Imaging techniques for bone disease are: X-ray, Isotope, US, CT, and MRI.

**A. Plain bone radiograph**

Initially, a musculoskeletal lesion should be simply imaged with a plain film. It should be remembered that plain films remain the most reliable imaging method for assessment of both biological activity and probable histological diagnosis of an osseous lesion. Signs of bone diseases in plain X-ray are:

1. Decreased bone density
2. Increased bone density (sclerosis).
3. Periosteal reaction
4. Cortical thickening
5. Alteration in the trabecular pattern
6. Alteration in the shape of a bone
7. Alteration in bone age

1- Decreased bone density: It is either *localized* (lytic area or area of ‘bone destruction’), or *generalized*.

2- Increased bone density (sclerosis): It is either *focal* or *generalized*.

3- Periosteal reaction: It refers to excessive bone produced by the periosteum, which occur in response to infection, trauma & tumors. Patterns of periosteal reaction are:

   a. linear
   b. sunray (speculated)
   c. onion skin
   d. Codman’s triangle

4- Cortical thickening: Also involve laying down of new bone by the periosteum, but the process is very slow & it has the same homogeneous density as does the normal cortex & there is no separate lines or specules of calcification as seen in a periosteal reaction. Causes are:

   a. chronic osteomyelitis.
   b. healed trauma
   c. response to chronic stress or benign tumor

5- Alteration in the trabecular pattern: Usually involving a reduction in the no. of trabeculae with an alteration in the remaining trabeculae. E.g. in **osteoporosis**, there is reduction in the no. of the trabeculae & remaining trabiculae are more prominent than usual associated with thinning of the cortex. In **paget’s disease**, there is thickening of the trabeculae & associated with thickening of the cortex & bone expansion

6- Alteration in the shape of a bone: It can be congenital (e.g. osteogenesis imperfect) or acquired (e.g. Acromegaly, expanding bone tumors)

7- Alteration in bone age

**B. US in musculoskeletal disease**

US can not demonstrate bone pathology but does have a complementary imaging role;

1. Detecting tenosynovitis, tendon tear & rupture.
2. In diagnosis of arthritis & osteomyelitis
C. Radionuclide bone scanning

It uses Technetium-99m-labelled phosphate complexes. Indications of radionuclide scan are:

1. Detection of metastasis.
2. Detection of osteomyelitis.
3. Determination of whether a lesion is solitary or multiple.
4. Investigation of clinically suspected lesion when the Plain radiograph is –ve.
5. Investigation of radiographically equivocal cases whether is significant or not.

D. CT in bone disease

It is only needed in selected cases. Indications for bone CT are:

1. Demonstrating abnormalities in the areas where interpretation of plain films are frequently difficult for exam. Spine, hip & pelvis.
2. As a guide for bone biopsy.
3. Demonstration of the extent & characterization of the bone tumor in selected cases to complement MRI.

E. MRI (magnetic resonance imaging)

It plays a vital important role in musculoskeletal disorders. It can demonstrate bone marrow directly but calcified tissues & cortical bones produces no signal. MRI particularly good for showing soft tissue abnormalities. Indications of MRI:

1. Disc herniation & spinal cord or nerve roots compression.
2. Dx of bone metastasis.
3. Extend of primary bone tumor.
4. To image soft tissue masses.
5. To Dx osteomyelitis & shows any soft tissue abscess.
6. To Dx avascular necrosis & other joint pathologies.

Classification of Bones

Bones are classified by shape, as follows (Fig. 3-17):
• Long
• Short
• Flat
• Irregular
• Sesamoid

Long bones

Long bones are found only in the limbs. They consist primarily of a long cylindric shaft called the body and two enlarged, rounded ends that contain a smooth, slippery articular surface. A layer of articular cartilage covers this surface. The ends of these bones all articulate with other long bones. The femur and humerus are typical long bones. The phalanges of the fingers and toes are also considered long bones. A primary function of long bones is to provide support.

Short bones

Short bones consist mainly of cancellous bone containing red marrow and have a thin outer layer of compact bone. The carpal bones of the wrist and the tarsal bones of the ankles are the only short bones. They are varied in shape and allow minimum flexibility of motion in a short distance.

Flat bones

Flat bones consist largely of two tables of compact bone. The narrow space between the inner and outer tables contains cancellous bone and red marrow, or diploë, as it is called in flat bones. The bones of the cranium, sternum, and scapula are examples of flat bones. The flat surfaces of these bones provide protection, and their broad surfaces allow muscle attachment.

Irregular bones

Irregular bones are so termed because their peculiar shapes and variety of forms do not place them in any other category. The vertebral and the bones in the pelvis and face fall into this category. Like other bones, they have compact bone on the exterior and cancellous bone containing red marrow in the interior. Their shape serves many functions including attachment for muscles, tendons, and ligaments, or they attach to other bones to create joints.

Sesamoid bones

Sesamoid bones are small and oval. They develop inside and beside tendons. Their precise role is not understood. Experts believe that they alter the direction of muscle pull and decrease friction. The largest sesamoid bone is the patella, or the kneecap. Other sesamoids are located beneath the first metatarsophalangeal articulation of the foot and on the palmar aspect of the thumb at the metacarpophalangeal joint of the hand. Two small but prominent sesamoids are located beneath the base of the large toe. Like all other bones, they can be fractured.