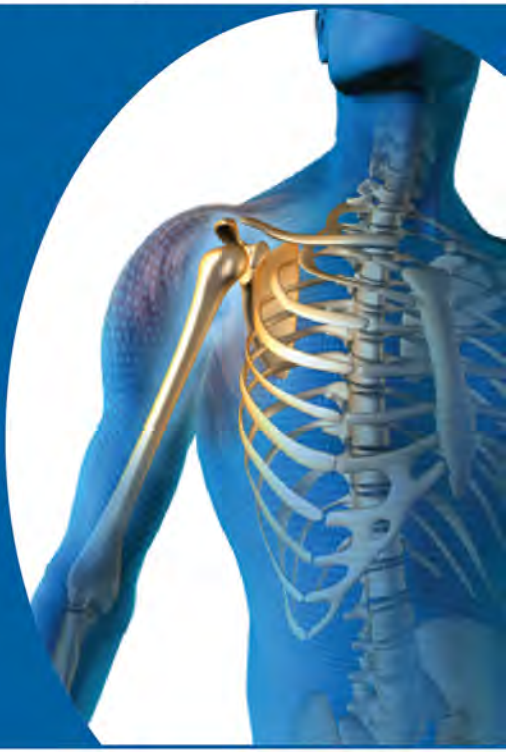
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MOM Mehra's Orthopedics for MCI

Orthopedics Made Easy for Foreign Medical Graduates

- Images
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Apurv Mehra

Author of OrthoPedics Quick Review (OPQR)
Best seller & Magic Book of OrthoPedics for PG-Aspirants

2nd Edition

JAYPEE

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Chapter 1

Imaging for Orthopedics

Orthopaedics: The term was coined by **Nicolas Andry**. Orthos means straight and paedics means child so orthopaedics means **Straight child.**

Definition of orthopaedics: The branch of surgery that deals with the prevention or correction of injuries or disorders of the skeletal system and associated muscles, joints and ligaments.

ROLE OF IMAGING IN ORTHOPAEDICS

A. X-rays are usually the first radiological investigation done in orthopaedics and its uses involves Screening of Cortex and Marrow. **X-rays are the first investigations in traumatic disorders.**

- Glass pieces are visualized on X-rays.

Soft tissue planes (muscle and fat planes) are visualised on X-rays and often students forget this!

(Loss of soft tissue planes is earliest X-ray changes in infection/swelling in limb and it is seen after 24–48 hours of onset of disease, they are more useful for infections than tumors).

Cartilage is not seen on X-rays



Fig. 1.1: X-ray of forearm with wrist with elbow

Note: Joint space is a misnomer, Actually there is no space in areas of joints, **it is the cartilage occupied area** which is not visualised on X-ray. Thus whenever joint is destroyed, cartilage is destroyed hence joint space is reduced on X-rays.

Types of Periosteal Reaction : Periosteal Reaction : Indicates Bone Damage

1. *No reaction:* **Tuberculosis of bones does not usually have a periosteal reaction.**
2. Narrow zone of activity e.g. Solid periosteal reaction (single layer of periosteal elevation) is seen in benign lesion like.
   a. **Benign tumors or Pyogenic Osteomyelitis**
   b. In case of osteomyelitis the periosteal reaction is seen on day 7 to 10th (or 2nd week or day 10th)

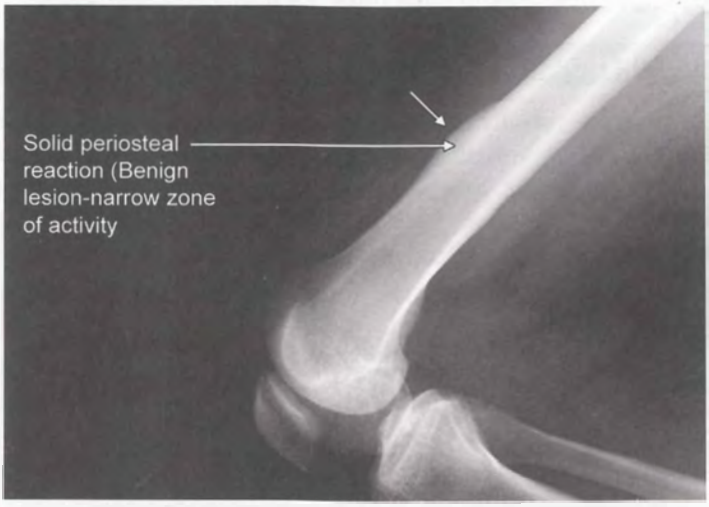


Fig. 1.2: Solid periosteal reaction

3. In **malignant lesions** there is wide area of activity e.g. Onion peel/codmans triangle and sunray appearance (all are indicative of wide area of activity).
   a. Onion peel or lamellated appearance—Seen in any malignant or chronic lesions (e.g. chronic osteomyelitis) but usually ewings sarcoma.

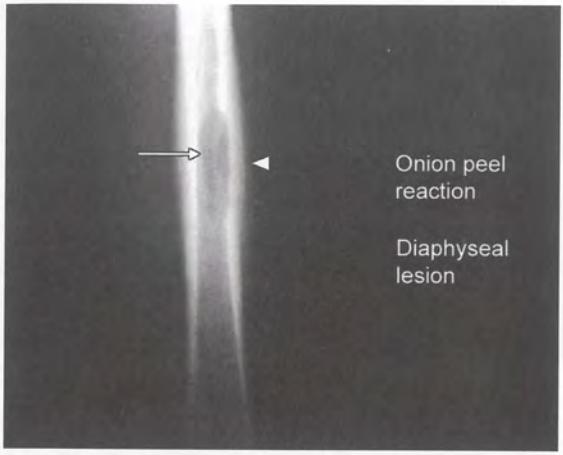


Fig. 1.3: Onion peel reaction

b. **Codman Triangle:** Triangular bone growth seen at angle of lifting of periosteum; it can be seen in any malignant lesion but usually osteosarcoma.

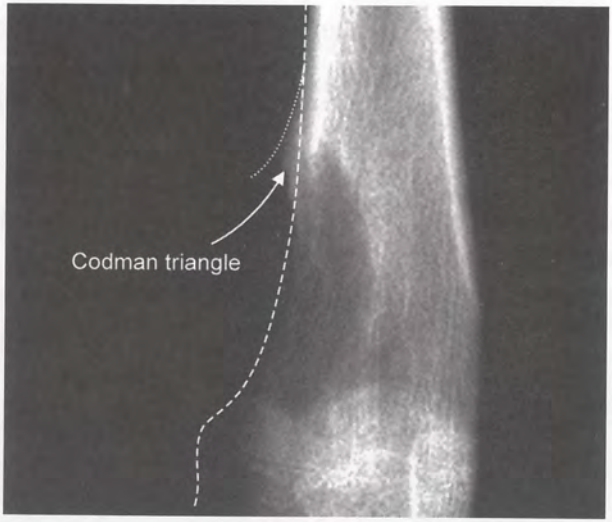


Fig. 1.4: Codman triangle

c. **Sunray appearance**/sunburst/spiculated appearance – can be seen in **any malignant lesion** but usually **osteosarcoma**.

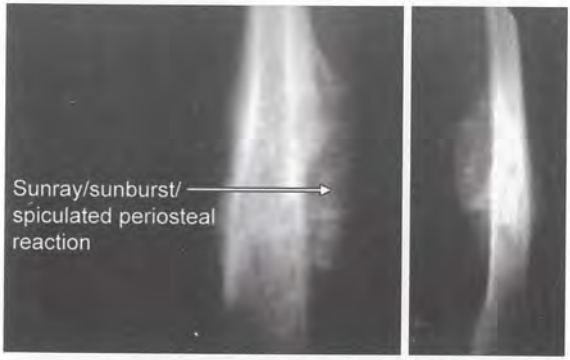


Fig. 1.5: Sunray appearance

B. **CT Scan:** CT Scan is the investigation for cortex and calcification.

C. **MRI:** is investigation of choice for Marrow, Soft tissues (Brain/ Spinal cord/Ligaments/Tendons/nerves/vessels) and Cartilage.

Basic Images in MRI are T_1 and T_2

- T_1 – 1st professional subject anatomy – so in T_1 image anatomy is seen.
- T_2 – 2nd professional subject pathology – so in T_2 image pathology is seen.

'Water is white on T_2'

Water is any body fluid example, synovial fluid/C.S.F/ inflammatory or traumatic edema.

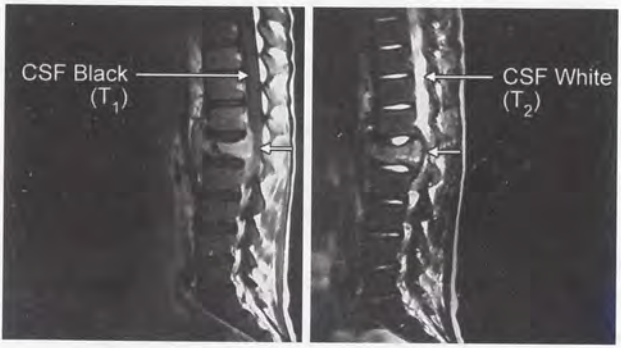


Fig. 1.6: MRI of spine (T_1 and T_2 images)

Please Note:

- Any occult fracture (not visualised on X-ray) e.g. Fracture neck femur ~ MRI is investigation of choice.
- Any fracture in which there is marrow edema example stress fracture– MRI is investigation of choice.
- Osteomyelitis starts in marrow of metaphysis—MRI is best radiological investigation.
- Tumors with marrow involvement, any micrometastasis or soft tissue component – MRI can aid in diagnosis.
- MRI is investigation of choice for Developmental Dysplasia of Hip (DDH).

D. **Bone scan:** can pick up – Blastic **(Osteoblastic)** activity – **Methylene diphosphonate** is taken up by osteoblasts on scanning the whole skeleton.



Fig. 1.7: Bone scan

Bone scan show activity in areas with increased osteoblastic activity example tumors, infection or fracture. Thus in cases with bilateral stress fractures bone scan is preferred investigation.

Note: investigation of choice for unilateral stress fracture is MRI and bilateral is Bone Scan.

It can pick up tumors that go from one bone to other i.e bone to bone metastasis. **BONE: B**one to bone/**O**steosarcoma/**N**euroblastoma/**E**wing sarcoma (maximum incidence).

Limitation: Bone Scan cannot indentify the source of unknown primary.

Note: Lesions with lytic activity do not show activity on bone scan e.g. multiple myeloma.

E. **PET CT:** Position emission tomography + CT Scan for whole body. It is a combination of 2 modalities.

18 F Deoxy glucose uptake by tumor cells (as they have anaerobic metabolism) and CT scan for all viscera so it can indentify unknown primary. (Bone Scan the uptake is by osteoblast and PET Scan by tumor cells).

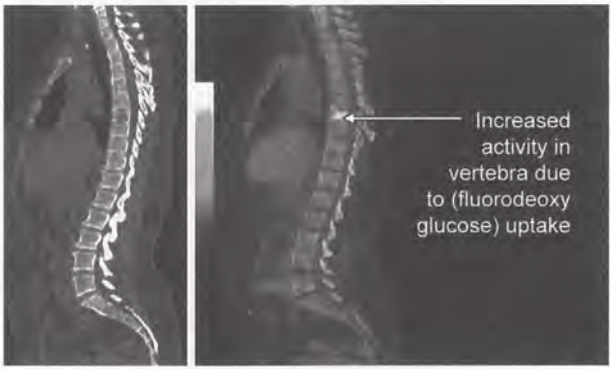


Fig. 1.8: PET scan

Thus PET-CT is more useful than Bone Scan as it can indentify primary and is more specific for tumor cells.

Limitation: Osteoblastic lesions have limited uptake where bone scan may be more valuable.

Remember that radiological diagnosis in cases of infection and tumors is suggestive never diagnostic.

F. Tumors and infection can mimic each other (clinically and radiologically) e.g. Osteosarcoma and Ewings sarcoma are two tumors that mimic osteomyelitis. (Both have accompanying pain, swelling, fever and increased local temperature).

Tumors and bone infections are usually metaphyseal and both need tissue diagnosis for differentiation.

- **Thus, Culture is gold standard for infection**
- **Histopathology is gold standard for tumors**

- So rule is Culture all biopsies, biopsy all cultures. That is whenever you obtain any sample from a suspected case of tumor or infection divide it into two parts send one for culture and other for histopathology.

Diagnostic is always tissue diagnosis.

Osteomyelitis

1. **X-ray:**

- Pyogenic Osteomyelitis on X-rays will show loss of soft tissue planes after 24-48 hours. (1st change)
- Day 7 to 10-solid periosteal reaction is identified. (1st Bony change)

Note:

- **In tuberculosis there is no periosteal reaction.**
- Chronic osteomyelitis- sclerosed dead bone (sequestrum) is important for diagnosis and onion peel appearance is the usual periosteal reaction.

2. **MRI:**

- MRI can pick up marrow changes in metaphysis. (Best radiological investigation for Oteomyelitis and Tuberculosis)

3. **Bone scan:**

- Bone scan is next in preference to MRI to pick up infections by picking osteoblastic activity at the site of infection.

4. Culture and growth of organism is most definitive diagnostic modality for Oteomyelitis.

Bone Tumors

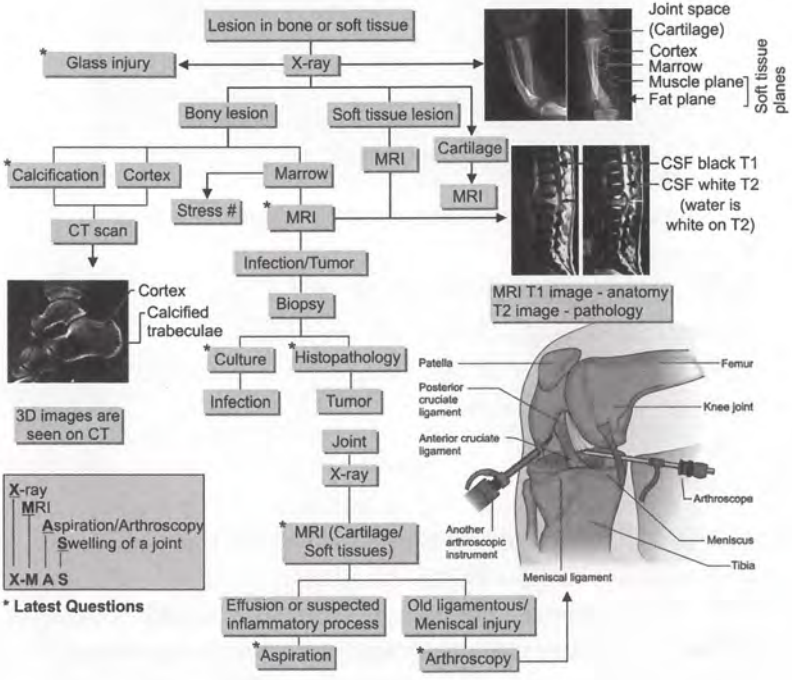
1. X-ray is to localize the tumor.
2. CT scan is for extent and cortical lesion
3. MRI is for Marrow extent, micrometastasis and soft tissue involvement (Most preferred investigation for most tumors)
4. PET-CT and Bone scan for multiple lesions (PET-CT is better than Bone Scan)
5. Biopsy is definitive diagnostic modality for any tumor.

Order of Investigations in any inflammatory Joint Swelling

- X-ray
- MRI
- Aspiration

X-ray
MRI
Aspiration by USG
Swelling of a joint

X-M A S



QUESTIONS

1. "ORTHOPAEDICS" means: *(Dec 2015)*

a. Study of bone
b. Study of fracture
c. Straight child
d. Study of disease of bone

Ans. is 'c' Straight child

2. Identify the periosteal reaction:



a. Onion peel appearance
b. Codman's triangle
c. Sunburst appearance
d. Onion ring appearance

Ans. is 'c' Sunburst appearance

3. Who coined the term orthopaedics? *(March 2010)*

a. Louis Pasteur
b. Edward Jenner
c. Nicolas Andry
d. Kuntscher

Ans. is 'c' Nicolas Andry

4. Investigation of choice for congenital dislocation of hip in an infant is:

a. X-ray
b. USG
c. CT Scan
d. MRI

Ans. is 'd' MRI

5. Sunburst appearance seen in:

a. Osteosarcoma
b. Osteopetrosis
c. Osteomyelitis
d. Osteo-radionecrosis

Ans. is 'a' Osteosarcoma

6. Periosteal reaction in a case of acute osteomyelitis can be seen earliest at: *(March 2012)*

a. 5 days
b. 10 days
c. 15 days
d. 20 days

Ans. is 'b' 10 days

7. Radiological finding of Ewings sarcoma is:

a. Soap bubble appearance
b. Sunray appearance
c. Onion peel appearance
d. Codman's triangle

Ans. is 'c' Onion peel appearance

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MOM Mehra's Orthopedics for MCI



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Dr. Apurv Mehra is the Leading Faculty of Orthopedics & is recognized Nationally & Internationally as an outstanding teacher, world class scholar & dedicated mentor. He is best known for his stupendous efforts in teaching, motivating & inspiring budding doctors. The quality that sets him apart is his unique style of teaching with fun & passion. Dr. Apurv Mehra is also Co-Founder of MedMiracle–Online Platform To Guide Students Preparing for Medical Entrance Exams. Dr. Apurv Mehra is a youth icon, guide, mentor & role model for aspiring doctors. He is known for his highly inspirational & motivational Speeches. Inspired from his lectures, students not only 'learn' but actually follow Dr. Apurv Mehra & also implement his advice & guidance in their day to day lives.

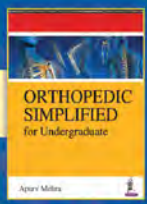


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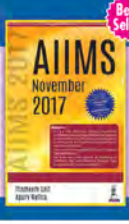


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