



## Issues Related to Bones

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**Received:** April 27, 2019; **Published:** May 10, 2019

### Bone

Bone is the substance that forms the skeleton of the body. It is composed chiefly of calcium phosphate and calcium carbonate, playing a vital role in calcium balance in the blood.

#### Function of bone

- Movement of limbs, via mechanical support of muscles
- Protection of the internal organs like heart and brain through Ribs, skull
- House bone marrow cells: medullary canal
- Storage of calcium and phosphate salts

Bone is susceptible to various problems like fractures, metabolic bone diseases, bone tumors, dislocations, bone infections and degenerative bone disorders. Bones are not affected by autoimmune diseases; Joints are affected by autoimmune diseases like Rheumatoid arthritis (RA).

**Heterotropic Ossification:** Bone formation in muscle and other soft tissue areas. Occurs mostly after trauma.

Symptoms include

- May be asymptomatic
- Pain and loss of motion
- Edema, warmth, erythema, tenderness

**Osteogenesis Imperfecta (OI):** Defective bone formation, related to gene mutations encoding collagen type I

- Collagen type I: Widespread in the body
- Thin skin, defective heart valves
- Affects bones and connective tissue

### Clinical presentation depends on severity of disease

Newborn has short extremities due to multiple intrauterine fractures. Multiple rib fractures may be present also. This type is neonatal lethal type of OI.

### Osteomyelitis

Inflammation of the bones caused by an infectious organism. In children, infection occurs via the circulatory system bacteria enters the metaphysis through arteries supplying nutrients to the bone. Metaphysis is very porous, so the infection spreads easily and multiplies rapidly → forms pus → spreads to the adjacent portions of the epiphysis.

Bone deformities result, increasing predisposition to fractures. Fractures heal poorly because of pus in the area.

In adults usually result of puncture wound into bone or respiratory/urinary tract infection

Clinical Manifestations include

- Vary between adults and children
- Pain
- Fever
- Local manifestations: edema, erythema, tenderness

### Risk factors

- Chronic illness
- Surgical procedure to bone
- Open fracture
- Implanted orthopedic device

**Osteopetrosis:** It is a bone disease that makes bones abnormally dense and prone to breakage (fracture). Researchers have described several major types of osteopetrosis, which are usually distinguished by their pattern of inheritance: autosomal dominant, autosomal recessive, or X-linked.

**Symptoms include**

Fractures, low blood cell production, and loss of cranial nerve function causing blindness, deafness, and/or facial nerve paralysis. Affected individuals may experience frequent infections of teeth and the bone in the jaws.

Characterized by reduction of total bone mass density (BMD) and micro damage to bone structure that results in susceptibility to fractures, most common metabolic bone disease. Osteoporosis is a major public health. Primarily a disease of older age, can occur at any age. 80% are females.

**Risk factors**

Gender, race, family history, age, low body weight, early menopause hormonal changes), low physical activity levels, calcium and Vit D intake and alcohol, smoking, caffeine intake.

**Clinical presentation**

Symptoms can be nonspecific, Fractures: Head of femur, distal radius, vertebrae, hips, ribs. In vertebrae, usually anterior wedge or compression fracture, Gradual height loss, Protuberant lower abdomen and forward flexed posture.

**Rickets**

A softening and weakening of bones in children, usually due to inadequate vitamin D.

Vitamin D promotes the body's absorption of calcium and phosphorus. Extreme or prolonged lack of vitamin D makes it difficult to maintain proper calcium and phosphorus levels in bones, which can cause rickets.

Symptoms include delayed growth, bow legs, weakness and pain in the spine, pelvis and legs.

**Symptoms**

- Pain areas: In the bones
- Muscular: cramping, flaccid muscles, or muscle weakness

- Also common: acquired deformity of chest and rib, bone fracture, bow legs, cavity, deformity of the skull, or slow growth

**Osteomalacia**

- Vitamin D deficiency or deficiency of phosphate metabolism is seen in adult's causing inadequate mineralization of bone matrix.
- Diagnosis difficult and delayed
- Most initially present with diffuse, generalized aching and fatigue
- Deformities of bones common
- Bowlegs common because bones unable to carry body weight.
- Thoracic kyphosis

**Paget's disease**

Metabolic bone disease with unknown etiology.

**Pathogenesis**

- Initial stage: osteoclasts proliferate unrestrained
- Bone resorption rapid and osteoblasts cannot keep up
- Bone replaced with fibrous tissue.Osteoblastic sclerotic phase

**Symptoms: Asymptomatic**

- Bone pain, arthritis, deformities, fractures
- Thickened cranial bones may compress CNs →headaches, hearing loss, dizziness

**Fractures**

Defect in the continuity of a bone.

**Types**

- Traumatic
- Stress or fatigue
- Pathologic
- Insufficiency

Simple –single fracture line

- Complete
- Extending through the entire thickness of the bones
- Incomplete
- Do not extend from one side to the other
- Displaced-bone has moved on either side of fracture

Comminuted –multiple lines and fragments

- Open –skin is disrupted
- Closed –skin is not disrupted
- Complicated-infected fracture

### Symptoms

- Pain areas: In the bones
- Also common: Bleeding, bruising, limping, loss of height, physical deformity, swelling, or tenderness

### Bone Tumors

Primary bone tumors

- Osteosarcoma (bone forming cells)
- Chondrosarcoma (cartilage cells)
- Ewing's sarcoma (primitive mesenchymal bone marrow cells)

### Secondary

Metastases from breast, prostate, lung, kidneys, thyroid.

### Symptoms

- Pain areas: in the bones or joints
- Also common: bone fracture, feeling tired, limping, swelling, or weight loss

**Osteoarthritis (OA):** Degenerative joint disease

- Most common joint disease
- Involves the entire synovial joint
- Develops under conditions that stress the joint surfaces
- Preferentially affects weight bearing joints
- Hips, knees, spine (vertebrae)
- Prevalence increases with age

### Etiology

- Active disease process with joint destruction and aberrant repair as a result of alterations in cellular function
- Multifactorial
- Includes genetics, nutrition, weight control, bone density, estrogen use, local biomechanical factors, previous injury

### Pathogenesis

Articular cartilage, Softens, has surface defects, irregular thinning, Decreased ability to attenuate load (+) inflammation, Joint space narrowing, Subchondral bone changes, Sclerosis and Osteophytes.

### Signs and symptoms

Joint pain (gradual onset, unilateral usually), Decreased strength and ROM, Increased pain with weight bearing and activity, Swelling localized to the joint, Morning stiffness, Crepitus and Locking of joint.

### Degenerative Disk Disease (DDD)

Common musculoskeletal disease, Peak in 40-50 y/o.

### Etiology

- Age related changes
- Genetic inheritance
- Inadequate metabolite transport
- Repetitive external mechanical loading

### Pathogenesis

- Same synovial process as in OA
- Intervertebral disks lose volume, shape and structure
- Intervertebral disk loses height with age
- Decline in arterial supply to the periphery of the disk and impaired nutrient delivery
- Affects cellular function
- Repetitive external mechanical loading
- Leads to fatigue failure of the matrix

### Clinical features

Low back pain, Lower extremity pain and parasthesias and Lower extremity weakness

**Gout:** Acute, monoarticular, inflammatory arthritis

Characterized by hyperuricemia, decreased excretion via kidneys or Overproduction of uric acid

- Primarily in joints, subcutaneous tissue, and kidneys
- Great toe, ankle, instep, knee, wrist, elbow, fingers
- Occurs primarily in middle age men

### Pathogenesis

(First symptoms occur in tarsometatarsal joints of the big toe), Elevated blood uric acid levels enters the joint, Hyper saturates the synovial fluid, uric crystals form and deposit in joints and periarticular connective tissue.

### Clinical features

**Acute gout:** Cardinal signs of inflammation

Systemic symptoms (fever, tachycardia, exhaustion, leukocytosis).

**Chronic gout:** Less inflammation, more bone deformities

- Painless subcutaneous deposits of uric acid (tophi)
- Deposits of urates in internal organs

**Rheumatoid Arthritis (RA):** A chronic inflammatory disorder affecting many joints, including those in the hands and feet.

In rheumatoid arthritis, the body's immune system attacks its own tissue, including joints. In severe cases, it attacks internal organs.

Rheumatoid arthritis affects joint linings, causing painful swelling. Over long periods of time, the inflammation associated with rheumatoid arthritis can cause bone erosion and joint deformity.

### Symptoms

- Pain areas: In the joints, back, or muscles
- Joints: Stiffness, swelling, tenderness, or weakness

- Whole body: Fatigue, anaemia, or malaise
- Skin: Lumps or redness
- Hand: Bump on the finger or swelling
- Also common: Flare, dry mouth, physical deformity, or sensation of pins and needles.

### Avascular Necrosis

The death of bone tissue due to a lack of blood supply. Avascular necrosis is associated with long-term steroid use and drinking too much alcohol. It's most common in people between the ages of 30 and 60 and often affects the hip. Early stages may be symptom-free. Eventually, the affected joint may hurt when weight is put on it or when lying down.

- Symptoms: Can have no symptoms, in some patients
- Pain areas: In the hip, buttocks, groin, knee, or thigh
- Also common: Collapse or limping.

**Volume 2 Issue 6 June 2019**

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