وزارة التعليم العالي والبحث العلمي
جامعة الفرات الأوسط التقنية
كلية البوليتكنك- القادسية
قسم تقنيات الاشعة والسونار

الحقيبة العلمية

التشريح الطبي النظري

المرحلة الثانية

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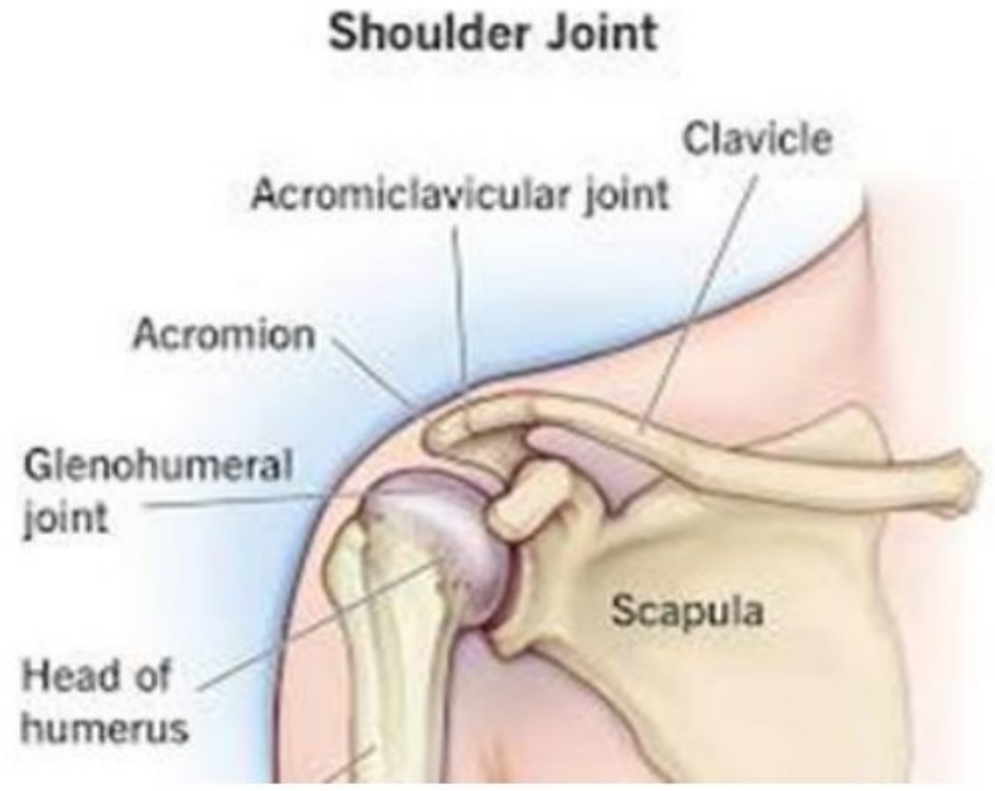
Lecture 1

Upper limb bone and shoulder joint, scapula bone and elbow joint and wrist joint by CT imaging and MRI.

Part 1: The Shoulder Joint & Scapula

The shoulder is a **"Ball and Socket"** joint. It offers the widest range of motion in the body but is inherently **unstable**. Because the socket (Glenoid) is very shallow compared to the large humeral head.

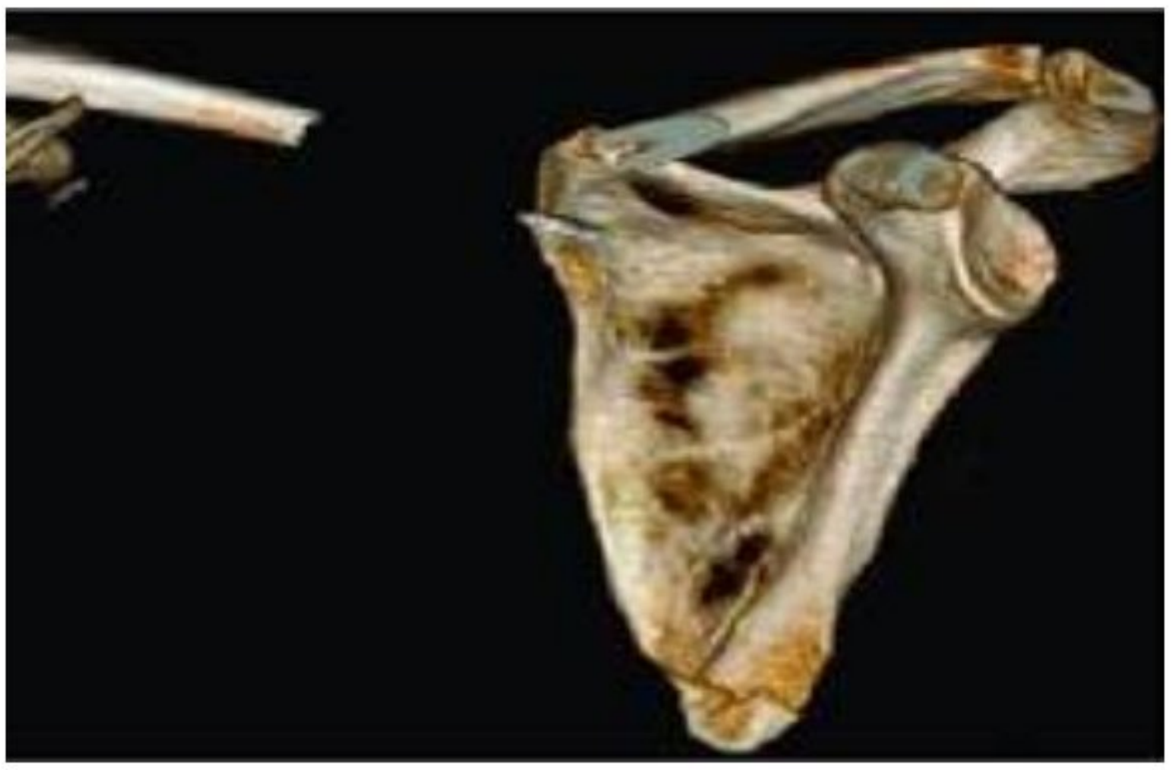
Stability relies heavily on **Soft Tissues** (Rotator Cuff muscles & Labrum), not just bone.



CT Scan Applications

We use CT primarily for **Complex Bony Trauma**.

- **Scapular Fractures:** These are often high-energy injuries. CT is mandatory because X-rays miss fracture lines due to rib overlap.
- **Glenoid Bone Loss:** In recurrent dislocations, the bone rim wears off. CT quantifies this loss for surgical planning.

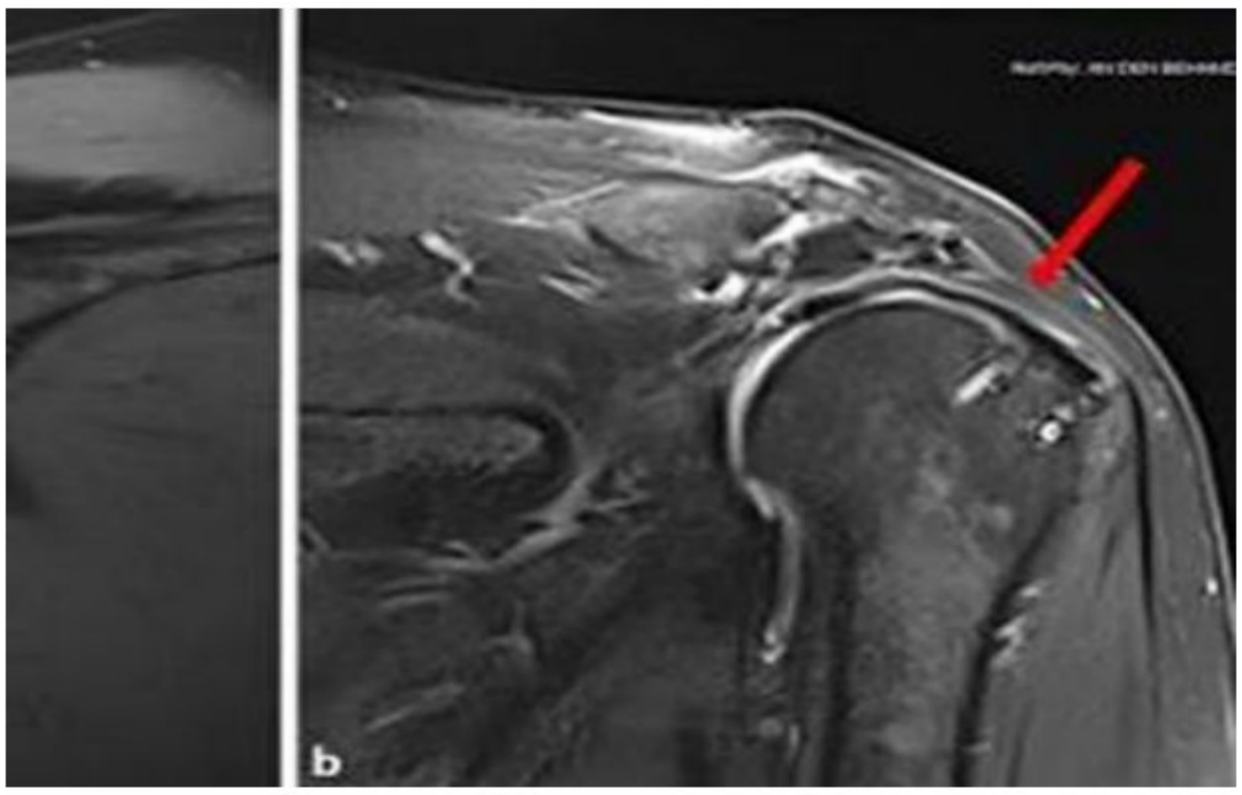


(CT Scapular Fracture)

MRI Applications

MRI is the gold standard for **Soft Tissue Pathology**.

- **Rotator Cuff Tears:** Especially the Supraspinatus tendon. Tears appear as high signal (white fluid) disrupting the dark tendon.
- **Labral Tears:** Detachment of the cartilaginous rim from the glenoid bone.



MRI Rotator Cuff Tear

Part 2: The Elbow Joint

The elbow is a **"Hinge Joint"** formed by three bones: Humerus, Ulna, and Radius. It is designed for stability through tight **"Bony Interlocking"**. Fractures here are often "comminuted" (shattered) and difficult to reconstruct without advanced imaging.

CT Scan Applications

- **Radial Head Fractures:** CT maps the number and position of fragments.
- **Loose Bodies:** Small bone chips trapped inside the joint causing "locking". CT finds them easily.

CT Radial Head Fracture

MRI Applications

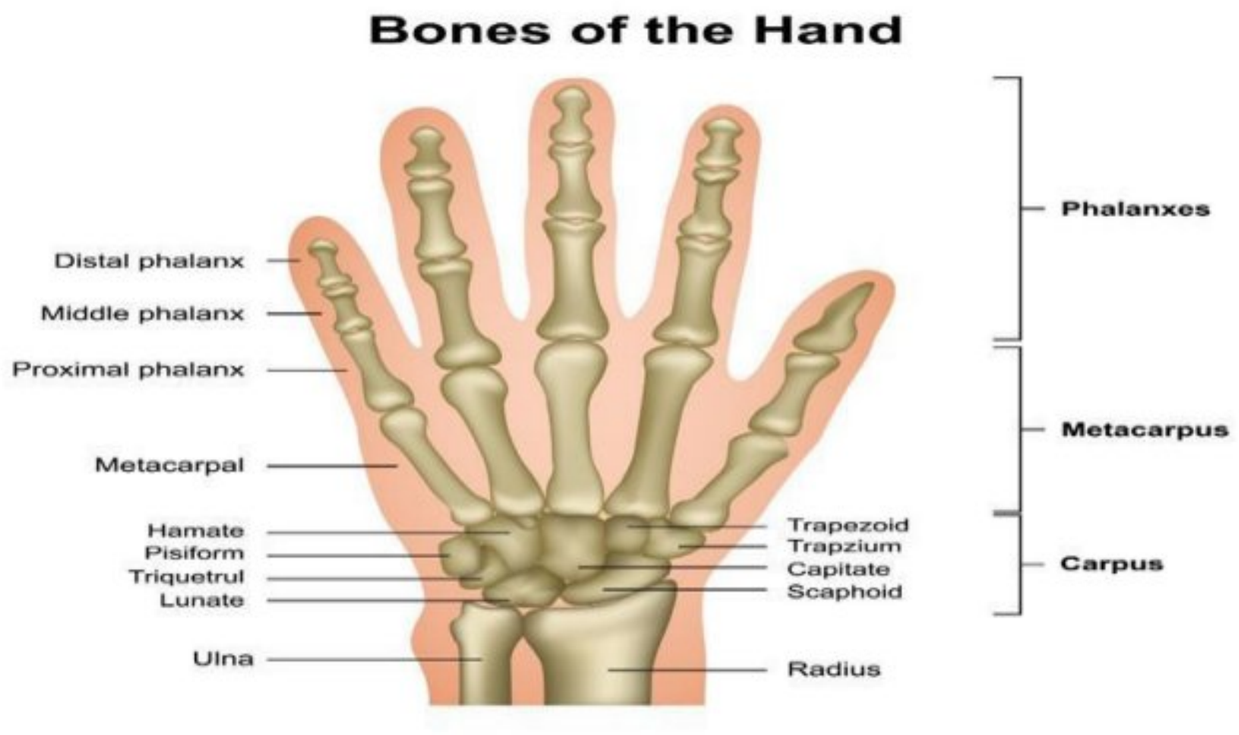
MRI is used for **Ligament & Tendon Injuries** (often in athletes).

- **UCL Injury:** The Ulnar Collateral Ligament is crucial for throwers. MRI shows edema or tears.
- **Distal Biceps Rupture:** Detachment of the biceps tendon from the radius.

MRI Ligament Tear

Part 3: The Wrist Joint

The wrist is not a single bone but a **"Mosaic"** of 8 small carpal bones. This arrangement allows complex movements. The **Scaphoid** bone acts as a bridge. It has poor blood supply, making fractures dangerous (risk of bone death).



CT Scan Applications

CT is the problem-solver for **Occult (Hidden) Fractures**.

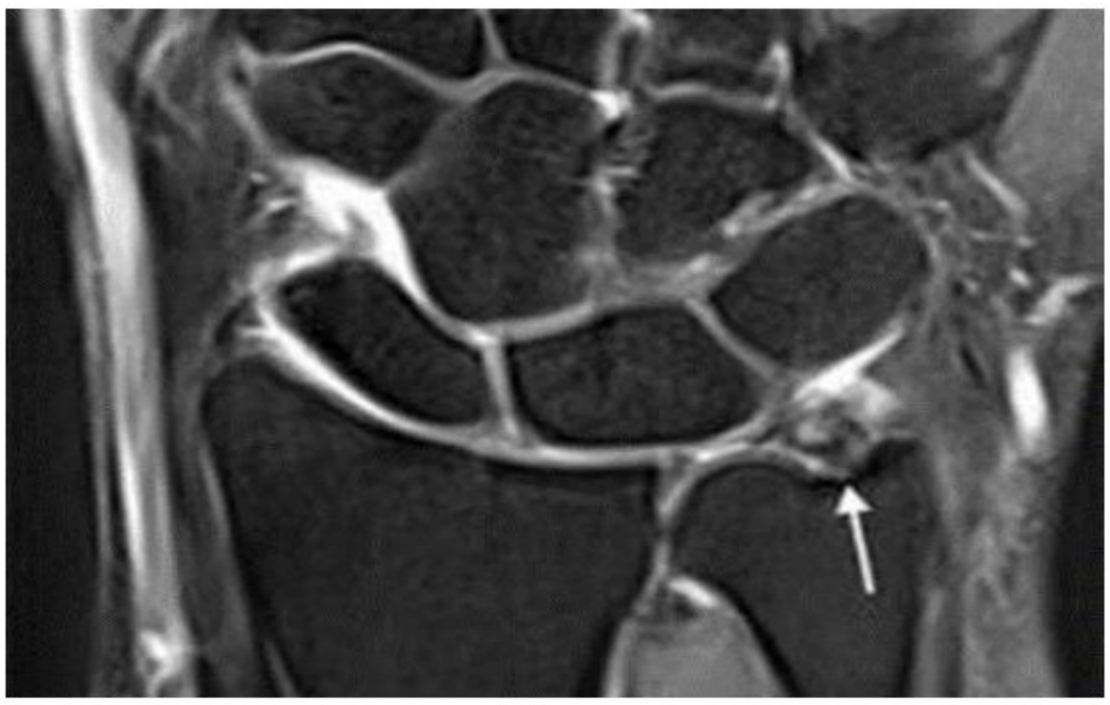
- **Scaphoid Fracture:** X-rays miss up to 20% of these fractures. CT detects hairline cracks to prevent Non-union or AVN.

CT Scaphoid Fracture

MRI Applications

MRI is indicated for **Chronic Pain** on the ulnar side.

- **TFCC Tear:** The Triangular Fibrocartilage Complex is the "meniscus" of the wrist. Tears are visible only on MRI.



MRI TFCC Tear

Comparison between CT Scan & MRI

Feature	CT Scan	MRI
Primary Goal	Bone Architecture	Soft Tissue
Shoulder Indication	Scapular Fractures	Rotator Cuff Tears
Elbow Indication	Radial Head Comminution	UCL Ligament Injury
Wrist Indication	Occult Scaphoid Fracture	TFCC Tear

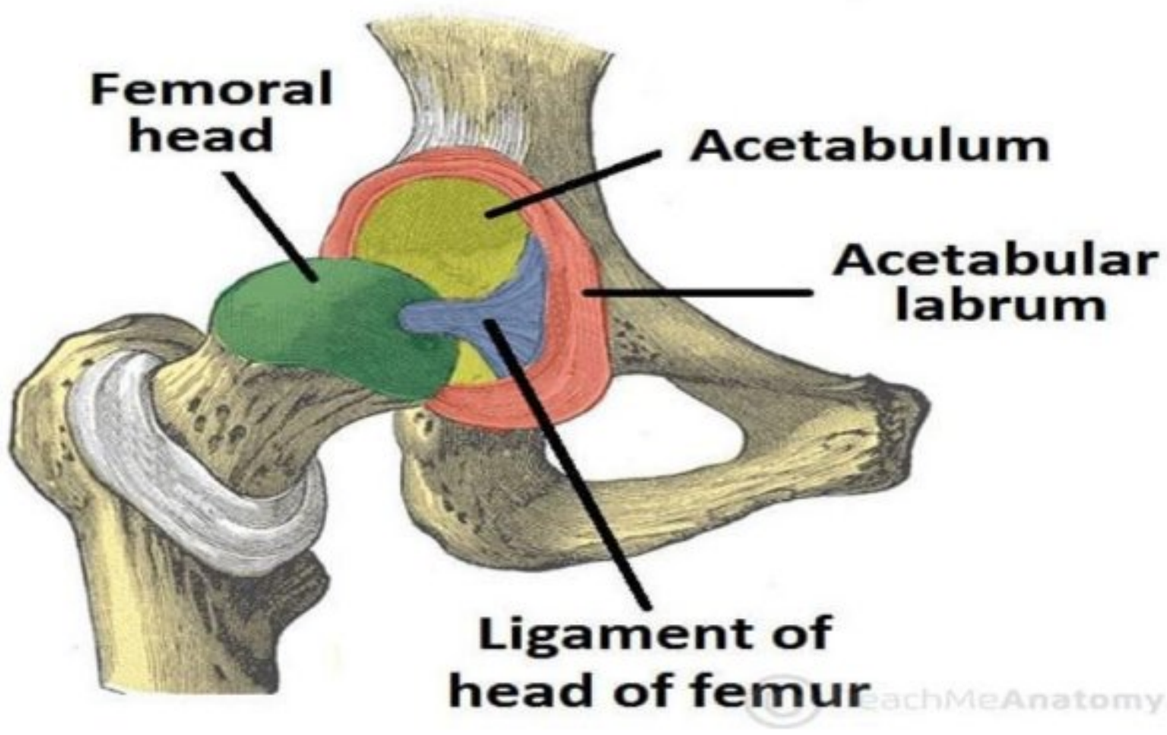
Lecture 2

Lower limb bone and pelvis bone and Hip joint and femur and Knee joint, pattela and leg Ankle joint, tarsal bone, meta tarsal, toe's with CT imaging.

Part 1: Pelvis, Hip Joint & Femur

The Pelvis is a **"Weight-Bearing Ring"**. Unlike the shoulder, the Hip joint is a deep **"Ball and Socket"** designed for maximum stability to carry body weight.

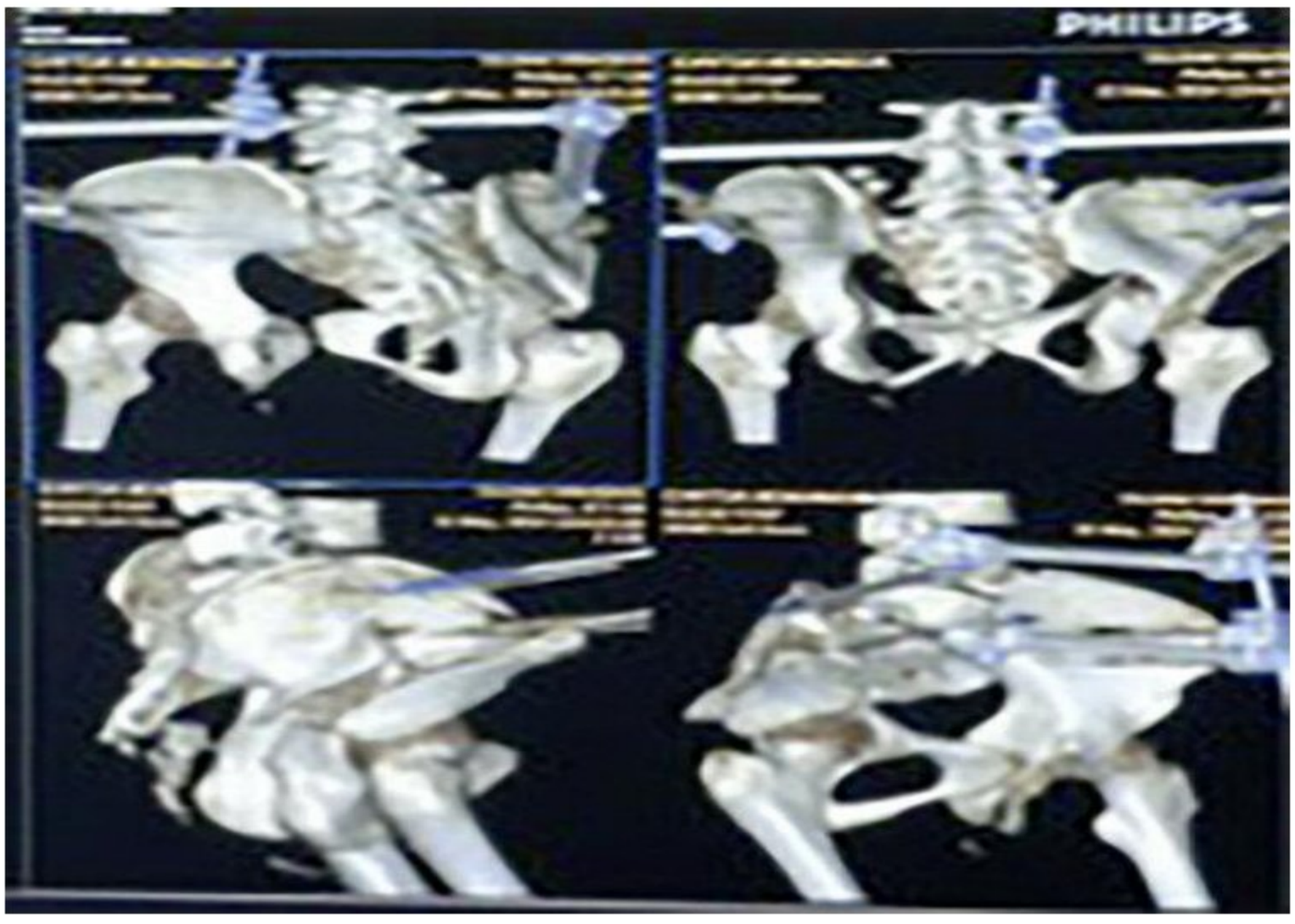
- **The Challenge:** Fractures here disrupt the "Ring", causing life-threatening bleeding or permanent disability.
- **The Femur:** The strongest bone in the body. The "Femoral Neck" is the most critical area for fractures in the elderly.



CT Scan Applications

CT is the master of **Complex Acetabular Fractures**.

- **Acetabular Fractures:** The socket breaks into multiple pieces. X-ray is confusing here. CT with **3D Reconstruction** is mandatory to map the "Columns" of the pelvis for surgery (Judet-Letournel Classification).
- **Femoral Head Fractures:** To check for loose bone fragments trapped inside the joint.

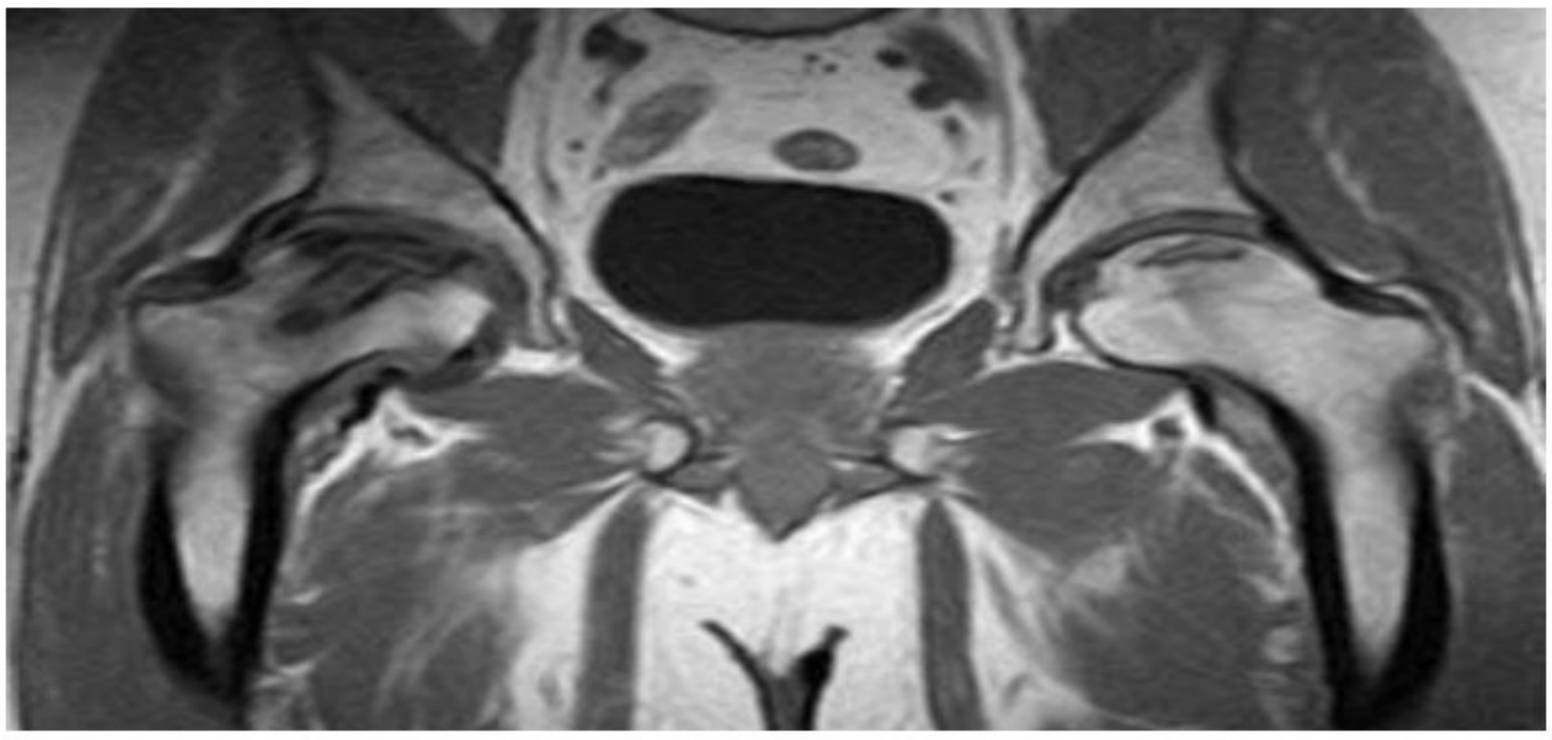


3D CT Pelvis Fracture

MRI Applications

MRI is crucial for **Avascular Necrosis (AVN)** and **Occult Fractures**.

- **AVN (Femoral Head Death):** The blood supply to the femoral head is precarious. MRI detects bone death early (**Double Line Sign**) before X-ray.
- **Labral Tears:** Tears in the hip cartilage causing clicking or pain (Femoroacetabular Impingement - FAI).

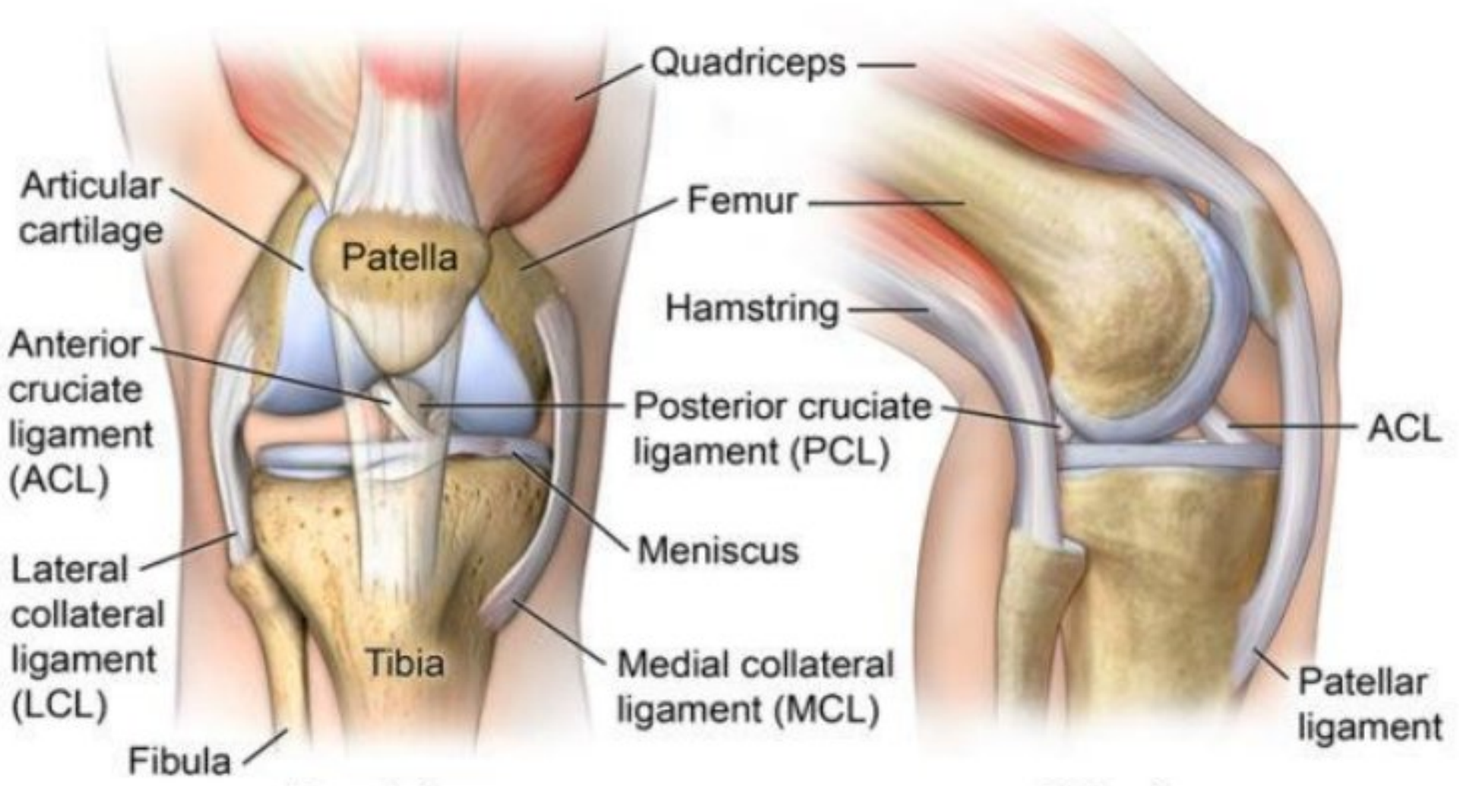


MRI Hip AVN

Part 2: Knee Joint, Patella & Leg

The Knee is a **"Complex Hinge"** bearing massive stress. It has no bony stability (just femur sitting on tibia).

- **Stability:** Depends entirely on **Ligaments** (ACL, PCL, MCL, LCL) and **Meniscus** (shock absorbers).
- **The Patella:** Acts as a pulley to increase muscle power.



Knee anatomy

CT Scan Applications

CT is used for **Tibial Plateau Fractures**.

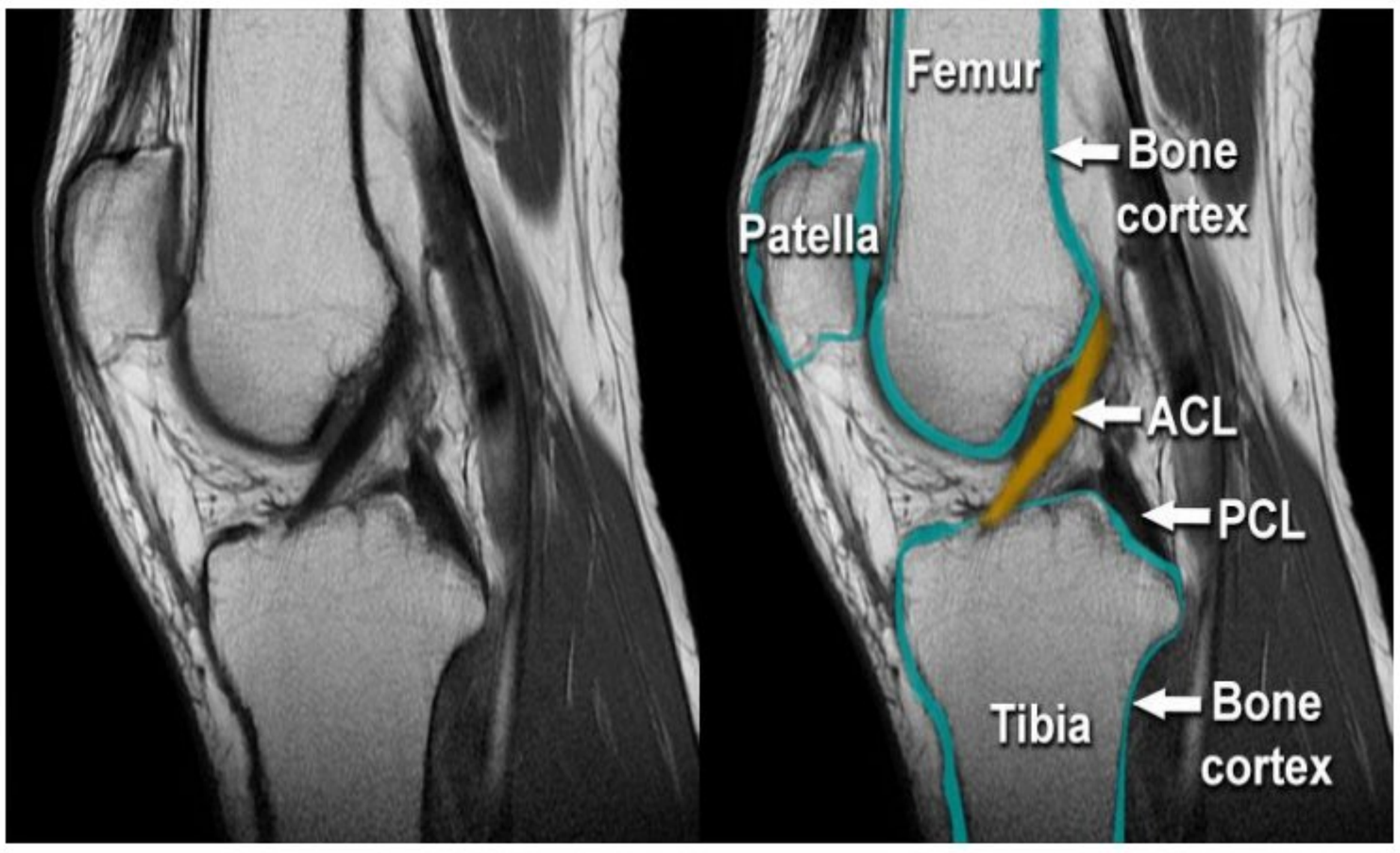
- **Depressed Fractures:** When the femur smashes into the tibia, it pushes the bone surface down. CT measures this "depression" in millimeters (Schatzker Classification) to decide if surgery is needed.
- **Patellar Tracking:** To measure TT-TG distance (alignment of the kneecap) in patients with dislocating patella.

CT Tibial Plateau Fracture

MRI Applications

MRI is the **"King of the Knee"**. It is the most common MRI exam performed.

- **ACL Tear:** The Anterior Cruciate Ligament is the most commonly injured. MRI shows fiber disruption and "Bone Bruising".
- **Meniscal Tears:** Tears in the shock absorbers (Medial or Lateral Meniscus).

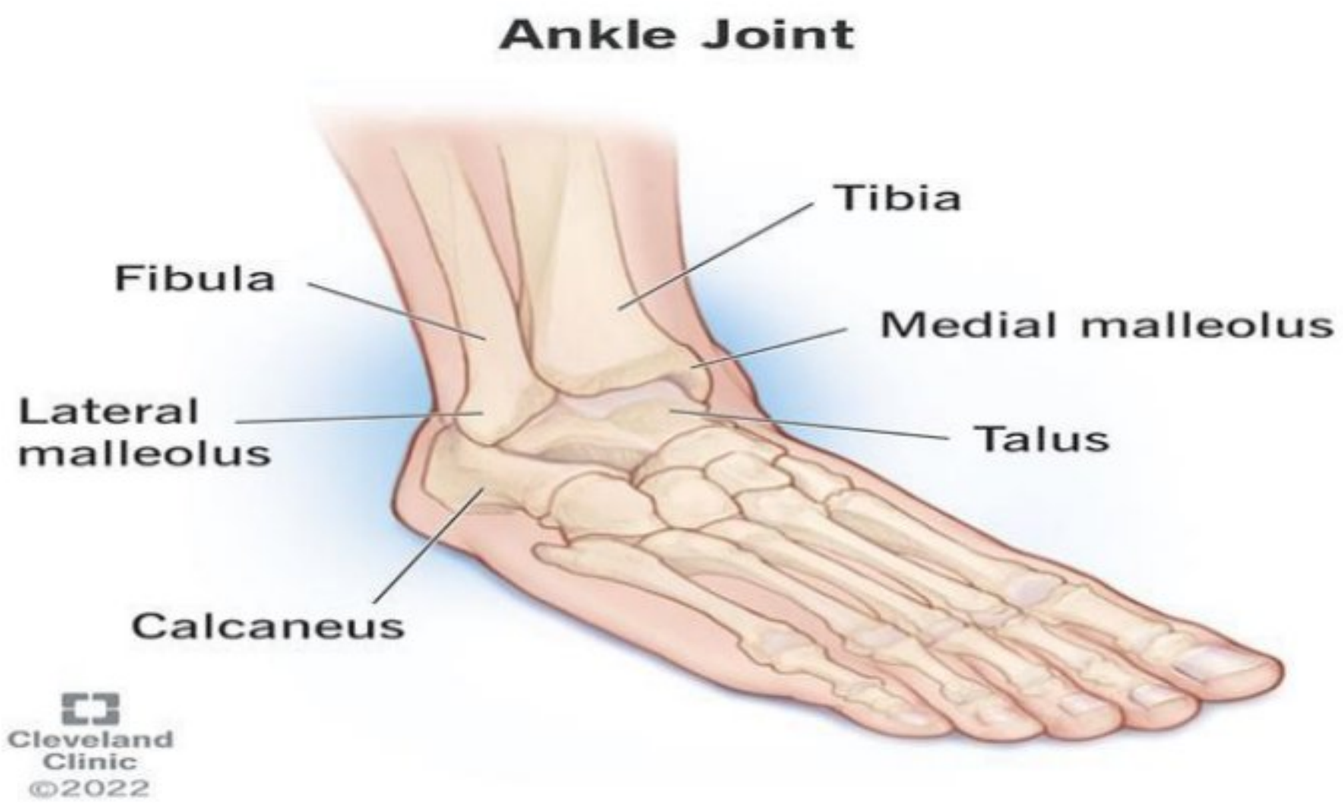


MRI ACL Tear

Part 3: Ankle Joint & Foot

The Ankle is a **"Mortise"** (socket) made by Tibia and Fibula wrapping around the Talus.

- **The Foot:** A complex arch of Tarsal bones (like the wrist but for weight) and Metatarsals.
- **Calcaneus (Heel):** The sponge-like bone that hits the ground first.



CT Scan Applications

CT is essential for **Calcaneal (Heel) Fractures** and **Lisfranc Injuries**.

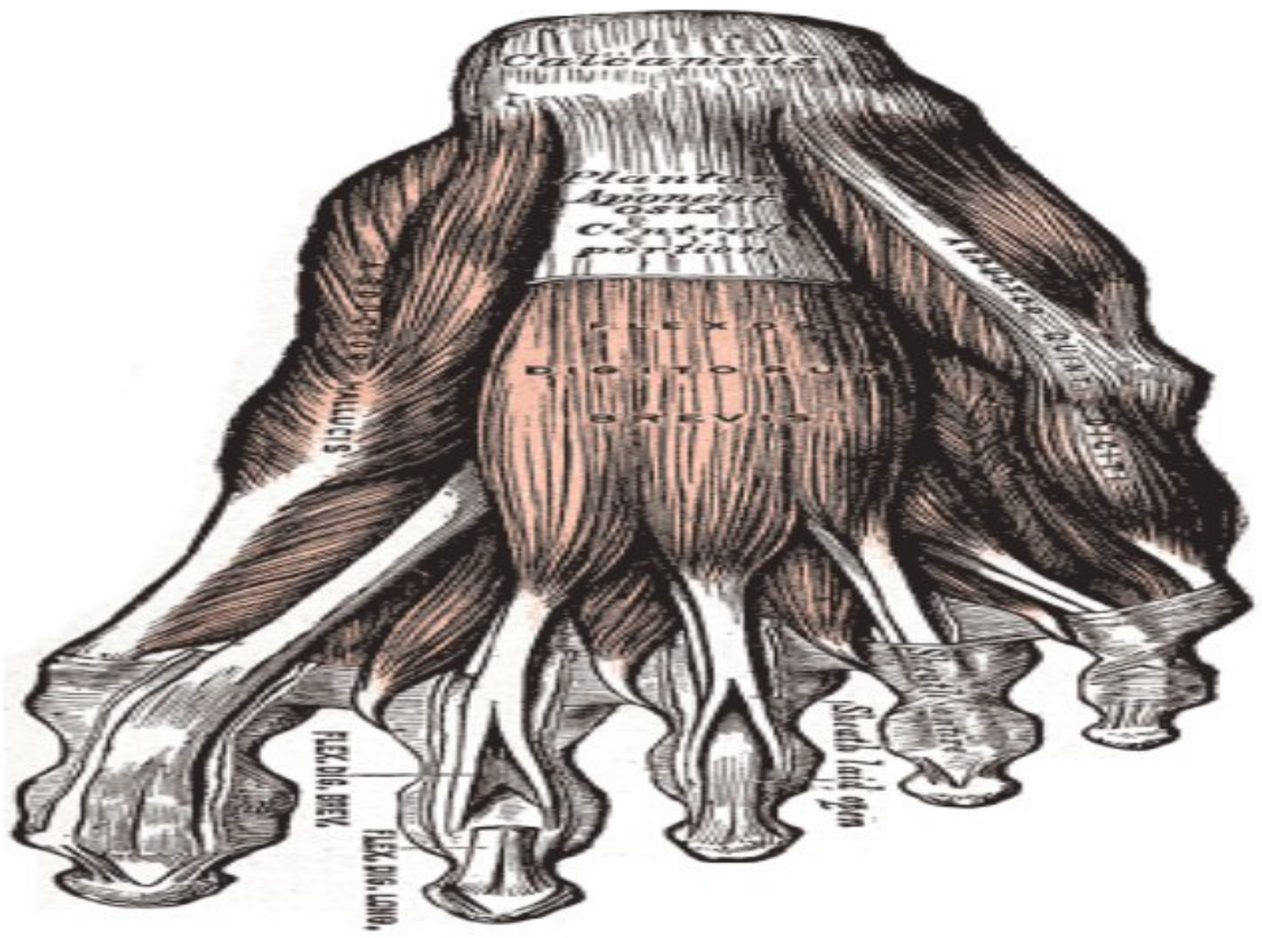
- **Calcaneal Fractures (Sanders Class):** Heel fractures are often shattered (like an eggshell). CT counts the fragments.
- **Lisfranc Injury:** A subtle dislocation between tarsals and metatarsals (midfoot). CT checks the alignment.

CT Calcaneus Fracture

MRI Applications

MRI is used for **Achilles Tendon** and **Ankle Ligaments**.

- **Achilles Rupture:** The strongest tendon in the body. MRI shows the gap size for surgery.
- **ATFL Tear:** Anterior Talo-Fibular Ligament (the one you hurt when you twist your ankle).



MRI Achilles Tendon

Comparison between CT Scan & MRI

Region	Anatomy Focus	CT	MRI
Pelvis & Hip	**Weight-Bearing Ring**	Acetabular Fractures	Avascular Necrosis (AVN)
Knee	**Ligaments & Meniscus**	Tibial Plateau Depression	ACL / Meniscal Tears
Ankle & Foot	**Mortise & Arches**	- Calcaneal Fractures - Lisfranc Injury	- Achilles Tendon Rupture - Ankle Sprain (ATFL)

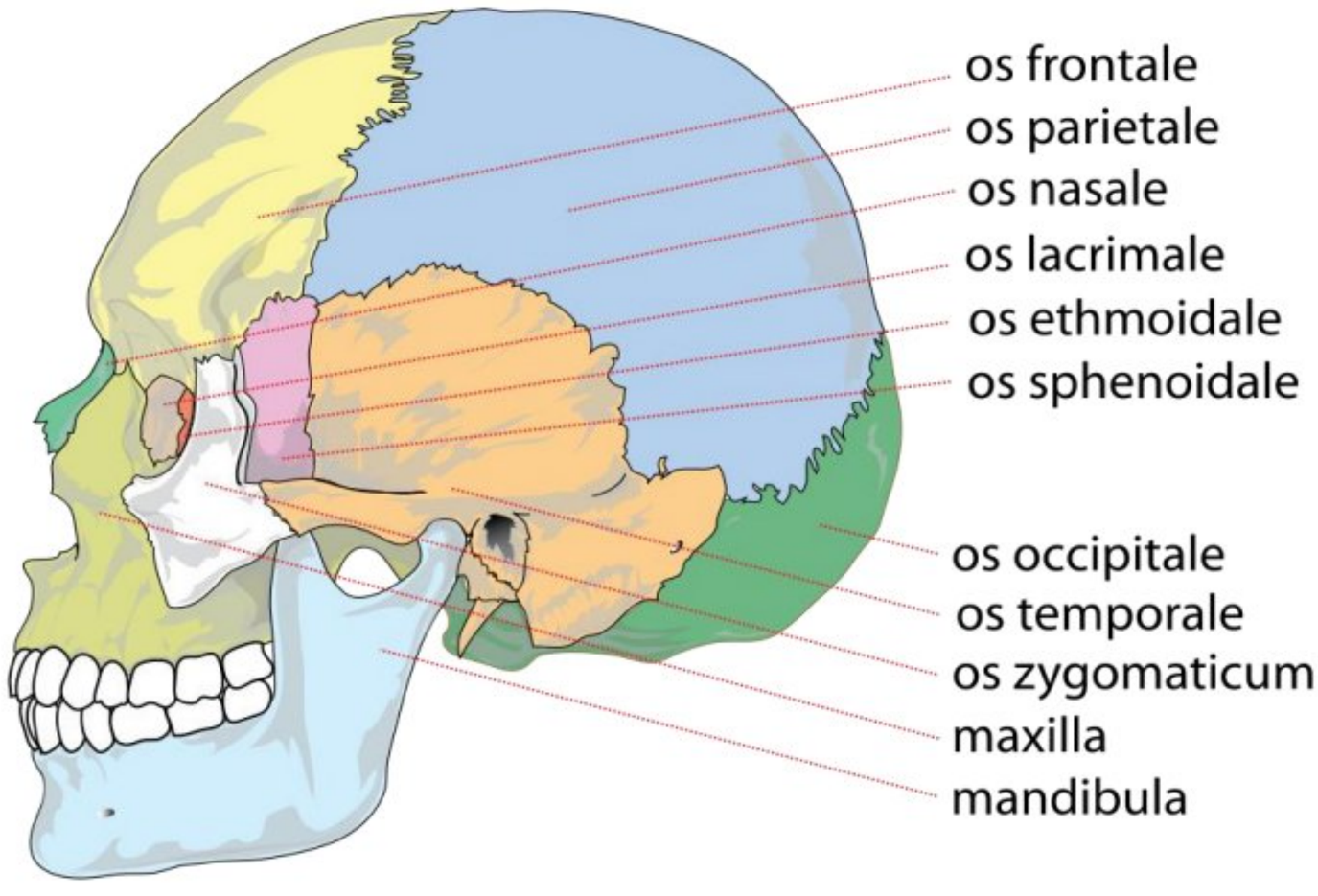
Lecture 3

Study the structure of the skull bone with CT imaging

Part 1: The Calvaria (Skull Vault)

The Calvaria acts as a **"Protective Helmet"** for the brain. It is made of flat bones (Frontal, Parietal, Occipital) joined together by sutures (zigzag joints).

- **Structure:** It has three layers: Outer table (hard), Diploë (spongy middle), and Inner table (hard).
- **Danger:** The Middle Meningeal Artery runs just beneath the temporal bone (Pterion). A fracture here can cause a fatal Epidural Hematoma.



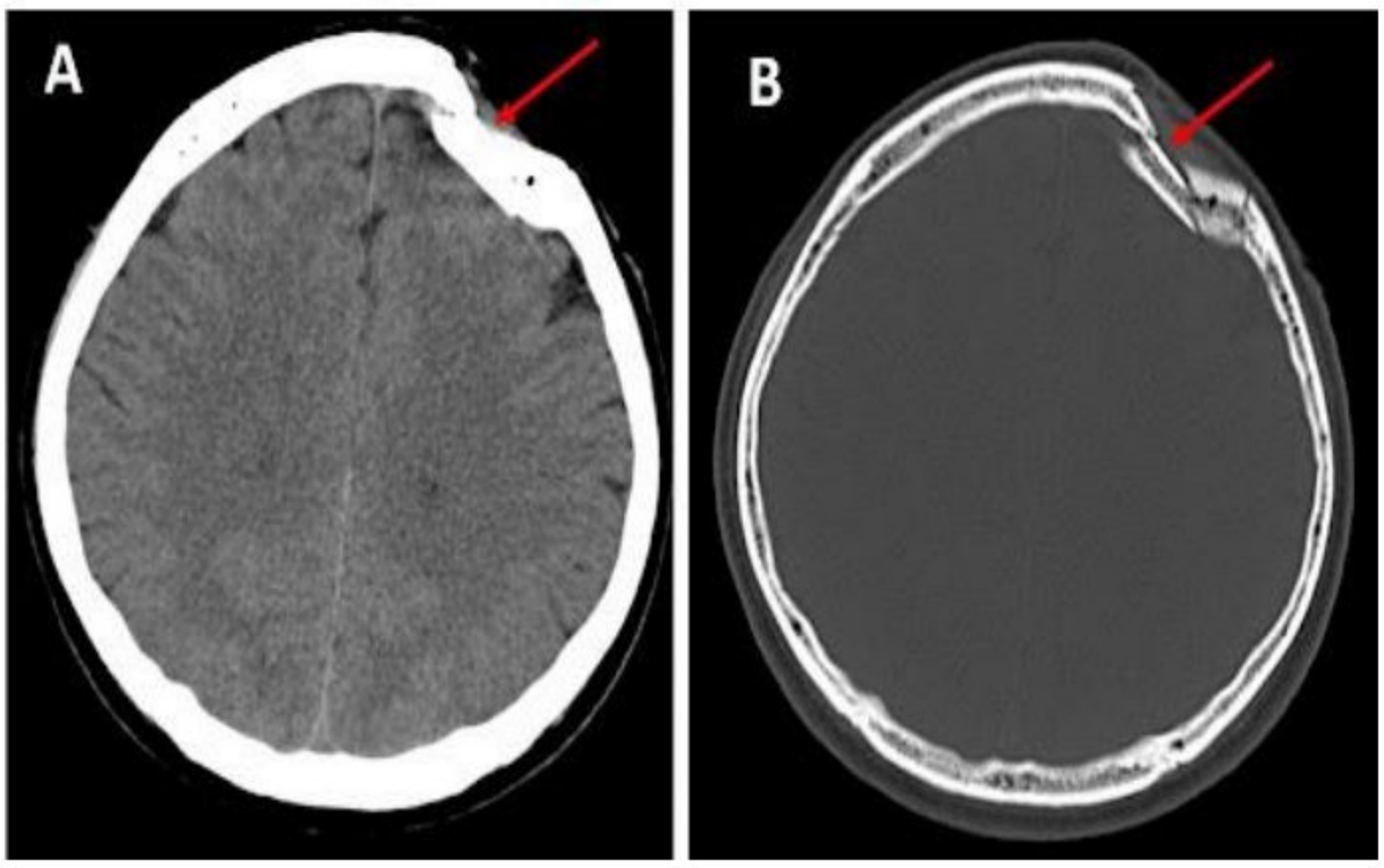
Skull Anatomy

CT Scan Applications

CT with **Bone Window** is the standard for head trauma.

- **Linear Fractures:** Simple cracks. CT distinguishes them from sutures.

- **Depressed Fractures:** Like a dent in a ping-pong ball. The bone is pushed inward, pressing on the brain. CT measures the depth of depression to decide on surgery.

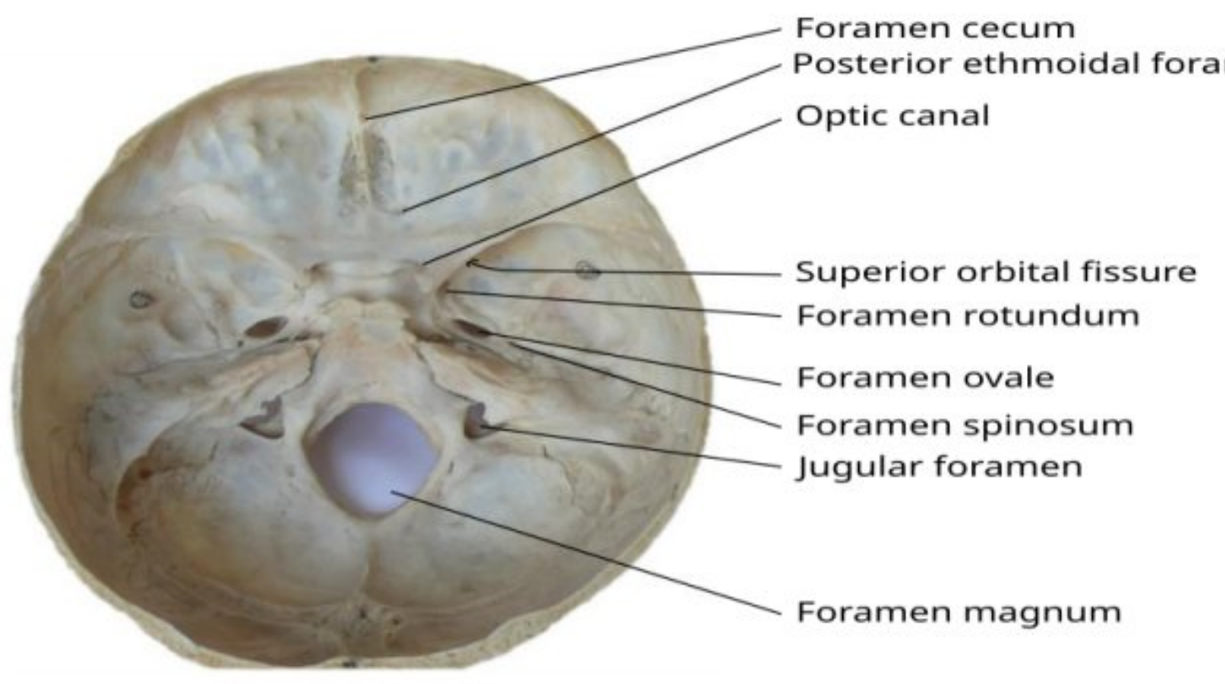


CT Depressed Fracture

Part 2: The Skull Base (The Floor)

The Skull Base is the **"Complex Floor"** on which the brain sits. It is not flat; it has three levels (Anterior, Middle, Posterior Fossae).

- **The Swiss Cheese:** It is full of holes (**Foramina**) allowing nerves and blood vessels to enter and exit the brain.
- **Temporal Bone:** The hardest bone in the body, housing the hearing and balance organs.



Skull Base Foramina

CT Scan Applications

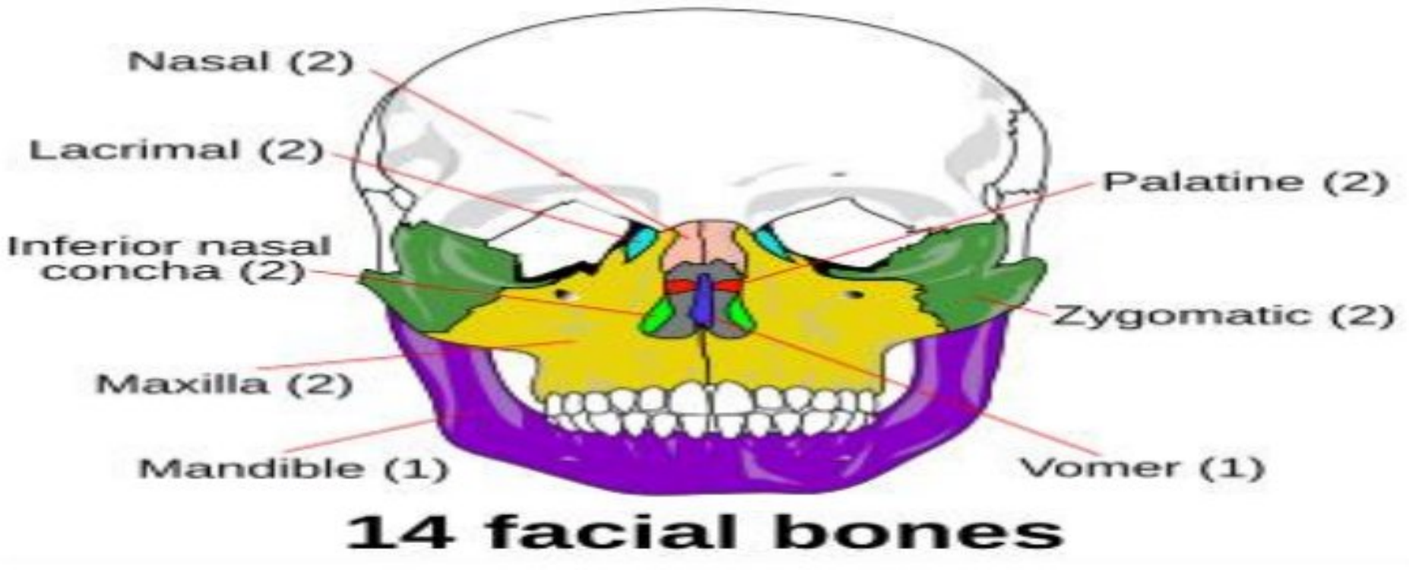
- **Basilar Skull Fracture:** Signs include "Raccoon Eyes" or CSF leak from the nose/ear. CT detects air inside the skull (**Pneumocephalus**).
- **Temporal Bone CT:** Used to diagnose conductive hearing loss (ossicle dislocation) or facial nerve paralysis after trauma.

CT Skull Base Fracture

Part 3: The Facial Skeleton (Viscerocranium)

The Face acts as a **"Crumple Zone"** (shock absorber) to protect the brain behind it.

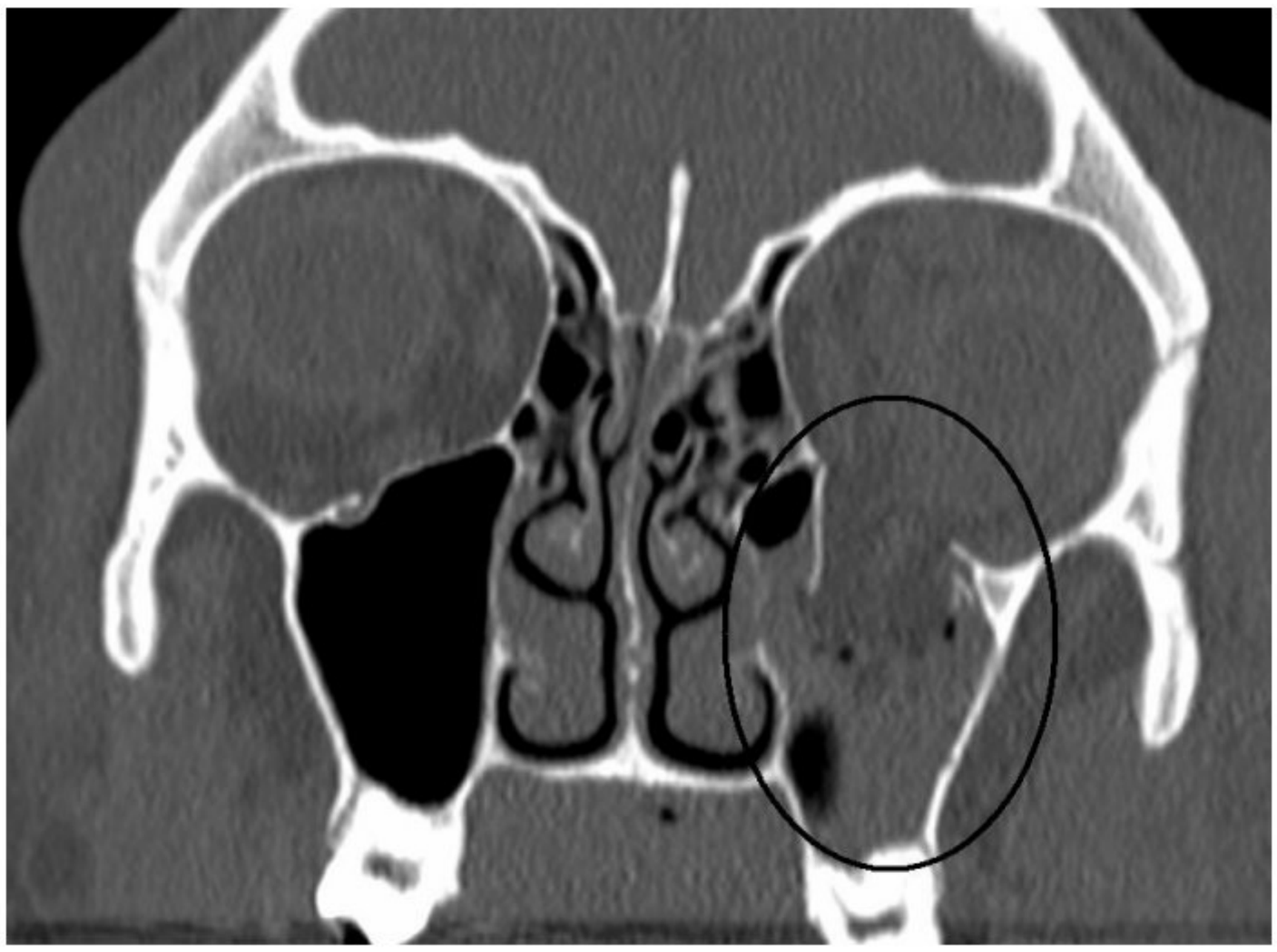
- **Structure:** It is a lattice of struts (buttresses) surrounding cavities (Orbits, Nasal cavity, Sinuses).
- **Orbits:** Cone-shaped sockets protecting the eyes. The floor is very thin (paper-thin).



14 facial bones

CT Scan Applications

- **Blowout Fracture:** When a ball hits the eye, the pressure breaks the thin floor. The eye muscle gets trapped, and the patient sees double (Diplopia). CT Coronal view is diagnostic.
- **Le Fort Fractures:** Complex fractures separating the face from the skull base. CT maps the fracture lines to classify them (Type I, II, or III).



CT Orbital Blowout

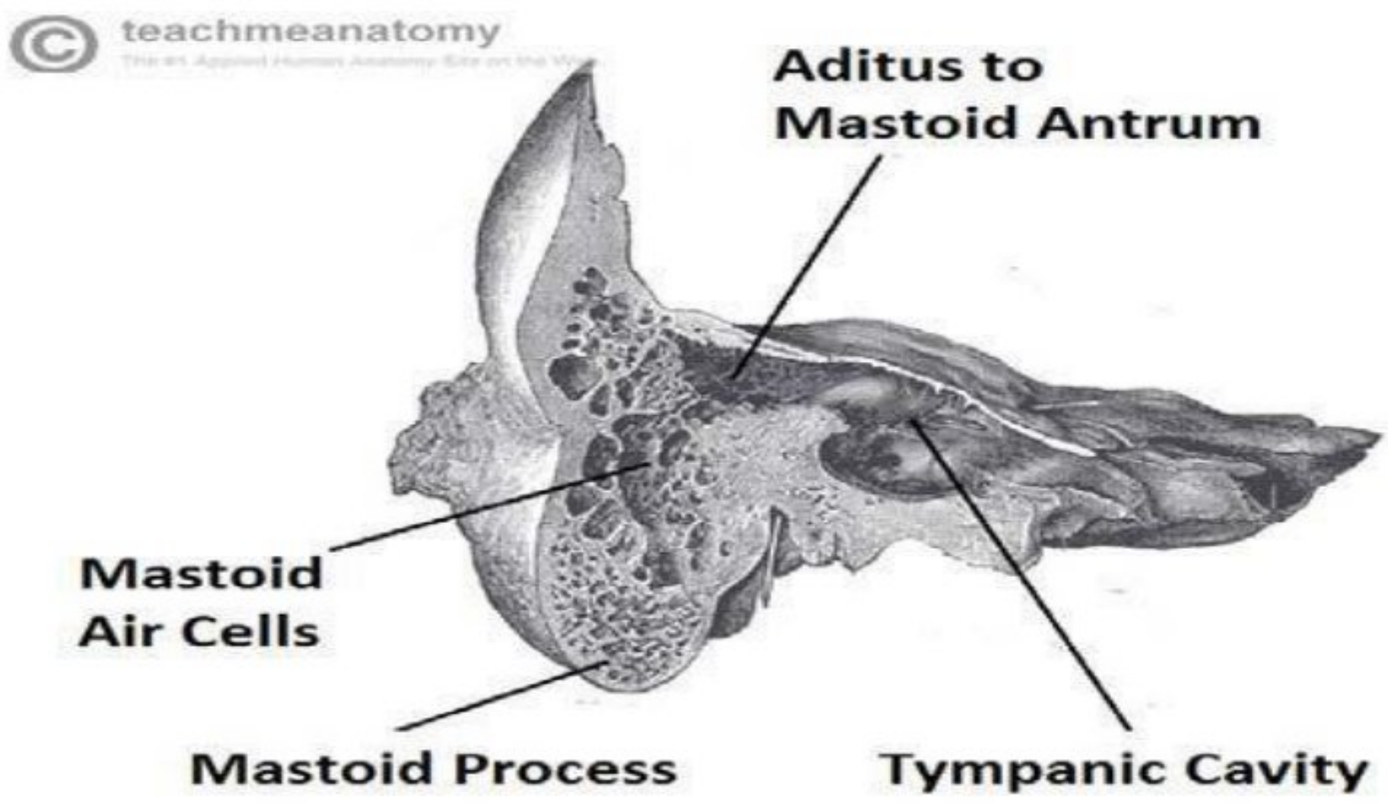
Lecture 4

Temporal bone and sella turcica with conventional x ray and CT imaging.

Part 1: The Temporal Bone (The Complex Rock)

The Temporal bone is the hardest bone in the body (Petrous part). It is a **"Complex Labyrinth"** housing delicate structures:

- **Hearing Organs:** The tiny ossicles (Malleus, Incus, Stapes).
- **Balance Organs:** Semicircular canals.
- **Facial Nerve:** Runs through a tortuous canal inside it.
- **Mastoid:** Honeycomb-like air cells behind the ear.



Temporal bone from inside

Conventional X-ray Applications

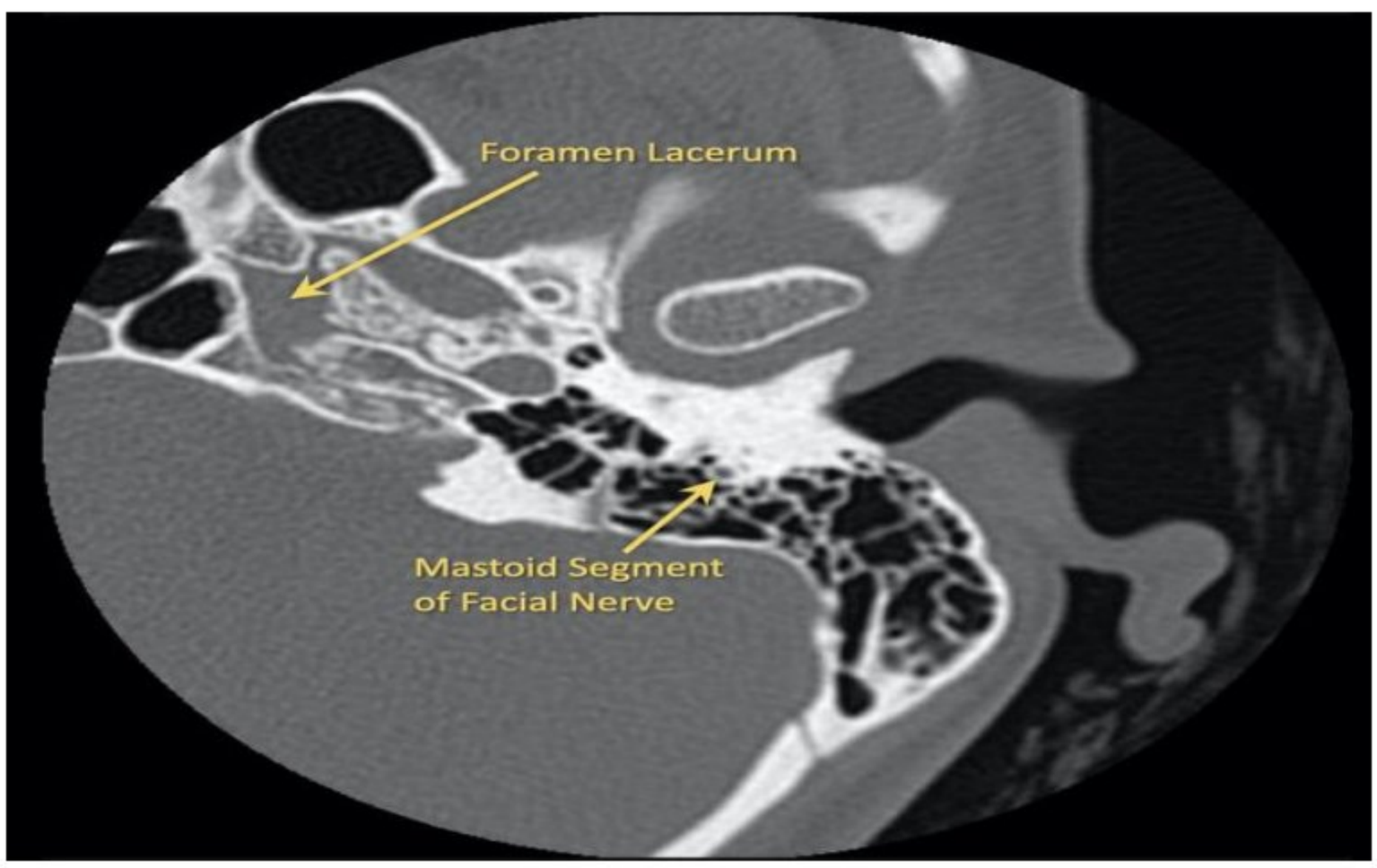
Plain X-ray is limited due to bone overlap, but historically used views include:

- **Schuller's View (Lateral):** Best to see the **Mastoid Air Cells**. We look for "Cloudiness" which indicates Mastoiditis (infection).
- **Stenvers View:** To see the petrous apex and inner ear (rarely used now).
- **Today's Use:** Quick check for cochlear implant position or severe trauma.

CT Scan Applications

High-Resolution CT (HRCT) is the **"Gold Standard"**.

- **Trauma:** It is the only way to see **Ossicular Disruption** (dislocation of the tiny hearing bones) after a slap to the ear.
- **Cholesteatoma:** A destructive skin cyst that eats away the bone. CT shows "Bony Erosion" clearly.
- **Pre-Surgery:** Surgeons need CT to map the Facial Nerve path to avoid cutting it.

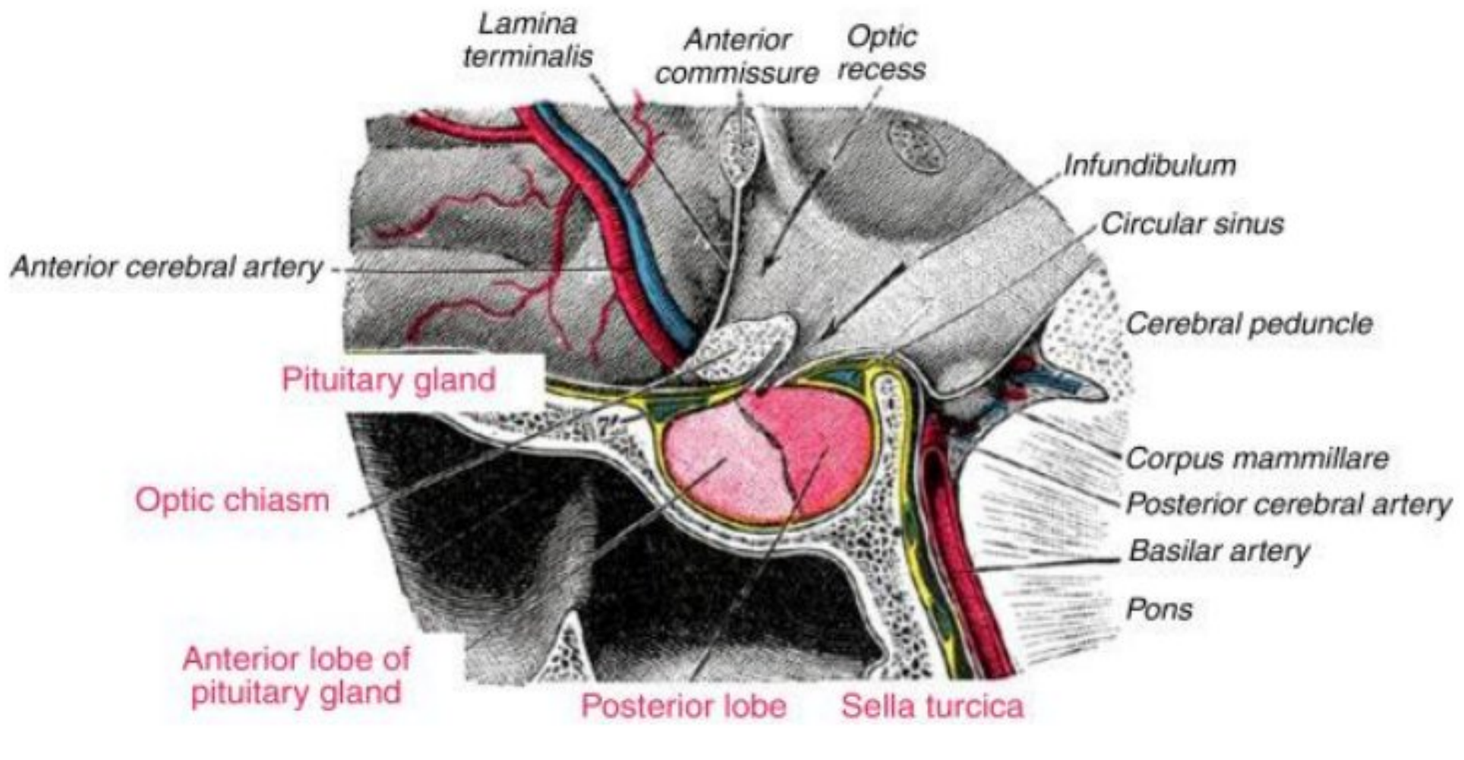


CT Temporal Bone

Part 2: The Sella Turcica (Pituitary Fossa)

The Sella Turcica (Latin for **"Turkish Saddle"**) is a cup-shaped depression in the Sphenoid bone.

- **Function:** It protects the **Pituitary Gland** (The Master Gland).
- **Relations:** Situated directly above the Sphenoid Sinus and below the Optic Chiasm (crossing of optic nerves).
- **Pathology:** If the gland grows (tumor), it expands the saddle or erodes the bone.



Sella Turcica Anatomy

Conventional X-ray Applications

We use the **Lateral Skull View**. Ideally, the Sella looks like a distinct "U" or "J" shape.

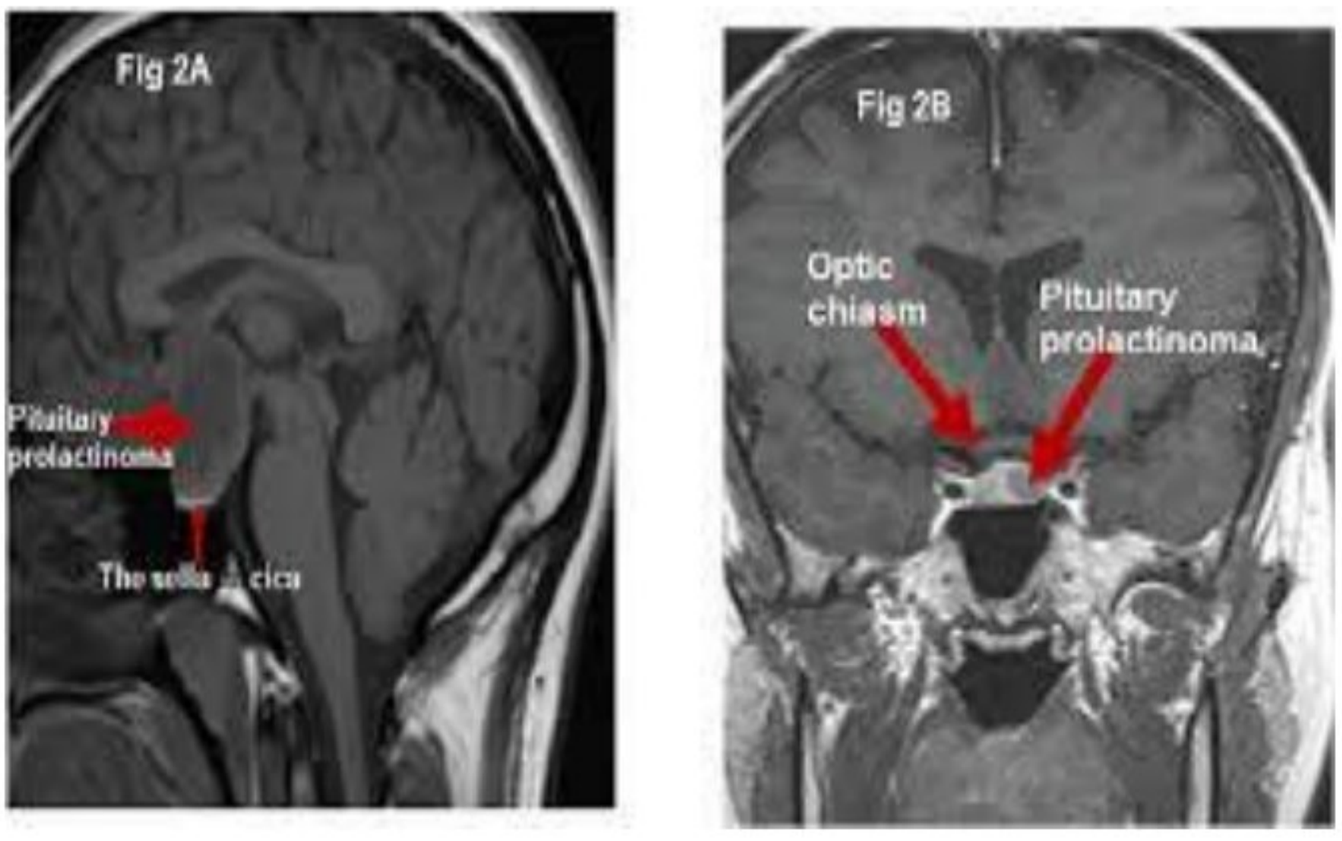
- **Enlargement:** If the Sella is deep and wide, it suggests a large Pituitary Macroadenoma (Tumor).
- **Double Floor Sign:** Indicates uneven erosion of the bone floor.
- **Calcification:** Can be seen in Craniopharyngioma (a specific type of tumor).

Lateral X-ray Sella

CT Scan Applications

CT focuses on the **"Bony Box"** and surrounding sinuses. (Note: MRI is better for the gland itself).

- **Bony Erosion:** CT detects subtle erosion of the Sella floor (invasion into Sphenoid sinus).
- **Calcification:** CT is superior to MRI in detecting calcium deposits within a tumor.
- **Navigation:** Used before surgery (Trans-sphenoidal surgery) to verify the anatomy of the septa inside the nose.



CT Sella Turcica

Lecture 5

Anatomy of the brain with conventional x-ray and CT imaging

Part 1: The Temporal Bone (The Complex Rock)

The Temporal bone is the hardest bone in the body (Petrous part). It is a "Complex Labyrinth" housing delicate structures:

- **Hearing Organs:** The tiny ossicles (Malleus, Incus, Stapes).
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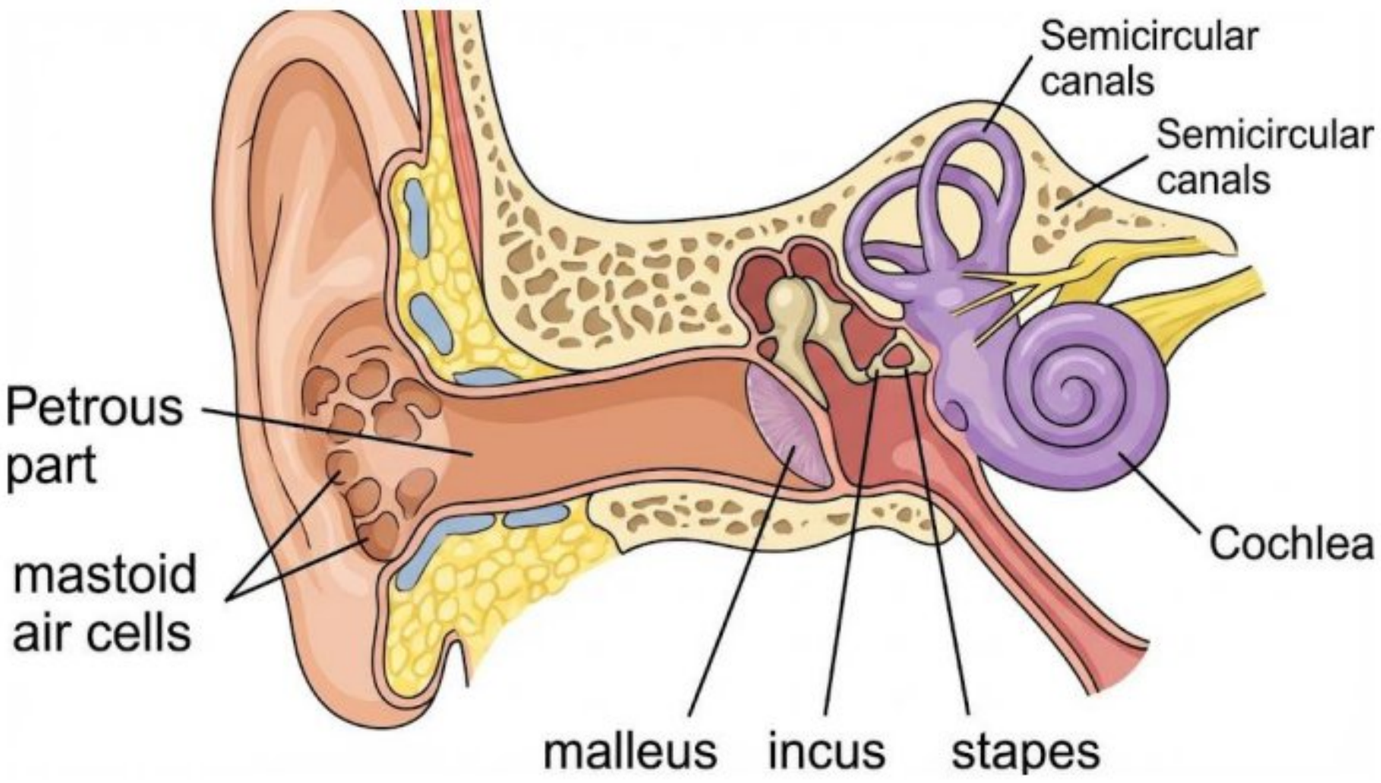


Anatomy of the inner ear and temporal bone

Conventional X-ray Applications

- **Schuller's View (Lateral):** Best to see the Mastoid Air Cells. We look for "Cloudiness" which indicates Mastoiditis (infection).
- **Stenvers View:** To see the petrous apex and inner ear.

CT Scan Applications

High-Resolution CT (HRCT) is the "Gold Standard".

- **Trauma:** It is the only way to see Ossicular Disruption (dislocation of the tiny hearing bones).

- **Cholesteatoma:** A destructive cyst; CT shows "Bony Erosion" clearly.

Part 2: The Sella Turcica (Pituitary Fossa)

The Sella Turcica (Latin for "Turkish Saddle") is a cup-shaped depression in the Sphenoid bone.

- **Function:** It protects the Pituitary Gland (The Master Gland).
- **Relations:** Situated directly above the Sphenoid Sinus and below the Optic Chiasm.

Conventional X-ray Applications

We use the Lateral Skull View.

- **Enlargement:** If the Sella is deep and wide ("U" or "J" shape), it suggests a large Pituitary Tumor.
- **Double Floor Sign:** Indicates uneven erosion of the bone floor.

CT Scan Applications

- **Bony Erosion:** CT detects subtle erosion of the Sella floor (invasion into Sphenoid sinus).
- **Navigation:** Used before Trans-sphenoidal surgery.

Part 3: The Brain Parenchyma & Ventricles

The Brain consists of Gray Matter (Cortex) and White Matter (Axons), containing fluid-filled cavities called Ventricles.

- **Ventricles:** Lateral, 3rd, and 4th ventricles filled with CSF.
- **Basal Ganglia:** Deep gray matter nuclei (Caudate, Thalamus).

Conventional X-ray Applications

Brain tissue is radiolucent (invisible). We look for indirect signs.

- **Pineal Shift:** Displacement of the calcified pineal gland indicates a mass effect.
- **Copper Beaten Skull:** Indicates increased intracranial pressure.

CT Scan Applications

CT differentiates tissues based on Density (Hounsfield Units).

- **Acute Hemorrhage:** Fresh blood appears **Hyperdense (Bright White)**.
- **Ischemic Stroke:** Dead tissue appears **Hypodense (Dark/Black)** due to edema.

Comparison between CT Scan & X-ray

Feature	Conventional X-ray	CT Scan
Brain Tissue	Invisible	Visible
Acute Bleeding	Invisible	Bright White
Main Use	Bone Fractures / Sinuses	Stroke / Tumors / Trauma
Bone Detail	2D Overlap	3D High Resolution

Lecture 6

Study the structure of vertebral column and Spinal cord by CT imaging

1. The Vertebral Column

It is the central bony axis of the body, consisting of **33 vertebrae** divided into 5 regions:

- **Cervical (7):** Neck region.
- **Thoracic (12):** Chest region.
- **Lumbar (5):** Lower back (Largest bodies).
- **Sacrum (5 fused):** Pelvic region.
- **Coccyx (4 fused):** Tailbone.

2. The Spinal Cord

A long, fragile tubelike structure that begins at the end of the brainstem and continues down to the **L1 or L2** vertebra (ending at the Conus Medullaris). It transmits nerve signals.

Part 1: CT Anatomy of the Vertebra (The Bony Protector)

On an **Axial CT Slice**, a typical vertebra consists of two main parts enclosing a hole (the foramen).

- **Vertebral Body (Anterior):** The large, block-like structure that bears weight. Appears **Bright White** (Hyperdense).
- **Vertebral Arch (Posterior):** The bony ring protecting the spinal cord. It consists of:
    - **Pedicles:** Two pillars connecting the body to the arch.
    - **Laminae:** Two plates forming the roof.
    - **Spinous Process:** Bony projection posteriorly.

CT Applications (Bone Pathology)

- **Fractures:** CT is the best way to see bony fragments (e.g., Burst Fracture after accidents)

Metastasis: Cancer spreading to bone appears as destructive holes (Lytic) or white spots (Sclerotic).

Part 2: CT Anatomy of Spinal Canal & Contents (Soft Tissue)

The bony ring forms the **Spinal Canal**. CT helps evaluate the "space" available for the cord.

- **Thecal Sac:** The membrane tube containing CSF and the Spinal Cord. It appears **Gray** inside the canal.
- **Epidural Fat:** Black fat surrounding the thecal sac. It acts as a cushion and creates contrast to see the nerve roots.
- **Intervertebral Disc:** The shock absorber between vertebral bodies. Appears as a soft tissue density (Gray).

CT Applications (Canal Pathology)

- **Disc Herniation:** The disc bulges posteriorly, compressing the thecal sac or nerve roots.
- **Spinal Stenosis:** The canal becomes narrow due to bone spurs or thickened ligaments, crushing the cord.

Part 3: Sagittal View & Neural Foramina

Reconstructing images into a **Sagittal View** (Side profile) is crucial for alignment.

- **Neural Foramen:** The "Keyhole" shaped opening on the side where the spinal nerve exits.
- **Vertebral Alignment:** The posterior borders of the vertebral bodies should form a smooth, unbroken line.

CT Applications (Alignment)

- **Spondylolisthesis:** Forward slippage of one vertebra over the one below it.

Table showing CT Appearance with Pathology

Component	Anatomy	CT Appearance	Pathology
Vertebra	Bone (Body & Arch)	Bright White	Fracture, Metastasis
Spinal Cord	Neural Tissue	Gray Oval	Compression (Myelopathy)
Disc	Fibrocartilage	Gray Density	Herniation (Bulge)
Epidural Space	Fat & Veins	Black	Obliteration (in Stenosis)

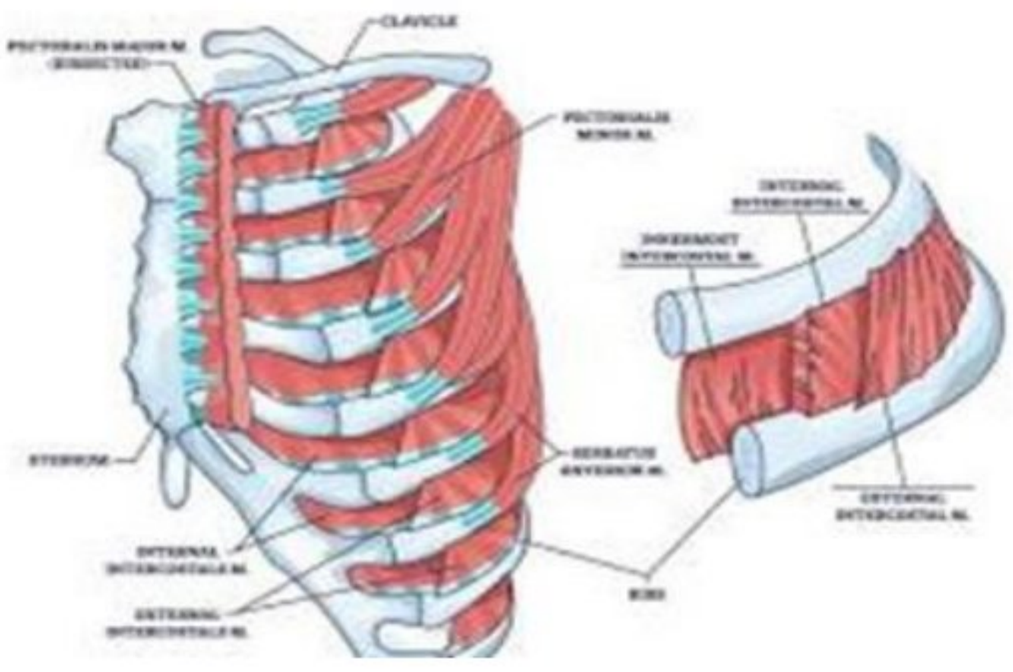
Lecture 7

Study the chest, ribs with conventional x ray and CT imaging

1- Thoracic Cage

Definition: The thoracic cage is a flexible osteocartilaginous framework that forms the central part of the human skeleton.

Vital Function: Its function is not limited to protection; it is the "engine" of respiration, protecting the heart, lungs, and liver, while allowing lung expansion during inspiration.



2- Anatomy

This defensive system consists of three main skeletal groups:

1. (The Sternum):

Known as the "Breastbone," it consists of three parts (Manubrium, Body, and Xiphoid process).

2. (Thoracic Vertebrae):

There are 12 vertebrae (T1-T12), serving as the posterior anchor where ribs attach.

3. (The Ribs):

There are 12 pairs of ribs, medically classified by their attachment to the sternum:

a. True Ribs (1-7)

Connect directly to the sternum via their own costal cartilages.

b. False Ribs (8-10)

Do not connect directly to the sternum; they join the cartilage of the 7th rib.

c. Floating Ribs (11-12)

Short ribs that end in the abdominal muscles with no anterior attachment.

* Conventional Radiography - X-ray

When looking at a chest X-ray, we see an overlapping mesh of bones. To distinguish them, follow this rule:

Posterior Ribs: Appear horizontal and are more distinct due to higher bone density and proximity to the detector.

Anterior Ribs: Appear downward-slanting towards the front.

* Radiographic Projections

1. **PA View:** Used for lungs and heart, but might miss some rib fractures).
2. **Oblique View:** The "Golden View" for ribs. The patient is rotated 45° to unmask the ribs from the spine shadow.

* Advanced CT Imaging

Why do we order a CT scan?

In trauma cases, plain X-rays may miss subtle fractures. CT scans provide immense accuracy.

- **Bone Window:** A technique that shows the rib cortex in high detail.
- **3D Reconstruction:** Provides a complete stereoscopic image, making complex fractures easier to diagnose.

Comparison between X-ray & CT Scan

Feature	X-ray	CT Scan
Dimensions	2D	3D
Bone Detail	Good for large fractures	Excellent for the smallest details
Cartilage	Poor	Excellent

Lecture 8

Study the bronchial position and pericardium with conventional x ray and CT imaging

Bronchi: Are the airways that conduct air into the lungs, starting from the tracheal bifurcation (Carina).

Pericardium: Is a double-layered sac surrounding the heart for protection and reducing friction during beats.

Bronchial Position on X-ray

On conventional X-ray (CXR), bronchi appear as black shadows because they contain air.

* **The Carina:** Usually located at the level of T4 or T5 vertebrae.

* **Right Main Bronchus:** Is more vertical, wider, and shorter than the left.

* **Left Main Bronchus:** Is more horizontal and longer to pass under the aortic arch.

Pericardium on X-ray

- **Normal State:** The pericardium cannot be seen as a separate layer on X-ray because it is very thin.
- **Effusion:** When fluid collects, the heart shadow enlarges, taking a "water-bottle" shape.

CT Imaging

CT scan is the gold standard for visualizing fine details of bronchi and pericardium.

Bronchi on CT

- Allows visualization of small segmental bronchi.
- We use MinIP technique to highlight airways clearly.

Pericardium on CT

**Appears as a very thin line (1-2 mm thick) surrounding the heart, separated by a thin epicardial fat layer.

Common Pathologies

- **Bronchiectasis**

  **(Bronchi appear wider than their accompanying vessels).

- **Pericardial Calcification**

  **(The pericardium appears as a bright white ring on CT, indicating chronic inflammation).

Comparison between X-ray & CT Scan

Feature	X-ray	CT Scan
Bronchial vision	Only the major bronchi are visible.	All branches are accurately displayed.
Pericardium vision	It only appears in the presence of fluids.	It appears as a thin layer even in its natural state.
Dimensions	2D (interlocking)	3D (precise cross-sections)

Lecture 9

Study the heart and mediastina by conventional x ray and CT imaging

Heart: The primary muscular organ that pumps blood throughout the body.

Mediastinum: The space in the chest between the two lungs, containing the heart, great vessels, bronchi, trachea, and esophagus.

* Mediastinum on X-ray

The mediastinum is anatomically and radiographically divided to localize masses or enlargements:

- **Anterior Mediastinum:** Located behind the sternum, containing the thymus gland.
- **Middle Mediastinum:** Includes the heart, great vessels, trachea, and bronchi.
- **Posterior Mediastinum:** Located directly behind the heart, containing the esophagus and spine.

* Heart on X-ray

Heart size and shape should be evaluated in both PA and Lateral views:

- **Size:** Measured by the Cardiothoracic Ratio (CTR).
- **Normal CTR:** Should be less than 0.5 (heart width less than half chest width).

- **Shape:**

- **Left Atrial Enlargement:** Elevates the left main bronchus.
- **Left Ventricular Hypertrophy:** Appears as a "Boot-shaped heart".

* Heart & Mediastinum on CT Scan

CT provides highly detailed anatomical information not visible on conventional X-rays.

- **Heart:** Assessment of heart chambers, coronary arteries, and valves (especially with contrast).
- **Mediastinum:**
  - **Great Vessels:** Precise visualization of the aorta and pulmonary artery.
  - **Lymph Nodes:** Assessing their size and morphology for pathology (e.g., tumors or inflammation).
  - **Masses:** Highly accurate localization and sizing of any mediastinal mass.

* Important Pathologies

* **Cardiomegaly:** Enlargement of the heart (CTR > 0.5).

* **Mediastinal Lymphadenopathy:** Enlarged lymph nodes in the mediastinum, seen in tumors or sarcoidosis.

* **Aortic Aneurysm:** Dilation of the aorta, accurately diagnosed by CT.

* **Mediastinal Tumors:** Such as thymomas or cysts.

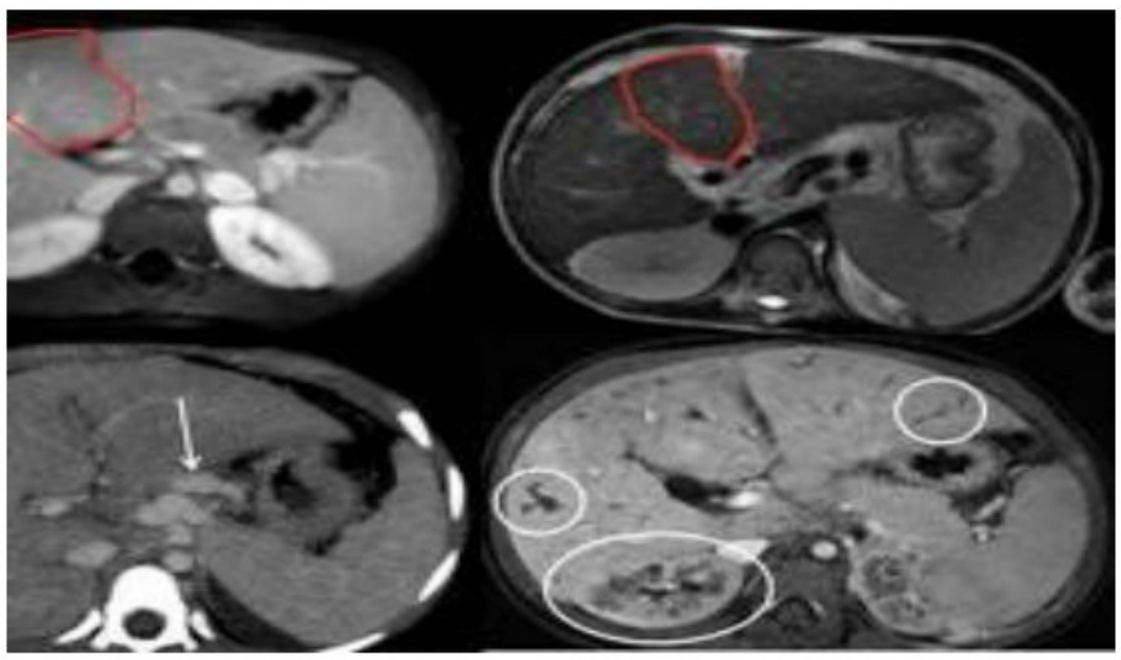
Lecture 10

Anatomy of the gastro intestinal tract and and small, large intestinal and Anatomy inter in abdomen spleen, liver, pancreasin in CT and MRI imaging

1- The Liver

Definition: The largest internal organ, located in the RUQ, responsible for metabolism and bile secretion.

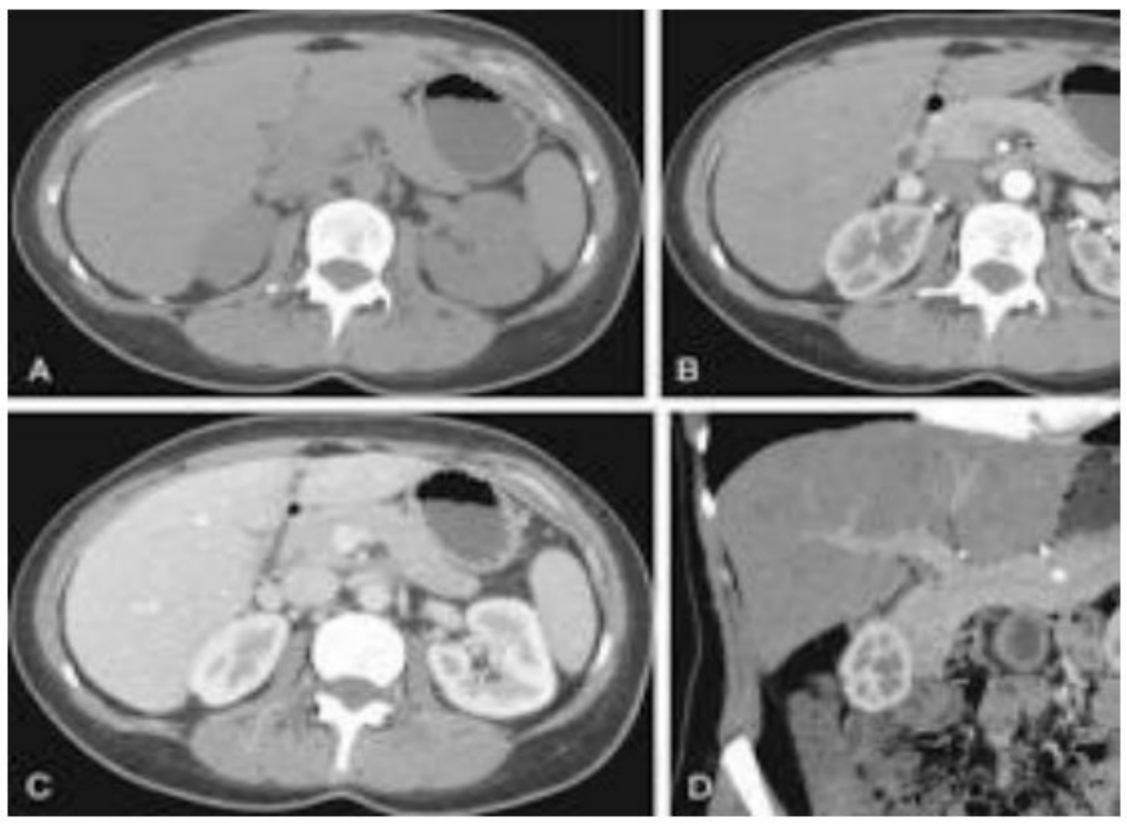
- **On CT:** Best for trauma and detecting calcified lesions. It shows liver density clearly.
- **On MRI:** Superior for characterizing soft tissue, liver fat, and small tumors (using T1/T2 sequences).



2- The Pancreas

Definition: A gland located behind the stomach that secretes digestive enzymes and insulin.

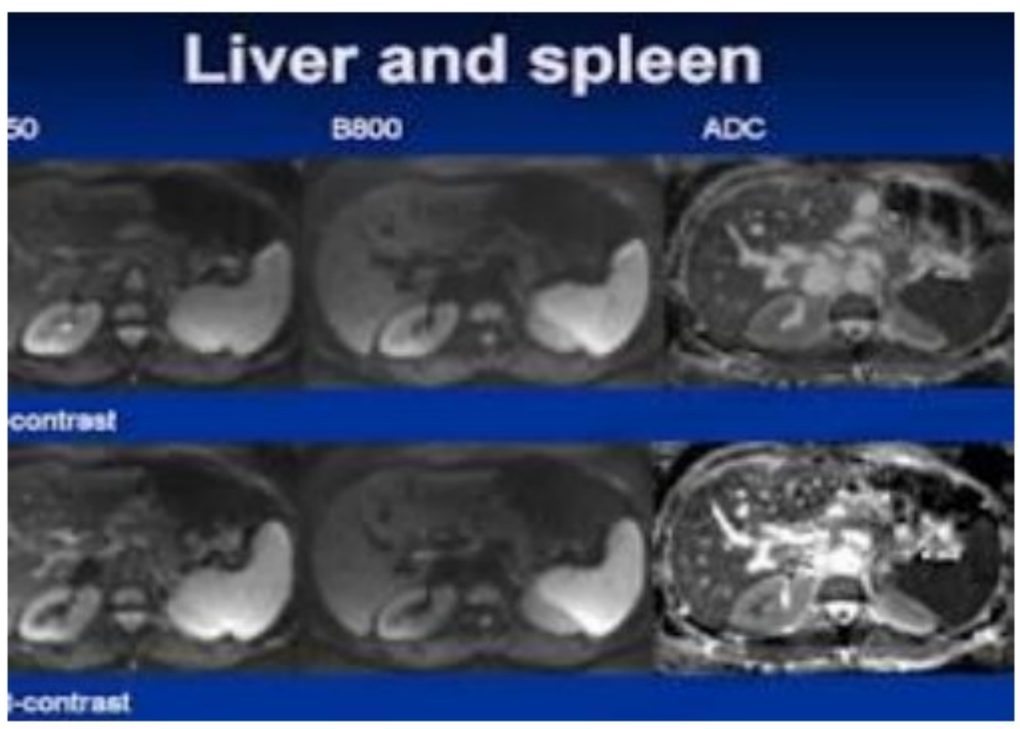
- **On CT:** Gold standard for "Acute Pancreatitis" and assessing surrounding fat inflammation.
- **On MRI (MRCP):** The best for visualizing the pancreatic duct and stones without radiation.



3- The Spleen

Definition: A lymphoid organ that filters blood; located in the left upper quadrant.

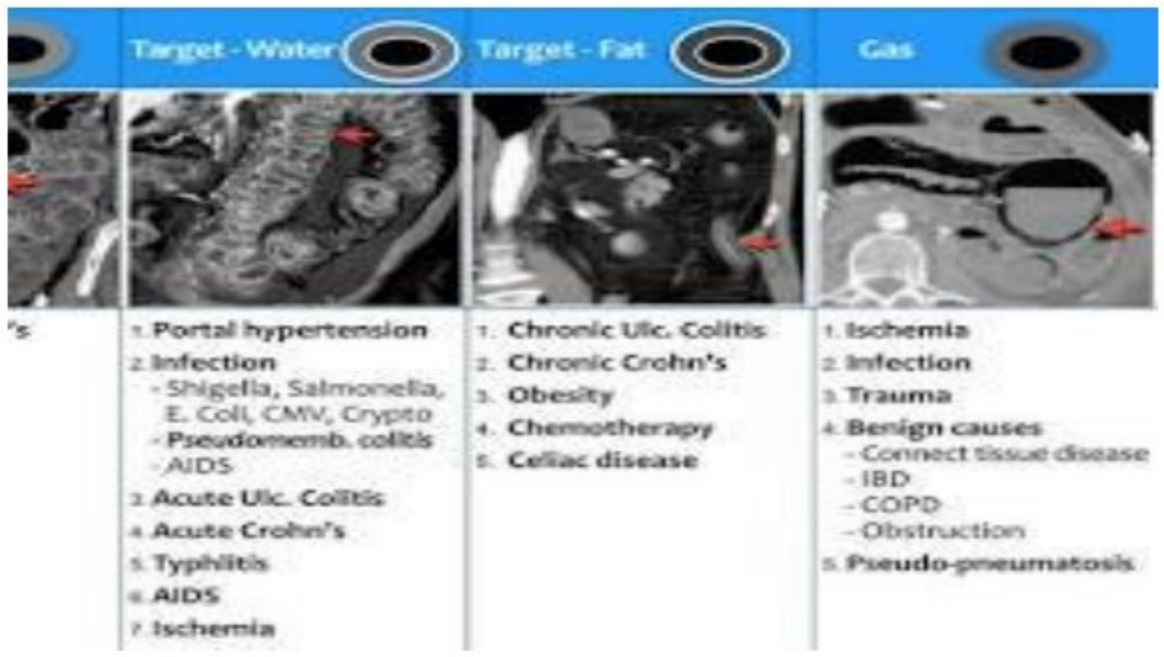
- **On CT:** Excellent for detecting splenic rupture or infarction during accidents.
- **On MRI:** Used to differentiate between benign and malignant splenic masses.



4- Small & Large Intestine

Definition: Tubes responsible for digestion (Small) and water absorption/waste storage (Large).

- **On CT (Enterography):** Uses oral contrast to find obstructions and wall thickening.
- **On MRI (Enterography):** Best for follow-up in "Crohn's disease" to avoid repeated radiation.



Comparison between MRI & CT Scan

Feature	MRI	CT Scan
Speed	Slow	Fast
Radiation	None	High
Soft Tissue	Excellent	Good
Bones/Calcification	Poor	Best

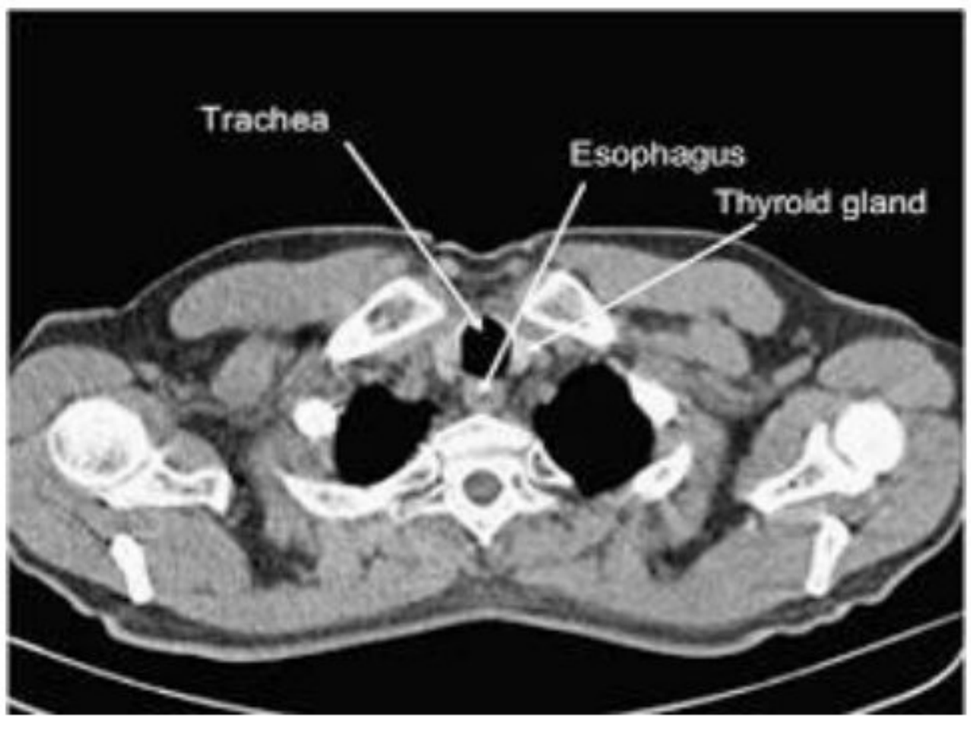
Lecture 11

Oesophagus, stomach and duodenum and biliary tract system in CT and MRI imaging

1- The Oesophagus

Definition: A muscular tube that carries food from the pharynx to the stomach, passing through the mediastinum.

- **On CT:** Best for "Staging" esophageal cancer and seeing if it has spread to the lungs or lymph nodes.
- **On MRI:** Used to evaluate the depth of the esophageal wall layers and involvement of surrounding soft tissues.



2- The Stomach

Definition: A J-shaped organ that digests food using acids and enzymes, located in the left upper abdomen.

- **On CT:** Requires the stomach to be distended with water or oral contrast to see wall thickening or tumors.
- **On MRI:** Excellent for distinguishing between different types of gastric wall tumors (like GIST).

3- The Duodenum

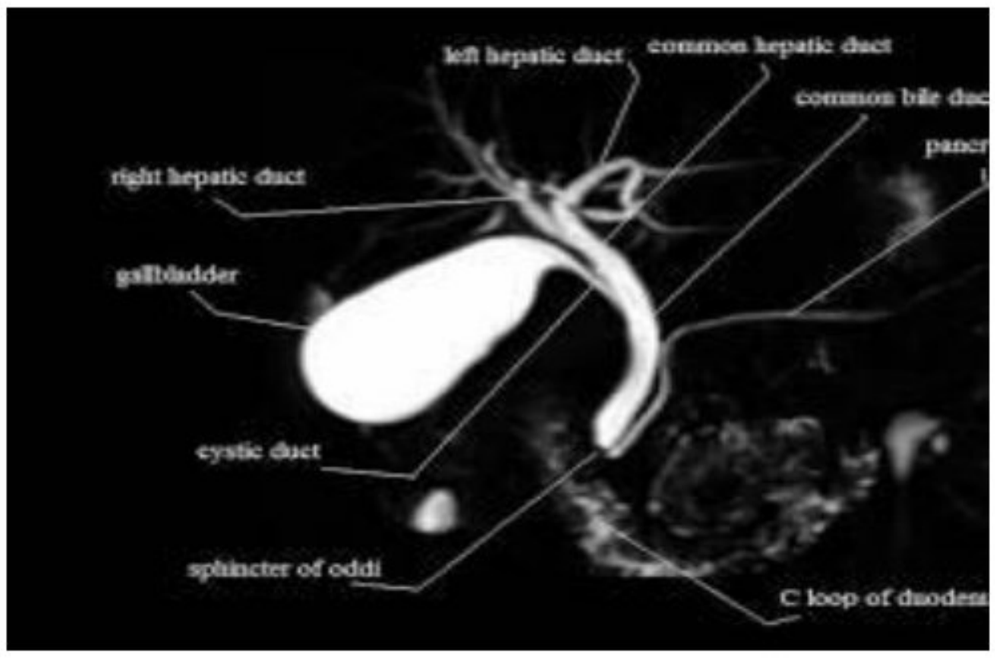
Definition: The first part of the small intestine, C-shaped, where most chemical digestion takes place.

- **On CT:** Important for seeing the relationship between the duodenum and the head of the pancreas.
- **On MRI:** MRI can detect small mucosal ulcers or diverticula within the duodenal wall.

4- The Biliary Tract System

Definition: A system of ducts that transport bile from the liver and gallbladder into the duodenum.

- **On CT:** Good for detecting calcified gallstones and bile duct dilation due to tumors.
- **On MRI (MRCP):** The "Gold Standard" for non-invasive imaging of the bile ducts and gallbladder (shows bile as bright white).



Comparison between CT& MRI

Organ	CT Usage	MRI Usage
Esophagus	Cancer Staging	Tissue Invasion
Stomach	Wall Thickening	Tumor Characterization
Biliary Tract	Stones & Obstruction	MRCP

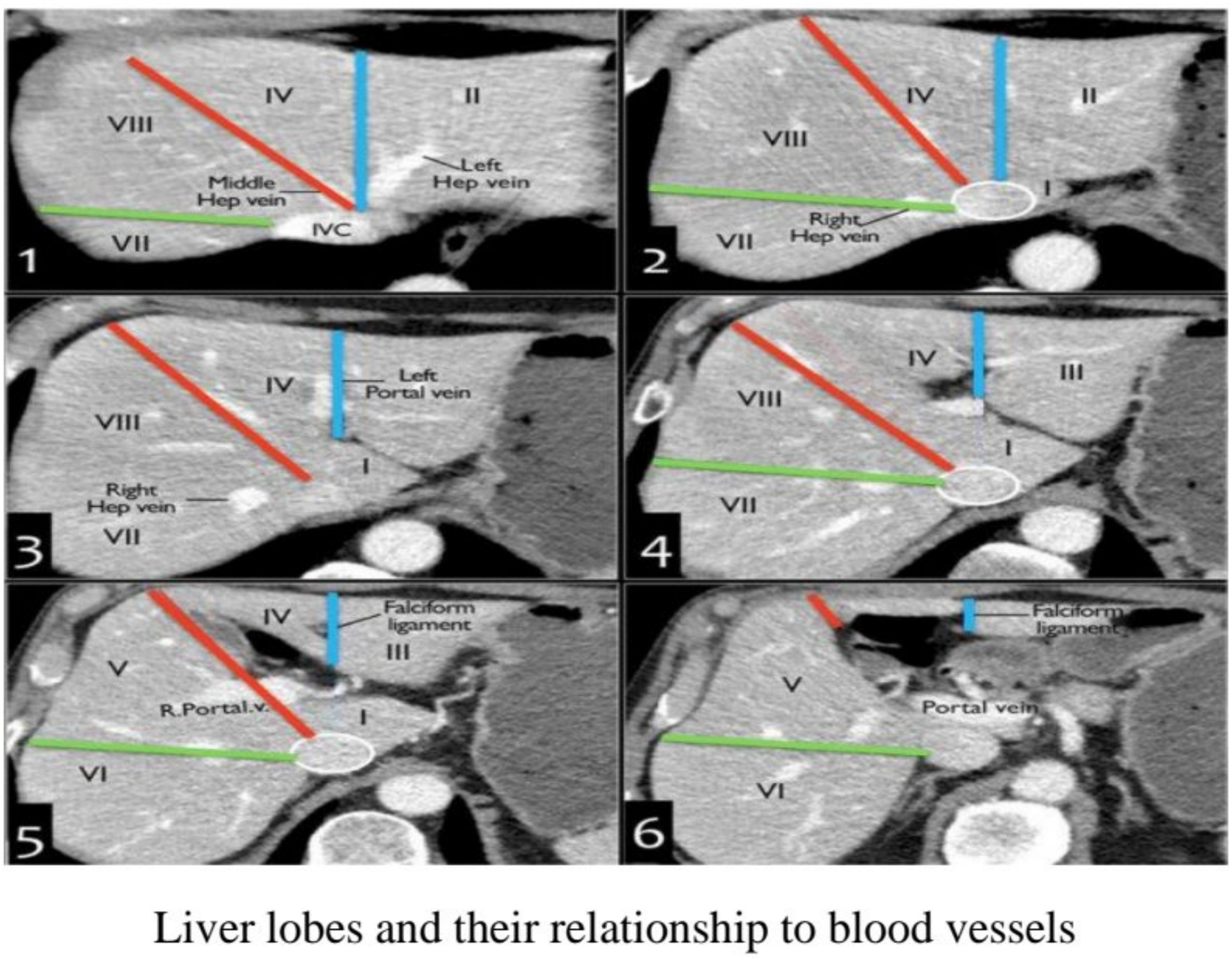
Lecture 12

Anatomy inter in abdomen spleen, liver, pancreasin in CT and MRI imaging

1- The Liver

The liver is the largest solid organ in the abdomen, divided into eight segments according to Couinaud's classification.

- **In CT Imaging:** It appears as a homogeneous structure. CT is excellent for detecting acute trauma (lacerations) and calcified lesions.
- **In MRI Imaging:** Superior for evaluating diffuse diseases (like fatty liver) and characterizing focal masses (hemangioma vs. malignancy).

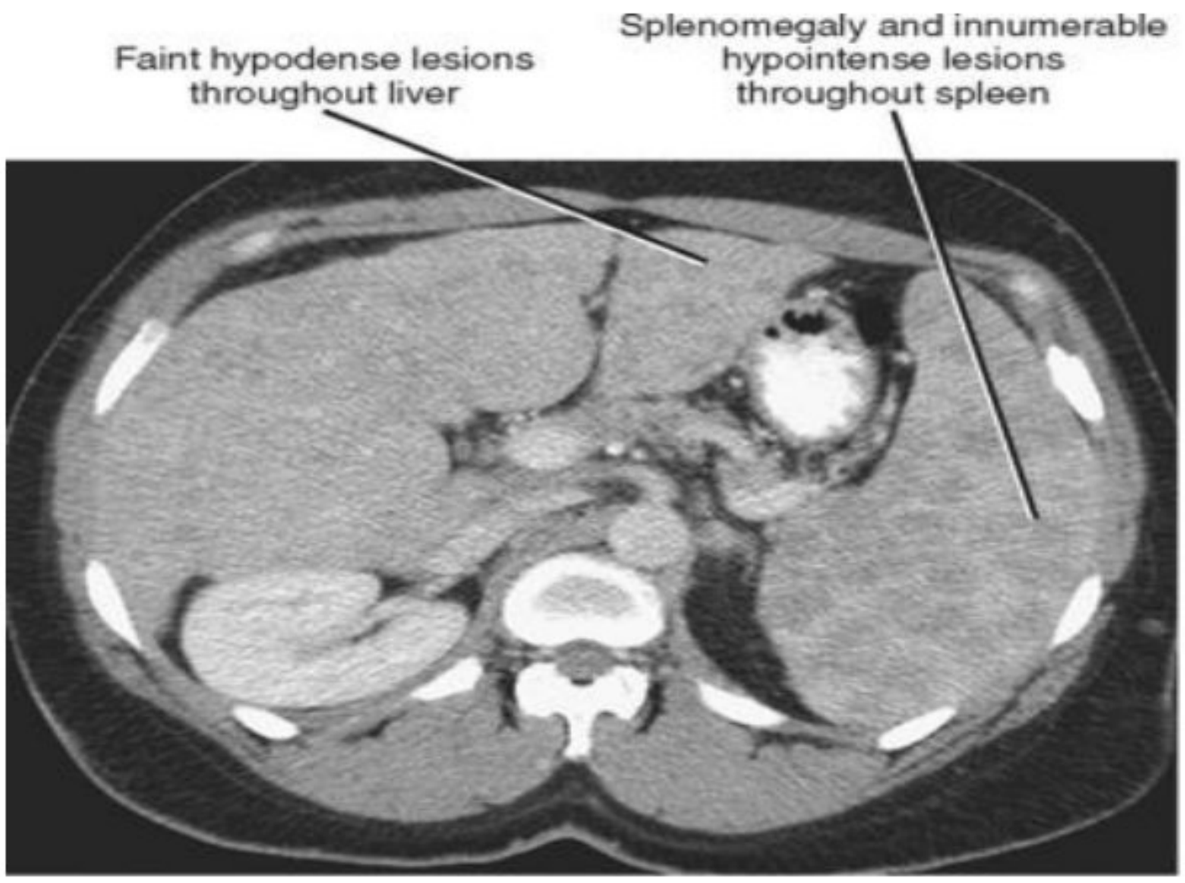


Liver lobes and their relationship to blood vessels

2- The Spleen

A lymphoid organ located in the left upper quadrant (LUQ), protected by the 9th to 11th ribs.

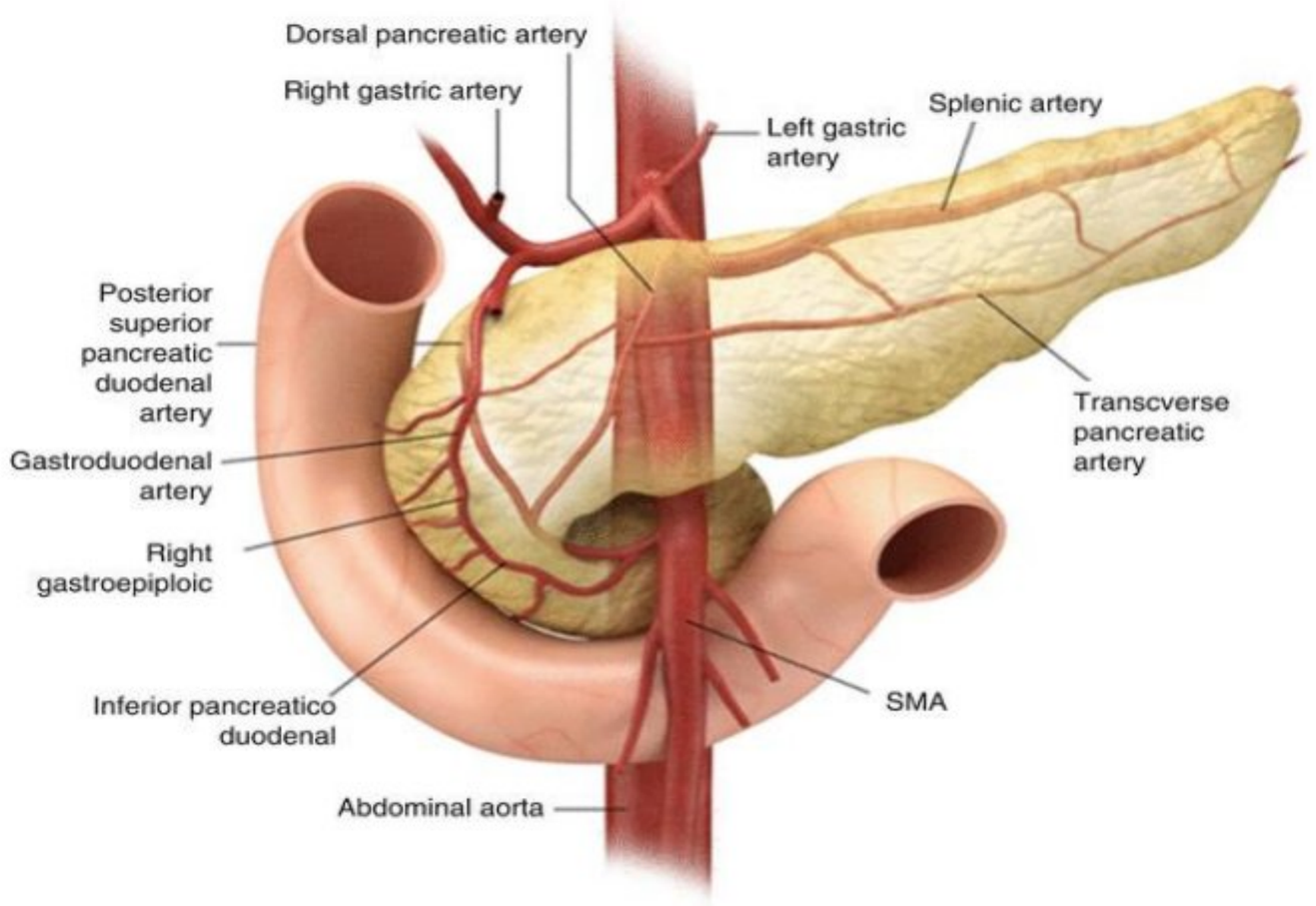
- **In CT Imaging:** During the arterial phase, it shows a heterogeneous "Zebra" pattern, which becomes homogeneous in the venous phase.
- **In MRI Imaging:** The spleen has a very high signal on T2-weighted images, making it appear brighter than the liver.



3- The Pancreas

A retroperitoneal organ located behind the stomach, consisting of a head, neck, body, and tail.

- **In CT Imaging:** It is the primary modality for diagnosing "Acute Pancreatitis" by showing gland swelling and peripancreatic fluid.
- **In MRI Imaging (MRCP):** MRI is the gold standard for visualizing the pancreatic ductal system and detecting small cysts or stones.



Comparison between CT Scan & MRI

Feature	CT Scan	MRI
Primary Strength	Trauma & Calcification	Soft tissue & Ducts
Liver Evaluation	Segmental anatomy	Lesion characterization
Pancreas Evaluation	Acute inflammation	Ductal details
Spleen Evaluation	Lacerations/Trauma	Mass differentiation

Lecture 13

Anatomy of the urinary system in kidney with conventional x ray and CT imaging

Introduction

The Kidneys: Are pair of retroperitoneal bean-shaped organs, located between T12 and L3 vertebrae.

The Function: They filter blood to produce urine and help regulate blood pressure and electrolytes.

Kidneys on Conventional X-ray

In plain X-ray (KUB), kidneys are often obscured by bowel gases unless we use contrast media.

- **Intravenous Pyelogram - IVP:** It is a special X-ray test where contrast is injected into the vein to visualize the kidneys, ureters, and bladder.
- **Renal Outline (حدود الكلية):** The renal shadow is usually visible due to the perirenal fat.
- **Stones (الحصى):** Plain X-rays are excellent for detecting radio-opaque stones (calcium stones).

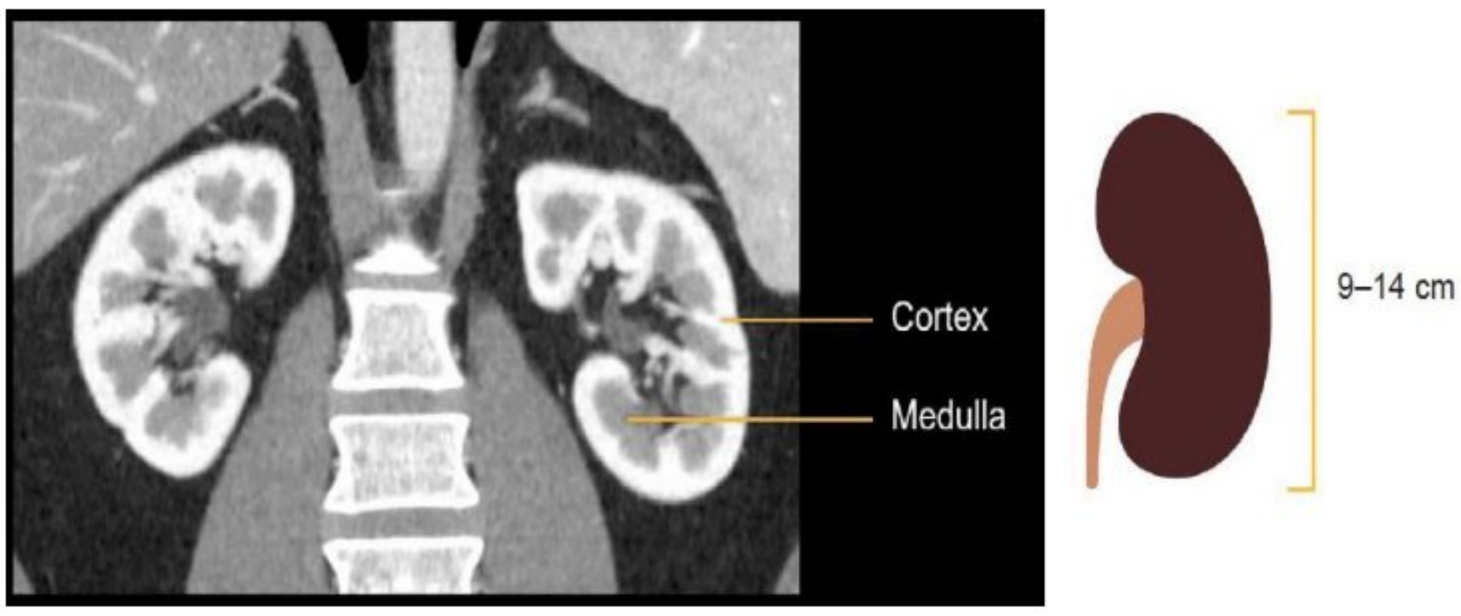
Calcium-rich stones appear on X-rays as white spots (radiochromatic) in the kidney area or along the ureteral tract; however, some other types of stones (such as uric acid stones) may not appear clearly on this type of X-ray and require more accurate examinations such as CT scans.

Kidneys on CT Imaging

CT is the most sensitive modality for evaluating renal anatomy and pathologies.

- **Non-Contrast CT:** It is the "Gold Standard" for detecting kidney stones.
- **Contrast-Enhanced CT:** It allows us to differentiate between the **Cortex** (outer part) and **Medulla** (inner part).
- **Renal Vasculature:** CT clearly shows the renal arteries and veins, helping in identifying vascular abnormalities.

** An image showing the details of the kidney, including the cortex and medulla, in a cross-section using computed tomography (CT) with the use of contrast material (dye).



The staining in the early stage (corticomedullary phase) shows a clear distinction between the outer cortex, which appears brighter, and the inner medulla, helping doctors to accurately assess kidney function and anatomical structure.

Comparison Summary X-ray & CT Scan

Feature	Plain X-ray	CT Scan
Visibility of Mass	Poor	Excellent
Detection of Stones	Good for calcified stones	Gold Standard for all stones
Internal Anatomy	Needs IVP	Very clear details
Function Evaluation	Possible with IVP	Excellent with dynamic contrast

Common Pathologies in Imaging

1. **Hydronephrosis:** Dilation of the renal pelvis, usually seen as dark fluid areas on CT.
2. **Renal Cysts:** Fluid-filled sacs that appear very dark and smooth on CT scans.

Lecture 14

Ureter and bladder with conventional x ray and CT imaging

Introduction

The Ureters: Are thin muscular tubes (25-30 cm long) that transport urine from the renal pelvis to the bladder.

The Urinary Bladder: A hollow muscular organ located in the pelvic cavity that stores urine.

Ureter and Bladder on Conventional X-ray

In plain X-ray (KUB), these structures are normally invisible unless they contain calcified stones.

- **IVP:** Used to see the "Peristalsis" of ureters and the shape of the bladder after filling with contrast.
- **Cystography:** A special X-ray where contrast is injected through a catheter to check for bladder leaks or reflux.
- **Ureteral Points:** X-ray shows the three physiological narrowings where stones usually get stuck.

** An image illustrating an intravenous urography (IVP) examination, showing the ureteral pathway and bladder fullness with contrast material (dye).

This test is used to assess the efficiency of kidney function and urine flow through the ureters to the bladder, helping to detect any blockages, narrowings, or anatomical abnormalities in the urinary tract.

Ureter and Bladder on CT Imaging

CT Urography (CTU) is the modern standard for evaluating the entire urinary tract.

- **The Ureters:** CT can trace the ureter along its entire course to find tumors or obstructions.
- **The Bladder:** When filled with contrast, CT shows the bladder wall thickness and any intraluminal masses.
- **Ureterovesical Junction:** The point where the ureter enters the bladder, clearly seen in axial CT slices.

** A CT scan showing an axial cross-section of the pelvic region, revealing the bladder and the lower part of the distal ureters as they connect to the bladder.

The above section helps in assessing the bladder wall, detecting the presence of stones at the end of the ureter, or any enlargement of the surrounding lymph nodes.

Comparison between X-ray& CT Scan

Feature	Plain X-ray	CT Scan (Urography)
Detection of Obstruction	Good (shows the site)	Excellent (shows the cause)
Bladder Wall Evaluation	Limited (poor detail)	Very high detail (3D imaging)
Ureter Course	Seen as a line (dynamic)	Seen in cross-sections (static)
Stones Detection	Only radio-opaque stones	All types of stones (Gold Standard)

Common Pathologies

1. **Vesicoureteral Reflux:** Urine flowing back from the bladder to the ureter.
2. **Bladder Tumors:** Appear as irregular growths from the wall inside the bladder cavity on CT scans.

Lecture 15

Anatomy of the uterus, uterus tube in x ray and CT and MRI imaging

Introduction

The Uterus: A hollow, pear-shaped muscular organ located in the female pelvis between the bladder and the rectum.

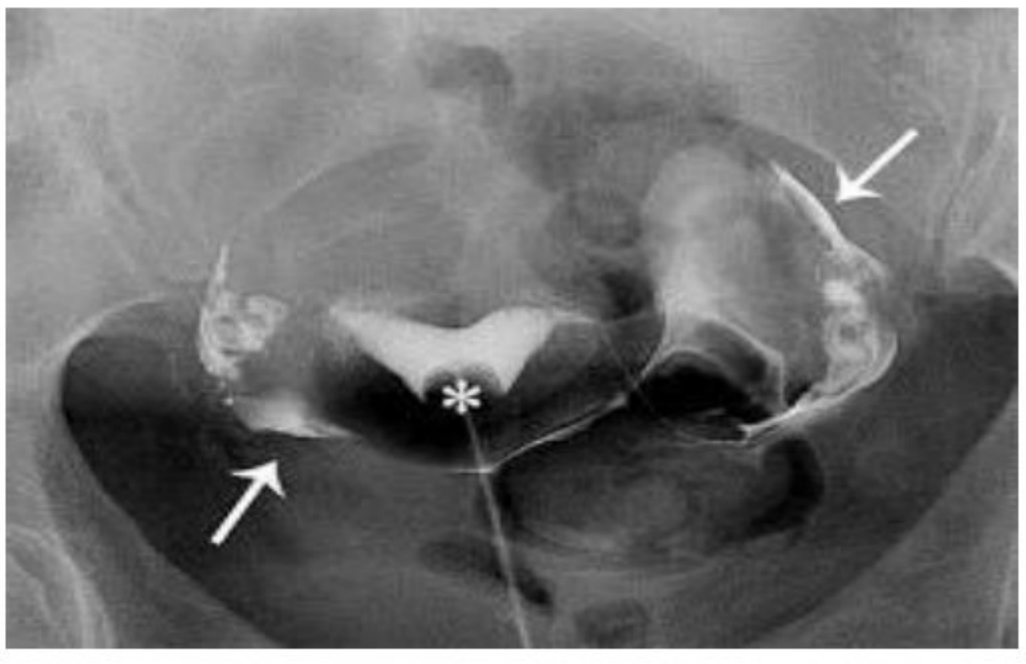
The Fallopian Tubes: Two thin tubes that extend from the uterus toward the ovaries; they are the site of fertilization.

X-ray Imaging: HSG

Normal X-rays do not show the uterus. We use a special procedure called **Hysterosalpingography (HSG)**.

- **Procedure:** Contrast media is injected through the cervix to fill the uterine cavity and tubes.
- **Clinical Use:** It is the "Gold Standard" to check for **Tubal Patency** (if the tubes are open or blocked) in infertility cases.

** This image shows a hysterosalpingogram (HSG), where the uterine cavity and fallopian tubes appear filled with contrast material.



This examination is primarily used to assess the permeability of the fallopian tubes and the shape of the uterine cavity, which helps in diagnosing the causes of delayed conception or congenital uterine defects.

CT Imaging

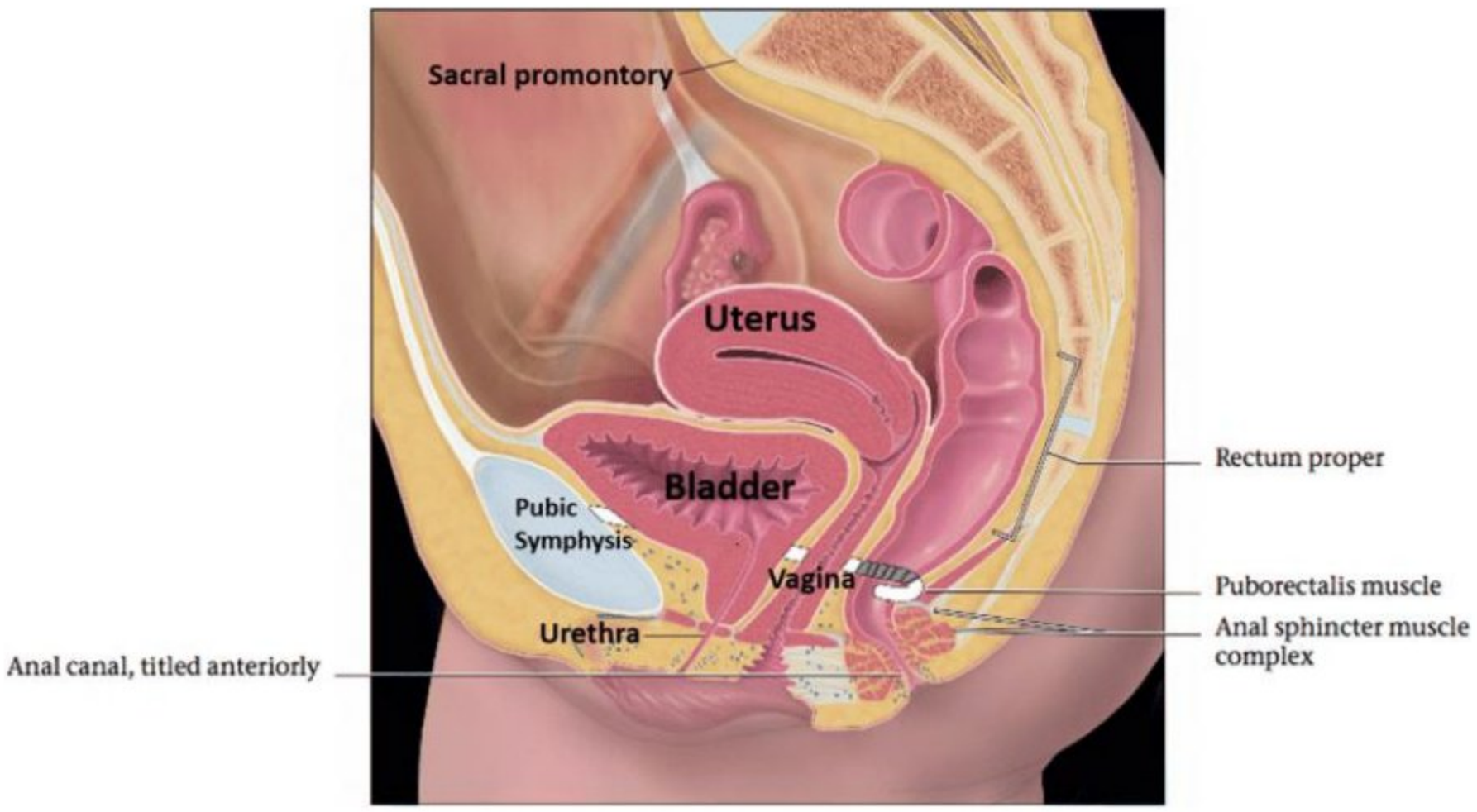
- **On CT:** The uterus appears as a soft tissue mass. It is not the best for inner details but excellent for "Staging" cancers.
- **Limitations:** CT cannot clearly differentiate between the layers of the uterine wall (Endometrium vs Myometrium).

MRI Imaging

MRI is the **Best** modality for uterine anatomy due to its high soft-tissue contrast.

- **Zonal Anatomy:** On T2-weighted images, we can see three distinct layers:
    1. **Endometrium:** Central bright (high signal) area.
    2. **Junctionals Zone:** Dark thin line (low signal).
    3. **Myometrium:** Intermediate grey signal.

** An image showing a sagittal section of the female pelvis using magnetic resonance imaging (MRI), showing the layers of the uterus (endometrium, muscularis, and ectopic membrane) and its anatomical relationship to the bladder.



Magnetic resonance imaging (MRI) is the optimal technique for visualizing the "junctional zone" in the uterine muscle. It also clearly shows how the bladder lies directly in front of the uterus, which helps in diagnosing conditions such as uterine fibroids, endometriosis, or tumors.

Comparison HSG& CT Scan& MRI

Feature	HSG (X-ray)	CT Scan	MRI
Tubal Patency	Best	Poor	Good
Uterine Layers	Not Seen	Poorly seen	Excellent
Congenital Anomalies	Good for cavity	Limited	Best
Cancer Evaluation	No Role	For metastasis	Best for local invasion

Common Pathologies

1. **Uterine Fibroids:** Common benign tumors clearly seen on MRI as dark well-defined masses.
2. **Bicornuate Uterus:** A congenital anomaly where the uterus is heart-shaped, best diagnosed by MRI or HSG.