cervical vertebrae (open mouth)

Clinical indications

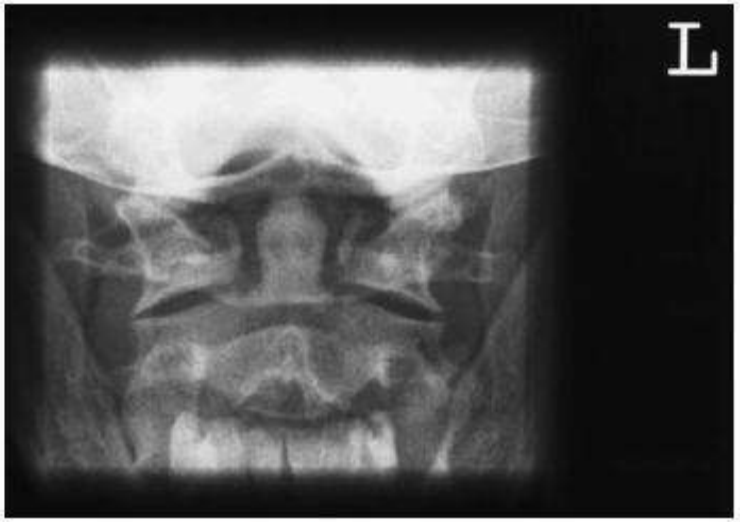
1. C1 and C2 fractures
2. To demonstrate the odontoid process (dense)

Position of patient and cassette

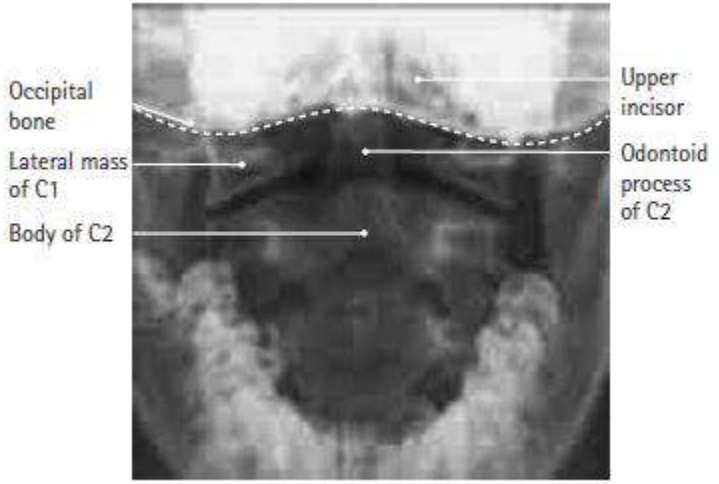
- The patient lies supine on the Bucky table or, if erect positioning is preferred, sits or stands with the posterior aspect of the head and shoulders against the vertical Bucky.
- The medial sagittal plane is adjusted to coincide with the midline of the cassette, such that it is at right-angles to the cassette.
- The neck is extended, if possible, such that a line joining the tip of the mastoid process and the inferior border of the upper incisors is at right-angles to the cassette. This will superimpose the upper incisors and the occipital bone, thus allowing clear visualization of the area of interest.
- The cassette is centered at the level of the mastoid process.

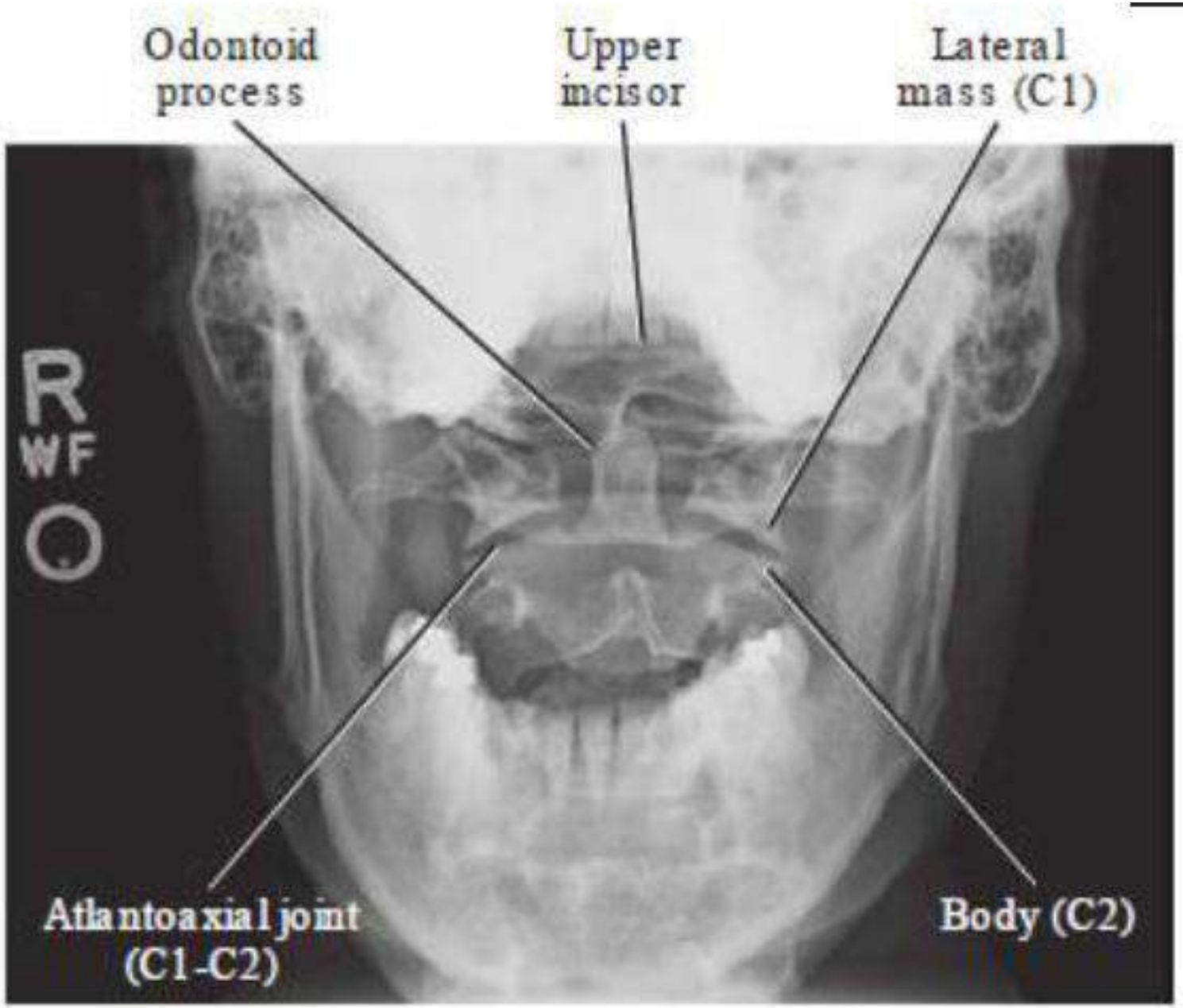
Direction and centering of the X-ray beam

- Direct the perpendicular central ray along the midline to the centre of the open mouth.
- If the patient is unable to flex the neck and attain the position described above, then the beam must be angled, typically 5-10 degrees cranially or caudally, to superimpose the upper incisors on the occipital bone.
- The cassette position will have to be altered slightly to allow the image to be centred after beam angulation.



Example of correctly positioned radiograph




Odontoid process
Upper incisor
Lateral mass (C1)
R
WF
Atlantoaxial joint (C1-C2)
Body (C2)

Cervical spine projections

LATERAL – FLEXION AND EXTENSION

THESE PROJECTIONS MAY BE REQUIRED, BUT ONLY AT THE REQUEST OF A MEDICAL OFFICER, TO SUPPLEMENT THE BASIC PROJECTIONS

CLINICAL INDICATIONS

-TRAUMA, E.G. SUBLUXATION,

-PATHOLOGY, E.G. RHEUMATOID ARTHRITIS

-BEFORE SURGERY TO ASSESS MOVEMENT IN THE NECK FOR INSERTION OF AN ENDOTRACHEAL TUBE).

Position of patient and cassette

- The patient is positioned as for the lateral basic or lateral supine projections; The patient is asked to flex the neck and to tuck the chin in towards the chest as far as is possible.
- For the second projection, the patient is asked to extend the

neck by raising the chin as far as possible.

- If imaged supine, the neck can be flexed by placing pads under the neck.

Extension of the neck can be achieved by placing pillows under the patient's shoulders.

Direction and centering of the X-ray beam

- Direct the central ray horizontally towards the mid-cervical region (C4).

Right and left posterior oblique – erect

Oblique projections are requested mainly to supplement the basic projections.

Clinical indications

- in cases of trauma. The images demonstrate

the intervertebral foramina, the relationship of the facet joints in suspected dislocation or subluxation.

-with certain pathologies, such as degenerative disease.

Position of patient and cassette

The patient stands or sits with the posterior aspect of their head and shoulders against the vertical Bucky

- The median sagittal plane of the trunk is rotated through 45 degrees for right and left sides in turn.
- The head can be rotated so that the median sagittal plane of the head is parallel to the cassette, thus avoiding superimposition of the mandible on the vertebra.
- The cassette is centred at the prominence of the thyroid cartilage.

Direction and centring of the X-ray beam

- The beam is angled 15 degrees cranially from the horizontal and the central ray is directed to the middle of the neck on the side nearest the tube

Fig. 8.54 Right posterior oblique.

Fig. 8.55 Left posterior oblique.

RAO, LAO—are preferred because of reduced

thyroid doses.

Anterior Oblique (RAO,LAO)

Direct CR 15°caudad to **C4** ***(level of upper margin of thyroid cartilage)***

.

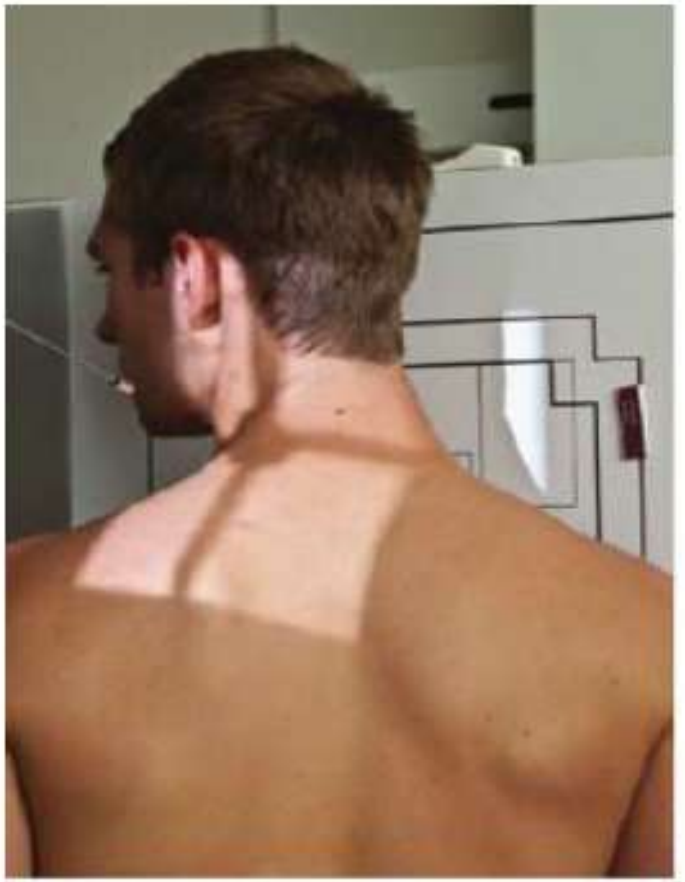


Fig. 8.52 Erect RAO position—CR 15° caudad (less thyroid dose).

Essential image characteristics

- The intervertebral foramina should be demonstrated clearly.
- C1 to T1 should be included within the image.
- The foraminae demonstrated on the posterior oblique are those

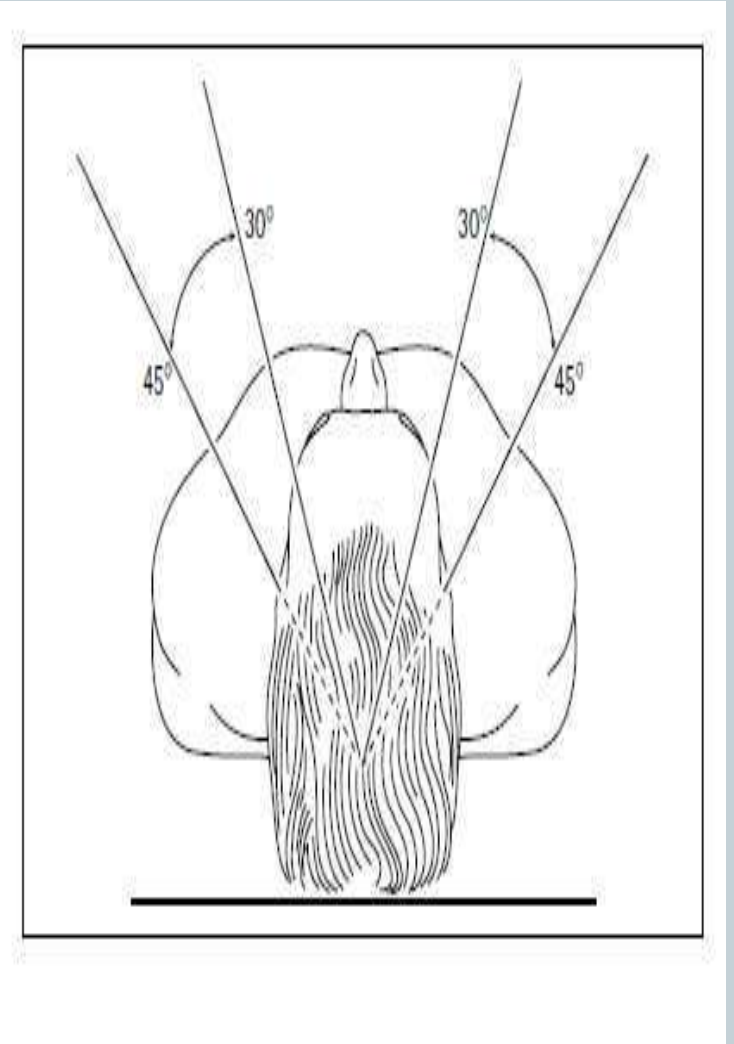
nearest the X-ray tube.

Right and left posterior oblique – supine

This positioning is often necessary in cases of severe injury.

Position of patient and cassette

- The patient remains in the supine position on the casualty trolley.
- To avoid moving the neck, the cassette should ideally be placed in the cassette tray underneath the trolley.
- If no cassette tray is available, then the cassette can be slid carefully into position without moving the patient's neck.



Direction and centering of the X-ray beam

- The beam is angled 30–45 degrees to the median sagittal plane(the degree of angulation will depend on local protocols).
- The central ray is directed towards the middle of the neck on the side nearest the tube at the level of the thyroid cartilage.

Cervico-thoracic vertebrae

Lateral swimmers' This is particularly important, if this area of the spine (Cervico-thoracic vertebrae) is suscepected to have injury.

Position of patient and cassette

- This projection is usually carried out with the patient supine on a trauma trolley.

The trolley is positioned adjacent to the

vertical Bucky, with the patient's median sagittal plane parallel with the cassette.

- The arm nearest the cassette is folded over the head, with the humerus as close to the trolley top as the patient can manage.

The arm and shoulder nearest the X-ray tube are depressed as far as possible.

- The shoulders are now separated vertically.
- The Bucky should be raised or lowered, such that the line of the vertebrae should coincide with the middle of the cassette.

- This projection can also be undertaken with the patient erect, either standing or sitting or supine.

Direction and centering of the X-ray beam

- The horizontal central ray is directed to the midline of the Bucky at a level just above the shoulder remote from the cassette.

MAIN CERVICAL SPINE FINDING , IMAGE INTERPRETATION OF CERVICAL FRACTURES

Cases review for cervical spine

د.احمد مذخر الغبشة

Quality

- The C7-T 1 vertebrae may be obscured in muscular or obese patients

- Shoulder depression is important to obtain high quality images and prevent overlapping structures.

Alignment

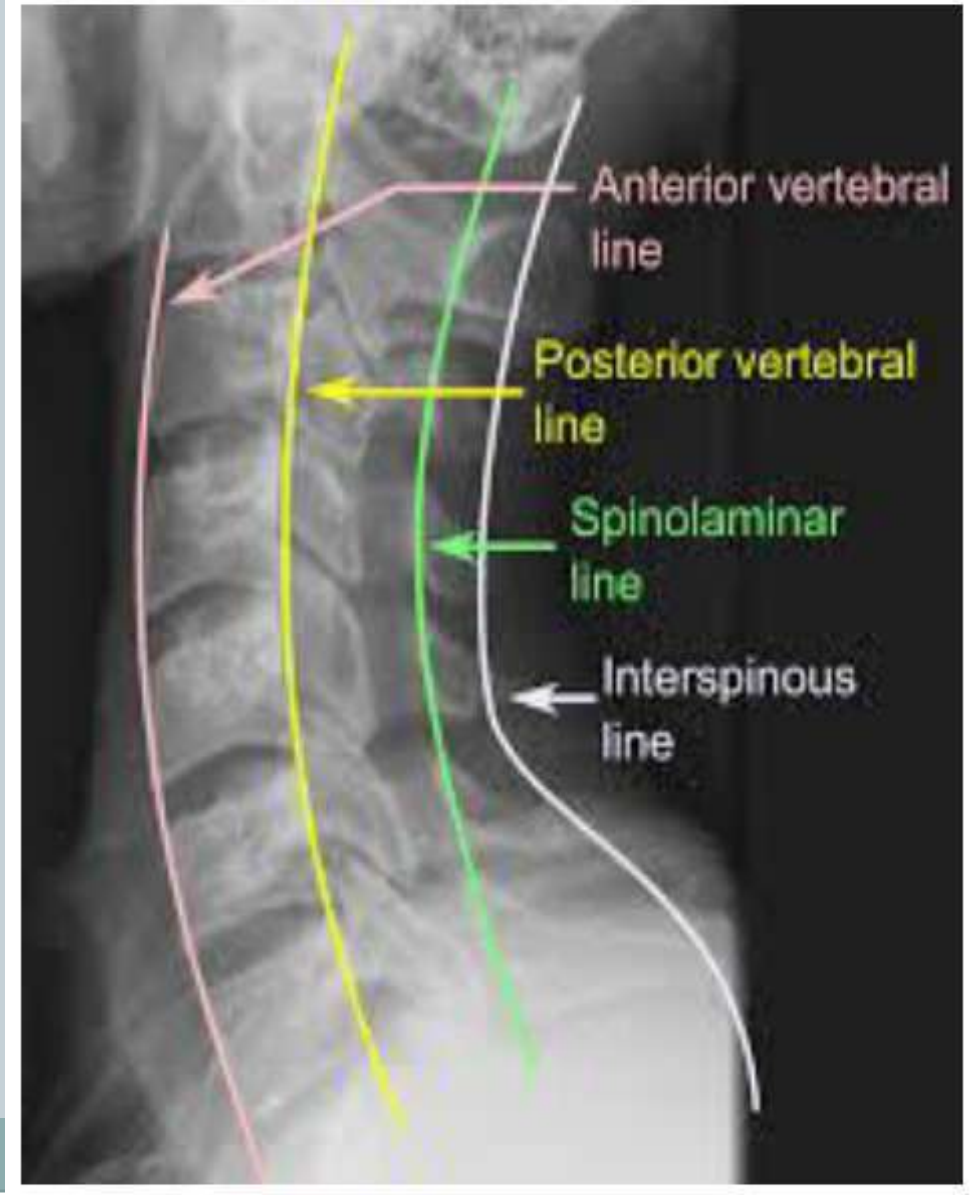
Assess 4 parallel lines for smoothness, no steps and no angulation:

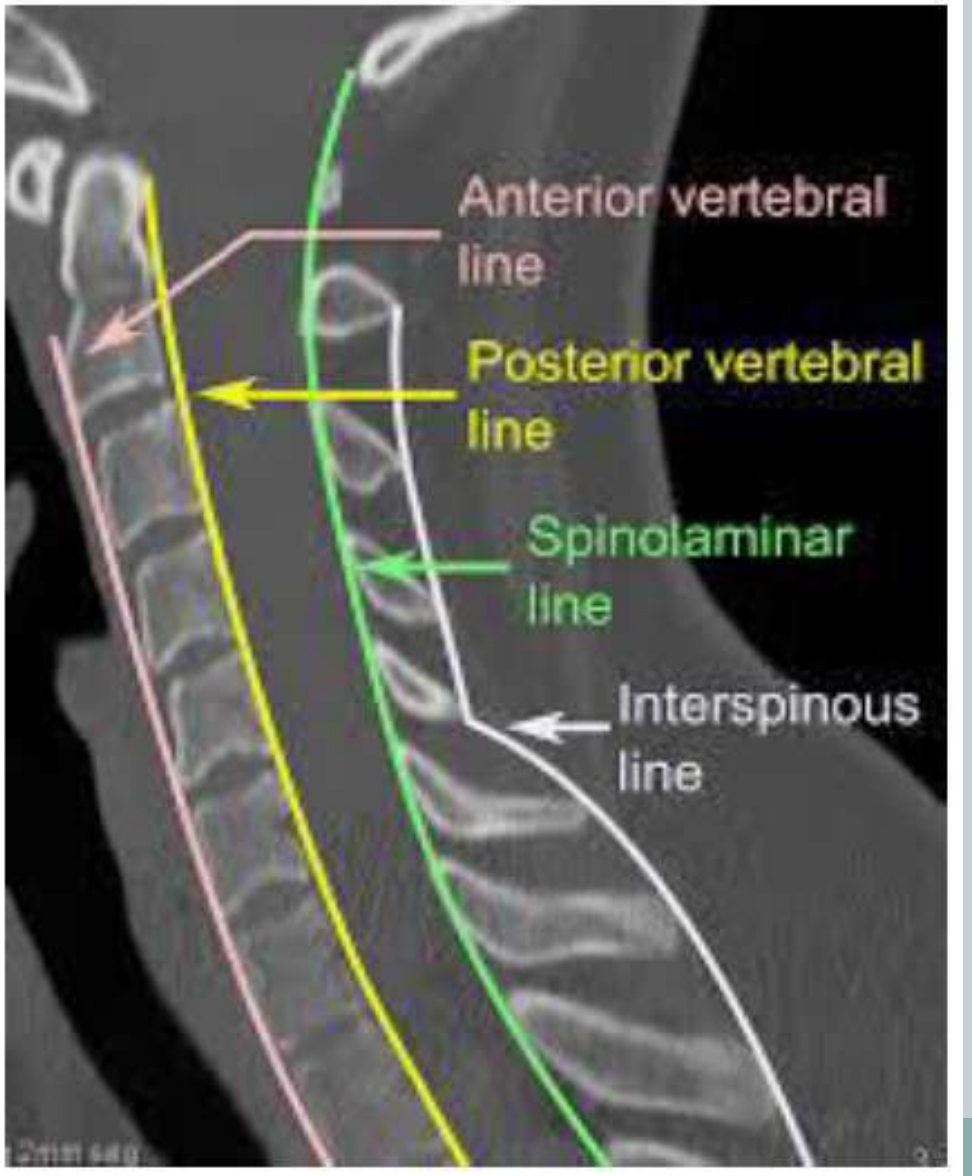
1. Anterior vertebral line: anterior margin of vertebral bodies

2. Posterior vertebral line: posterior margin of vertebral bodies and anterior wall of the spinal canal

3. Spino-laminar line: posterior wall of the spinal canal

4. Posterior spinous line: tips of the spinous processes


Anterior vertebral line
Posterior vertebral line
Spinolaminar line
Interspinous line

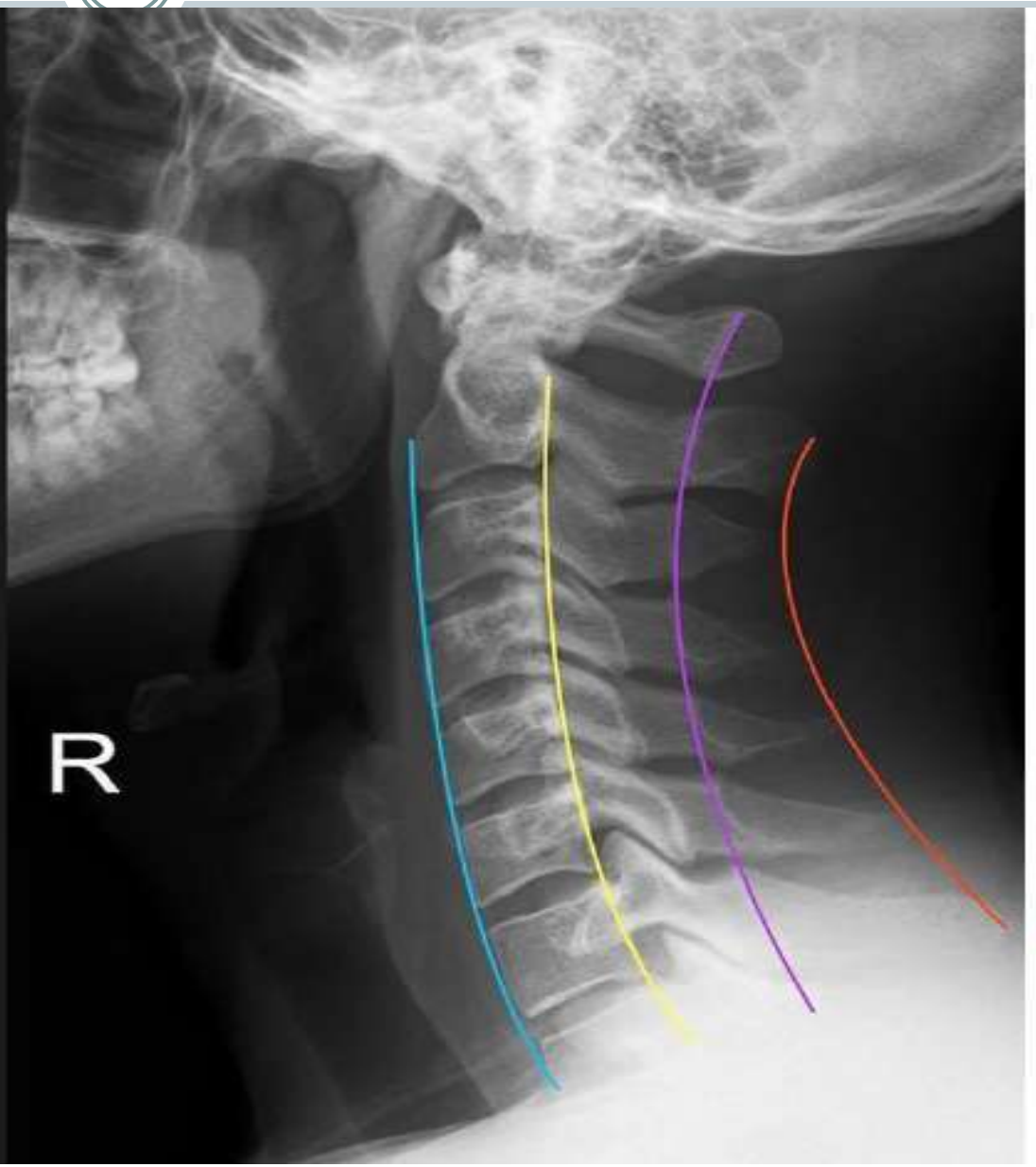

Anterior vertebral line
Posterior vertebral line
Spinolaminar line
Interspinous line

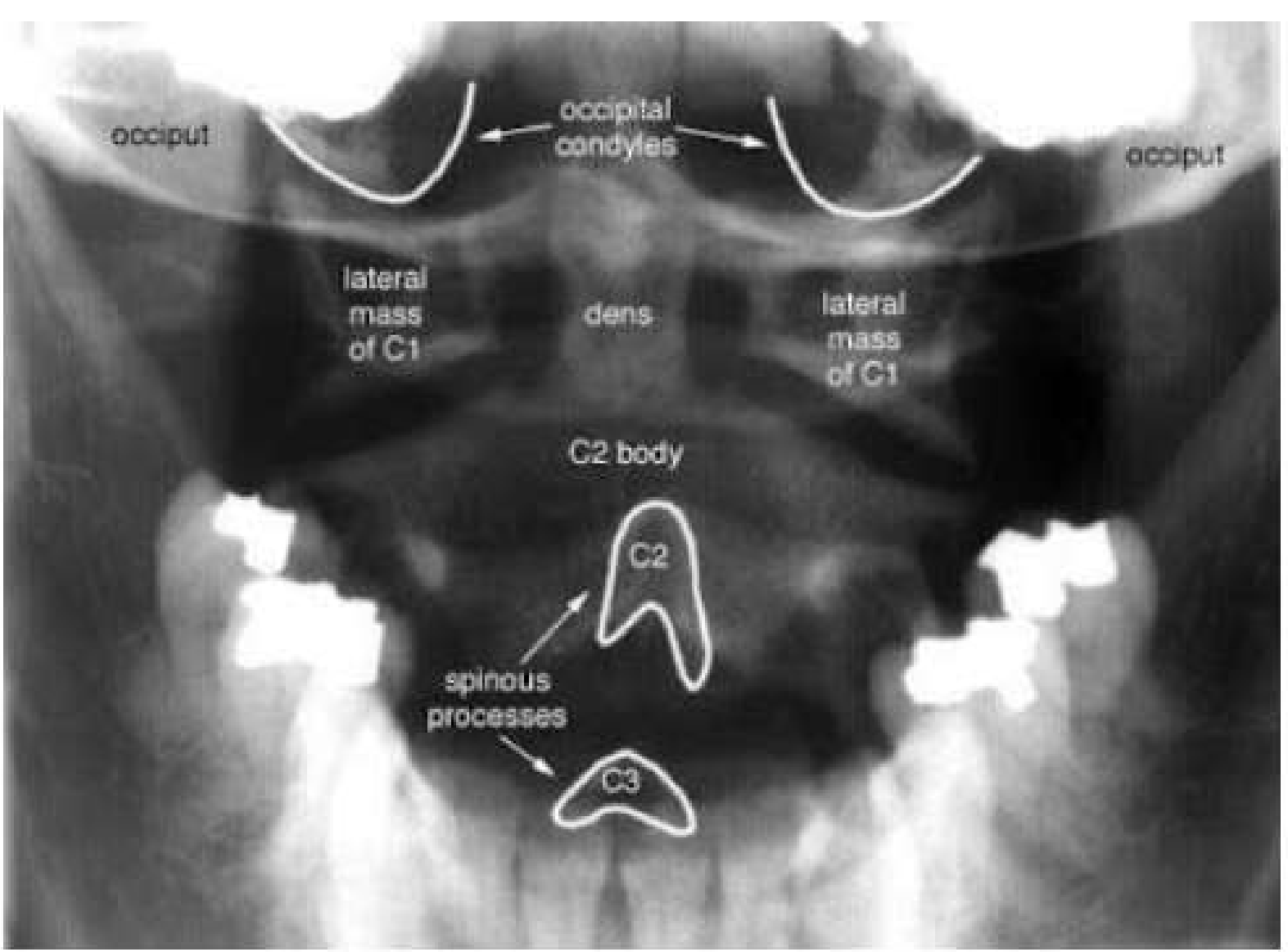
Lines

anterior vertebral
posterior vertebral
spinolaminar
posterior spinous

Prevertebral thickness

7mm at C2
2cm at C7




occiput
occipital condyles
occiput
lateral mass of C1
dens
lateral mass of C1
C2 body
C2
spinous processes
C3

How to Read Lateral C-Spine X-ray

consider evaluating the following:

Make sure you can see all 7 cervical spinous process

Make sure pre-vertebral soft tissue is < 7 mm in thickness in front of C2 and < 20 mm in front of C6

Evaluate the orientation of the tracheal shadow and check for any foreign bodies .

Check the anterior vertebral line (anterior longitudinal ligament line)

Check the posterior vertebral line (posterior longitudinal ligament line)

Check the spinolaminal line

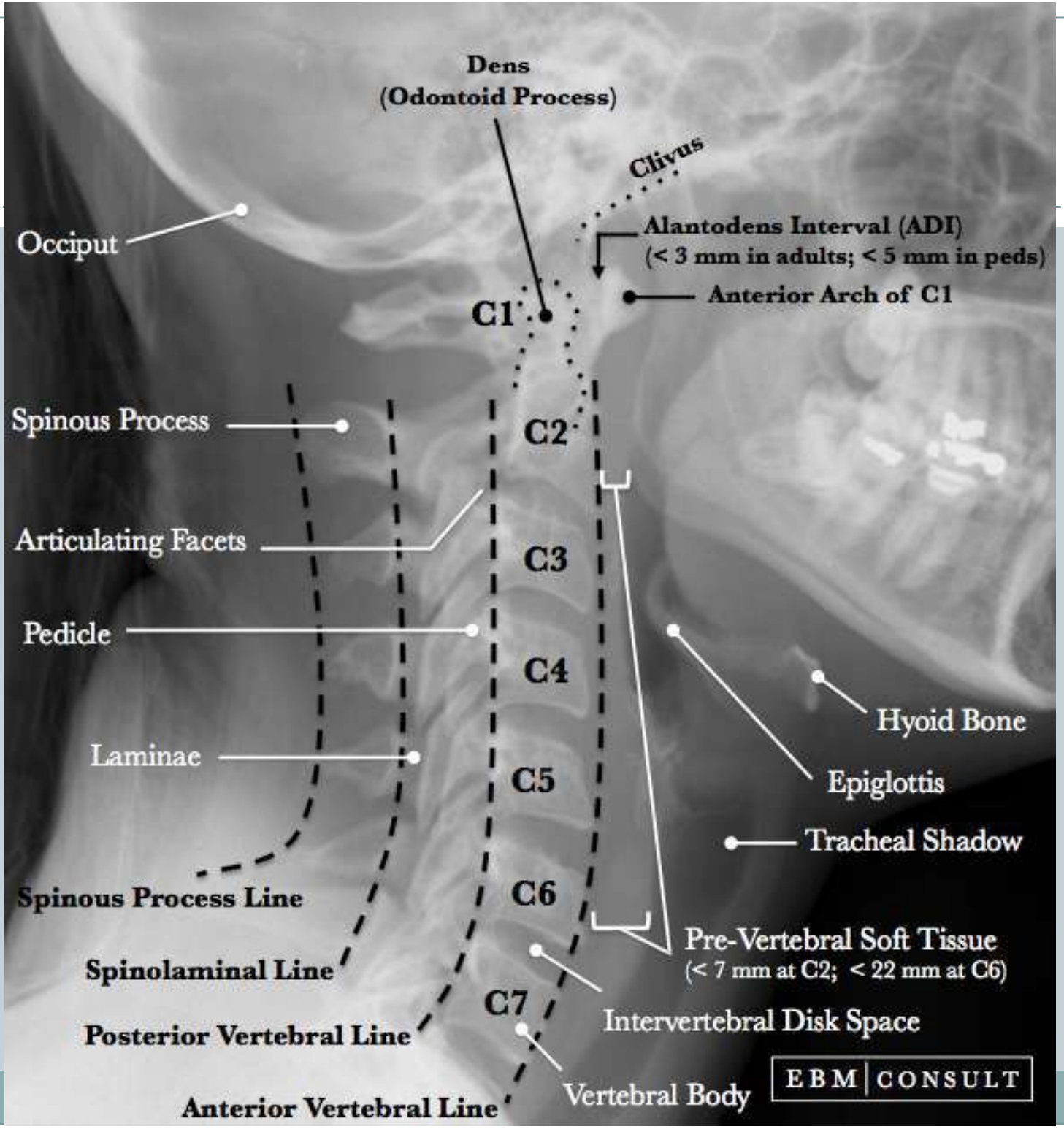
Check the spinous process line Inspect each vertebral body, pedicle, lamina and spinous process from C1 – C7.

Check that the intervertebral spaces are uniform at each level

Make sure the atlantodens interval (ADI; or pre-dental space) is < 3 mm in adults or < 5 mm in children

Make sure the C2 ring is smooth and continuous .

Scan the mandible and base of the skull.

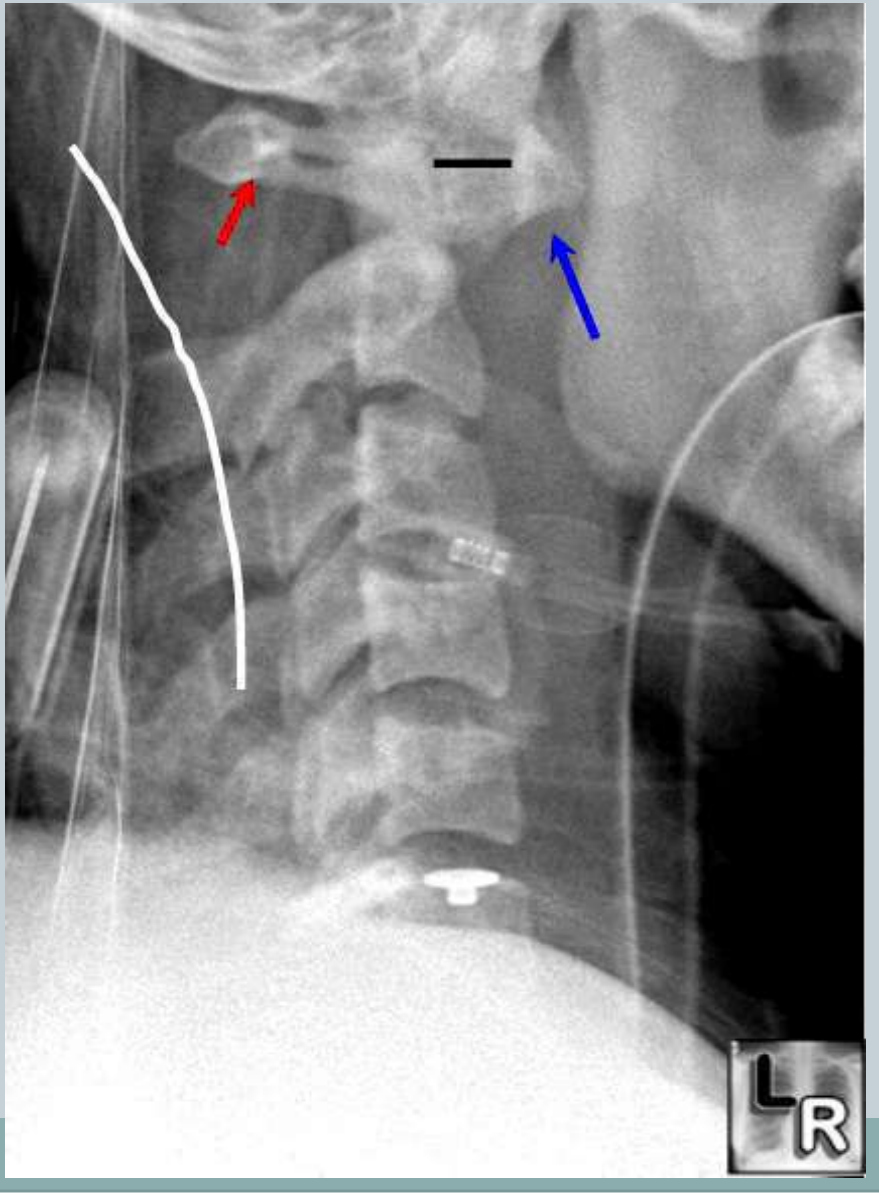

Dens
(Odontoid Process)
Clivus
Occiput
Alantodens Interval (ADI)
(< 3 mm in adults; < 5 mm in peds)
Anterior Arch of C1
C1
C2
Spinous Process
Articulating Facets
C3
Pedicle
C4
Hyoid Bone
Laminae
C5
Epiglottis
Tracheal Shadow
C6
Spinous Process Line
Pre-Vertebral Soft Tissue
(< 7 mm at C2; < 22 mm at C6)
Spinolaminal Line
C7
Intervertebral Disk Space
Posterior Vertebral Line
Vertebral Body
Anterior Vertebral Line
EBM | CONSULT

Atlanto-Axial Subluxation

Lateral view of the cervical spine done as a cross-table lateral shows a marked increase in the distance between the anterior surface of the dens and the posterior surface of the C1 tubercle (blue arrow) that measured 14 mm (black line) .

The imaginary line connecting the spinolaminar white lines (white line) shows that the body of C1 (red arrow) is displaced anteriorly relative to the remainder of the spine.

The patient died shortly after this study was obtained.



Atlanto-Axial Subluxation/Dislocation

- Distance between the anterior surface of the dens and the posterior surface of the tubercle of C1 is usually 3 mm or less in adults and 5 mm or less in children

  This space is called predental space, atlantodental distance.

  Traumatic atlantoaxial subluxation/dislocation usually results from a motor vehicle.

Non-traumatic conditions associated with increase in the atlantoaxial distance

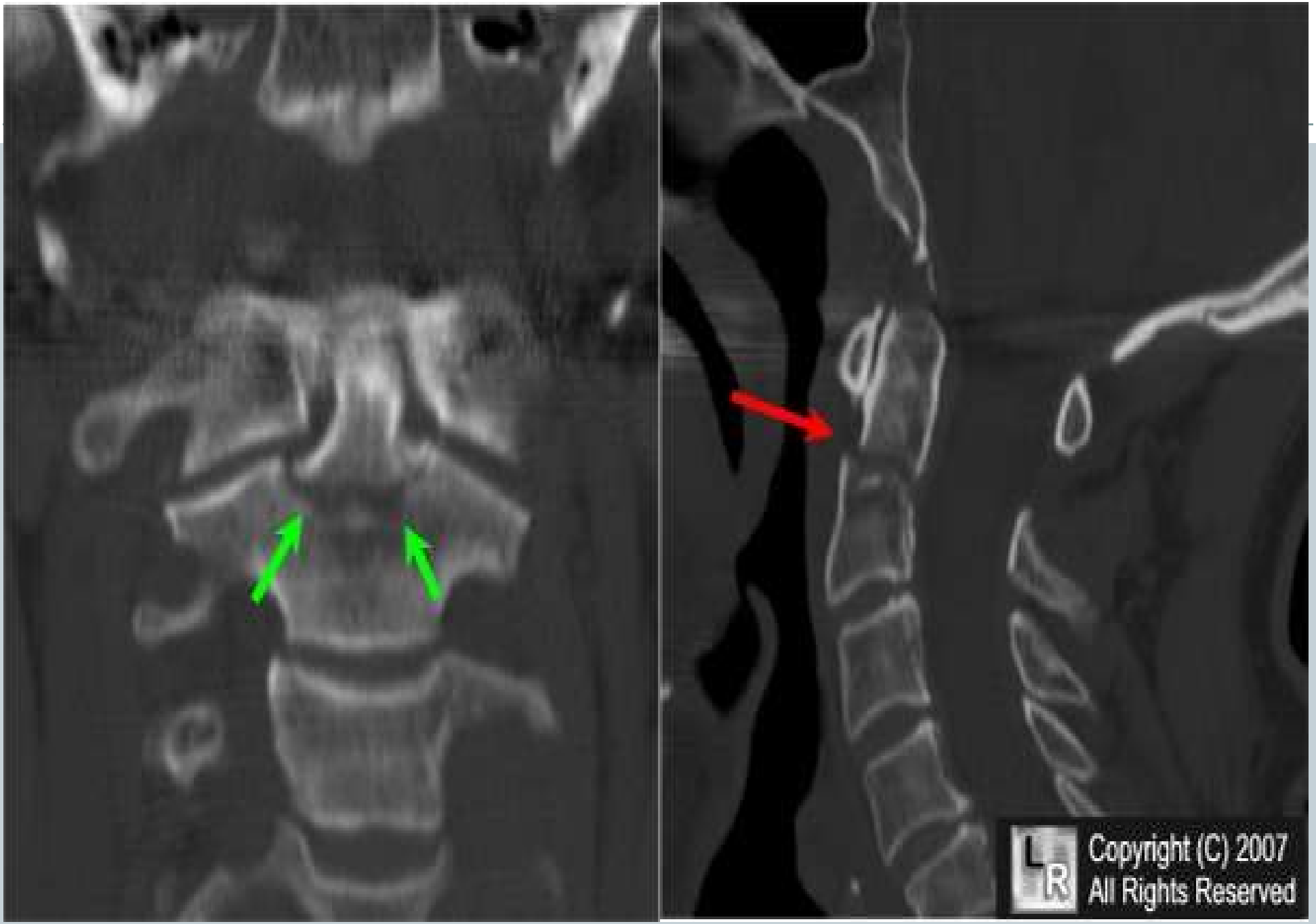
Down syndrome Due to laxity of the transverse ligament.

Rheumatoid arthritis Atlantoaxial subluxation associated with inflammation of adjacent soft tissues of the neck


Courtesy of Deyid Ahmetovic


A


L
K
P


Copyright (C) 2007
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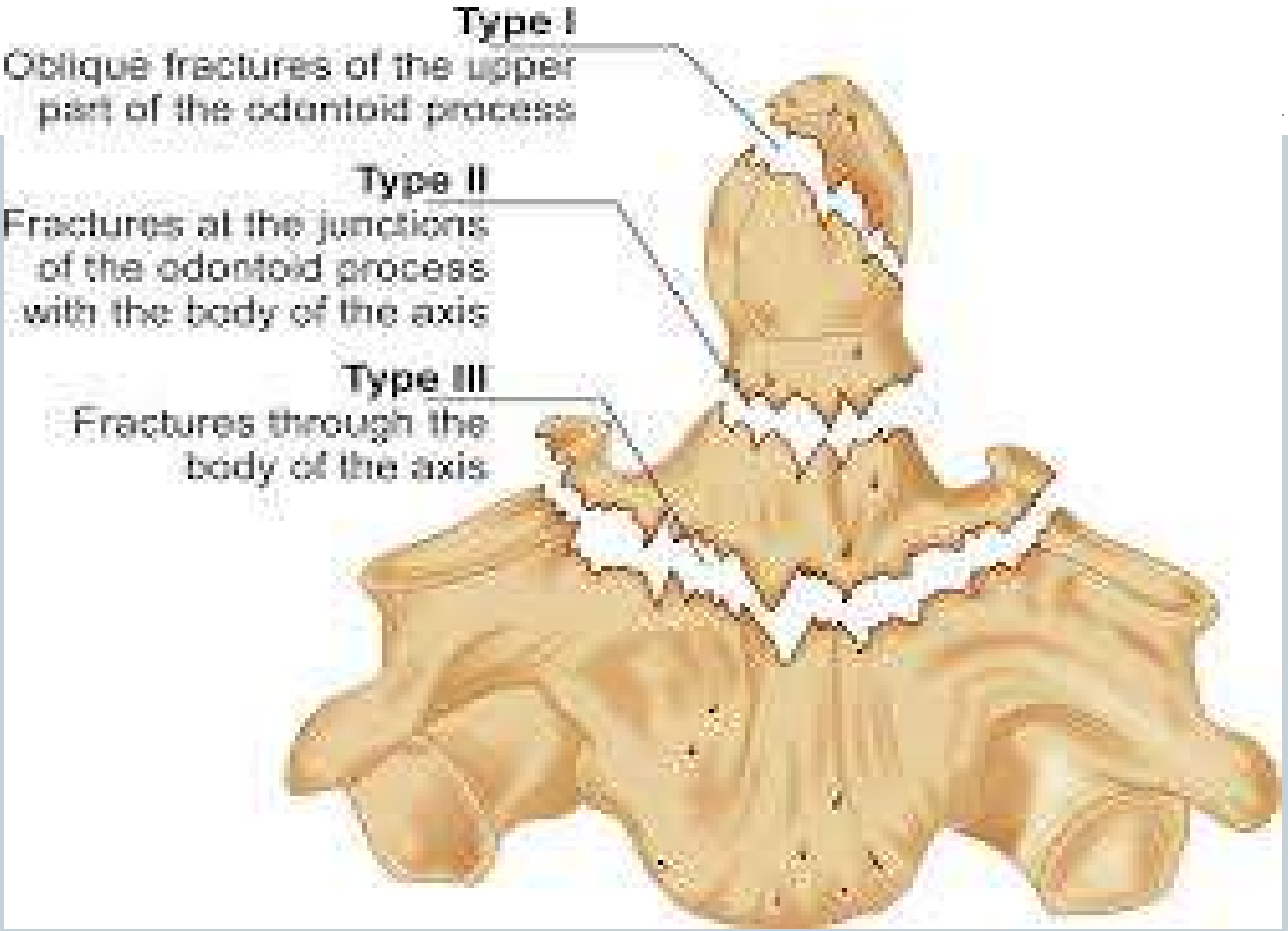
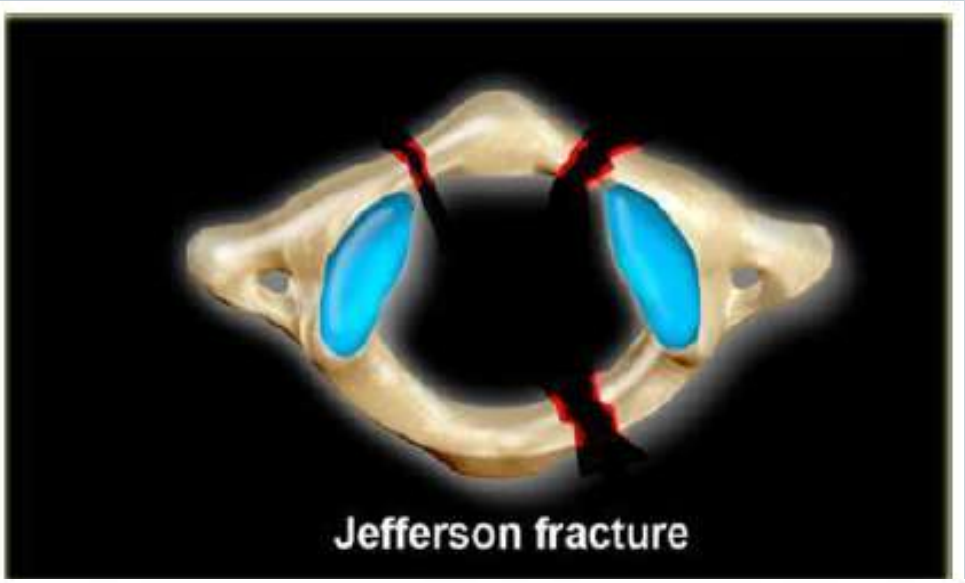
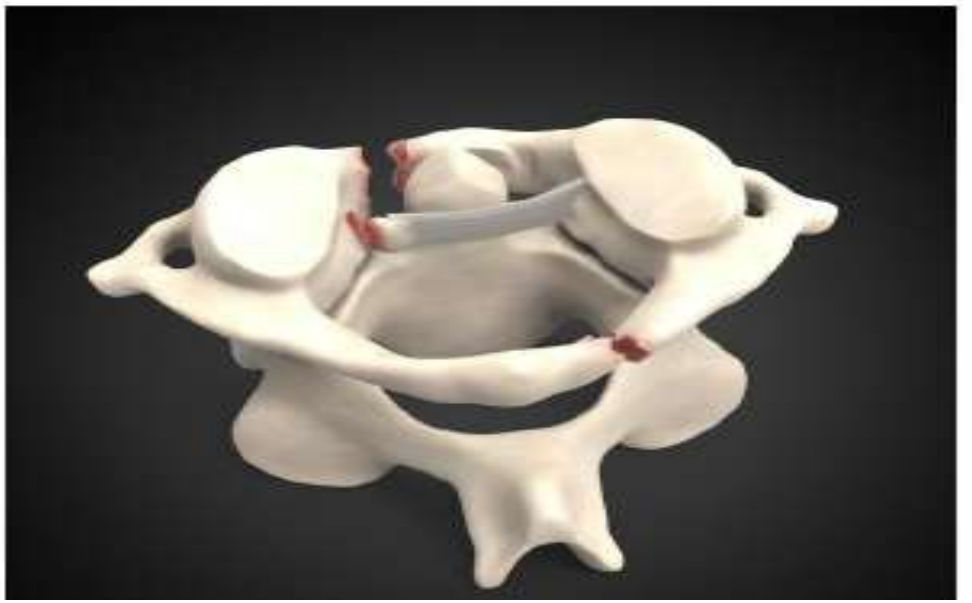

Type I
Oblique fractures of the upper part of the odontoid process
Type II
Fractures at the junctions of the odontoid process with the body of the axis
Type III
Fractures through the body of the axis

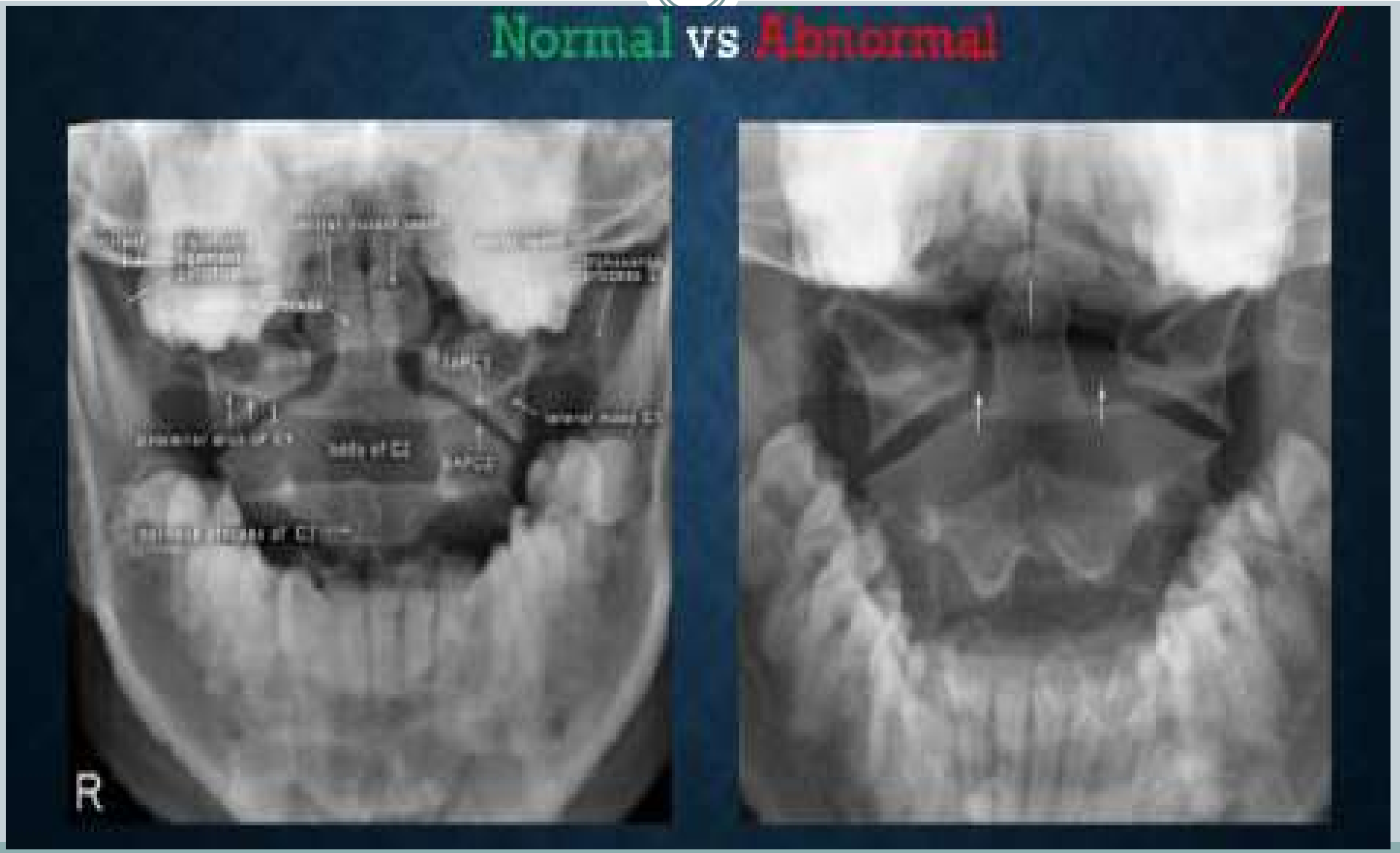
Axial compression injuries

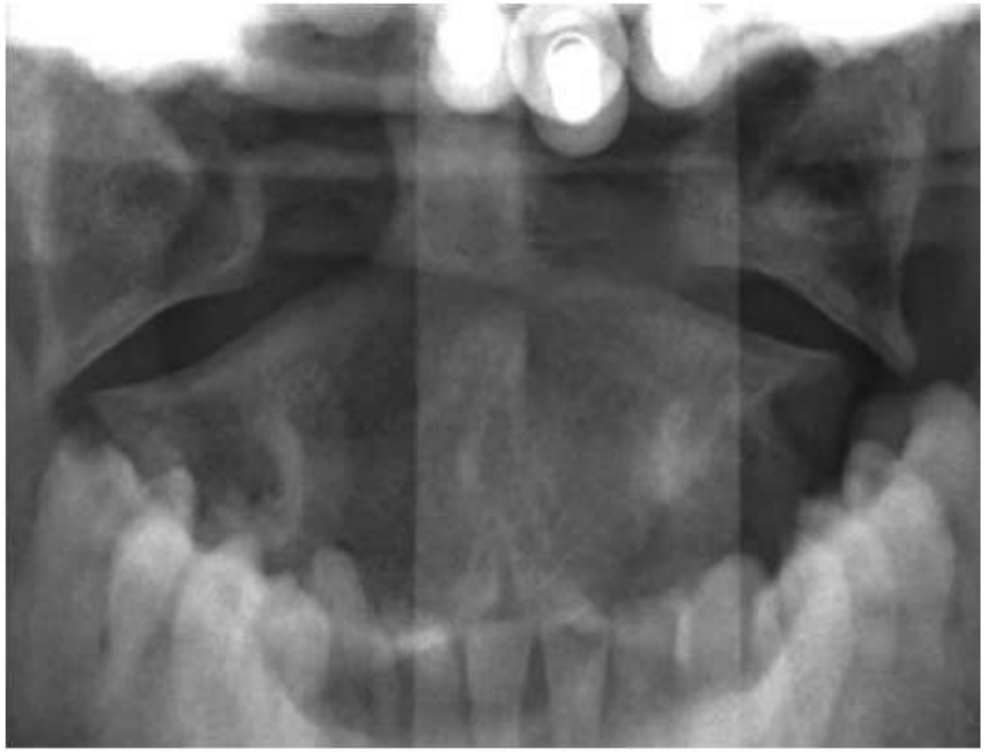
Jefferson fracture

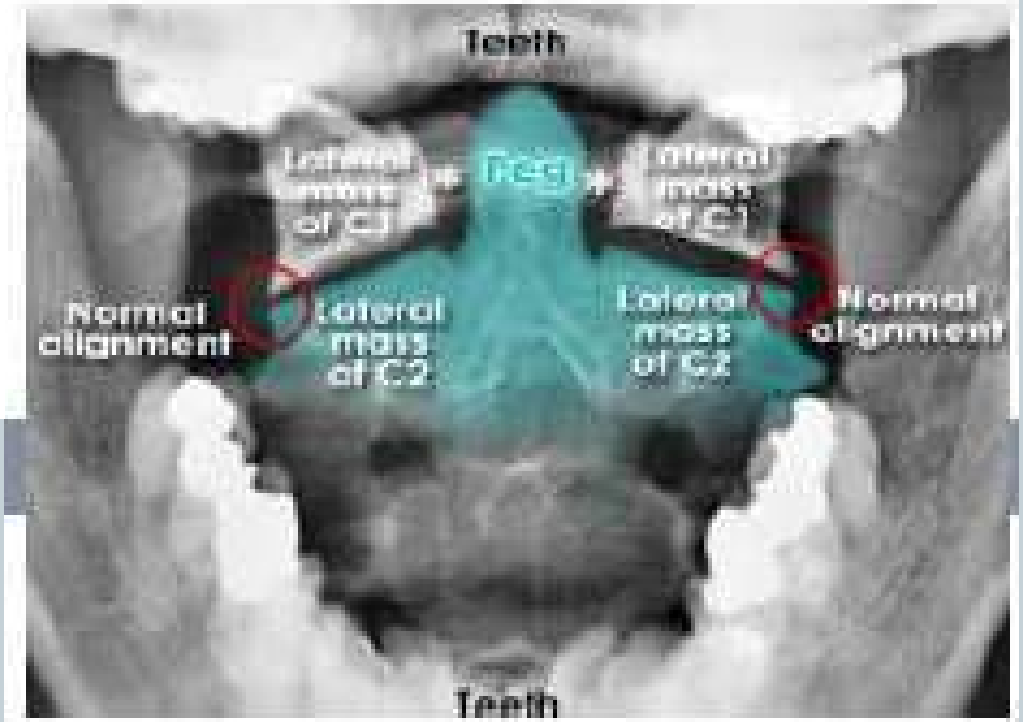
is a burst fracture of the ring of C1 with lateral displacement of both articular masses





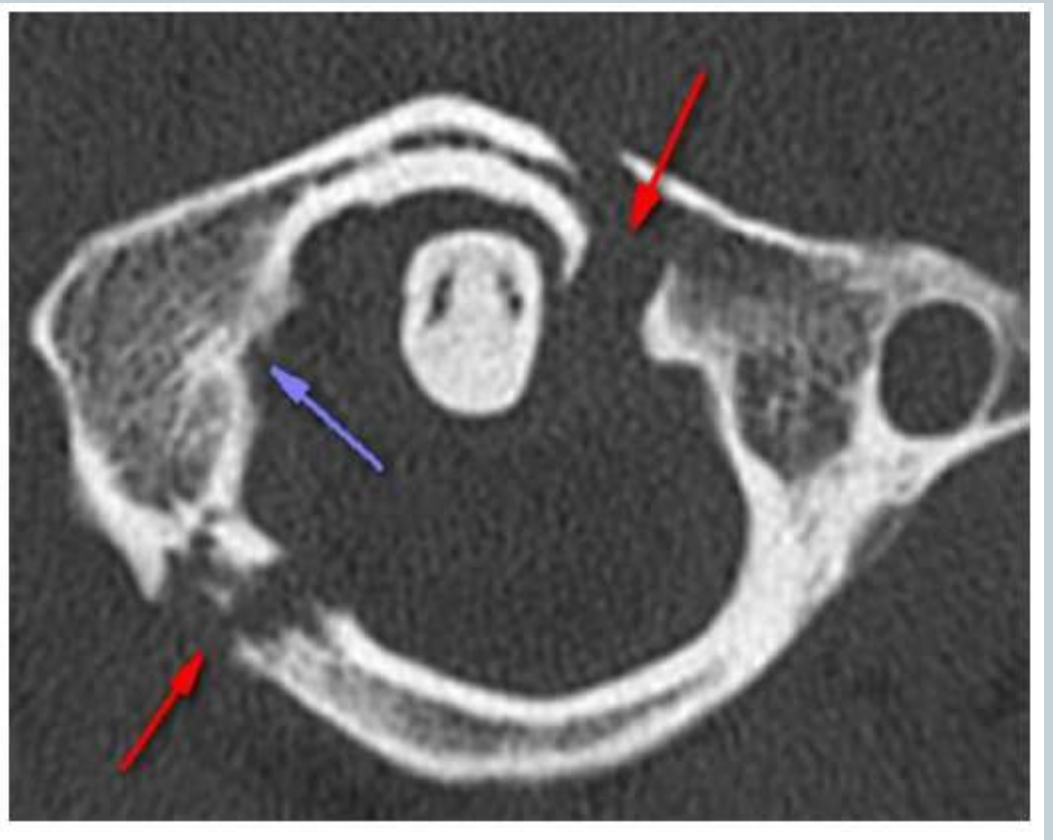

Normal vs Abnormal
R




Teeth
Normal alignment
Lateral mass of C2
Lateral mass of C2
Normal alignment
Teeth

Fractures (red arrows)

Avulsion fracture of atlantal transverse ligament (purple arrow).



CERVICAL SPINE CASES

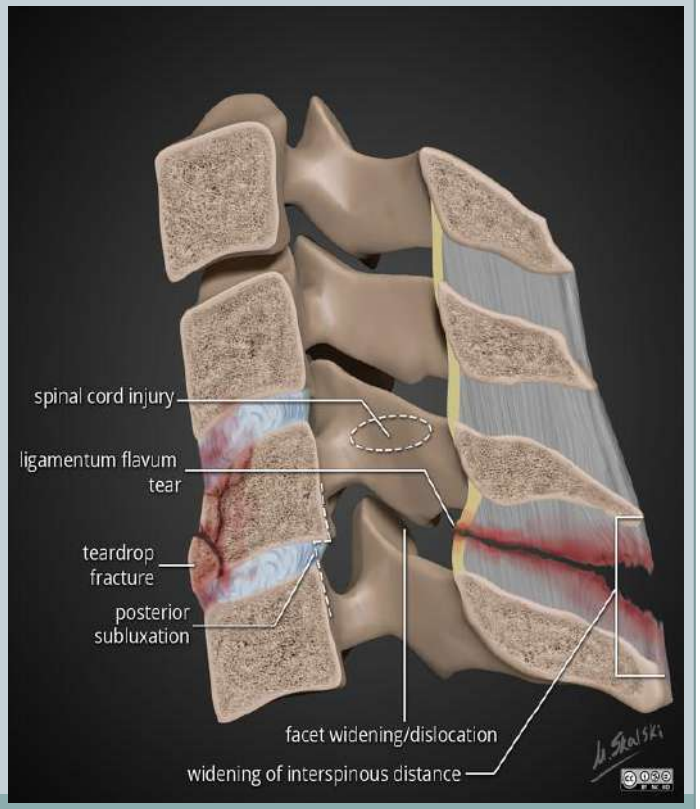
CONTINUES…

د.احمد مذخر الغبشة

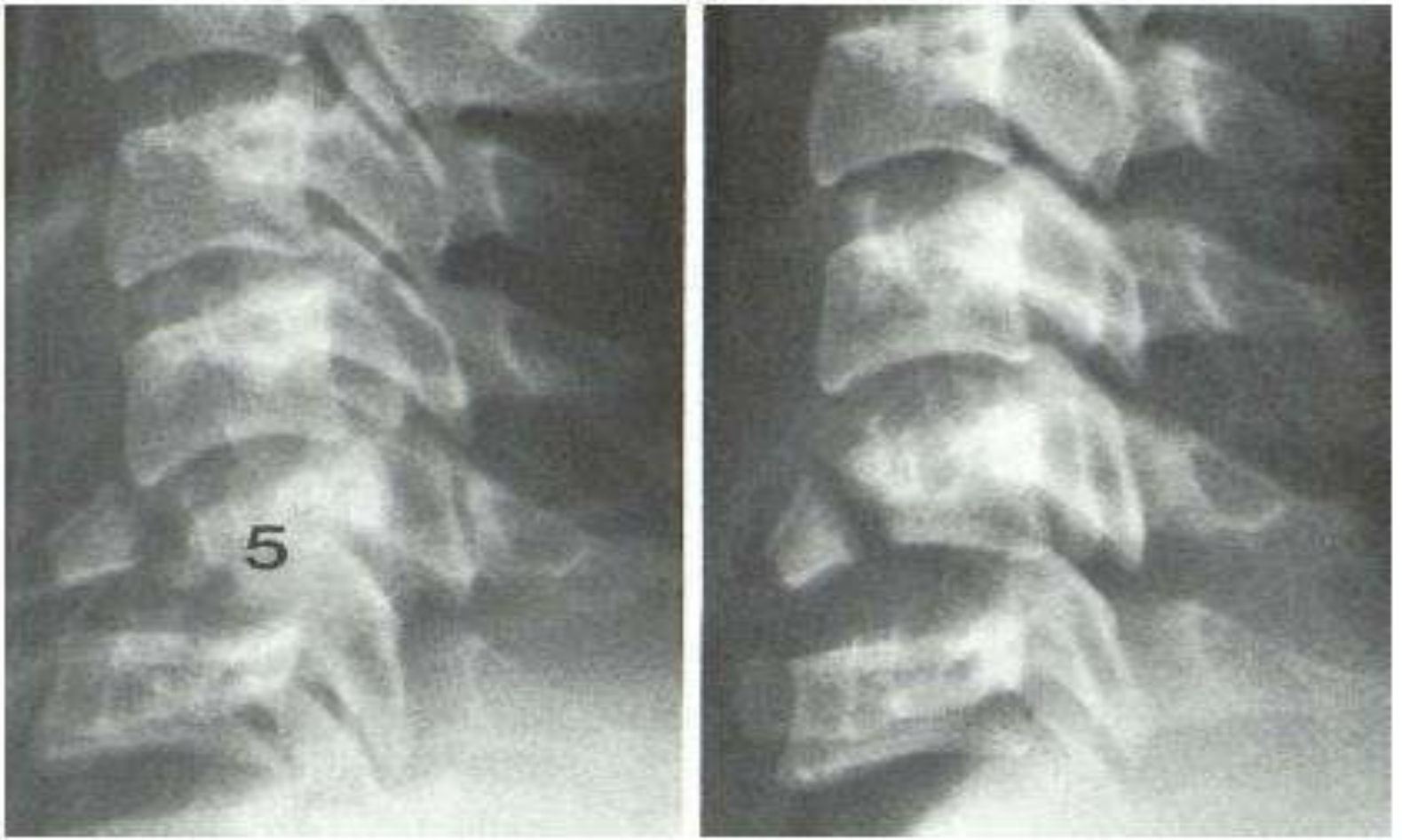
Flexion injuries most common mechanism

FLEXION TEARDROP FARCTURE

IS THE RESULT OF EXTREME FLEXTION WITH AXIAL LOADING TYPICALLY OCCURS FROM SEVERE FORCES (E.G. DIVING IMPACT, DECELERATION DURING MOTOR VEHICLE COLLISION.



- Flexion teardrop fractures most commonly occur at the mid/lower cervical spine, specifically at C4, C5
- fracture of the anteroinferior lip of vertebral body


5

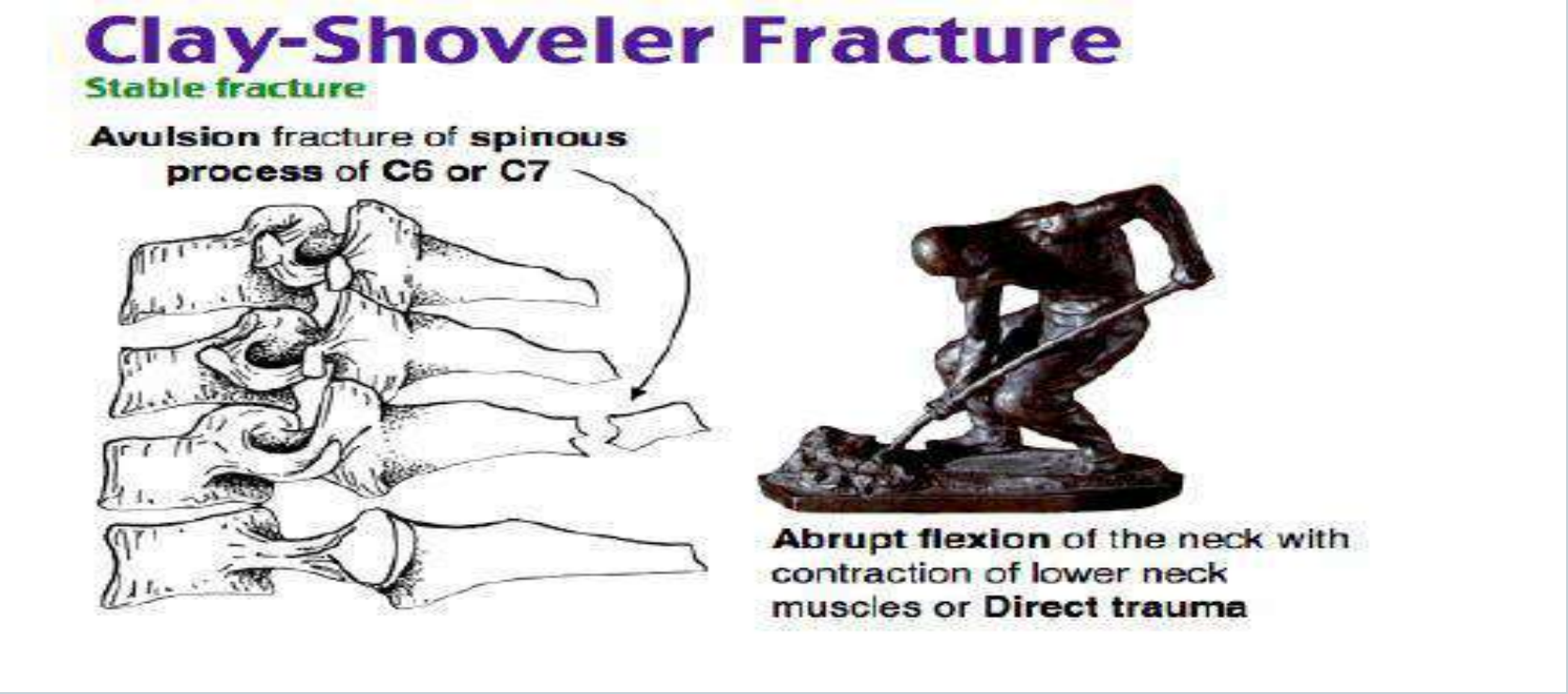
- classically a triangular fragment (teardrop sign)

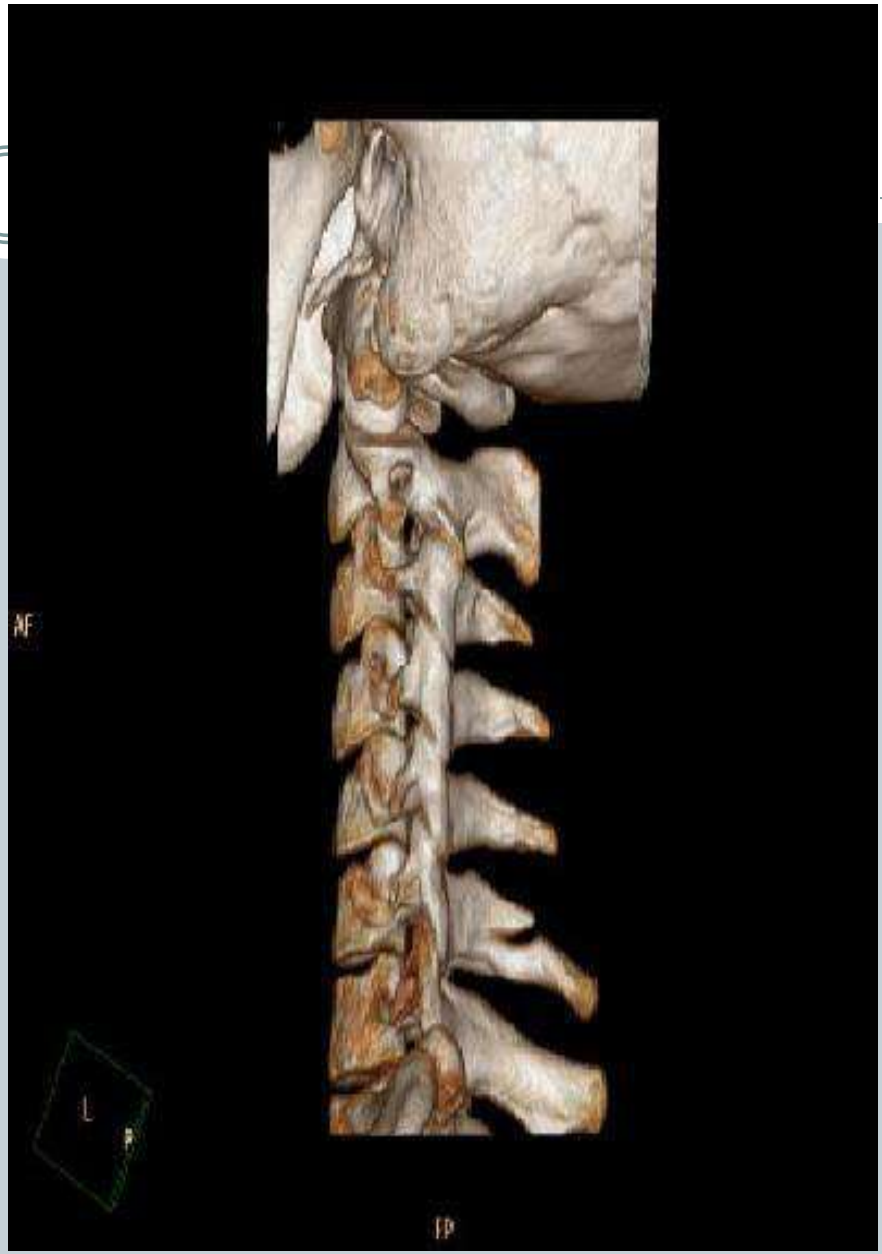
- Anterior fragment often minimally displaced

It is ***unstable and*** is associated with a high incidence of cord damage

Clay-shoveler fractures

Are fractures of the spinous process of a lower cervical vertebra usually C7




AF
L
P
PP


C7 spinous process fracture

Extension injuries

Hangman's fracture

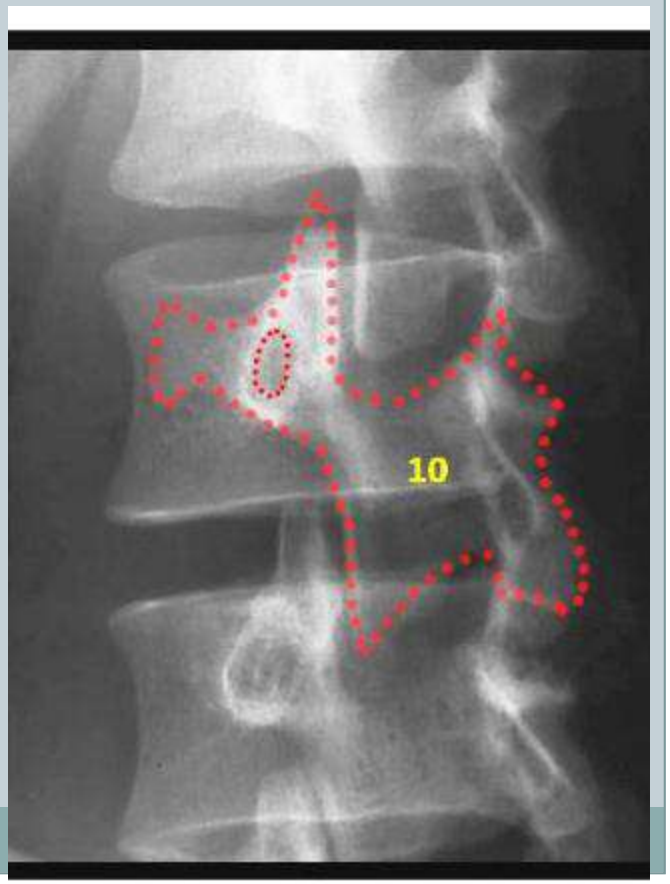
Also known as **traumatic spondylolisthesis of the axis**, is a fracture which involves the pars interarticularis of C2 on both sides, and is a result of hyperextension and distraction.

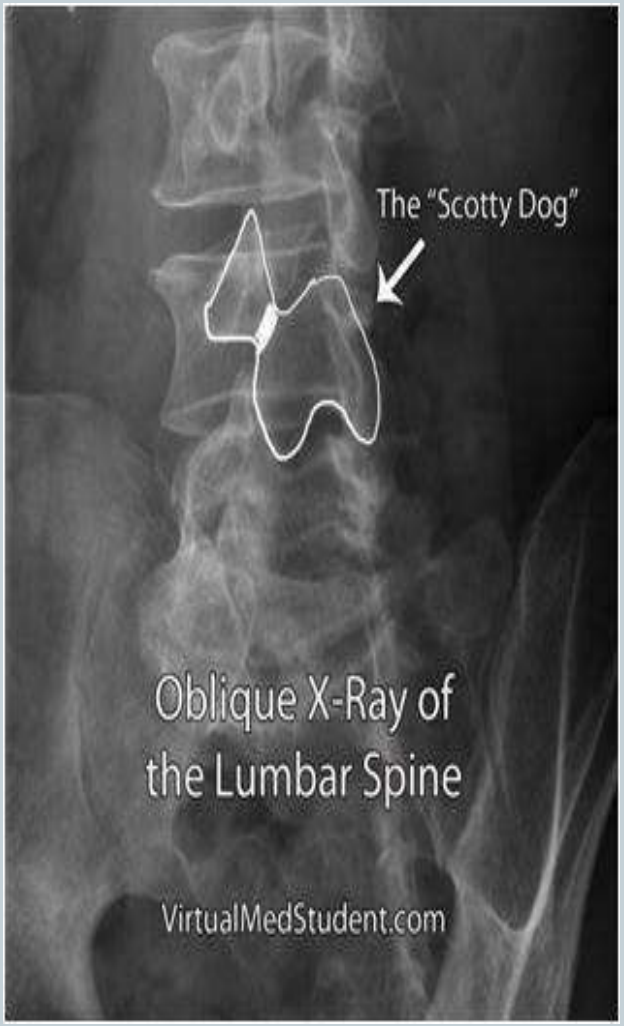
spondylolisthesis

- denotes the anterior or posterior slippage of one vertebra relative to the one below

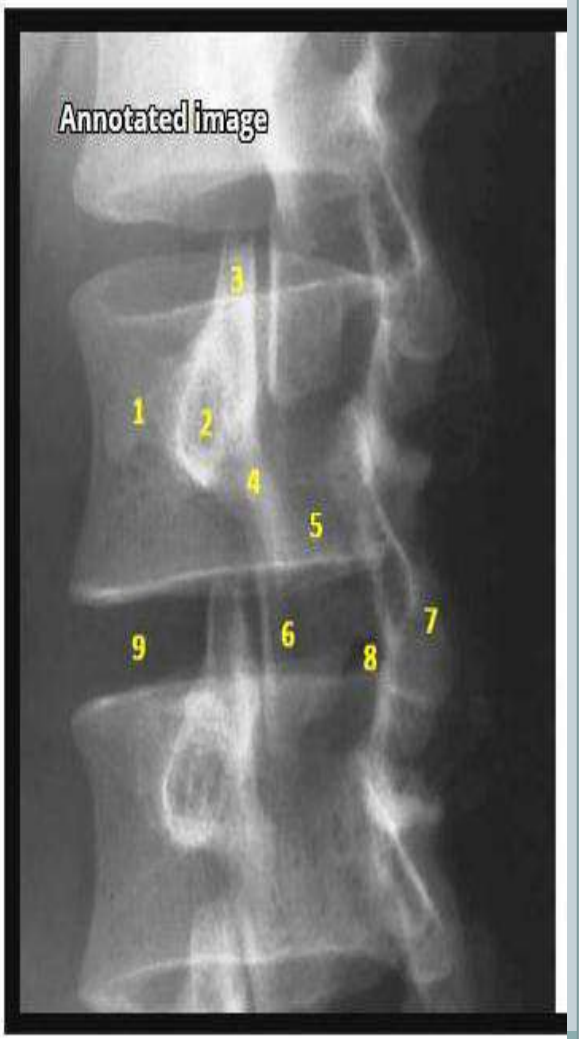
- it is due to a fracture which involves the pars interarticularis .

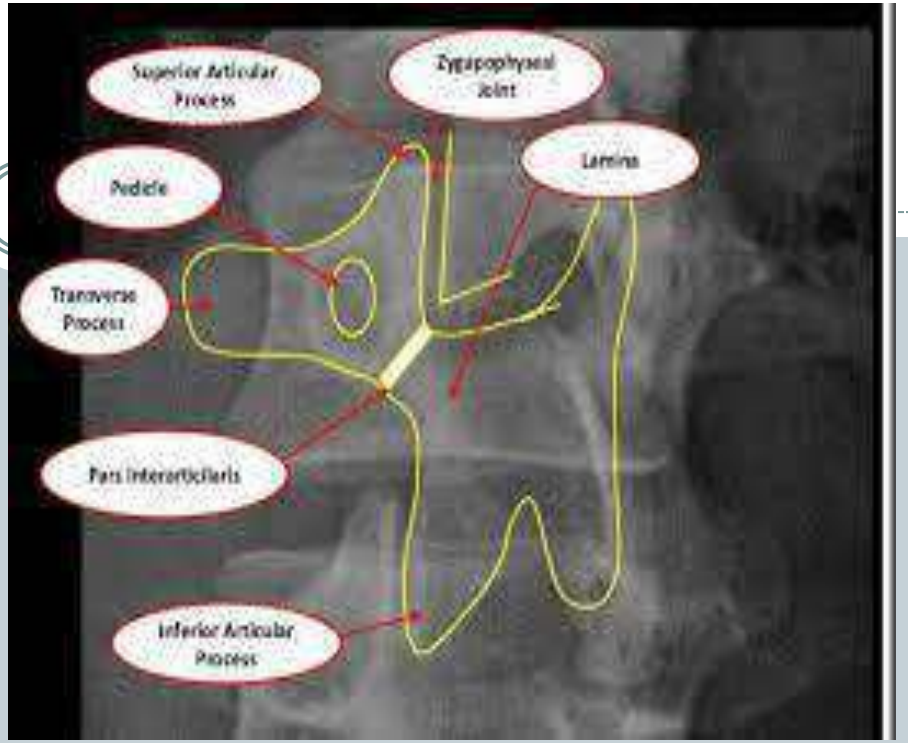
-The pars interarticularis (located between the superior and inferior articular facets) and normally represent the neck of scotish dog sign on obligue veiw .

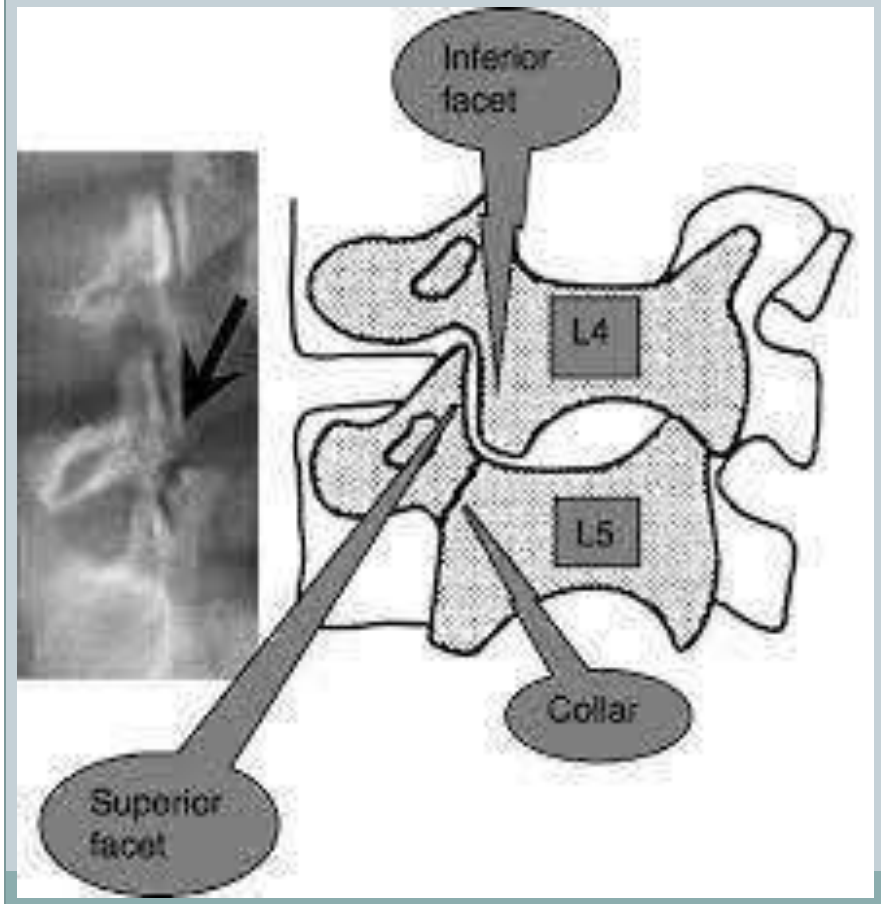




1. Transverse process
2. Pedicle
3. Superior articular process
4. Pars interarticularis (isthmus)
5. Lamina
6. Inferior articular process
7. Spinous process.
8. Interlaminar space
9. Intervertebral disc
10. Scotty dog sign




Superior Articular Process
Zygapophyseal Joint
Lamina
Pedicle
Transverse Process
Pars Interarticularis
Inferior Articular Process

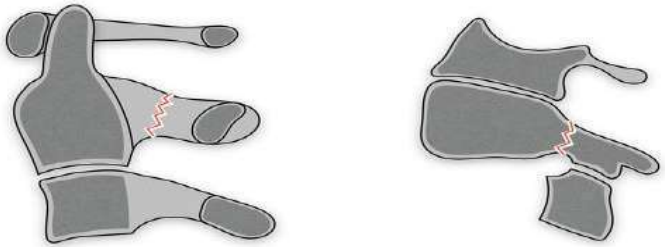

Inferior facet
L4
L5
Collar
Superior facet

Hangman's fracture

- usually associated with **spondylolisthesis** of C2 on C3

Hangman fracture

Levine and Edwards type 1

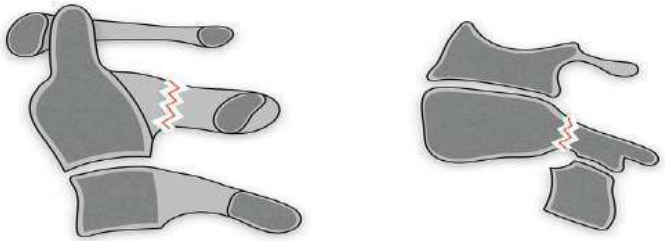


midsagittal parasagittal

displacement ≤3mm
and no angulation

Hangman fracture

Levine and Edwards type 2

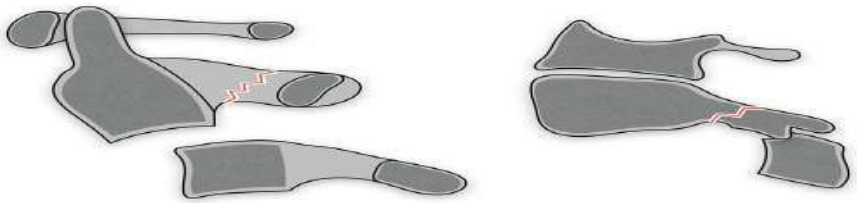


midsagittal parasagittal

displacement >3mm
and angulation ≤10°

Hangman fracture

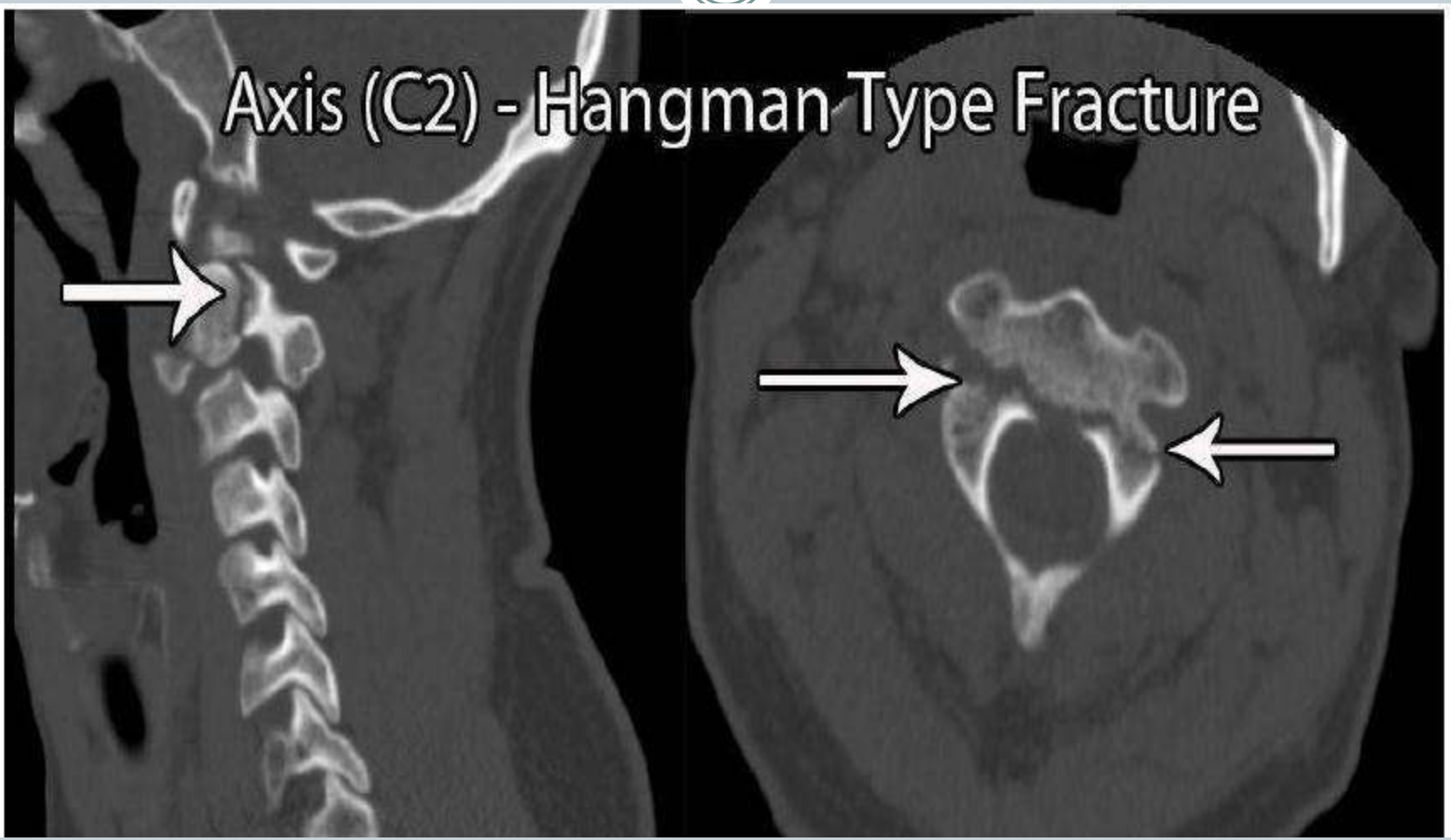
Levine and Edwards type 3



midsagittal parasagittal

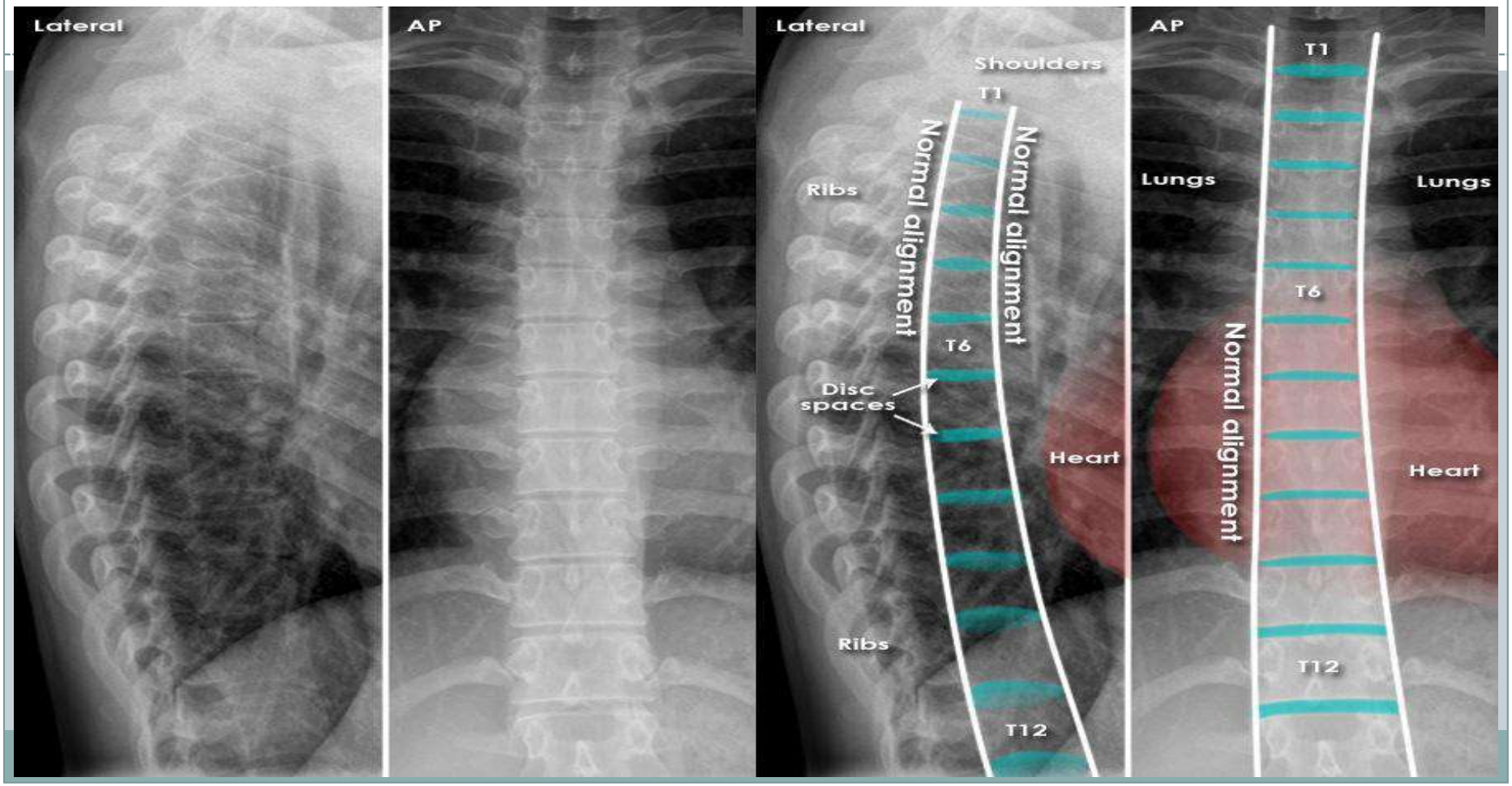
type 2 with bilateral
C2/3 facet dislocation

bilateral lamina and pedicle fracture at C2


Axis (C2) - Hangman Type Fracture

THORACIC SPINE IMAGING

د.احمد مذخر الغبشة



Anatomically

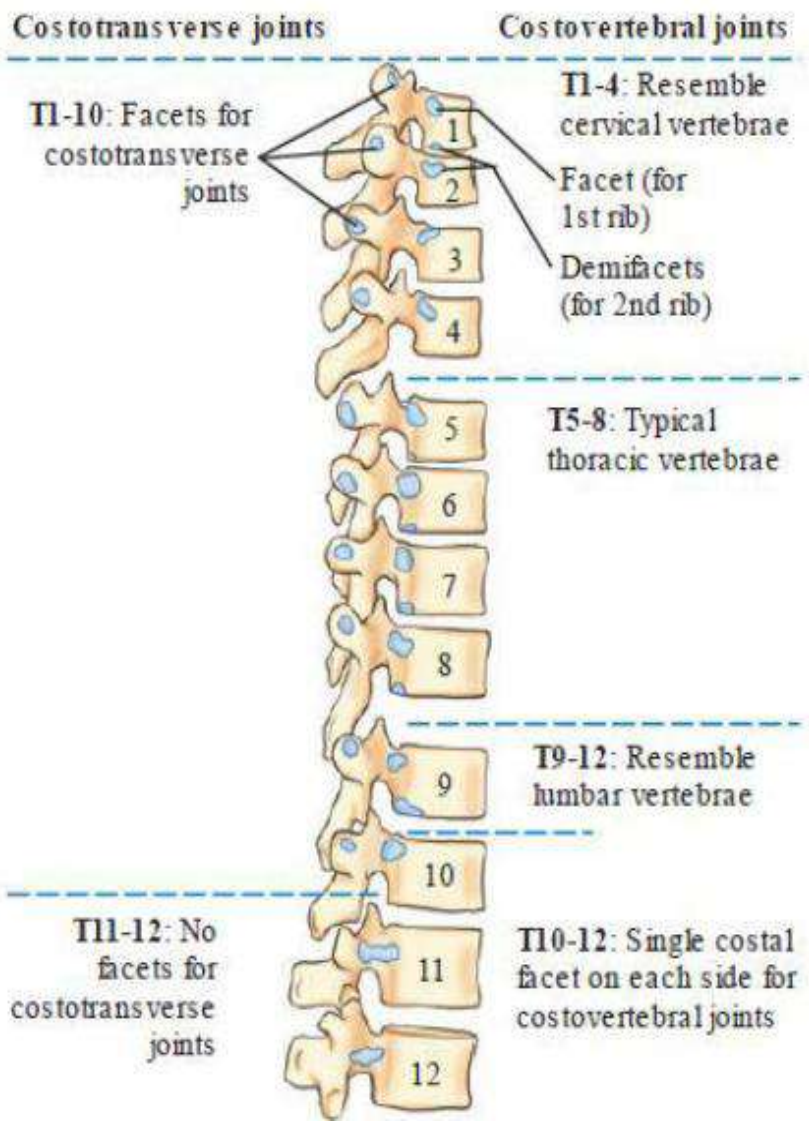
-There are 12 thoracic vertebrae .

-They reveals deference in the size and appearance of upper vertebrae compared with lower ones .

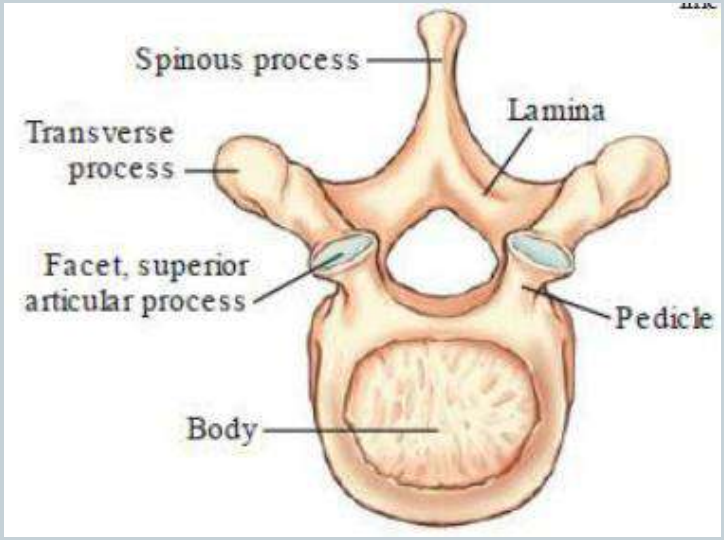
-The upper 4 thoracic vertebrae are smaller and share features of the cervical vertebrae

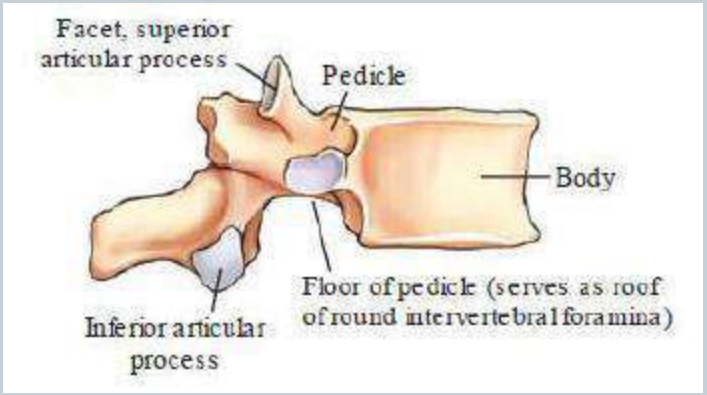
-T5, T6, T7, and T8 are considered typical thoracic vertebrae.

-The lower 4 thoracic vertebrae are larger and share characteristics of the lumbar vertebrae.



- A key distinguishing feature of all 12 thoracic vertebrae is their facets for articulation with ribs.
- Each thoracic vertebra is associated closely with one pair of ribs.
- Presence of demi-facets on the sides of each vertebral body – these articulate with the heads of the ribs.

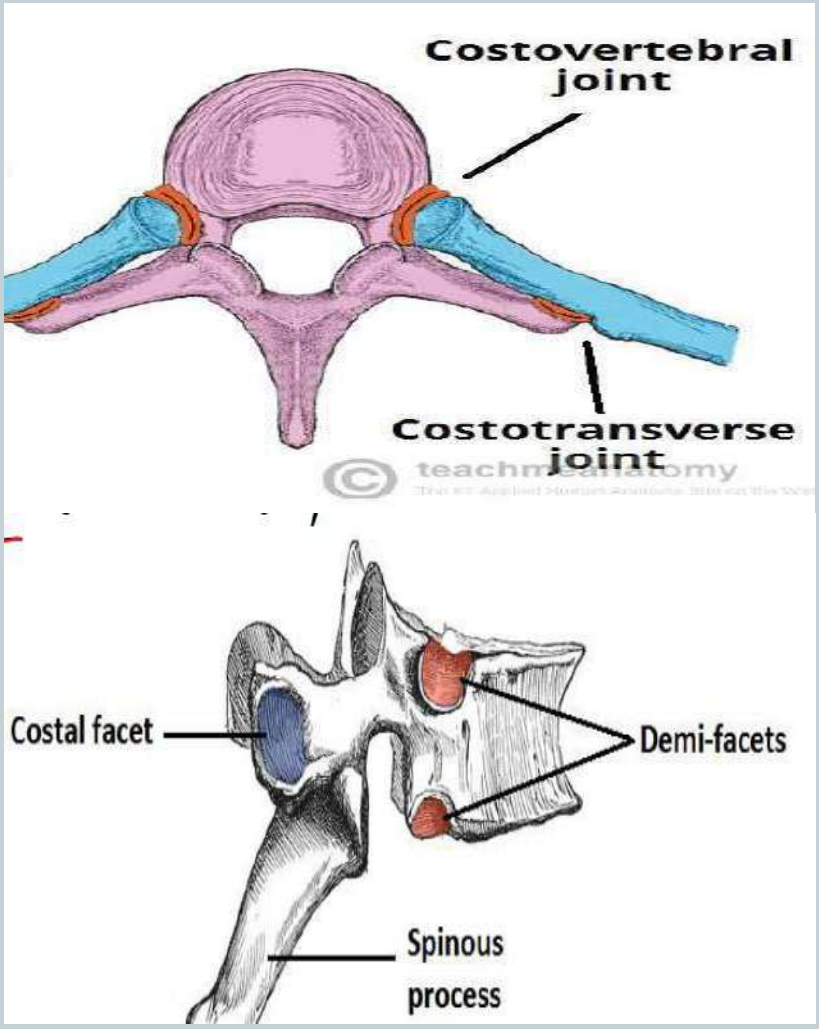




Presence of costal facets on the transverse processes

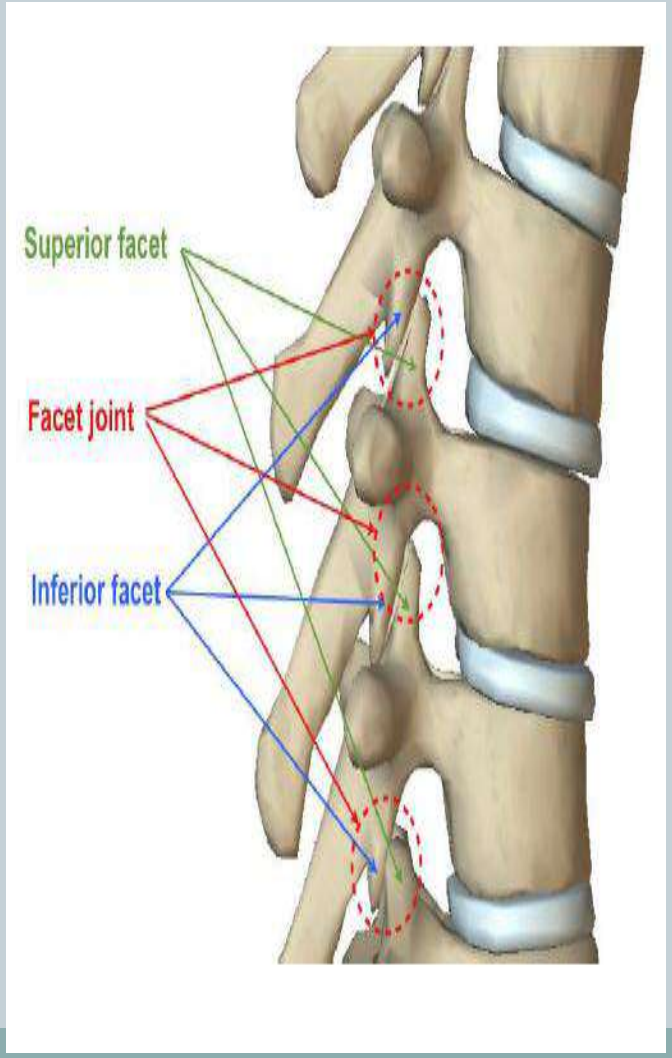
these articulate with the tubercles of the ribs.

They are present on T1-T10 only.

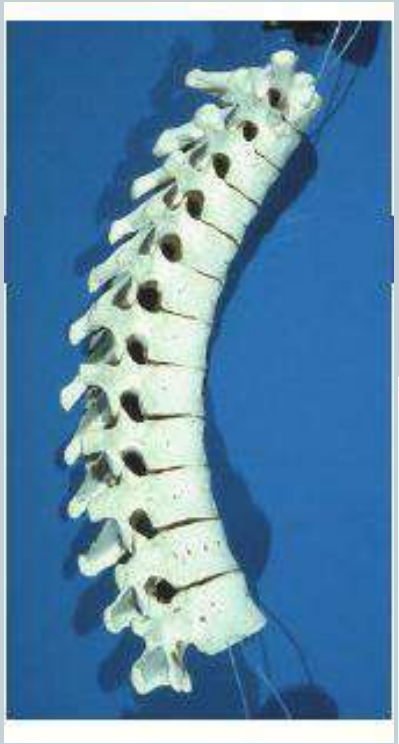


- Small joints located between and behind adjacent vertebrae.

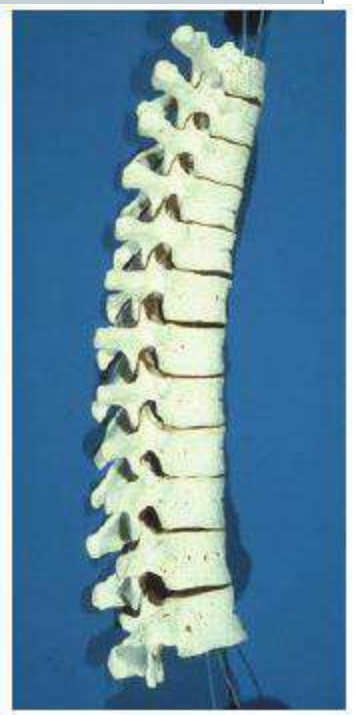
-There are two facet joints at each level of the vertebral column, providing stability to the spinal column while allowing movement.



The thoracic vertebrae on the top > lateral position.



Those on the bottom are in an >>> oblique position.



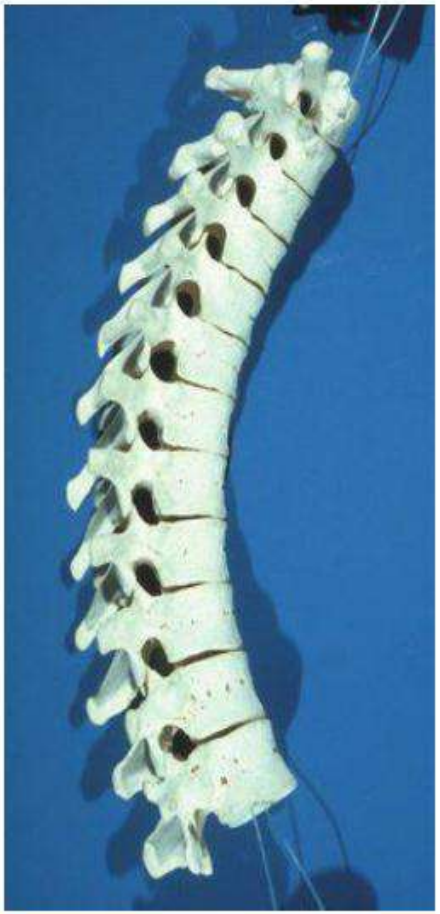
-The lateral position of the thoracic spine best shows the intervertebral foramina.

-A 70° oblique is necessary to open up the zygaoapphyseal joints(facet joint) on the thoracic spine.

-The posterior oblique position shows the zygapophyseal joint on the upside.

-The anterior oblique would demonstrate the downs side joints.

Lateral



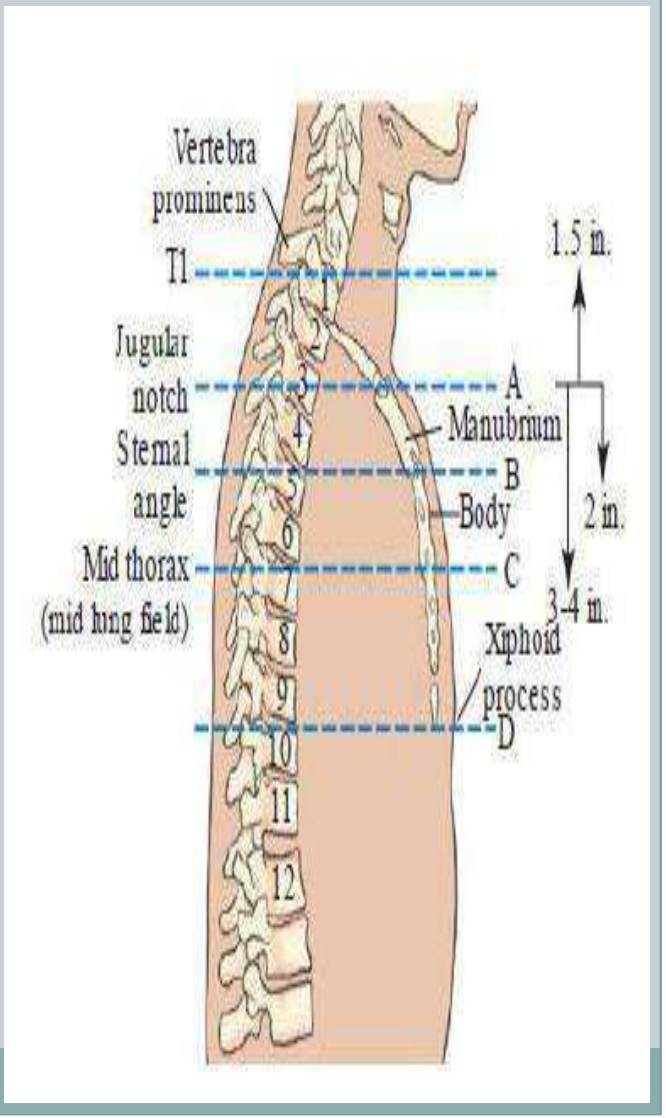
oblique

Thoracic spine landmarks

- The first thoracic vertebra can be palpated posteriorly at the prominent spinous process of C7.
- The sternum is divided into three basic sections.
- The upper section is the manubrium.
- The easily palpated U-shaped dip in the superior

margin is the jugular (suprasternal) notch(A).

- The jugular notch is at the level of T2 and T3.



-The central portion of the sternum is called the body.

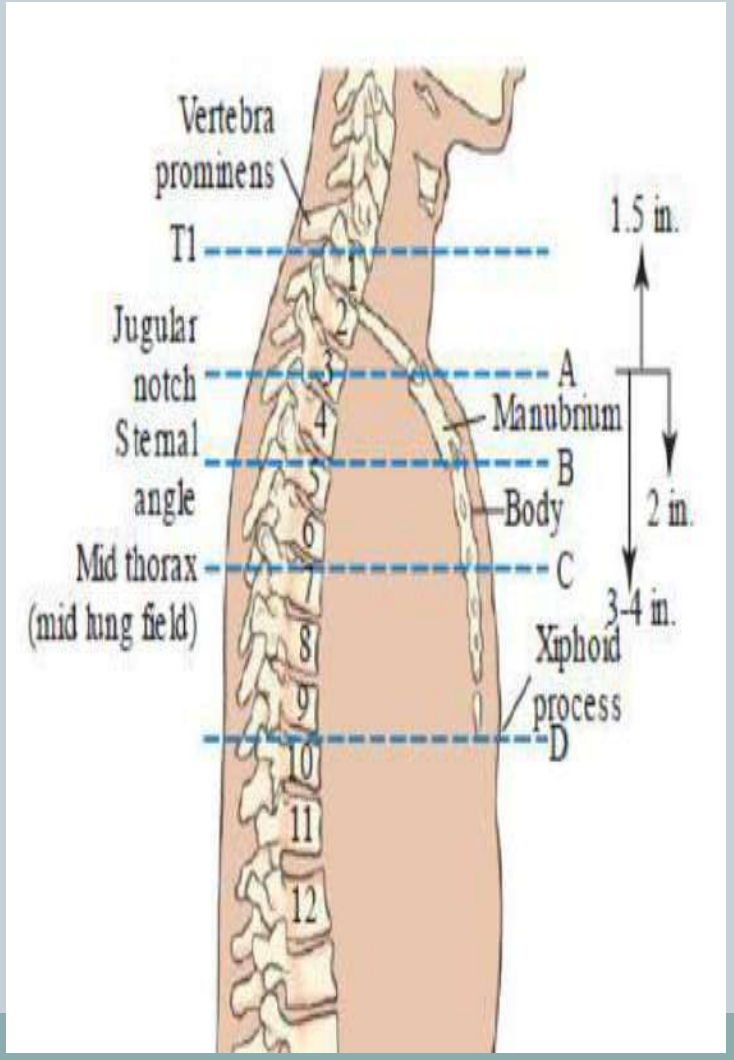
- Posteriorly, this is the level of the junction of T4 and T5.

- Anteriorly, this is the level of the articulation of the second rib onto the sternum

-The most inferior end of the sternum is called the

xiphoid process.

- The xiphoid tip is at the level of T9-T10.

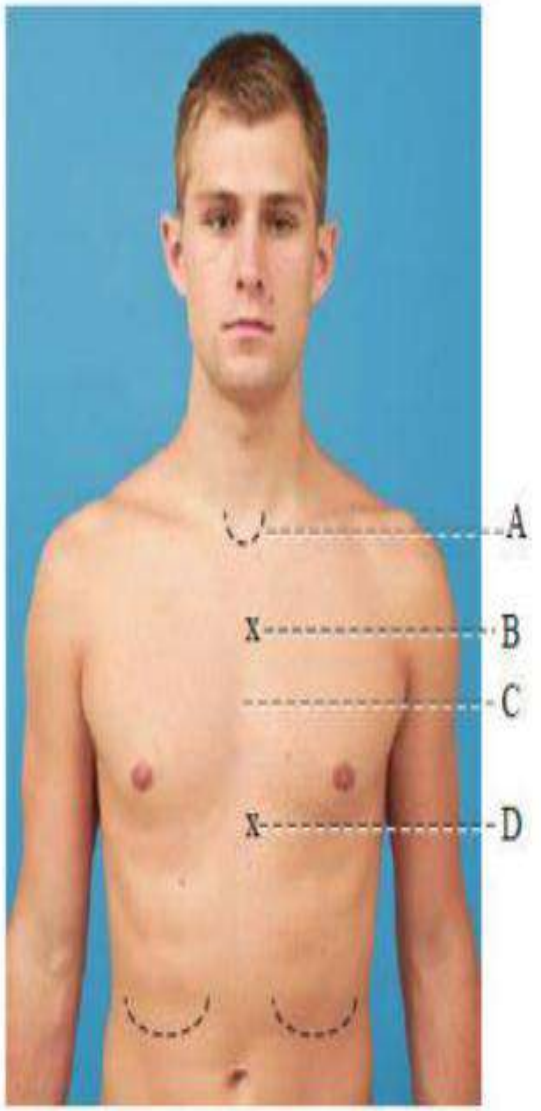


A frequently used landmark is the level of T7.

- Anteriorly, it is located about (8 to 10 cm) inferior to the jugular notch or at the midpoint of the jugular notch and the xiphoid process.

- Posteriorly, this is about (18 to 20 cm) below the vertebra prominens (C).

- This landmark indicates the approximate center of the 12 thoracic vertebrae because the inferior vertebrae are larger than the superior ones.



Thoracic Spine

BASIC PROJECTIONS

ANTERO-POSTERIOR

LATERAL

Antero-posterior – basic

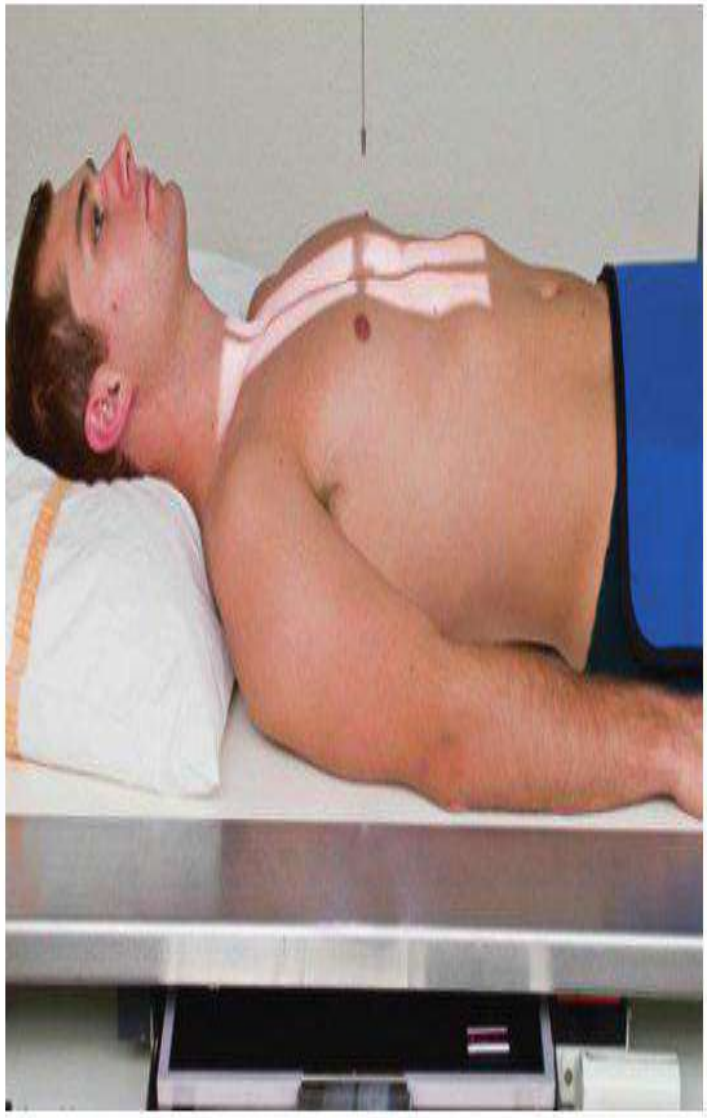
Position of patient and cassette

-The patient is positioned supine on the X-ray table, with the median sagittal plane perpendicular to the tabletop and coincident with the midline of the Bucky.

• Flex knees and to reduce thoracic curvature.

• Ensure that no rotation of thorax or pelvis.

-The upper edge of a cassette, which should be at least 40 cm long for an adult , should be at a level just below the prominence of the thyroid cartilage to ensure that the upper thoracic vertebrae are included.

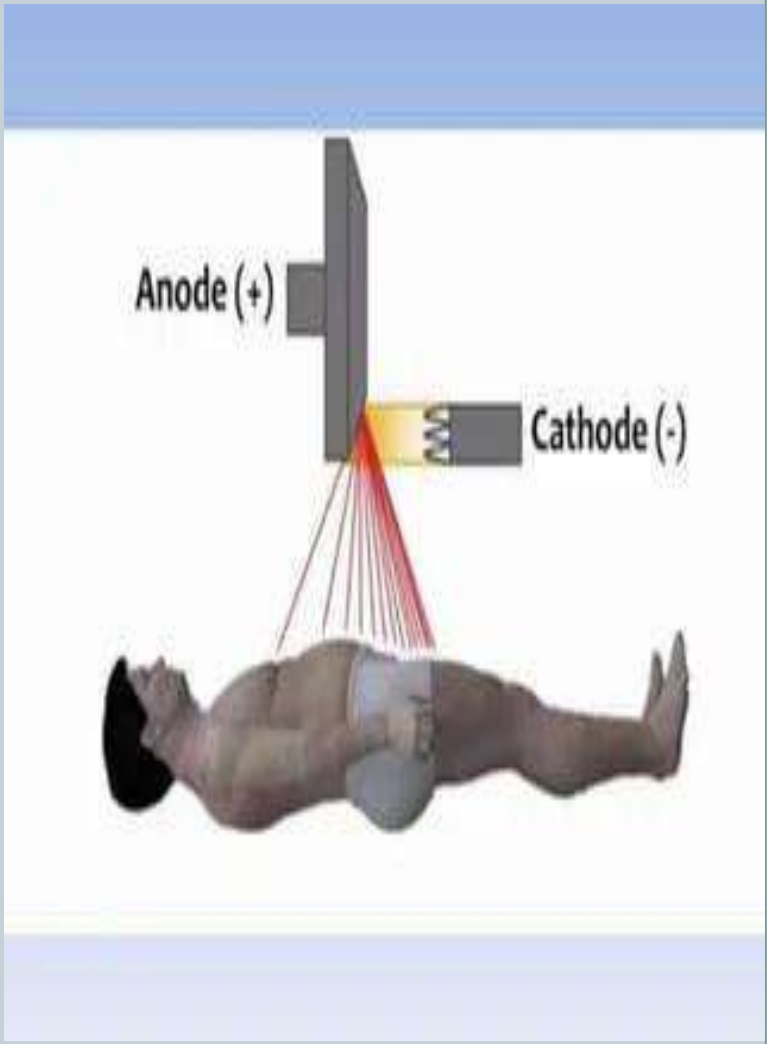


** Make exposure on arrested inspiration. This will cause the diaphragm to move down over the upper lumbar vertebra, thus reducing the chance of a large density difference appearing on the image from superimposition of the lungs.

* The radiographer can employ a number of strategies to reduce the high radiographic contrast associated with this region. The use of a relatively high kVp (80 kVp or more) will usually lower the radiographic contrast, thus demonstrating all the vertebrae within the useful density range.

• The anode heel effect can also be applicated by positioning the anode cranially and the cathode caudally.

(The heel effect is due to **attenuation at the anode**, causing less x-rays to be produced at the node side).



Radiographic contrast too high

Lower contrast producing acceptable density for upper and lower vertebra

Direction and centring of the X-ray beam

-Direct the central ray at right-angles to the cassette and towards a point 2.5 cm below the sternal angle at T7 or [8 to 10 cm] below jugular notch.

-Collimate tightly to the spine.

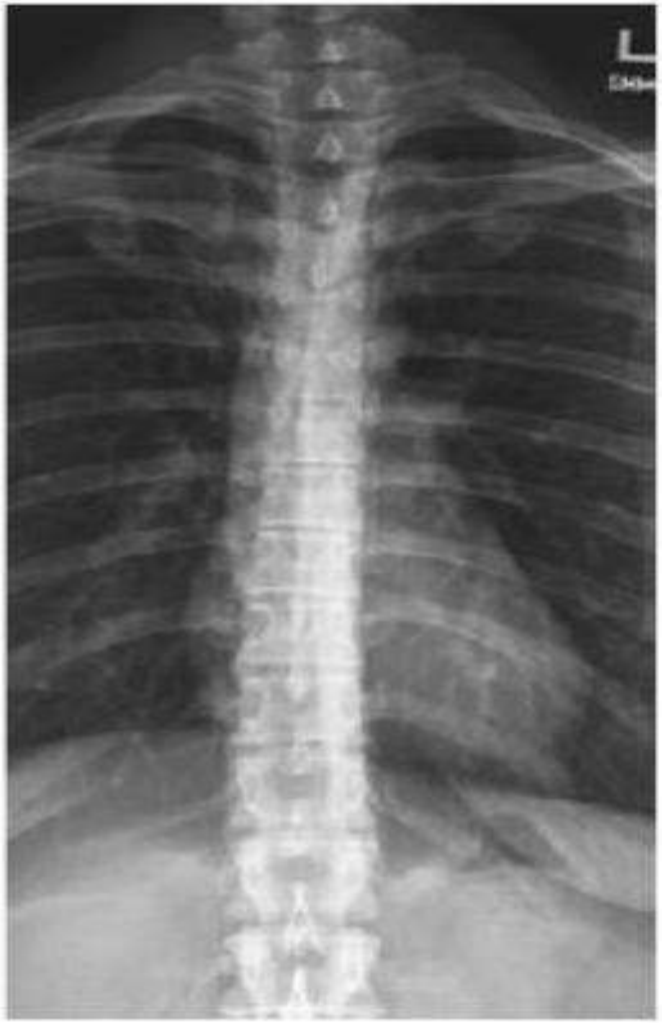


Fig. 8.81 AP thoracic spine.

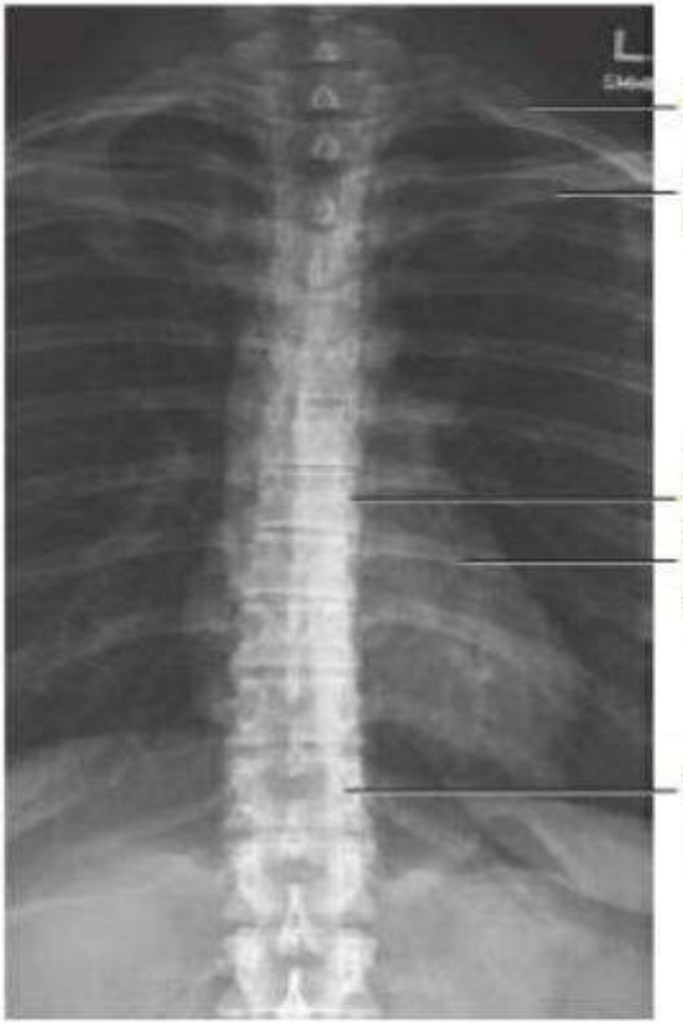


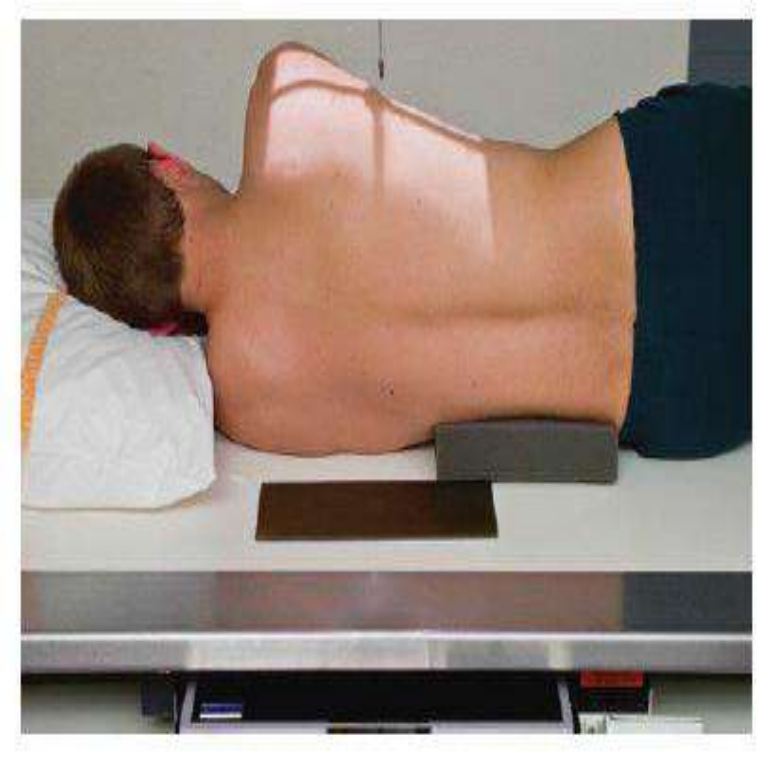
Fig. 8.82 AP thoracic spine.

Lateral – basic

Position of patient and cassette

- Usually undertaken with the patient in the lateral decubitus position on the X-ray table, although this projection can also be performed erect.
- Raise patient's arms to right angles to body with elbows flexed.
- The median sagittal plane should be parallel to the cassetteand the midline of the axilla coincident with the midline of the table or Bucky.

- The head can be supported with a pillow .
- The upper edge of the cassette should be at least 40 cm in length and should be positioned 3–4 cm above the spinous process of C7.



Direction and centring of the X-ray beam

• The central ray should be at right-angles to the long axis of the thoracic vertebrae. This may require a caudal angulation.

• Centre 5 cm anterior to the spinous process of T7. This is usually found just below the inferior angle of the scapula ,which is easily palpable or 20 cm below spinous process of C7.

The posterior ribs should be superimposed, thus indicating

that the patient was not rotated too far forwards or backwards.

Fig. 8.84 Lateral thoracic with breathing technique.

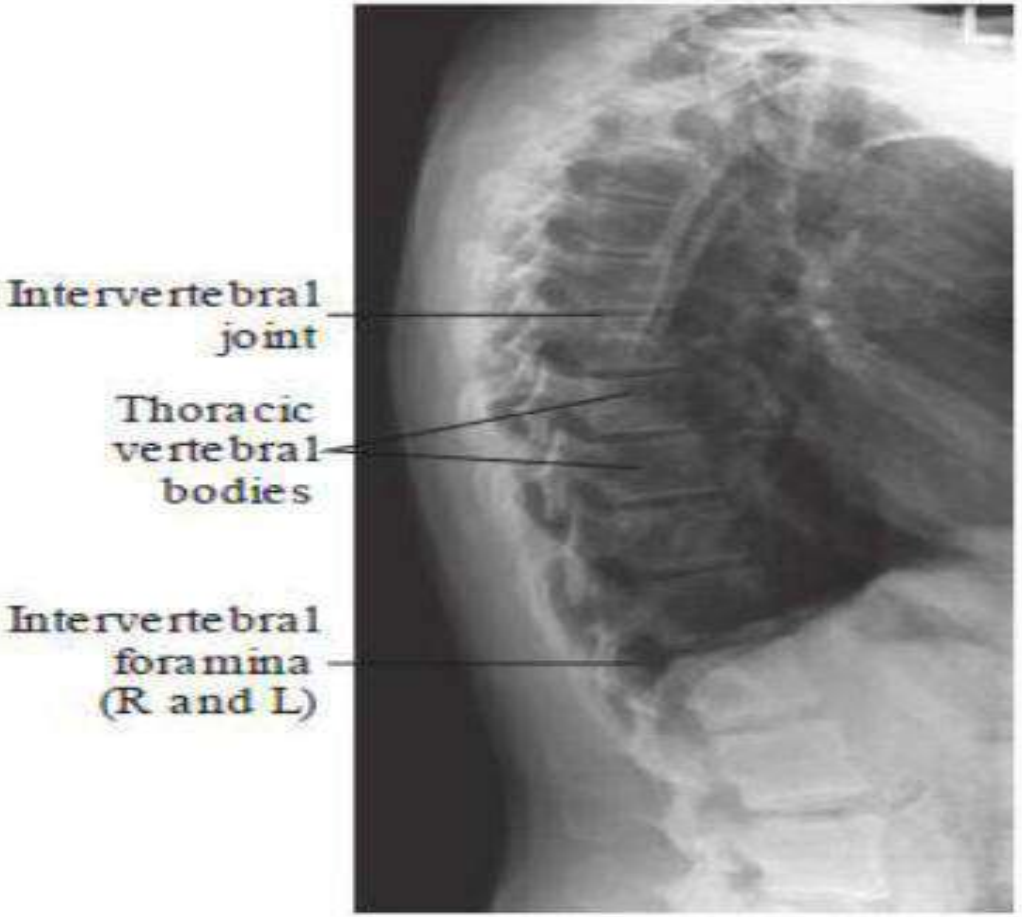


Fig. 8.85 Lateral thoracic spine.

ANTERIOR OR POSTERIOR OBLIQUE :

Clinical Indications

- Pathology involving the zygapophyseal joints of the thoracic spine

= Both right and left oblique projections are taken for comparison

Position of patient and cassette

- Oblique Anterior or Posterior Recumbent or Erect Positions
- Rotate the body 20° from true lateral to create a 70° oblique from plane of table..
- Flex hips, knees, and arms for stability as needed.
- Align spinal column to CR and midline of table.

- **Posterior Oblique Position (Recumbent)**
- LPO or RPO: Place arm nearest table up and forward; arm nearest tube down and posterior

Anterior Oblique Position (Recumbent)

- LAO or RAO: Place arm nearest table down and posterior; arm nearest tube up and forward

Fig. 8.86 Posterior oblique (RPO).

Fig. 8.87 Anterior oblique (LAO).

Erect Anterior Oblique Position

- Rotate total body, shoulders, and pelvis 20° anterior from lateral.
- Flex elbow and place arm nearest IR on hip.
- Raise opposite arm and rest on top of head

Fig. 8.88 Erect anterior oblique (RAO) thoracic spine.

Direction and centering of the X-ray beam

- The central ray perpendicular to IR.
- Direct CR to T7 [8 to 10 cm] below jugular notch or 20 cm below spinous process of C7.

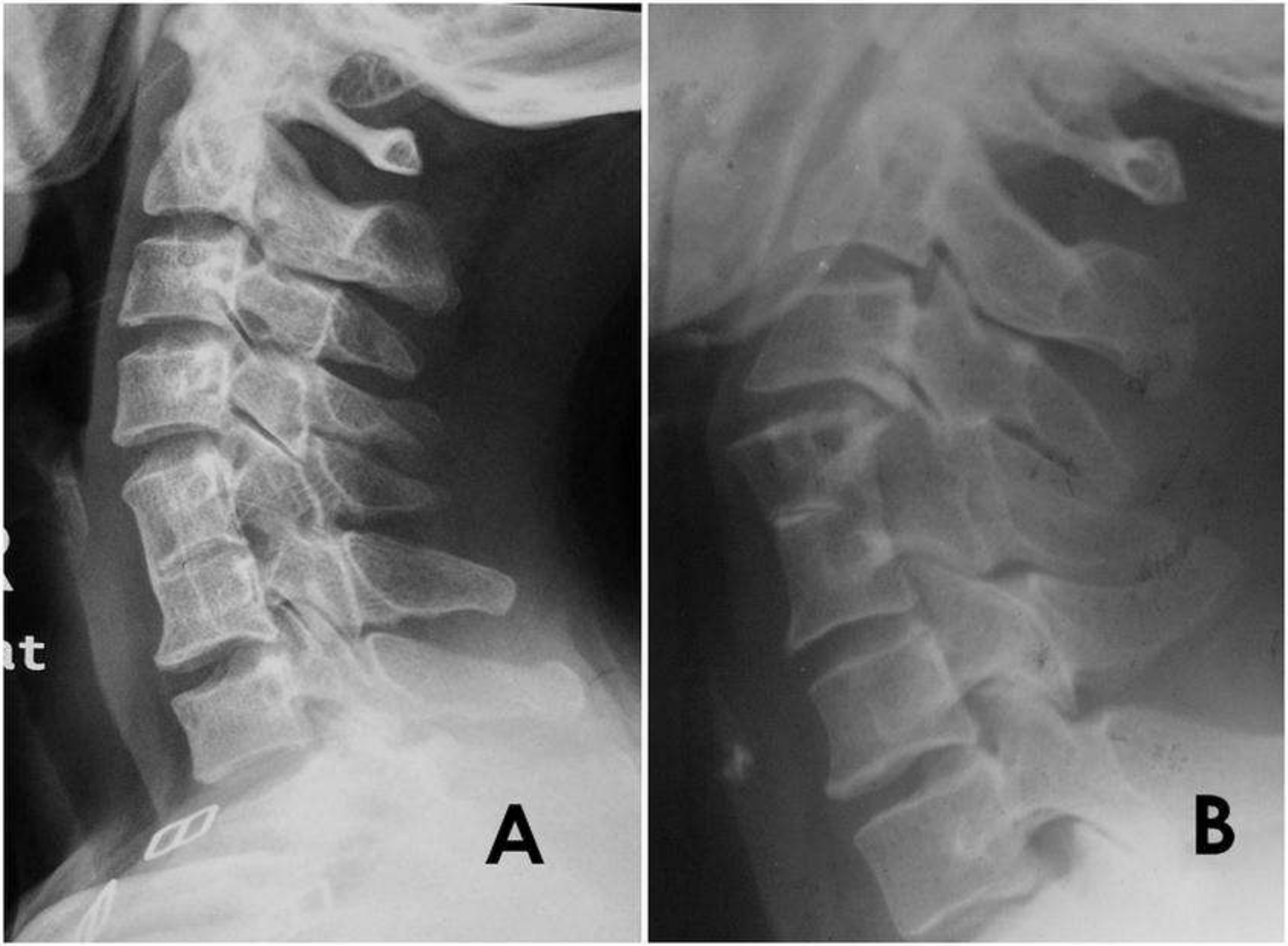
Fig. 8.89 RAO thoracic spine.

Fig. 8.90 RAO thoracic spine.

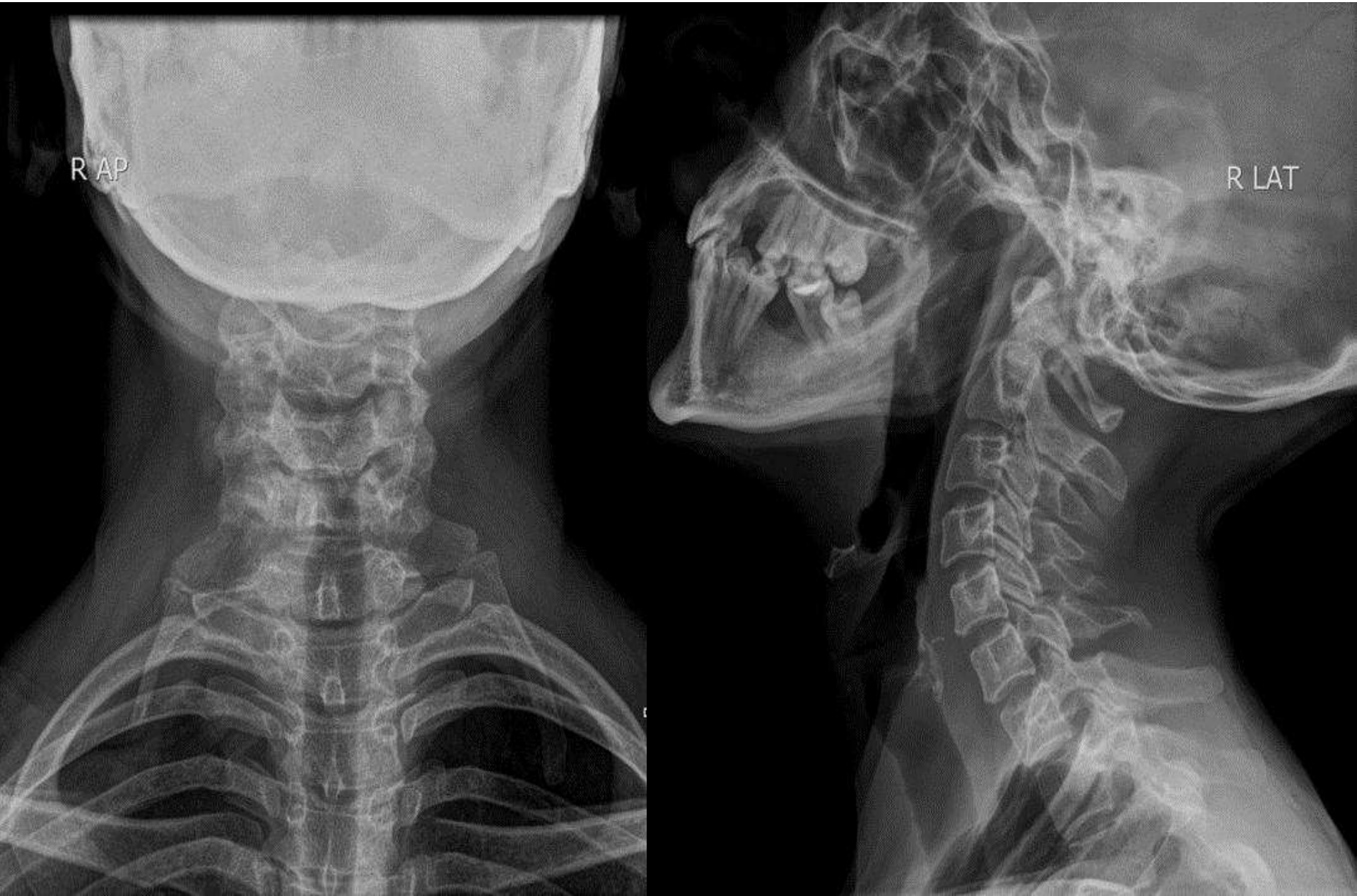
تصوير نظري-11-

Cases review for the spinal column

د.احمد مذخر الغبشة

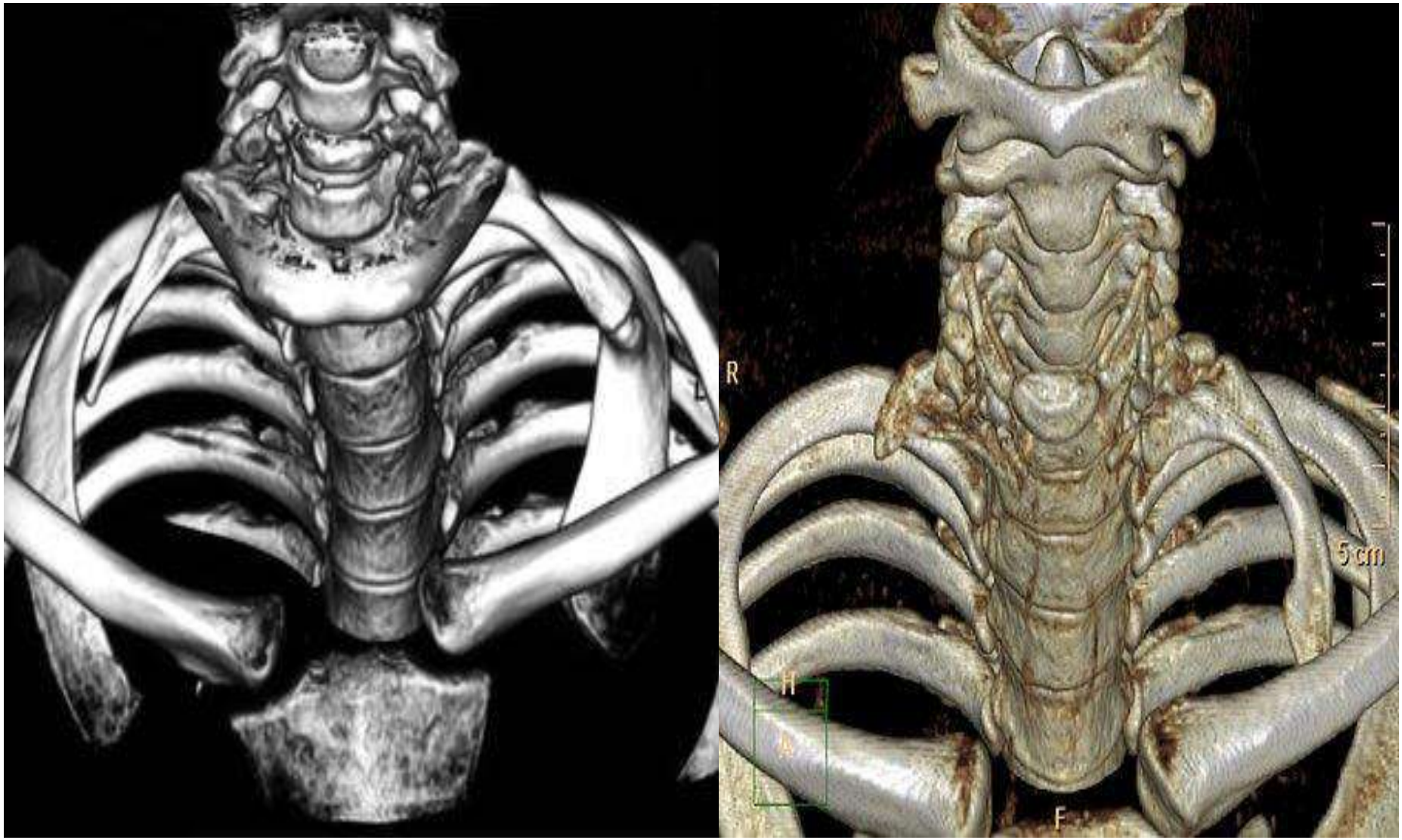

A
B


C2
C3
C4
C5
C6
C7


R AP
R LAT


4cm
R
4cm

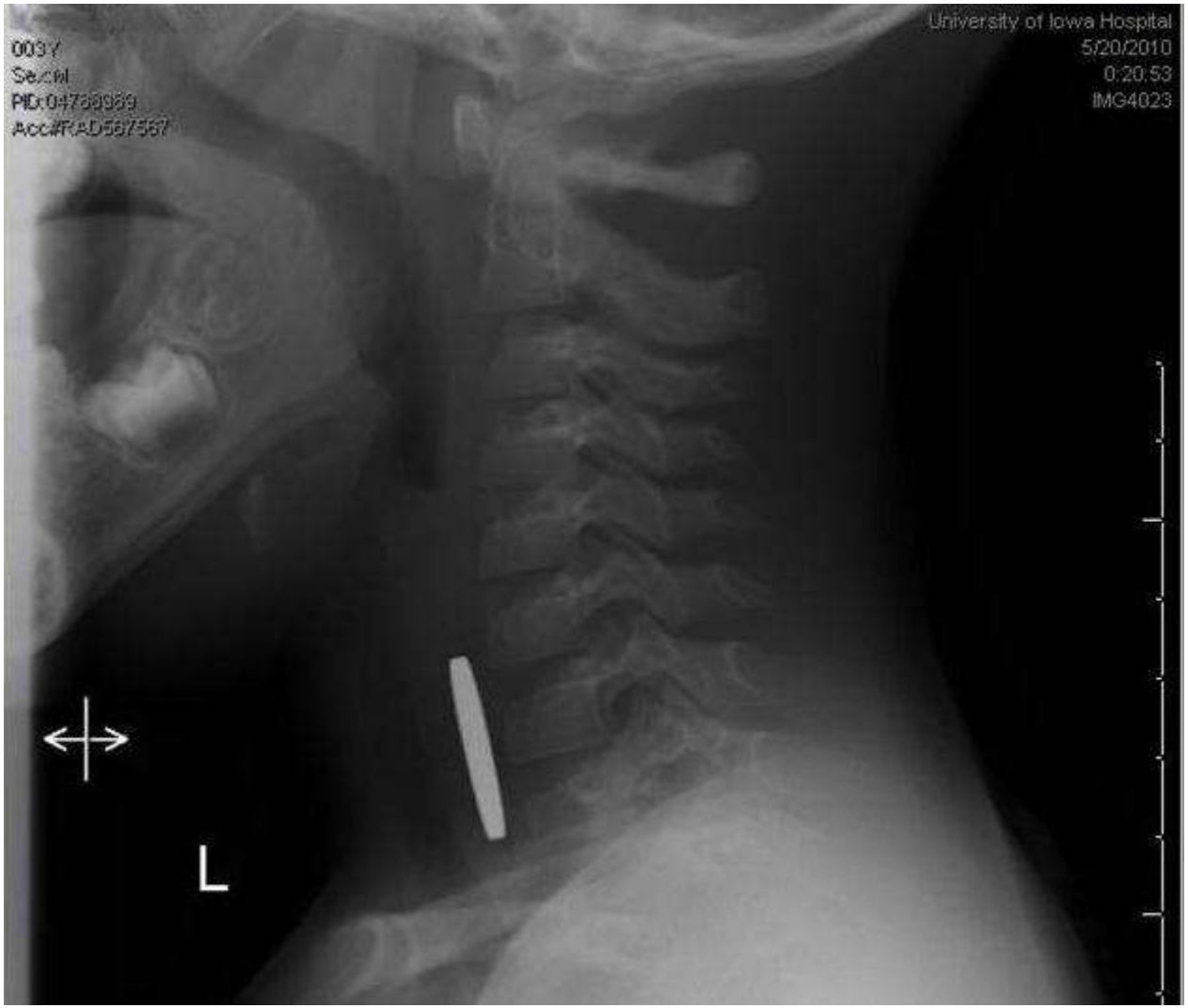

R


R
5 cm
H
A
F


Cervical Rib
L


LT


L
R


University of Iowa Hospital
5/20/2010
0:20:53
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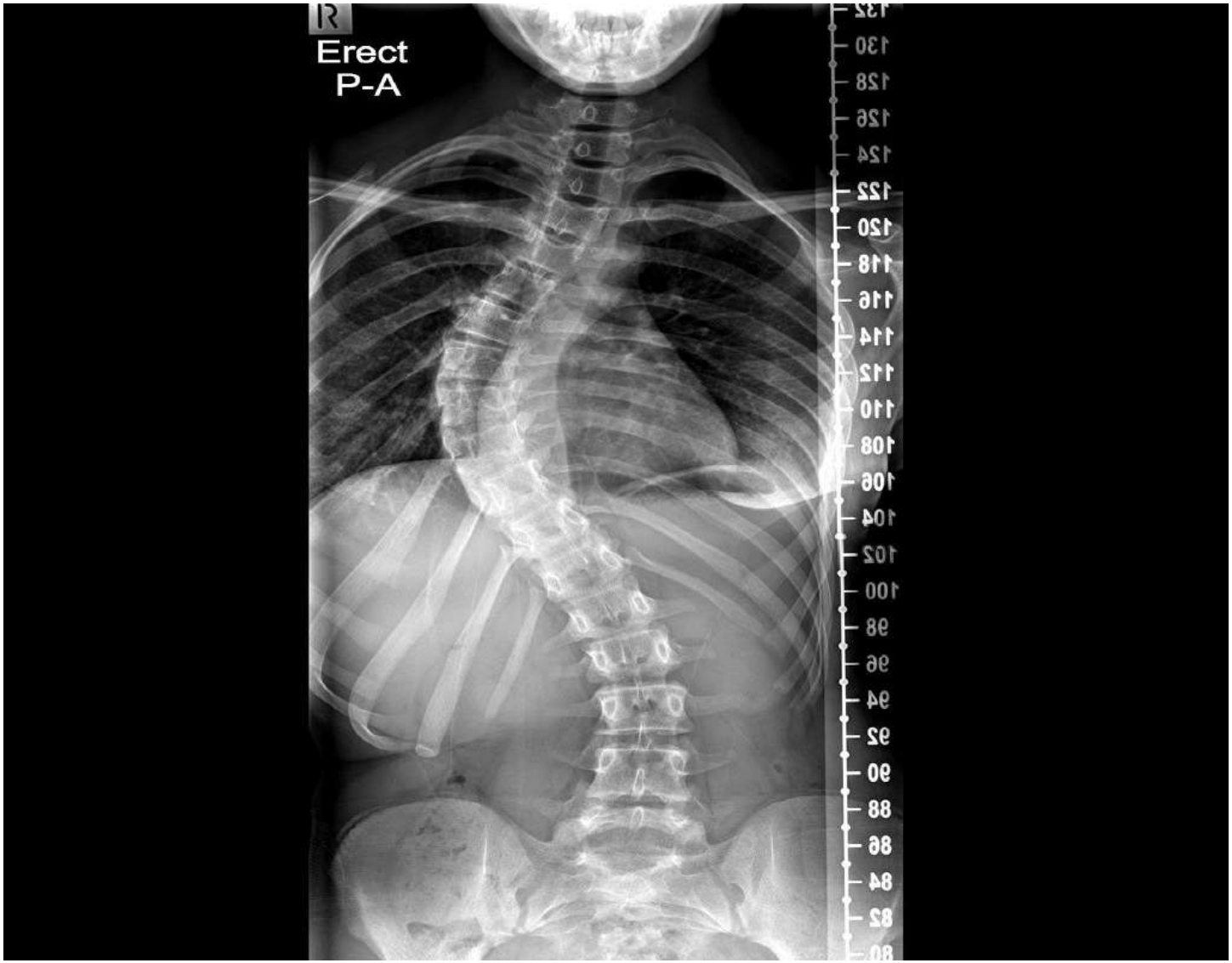
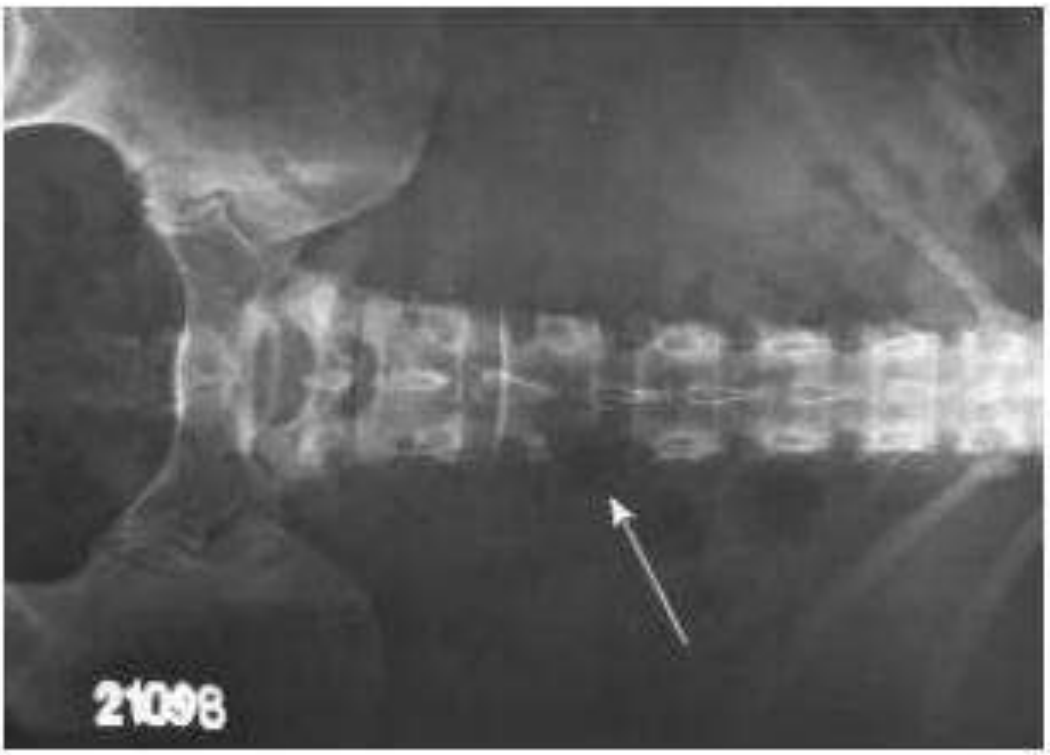
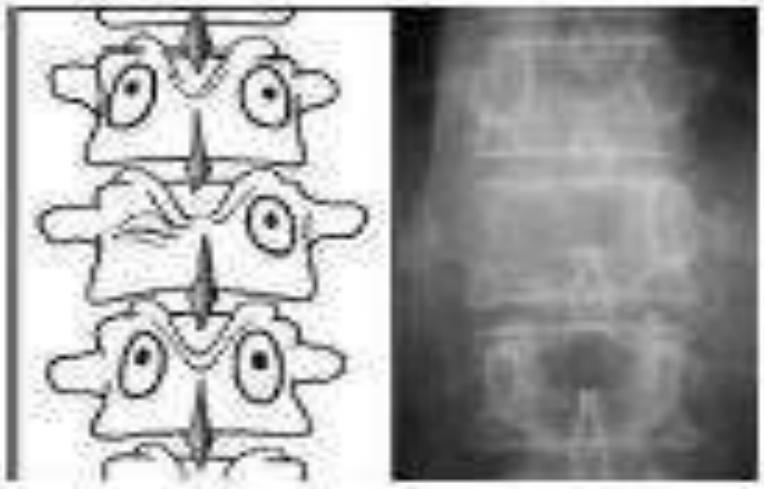
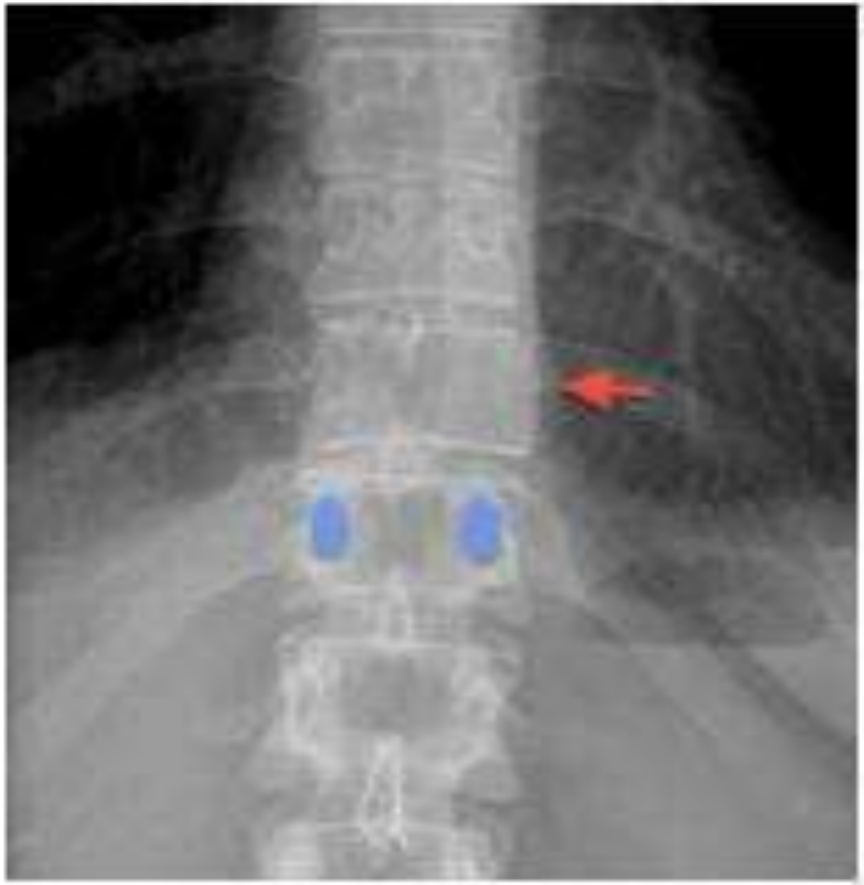
L


R
Erect
P-A


R
stehend


21098





CERVICAL MYELOGRAPHY

This performed by introduction of contrast medium into the thecal sac by cervical canal puncture at C l/2 or by lumbar puncture .

Indications
Suspected spinal cord pathology or root compression in patients unable or unwilling to undergo MRI imaging.

Cervical versus lumbar injection

Cervical puncture is quick, simple, safe and reliable, but is contra-indicated in patients with suspected high cervical pathology, and where the normal bony anatomy and landmarks are distorted or lost by anomalous development or rheumatoid disease.
Complications are rare but include vertebral artery damage and inadvertent cord puncture.
Cervical puncture is particularly indicated where there is severe lumbar disease, which may restrict the flow of contrast medium, and which may make lumbar puncture difficult, and when there is thoracic spinal canal stenosis.

When lumbar injection is used, a good lumbar study is possible without dilution, following which a cervical and thoracic study is entirely feasible.

Lumbar injection for cervical myelography is as effective as cervical injection when nothing restricts the upward flow of contrast medium.

The post-procedural morbidity, mainly consisting of headache is rather less after cervical puncture.

Technique

1. The patient lies prone with arms at the sides and the neck is in a neutral position or in slight extension. Marked hyperextension is undesirable, particularly in those with spondylosis, who comprise the majority of patients referred for this procedure. In such cases it will further compromise a narrowed canal and may produce symptoms of cord compression.

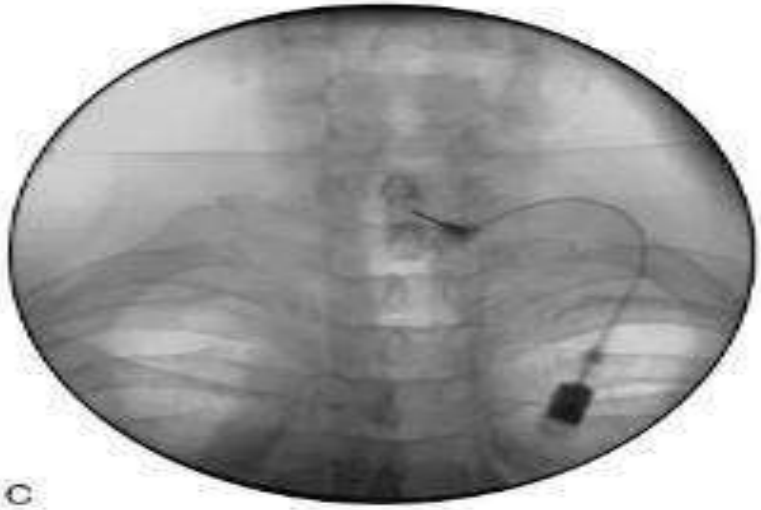
2. Using lateral fluoroscopy the C l/2 space is identified. Head and neck adjustments may be needed to ensure a true lateral position.
The aim is to puncture the subarachnoid space between the laminae of C1 and C2, at the junction of the middle and posterior thirds of the spinal canal, i.e. posterior to the spinal cord.
A 20-G spinal needle is used.

FIGURE 15.14 Lateral cervical myelography.

3. Using aseptic technique, the skin and subcutaneous tissues are anaesthetized with 1% lignocaine.
The spinal needle is introduced , Lateral fluoroscopy is used to adjust the direction of the needle, and ensure the maintenance of a perfect lateral position as the needle is advanced. It is very helpful if a nurse steadies the patient's head.

A

B



C

4. The sensation of the needle penetrating the dura is similar to that experienced during a lumbar puncture and the patient may experience slight discomfort at this stage.
Severe acute neck or radicular pain indicates that the needle has been directed too far anteriorly and has come into contact with an exiting nerve root.
Clumsy technique is known to have caused cord puncture, but permanent neurological damage as a result is unlikely.

5. Following removal of the stilette, CSF will drip from the end of the needle, and a sample may be collected if required.
6. Under fluoroscopy a small amount of contrast medium is injected to verify correct needle tip placement. This will flow away from the needle tip and gravitate anteriorly to layer behind the vertebral bodies.

7. Injection is continued slowly until the required dose has been delivered. The cervical canal should be opacified anteriorly from the foramen magnum to C7/T1.
If contrast tends to flow into the head before filling the lower cervical canal, tilt the table feet down slightly, and vice-versa if contrast is flowing into the thoracic region without filling the upper cervical canal.
The total dose should not exceed 3 g of iodine, i.e. 10 ml of contrast medium with a concentration of 300 mg/ml. Adequate filling usually only requires 7-8 ml, or even less when the canal is narrow.

https://www.youtube.com/watch?v=LTBdzNti26g
https://www.youtube.com/watch?v=Ngqgorv1XMY

Cervical Myelography Radiographs

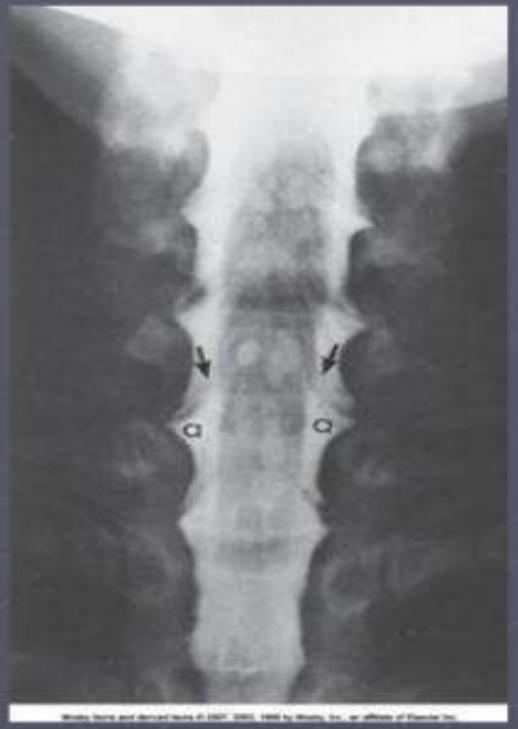
Overheads:

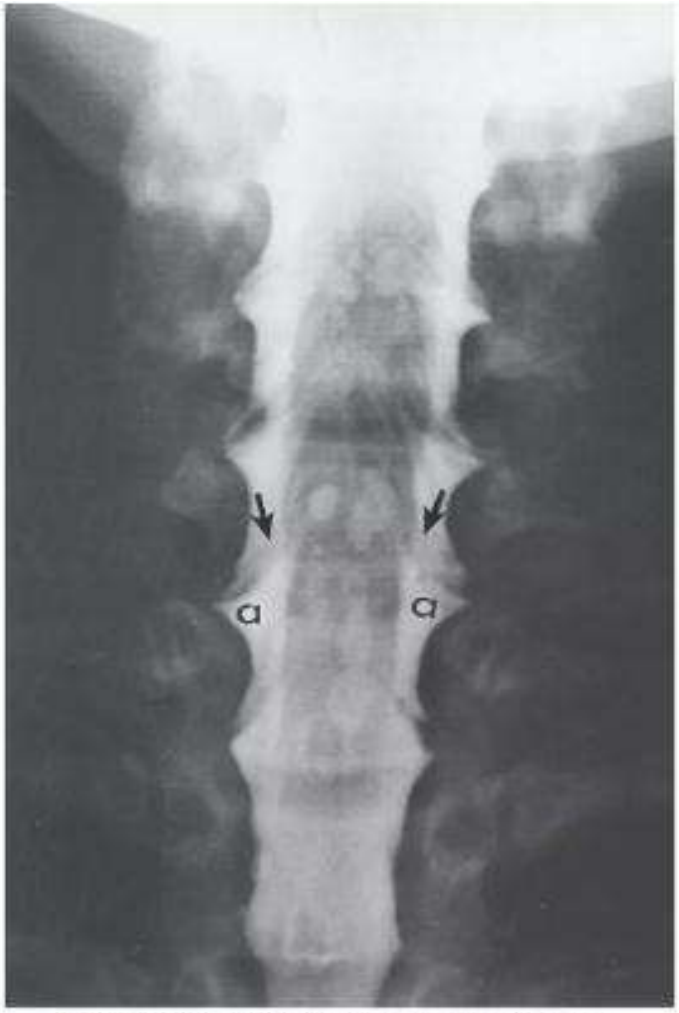
PA
PA Oblique projections
Cross-table lateral films

(flexion and extension)

FIGURE 15.14 Lateral cervical myelography.

Cervical Myelogram





CERVICAL MYELOGRAM
LATERAL VIEW

CERVICAL
MYELOGRAM
LATERAL VIEW

IODINATED
CONTRAST
IN THECAL
SAC

Oblique and anteroposterior myelogram. A large filling defect is seen...

Aftercare of Myelography

Many centres request the patient to remain sitting or semi-recumbent for about 6 h, however allowing the patient to remain ambulant does not increase the incidence of side-effects.

A high fluid intake is generally encouraged, though evidence for its usefulness is lacking.

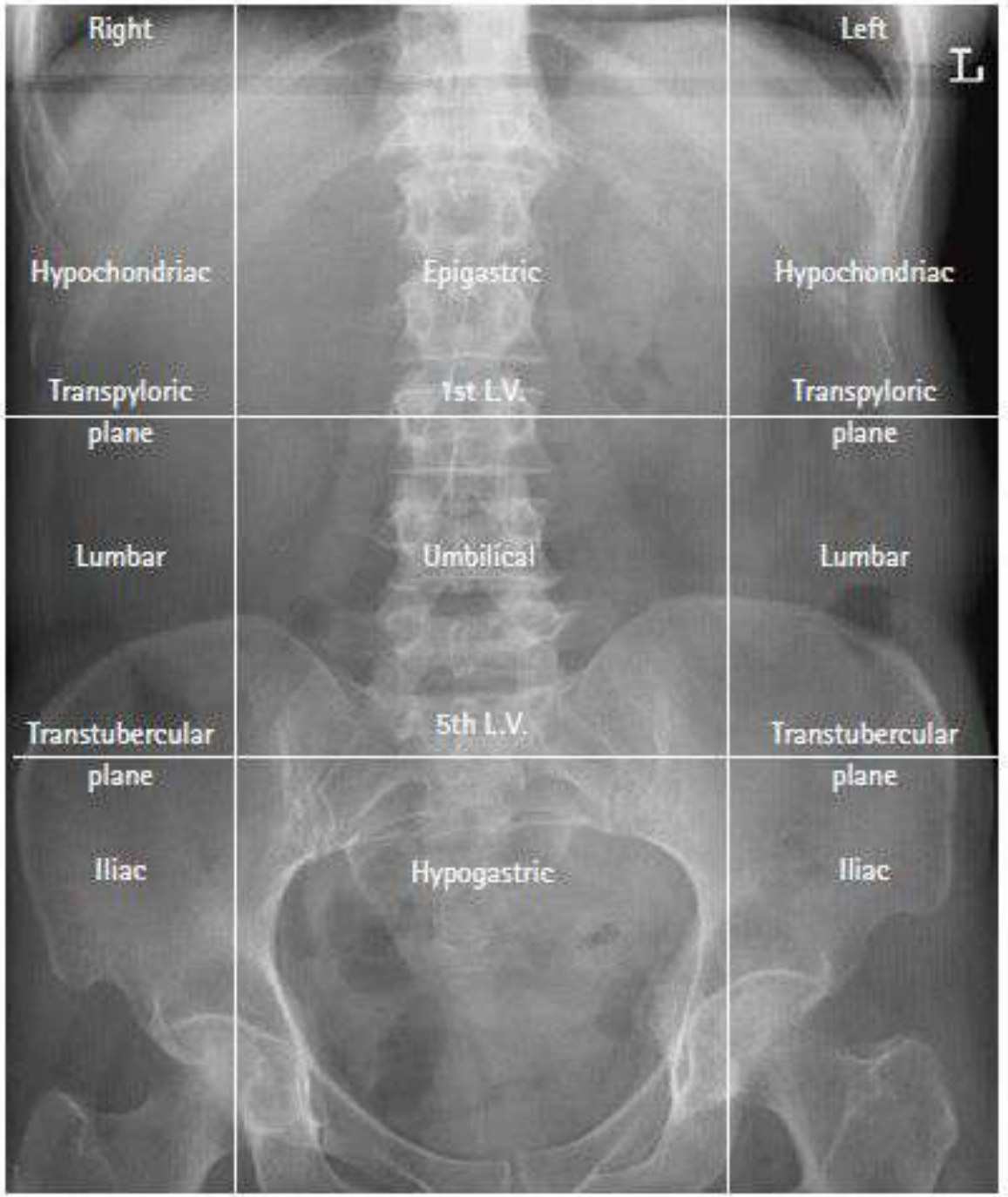
Complications of Myelography

1. Headache occurs in about 25% of cases, and is a little more frequent in females.
2. Nausea and vomiting in about 5%.
3. Infection and hemorrhage at site of puncture .
4. Subdural injection of contrast medium. This occurs when only part of the needle bevel is within the subarachnoid space.
5. Extradural injection of contrast medium outlines the nerve roots well beyond the exit foramina.
6. Intramedullary injection of contrast medium. This is a complication of lateral cervical puncture and is recognized as a slit-like collection of contrast medium in the spinal canal. Small collections are without clinical significance.

☛Limitations of Myelogram :-

* Its only sees inside the spinal canal & the very proximal nerve roots. Abnormalities outside these areas may be better imaged with MRI
* It may be difficult to inject contrast material in patients with structural defects of the spine or some forms of spinal injury
* Myelogram usually is avoided during pregnancy.

ABX Cases



د.احمد مذخر الغبشة

Pneumoperitoneum

Means free gas in the peritoneal cavity. It usually .indicates bowel perforation

:Main causes of pneumoperitoneum •

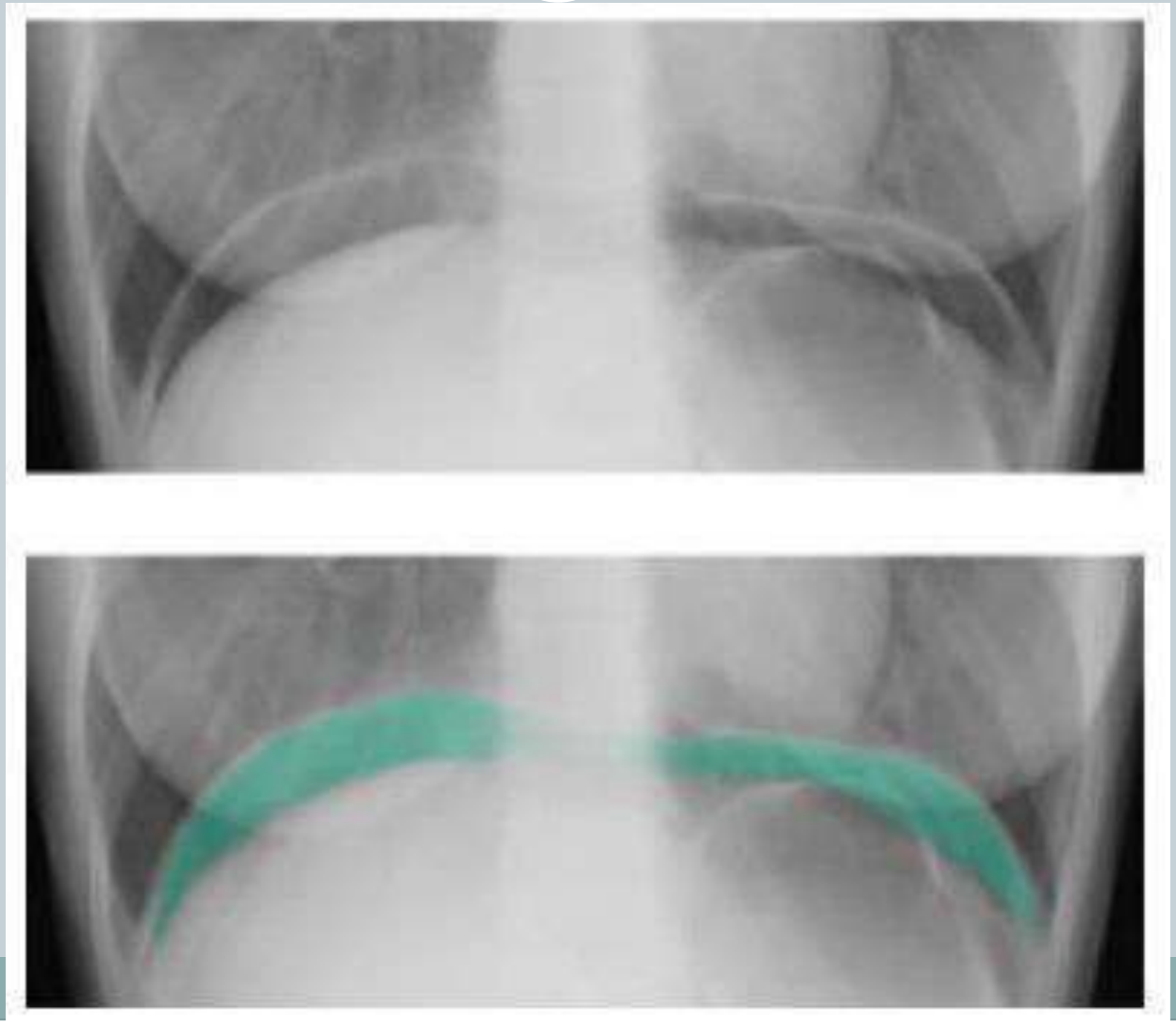
Perforated peptic ulcer .1 •

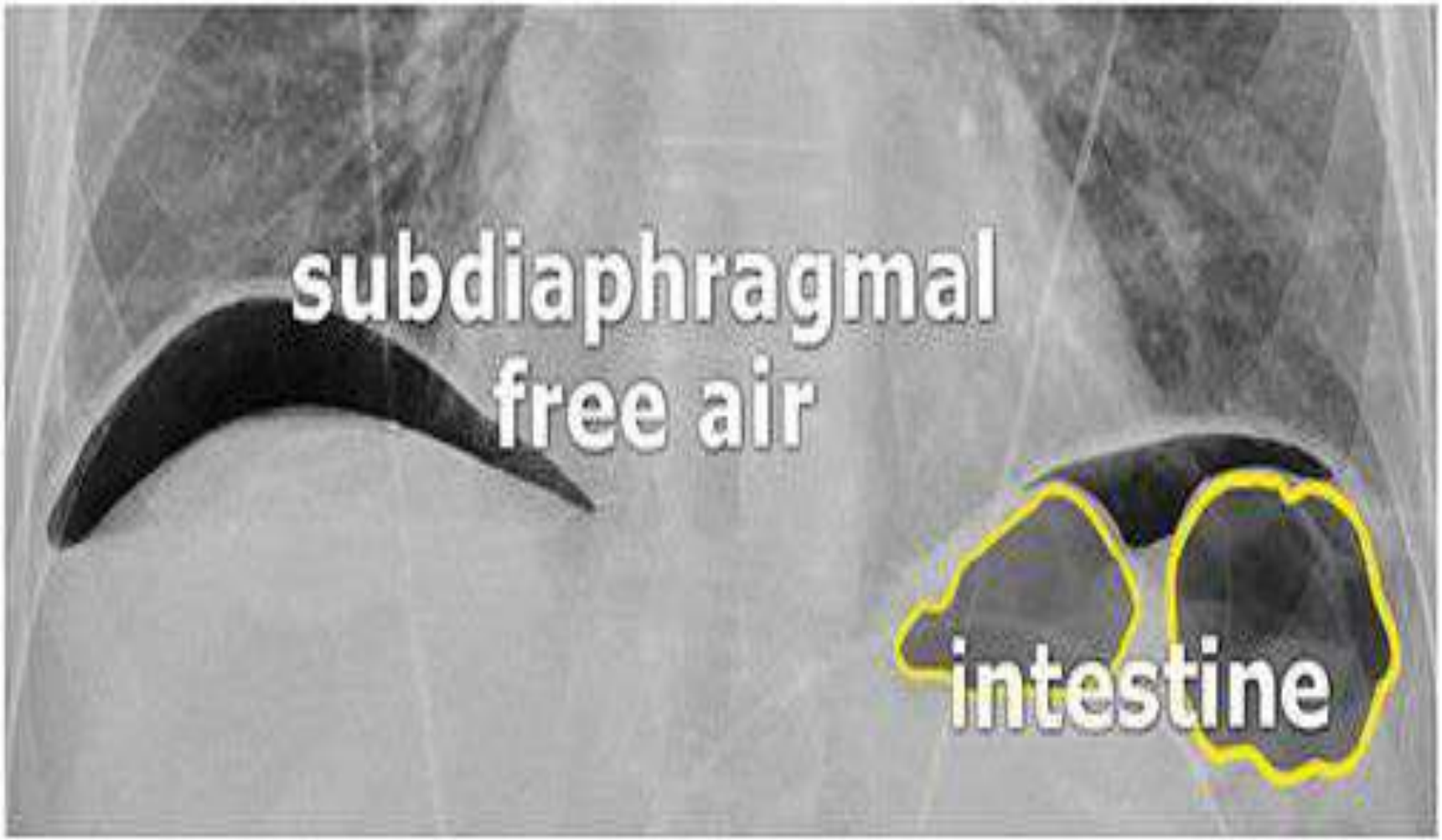
Perforated appendix/bowel diverticulum .2 •

Post-surgery , free gas may also be seen up to 3 .3 • weeks after abdominal surgery

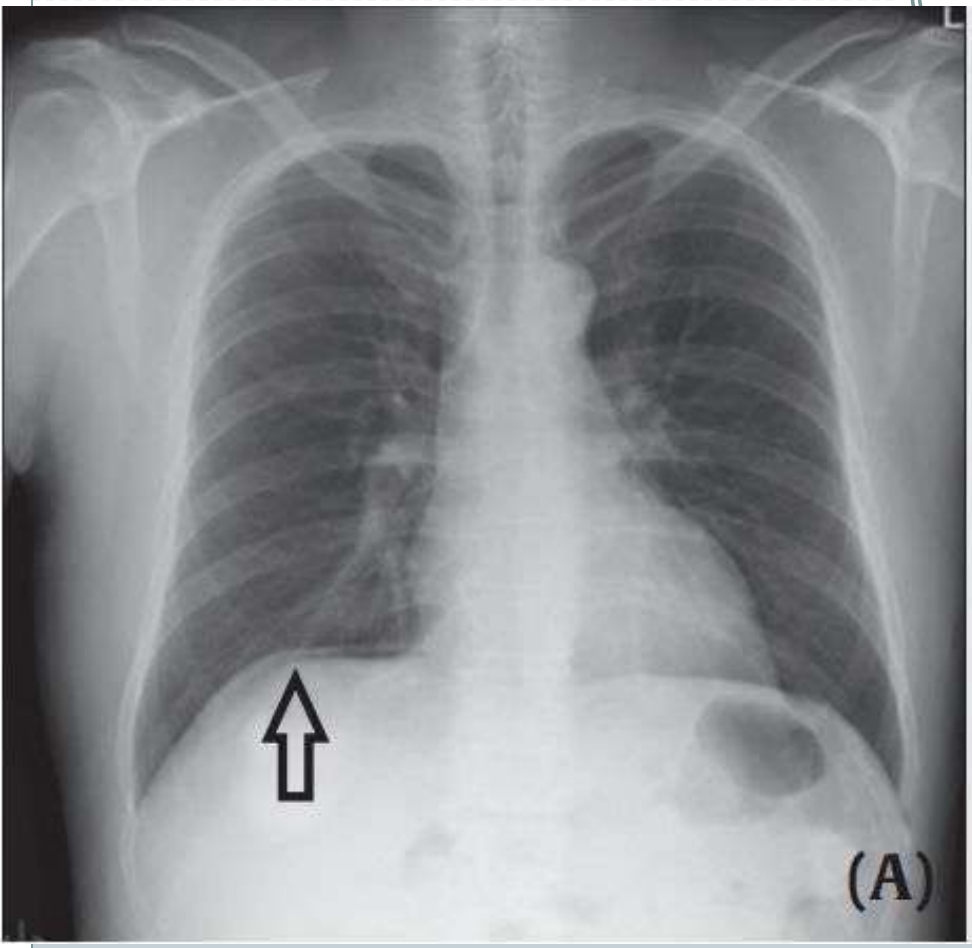
.Trauma , (e.g. stabbing) .4 •

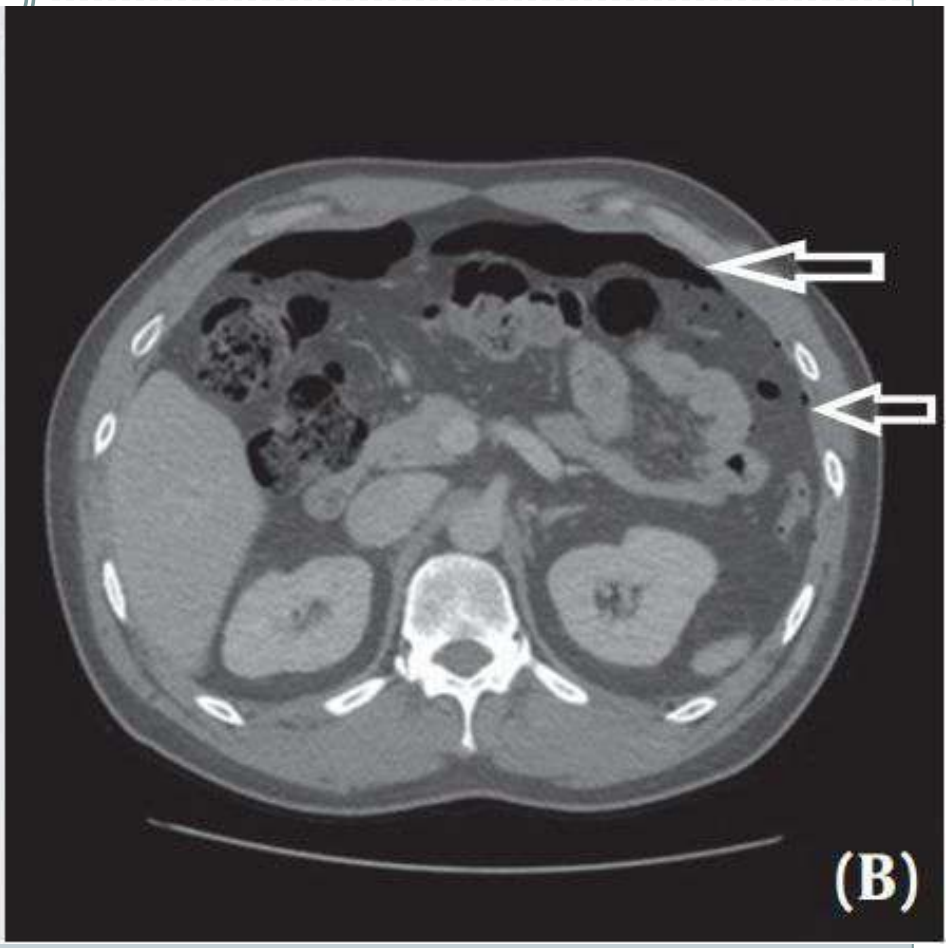
Pneumoperitoneum (gas in the peritoneal cavity)




subdiaphragmal
free air
intestine

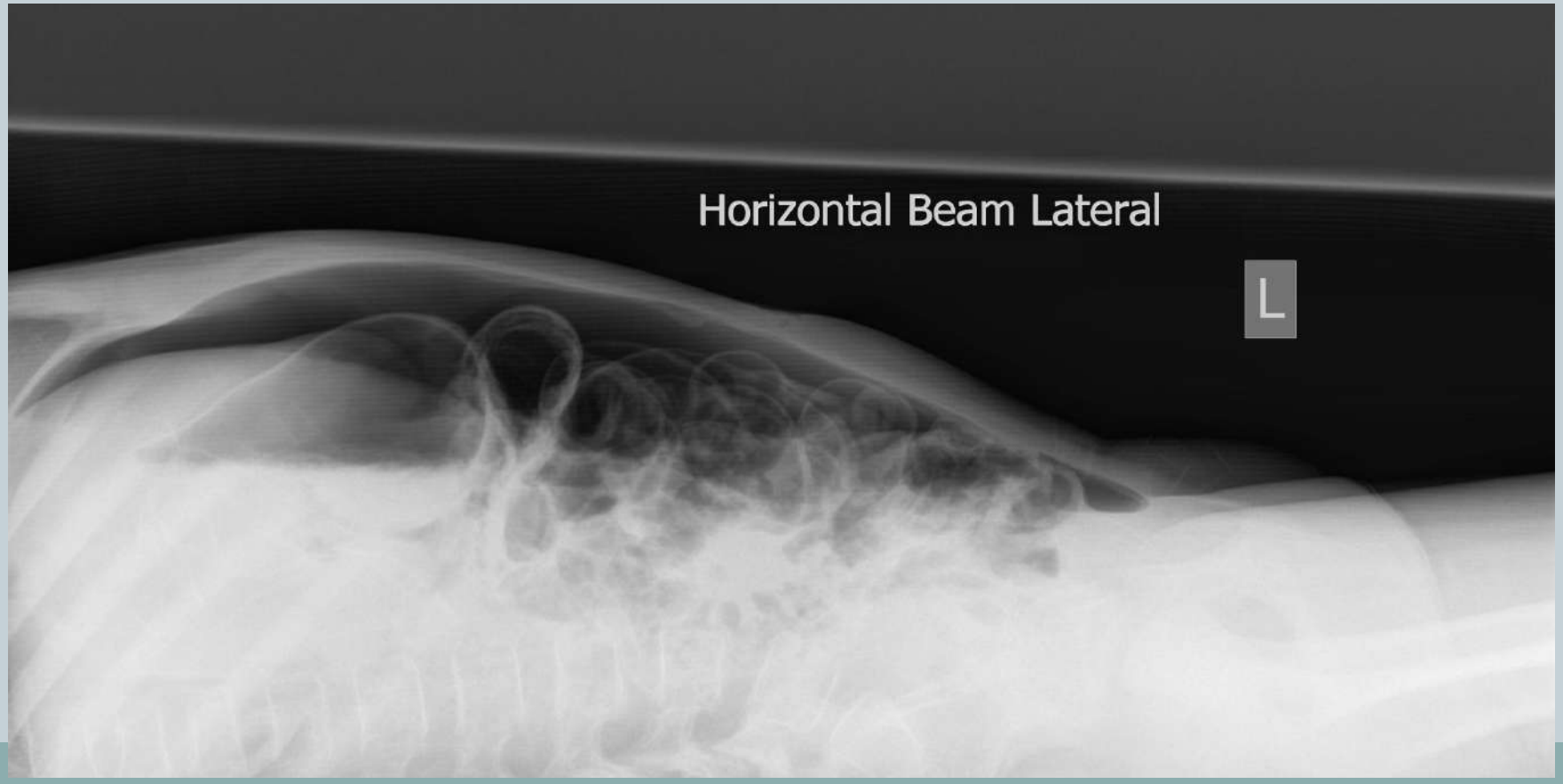

R
BKS
UPRIGHT


(A)


(B)

5) Decubitus Abdomen Sign

- Left lateral decubitus
- Air-fluid level
- White arrow = ***free air*** between the abdominal wall and the liver
- Black arrow = ***free fluid*** in the peritoneum

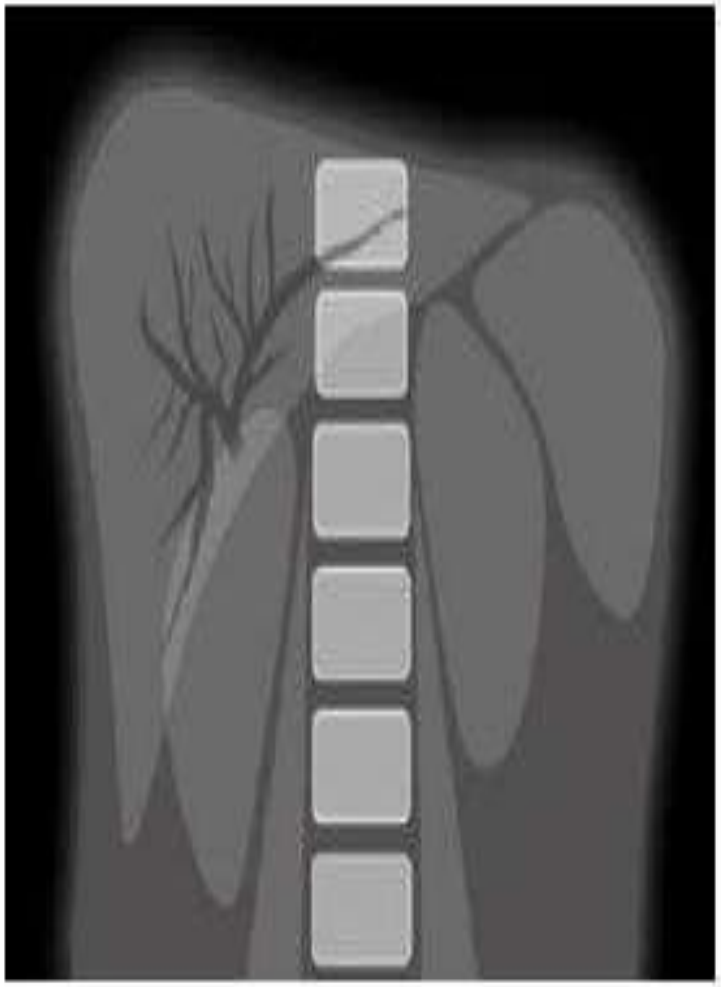

Horizontal Beam Lateral
L

Pneumobilia (gas in the biliary tree)

Pneumobilia is gas in the .biliary tree

It appears as branching dark lines in the centre of the liver, usually larger and more prominent towards the .hilum

Sometimes you can also see .gas in the common bile duct



Intestinal obstruction and bowel dilatation

:Small Bowel dilatation

.Distension of the small bowel is a sign of mechanical obstruction or ileus •

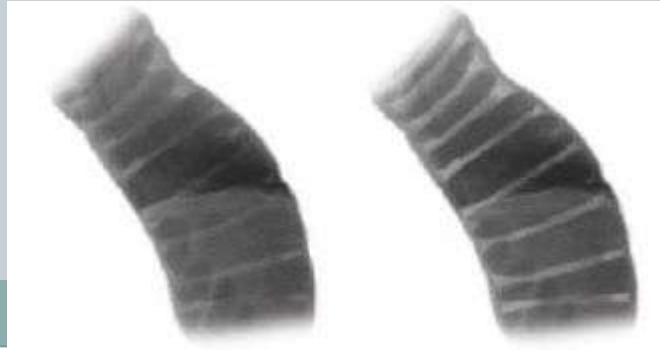
In a normal individual the small bowel is not visualised because it is •
.collapsed or contains fluid

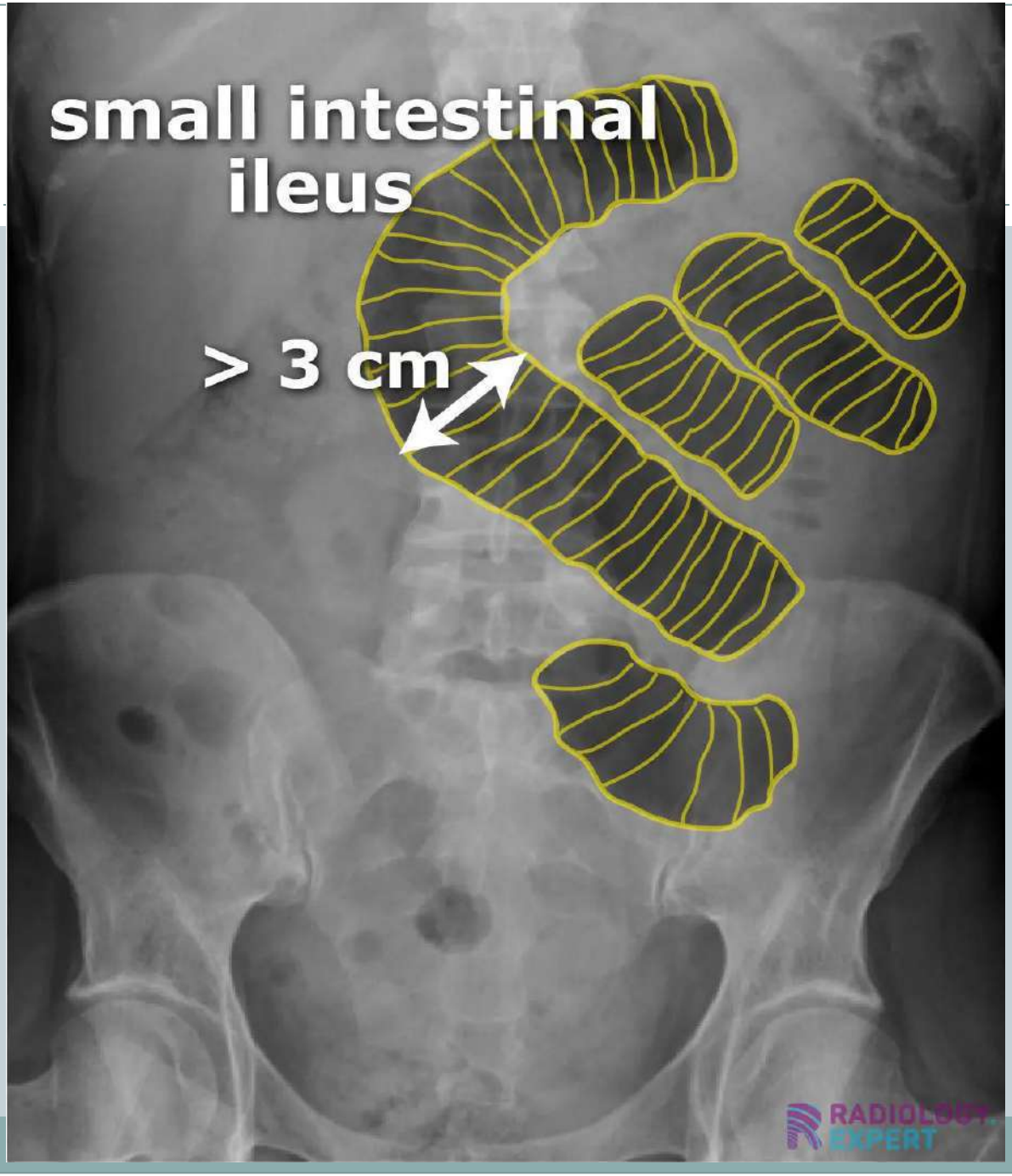
:Radiological signs to look for include the following •

Dilation >3 cm .1

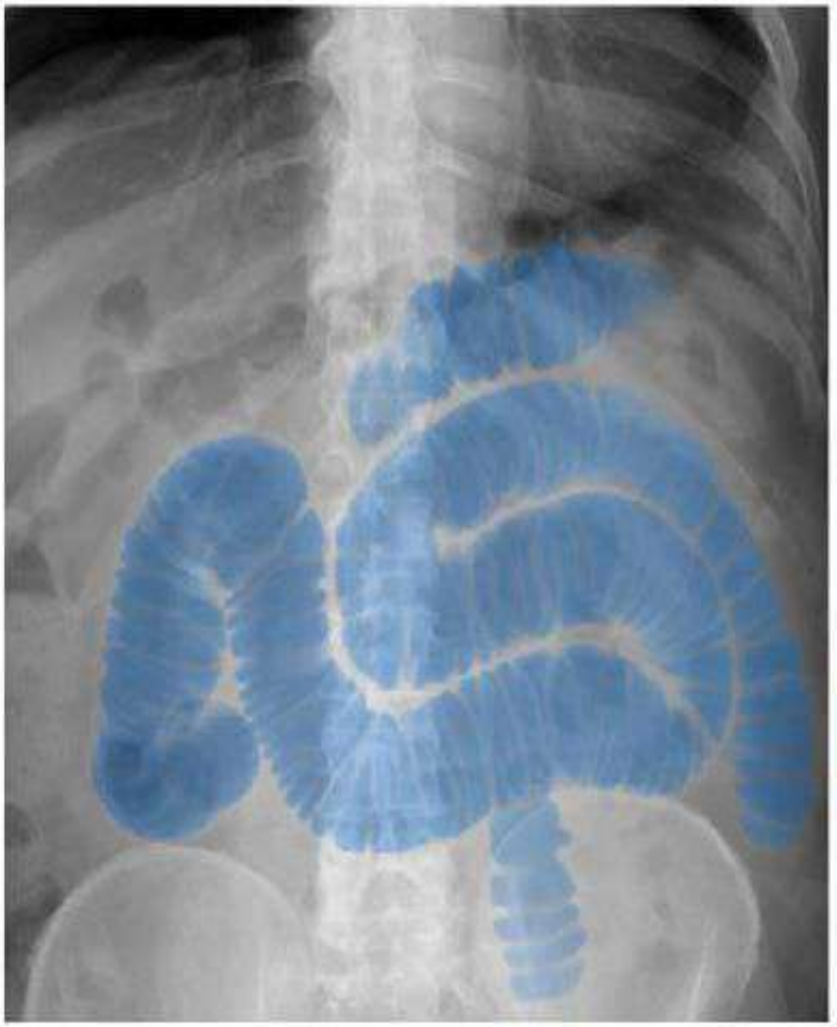
Central location .2

Valvulae conniventes: These are the mucosal folds of the small .3
intestine. They are thin, closely spaced and classically seen as a
continuous thin line across the entire width of the bowel




small intestinal
ileus
> 3 cm
RADIOLOGY
EXPERT

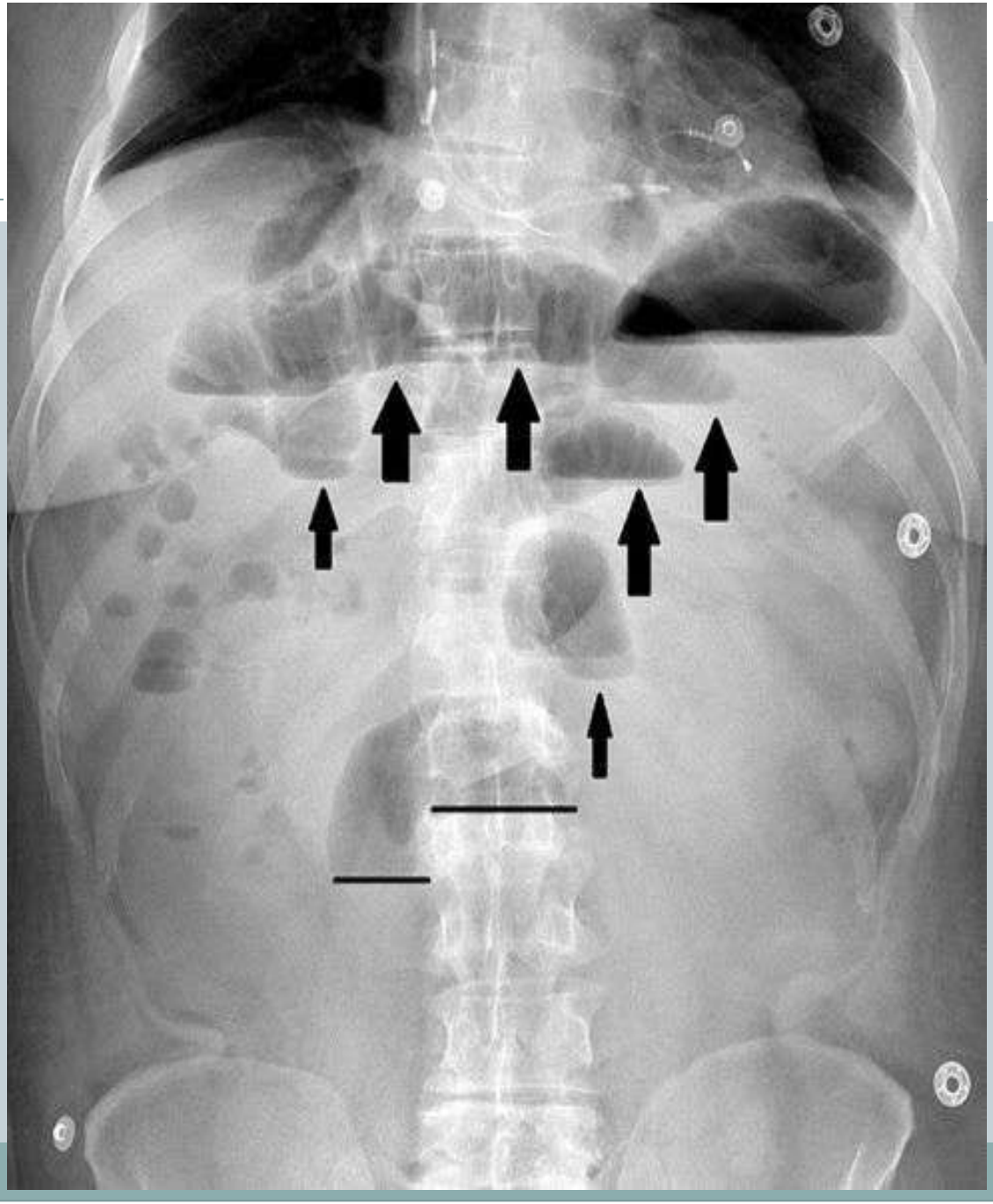
Two identical abdominal radiographs showing dilated small bowel. The bowel is visible as there is gas (black) within. You • can tell that it is small bowel as it is centrally located and valvulae conniventes can be seen throughout.
• The loops measure >3 cm in diameter therefore they are dilated. The right radiograph shows the dilated small bowel marked in blue



Erect

Multiple fluid levels with step ladder pattern

…




upright
R

Obstructed and dilated large bowel

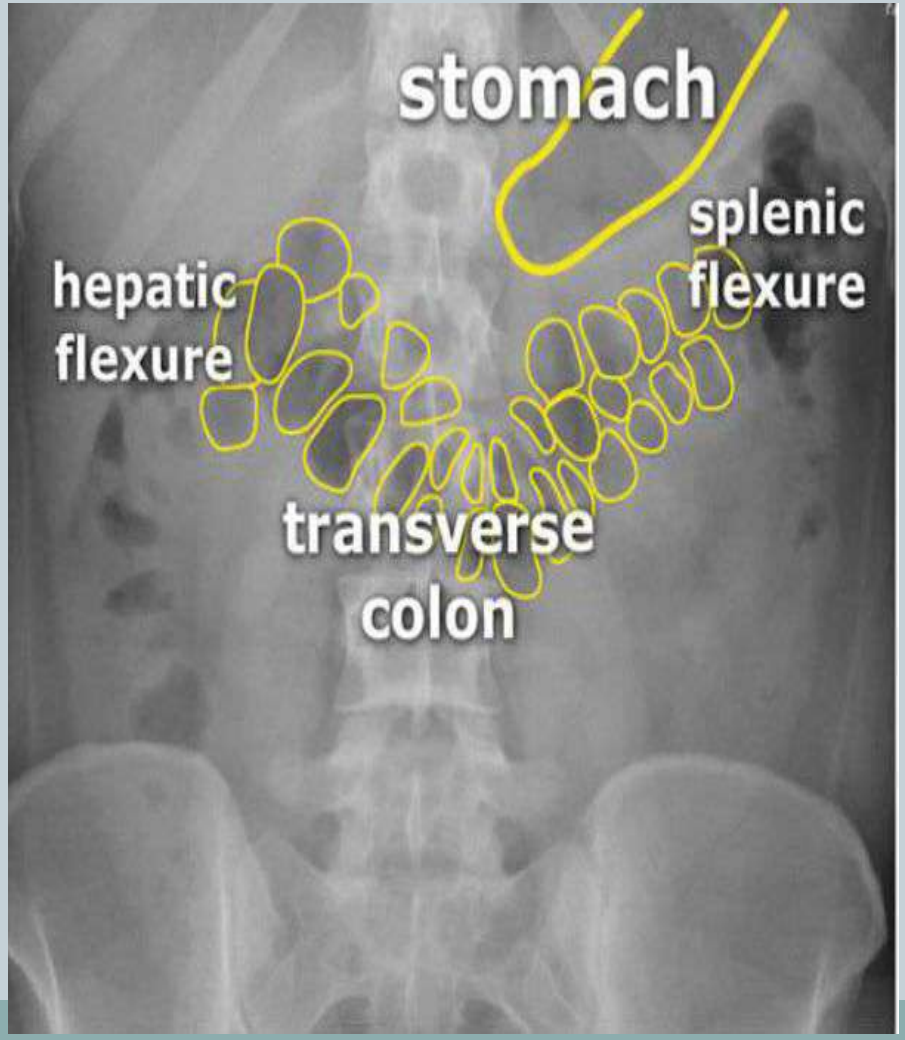
Causes of large bowel obstruction include the :following

Malignancy (colorectal • carcinoma is the most common cause of large bowel obstruction (in adults

Diverticular stricture •

Faecal impaction (most • common cause in immobile (elderly persons

Volvulus •

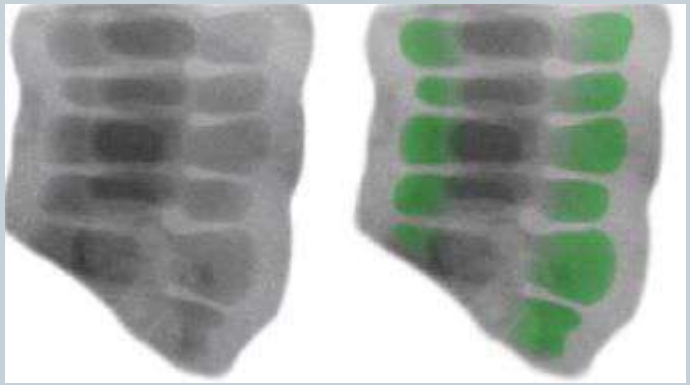


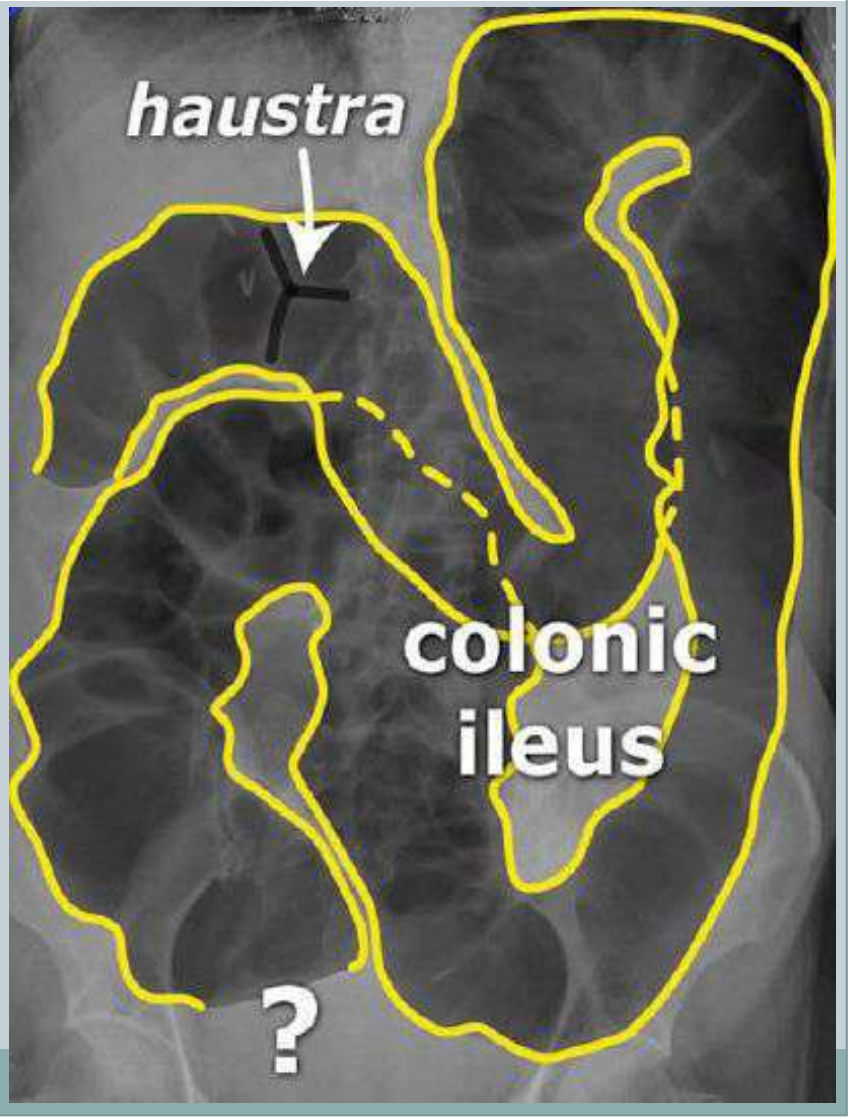
:Radiographic appearances •

Dilation >5.5 cm .1

Circumferential .2 location

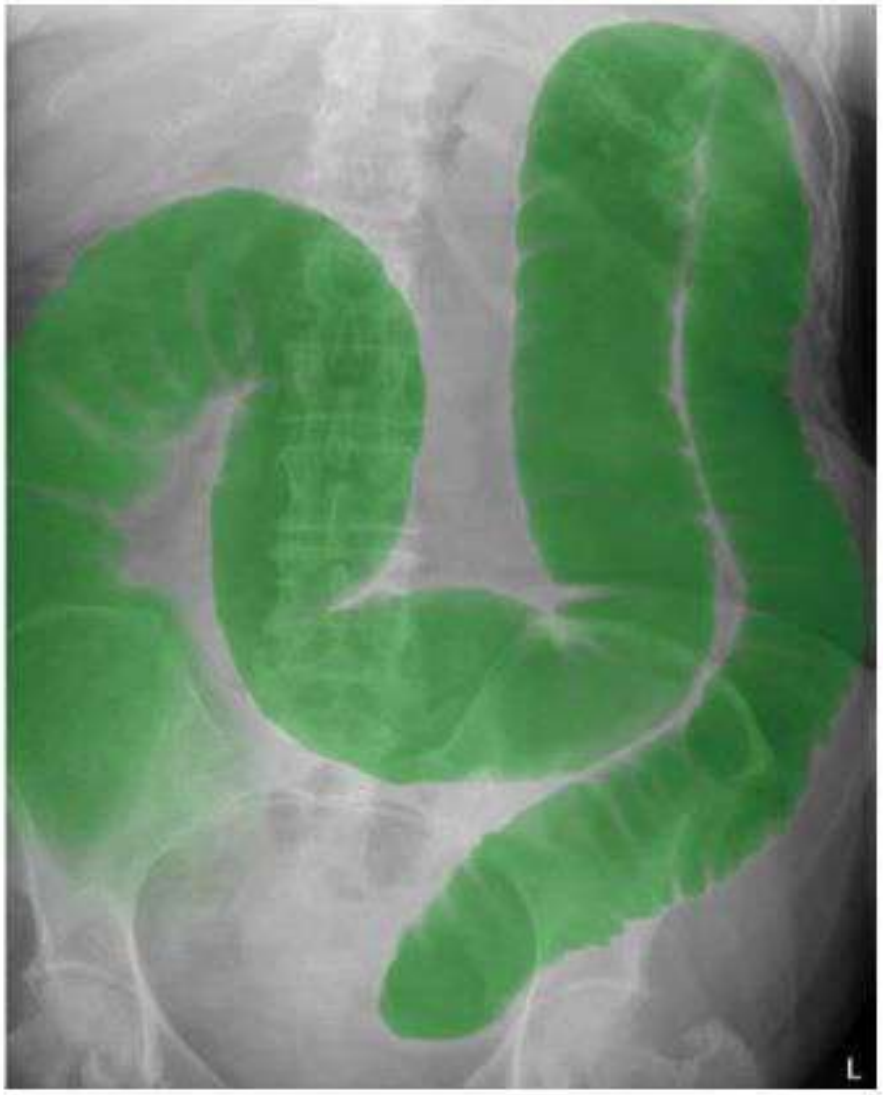
haustral folds .3





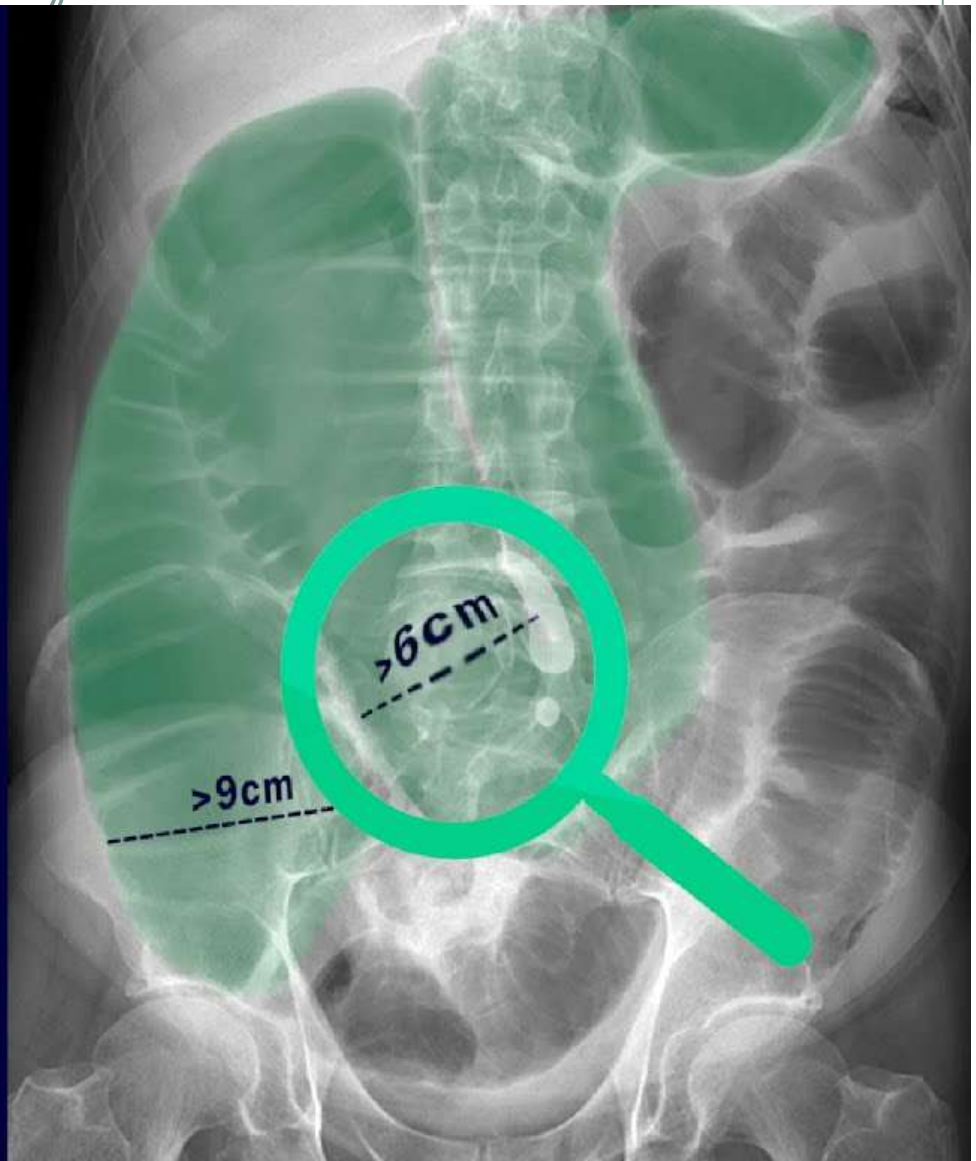
Two identical abdominal radiographs showing dilated large bowel. The large bowel is visible as there is gas (black) within.

You can tell that it is large bowel as it is distended >5.5 cm, circumferentially located and haustra are seen within. The right radiograph shows the dilated large bowel marked in green



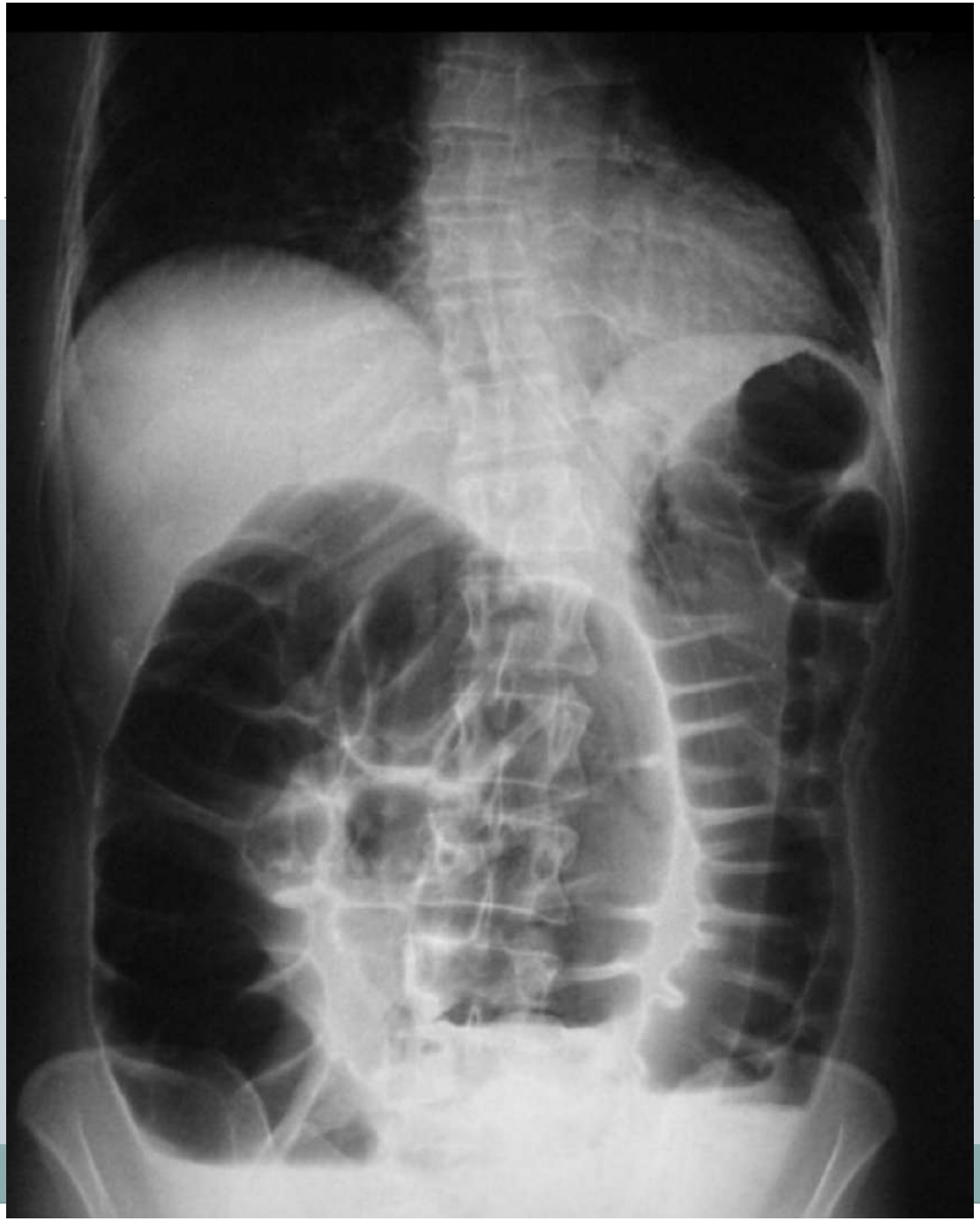
Surgical Teaching

How to Spot Large Bowel Obstruction on X-Ray



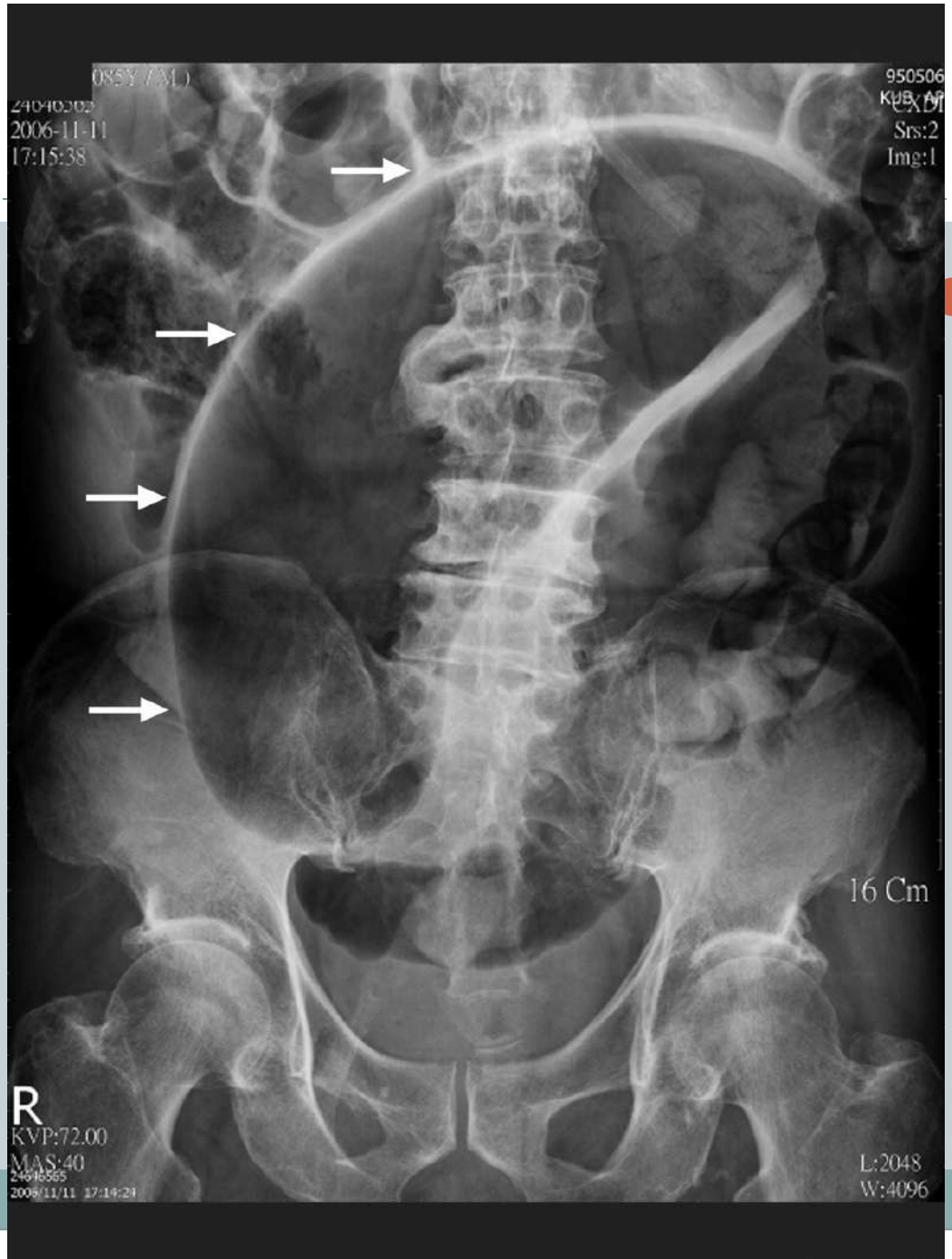
Volvulus

Inverted U sign

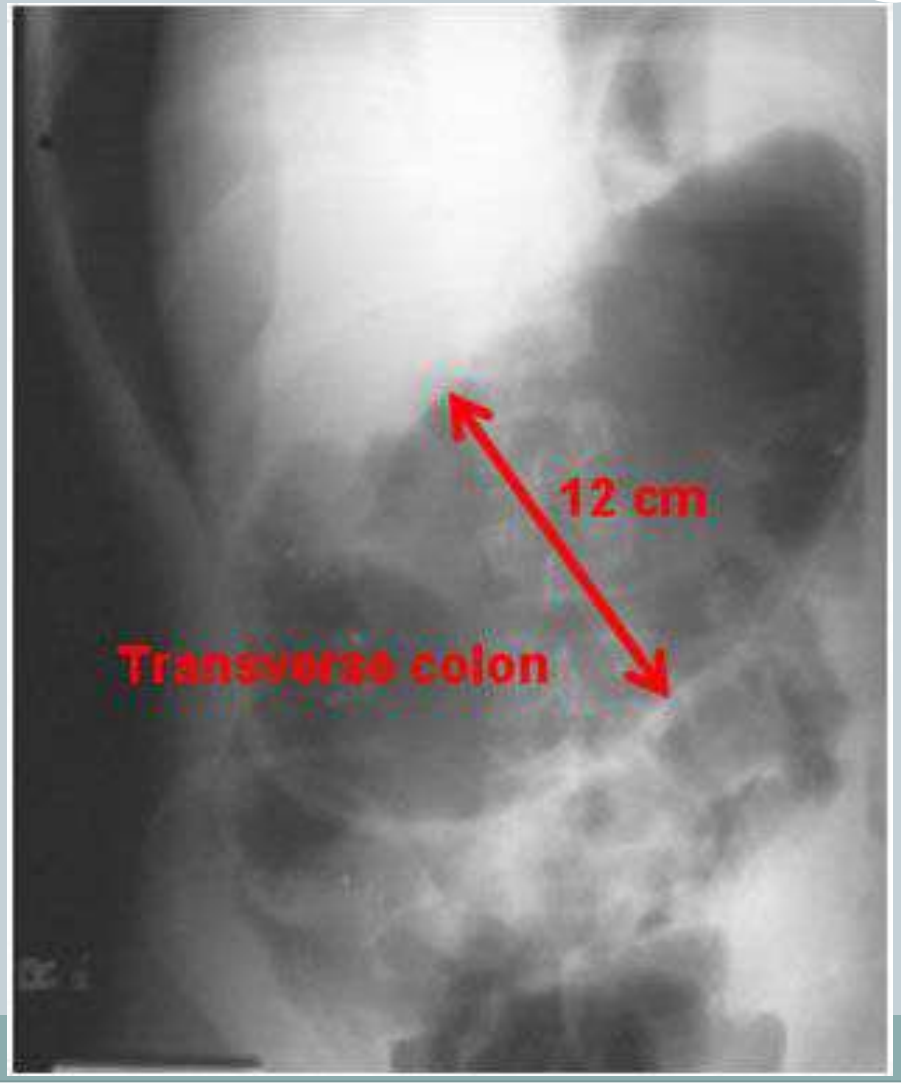


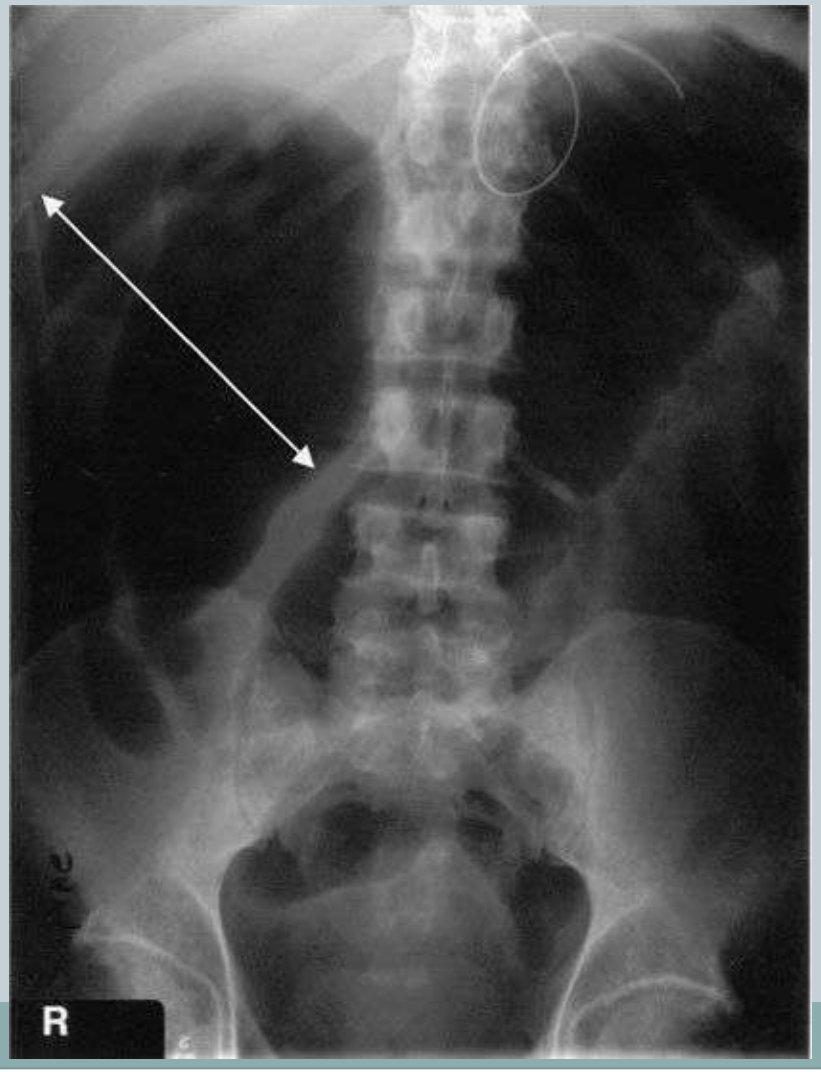
Volvulus

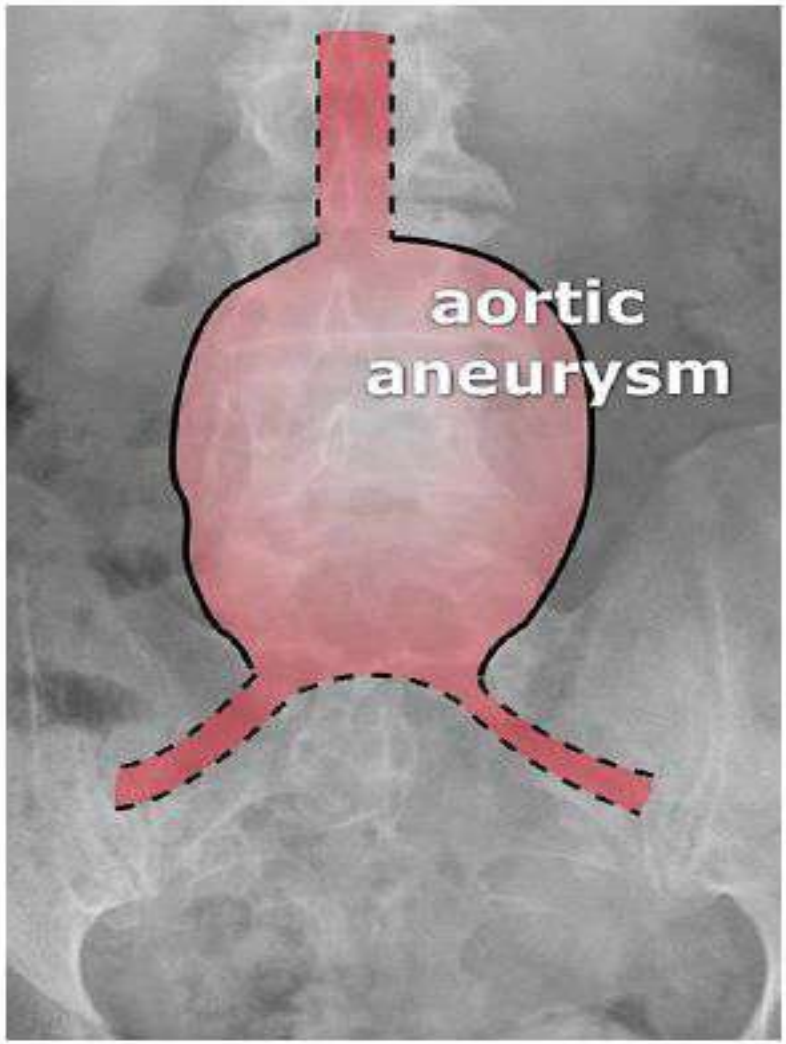
Coffee-bean sign

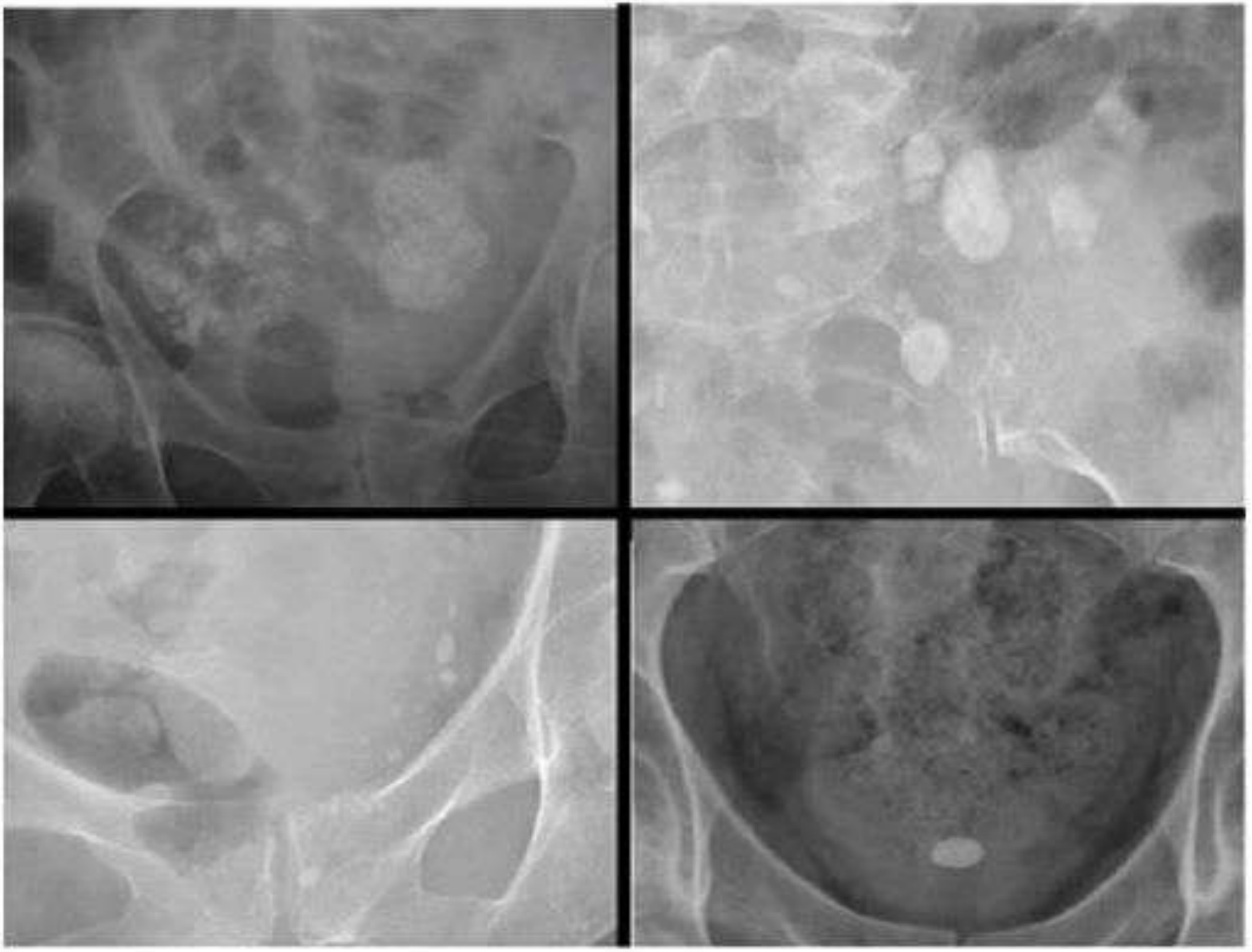


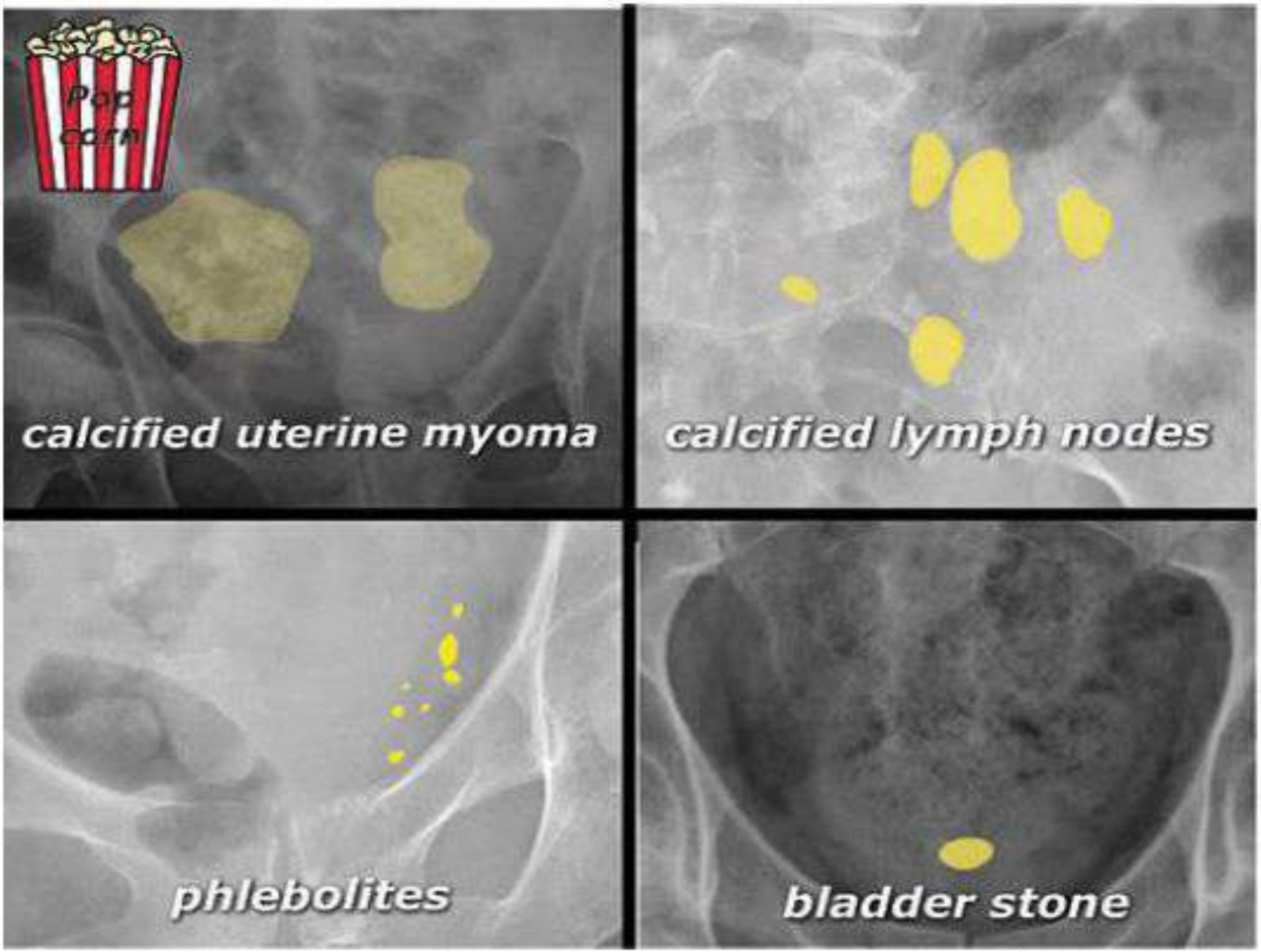
toxic megacolon





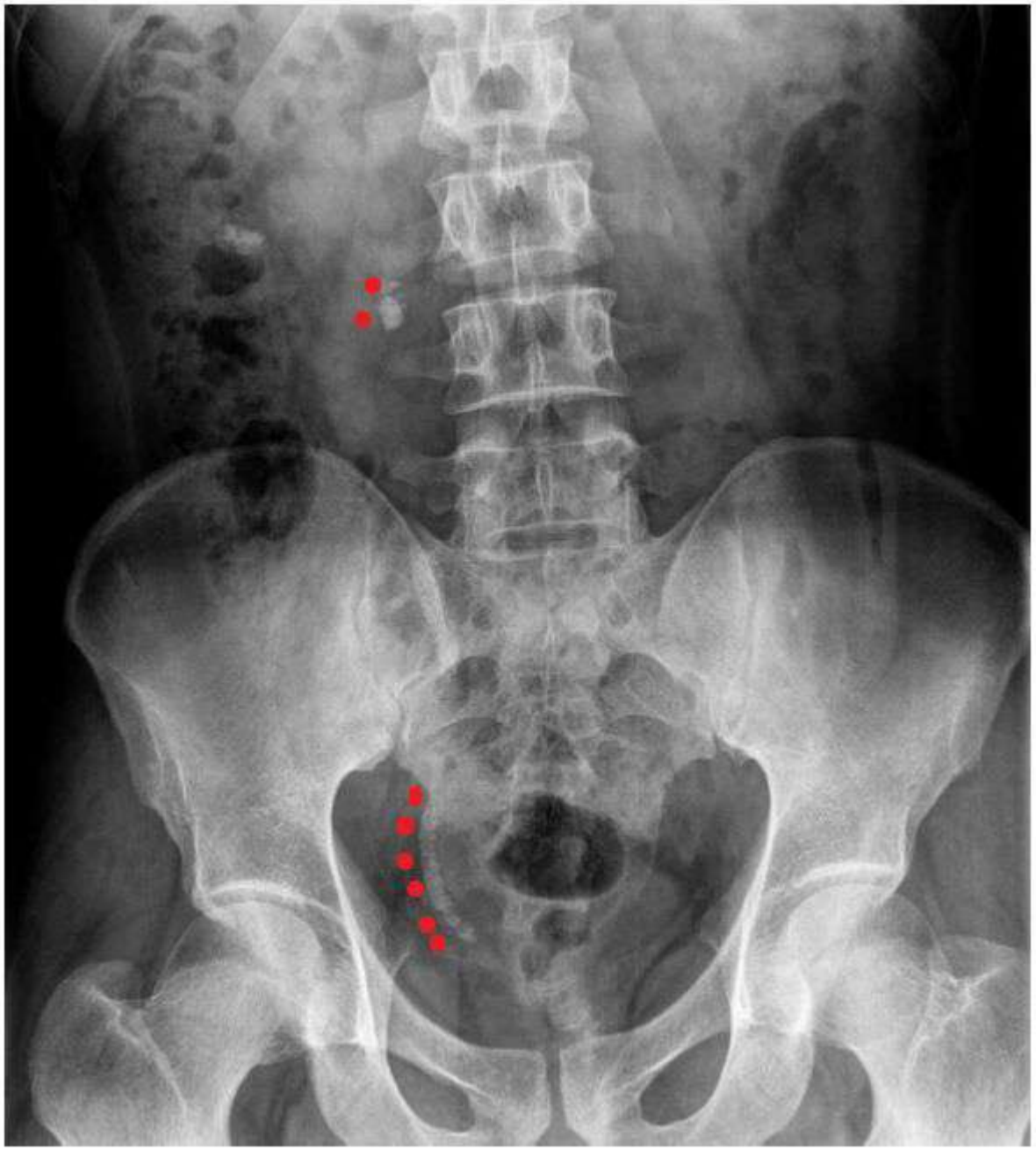

aortic
aneurysm




calcified uterine myoma
calcified lymph nodes
phlebolites
bladder stone

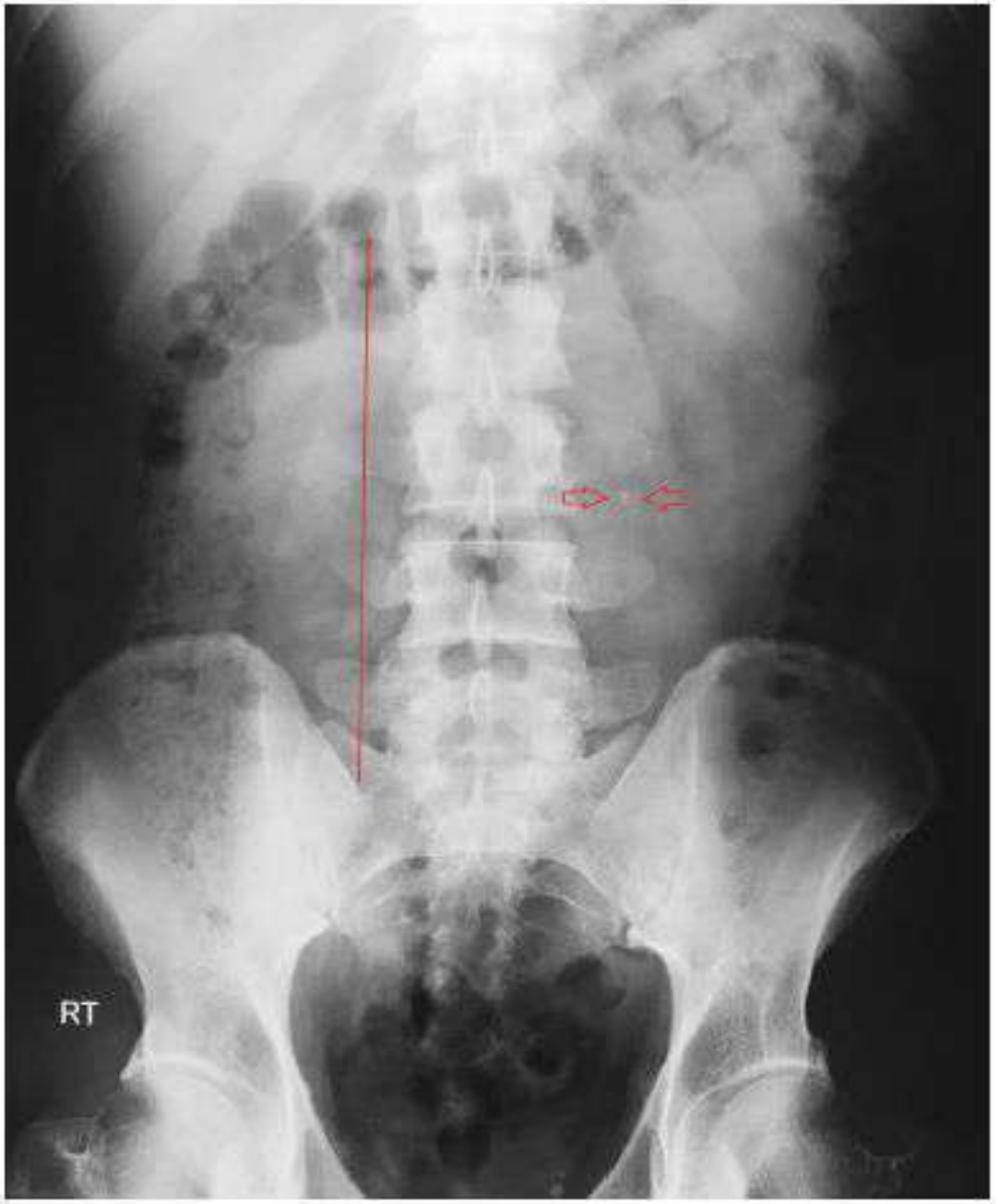
Foreign bodies

Multiple right renal calculi are noted, with multiple small calculi aligned in the lower right .ureter



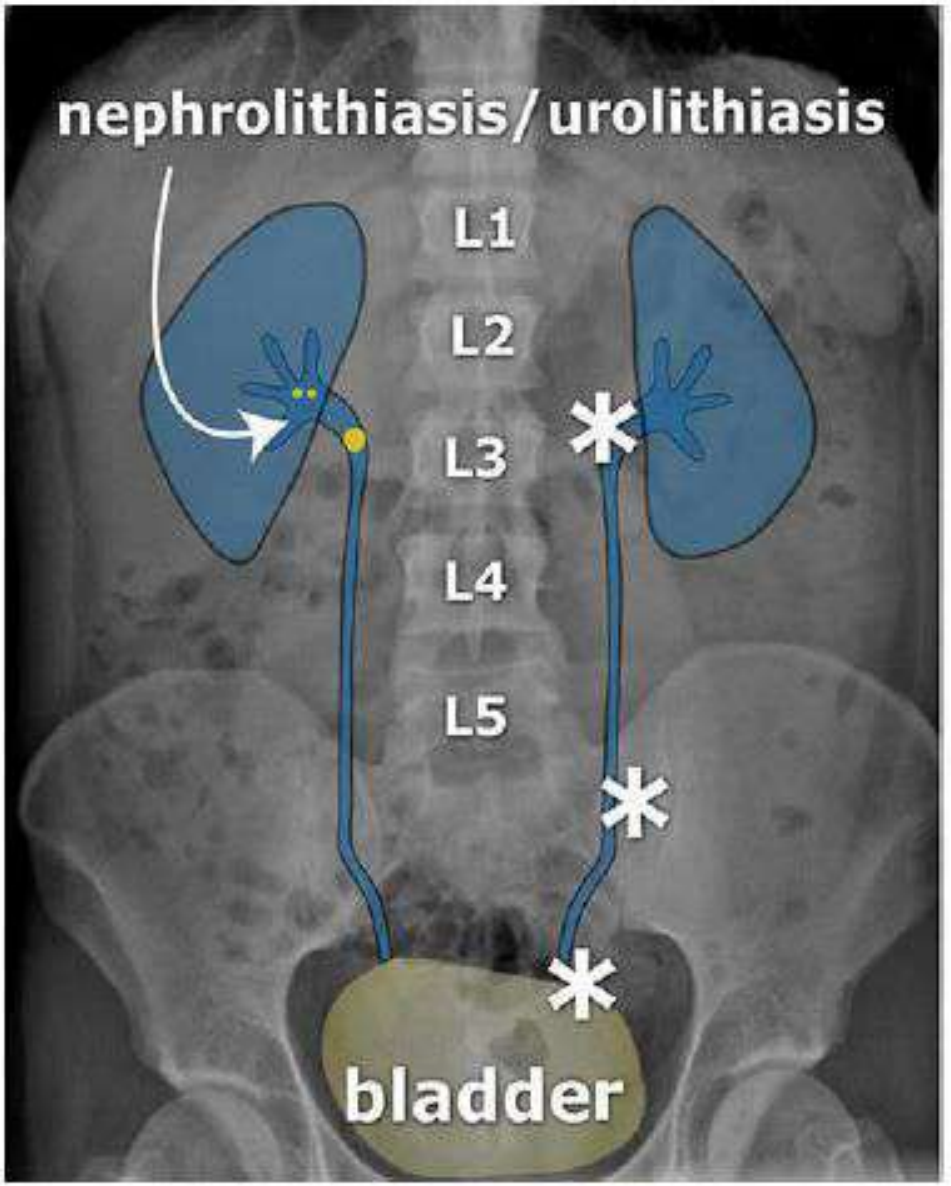
Left loin pain •

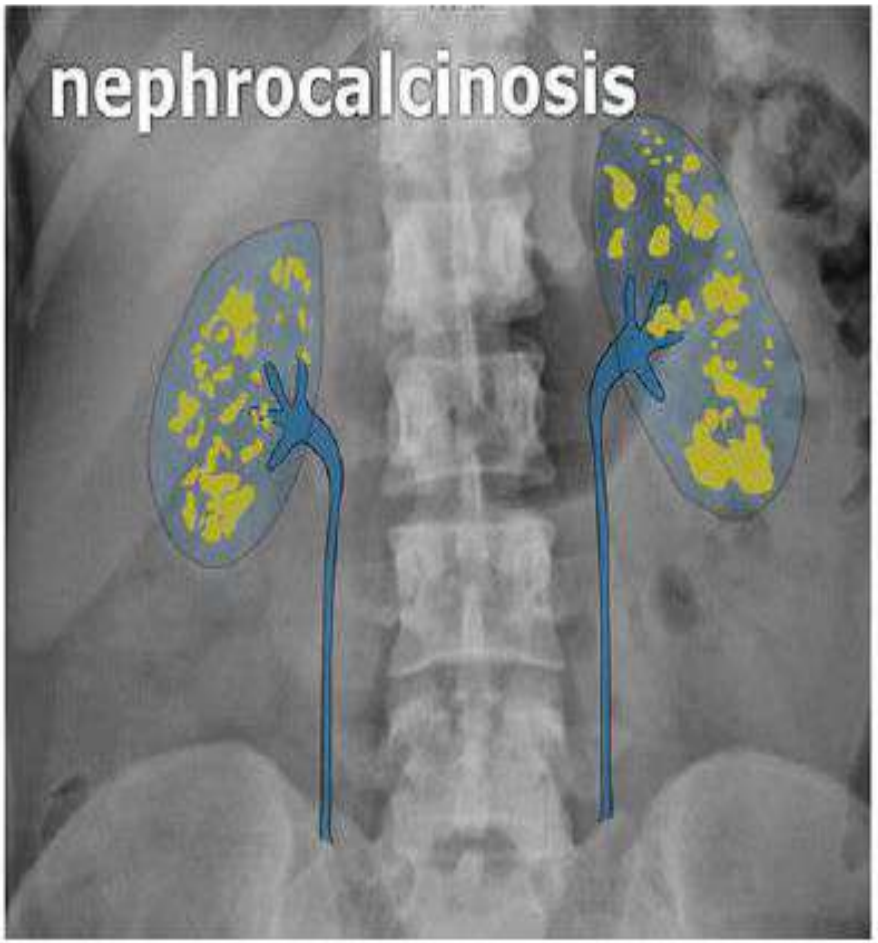
The mid ureteric stone is •
indicated by the RED
.arrows
The red line shows the •
typical
route of the ureter, and
hence
where to review for ureteric
.stones



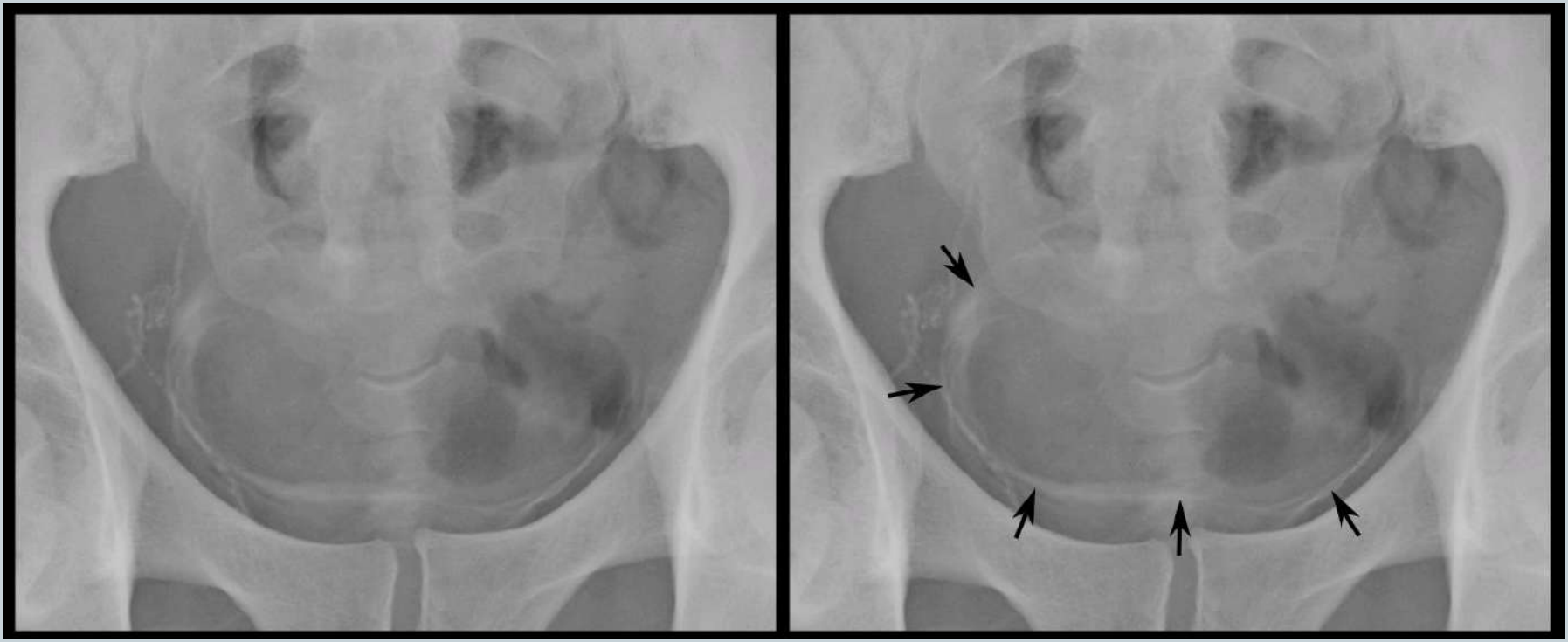
Right side •
…flank pain

Right VUJ stone


nephrolithiasis/urolithiasis
L1
L2
L3
L4
L5
bladder


nephrocalcinosis

Schistosomiaisis Bladder Calcifications



TB