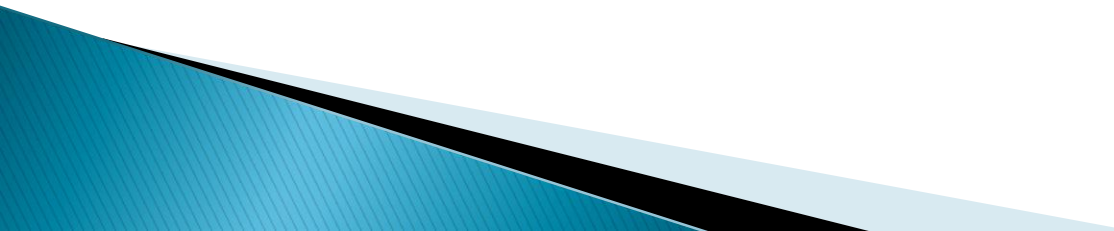
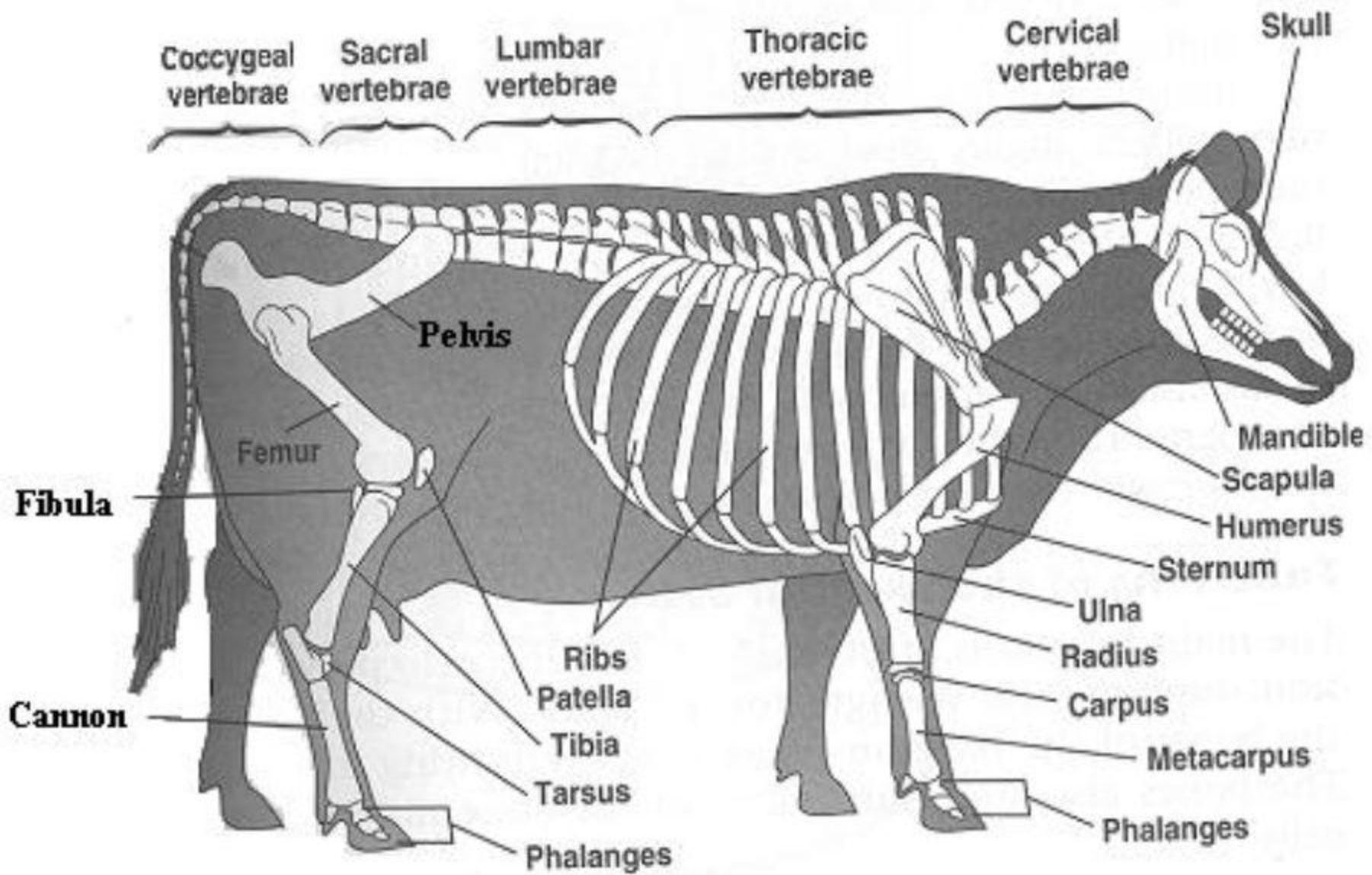


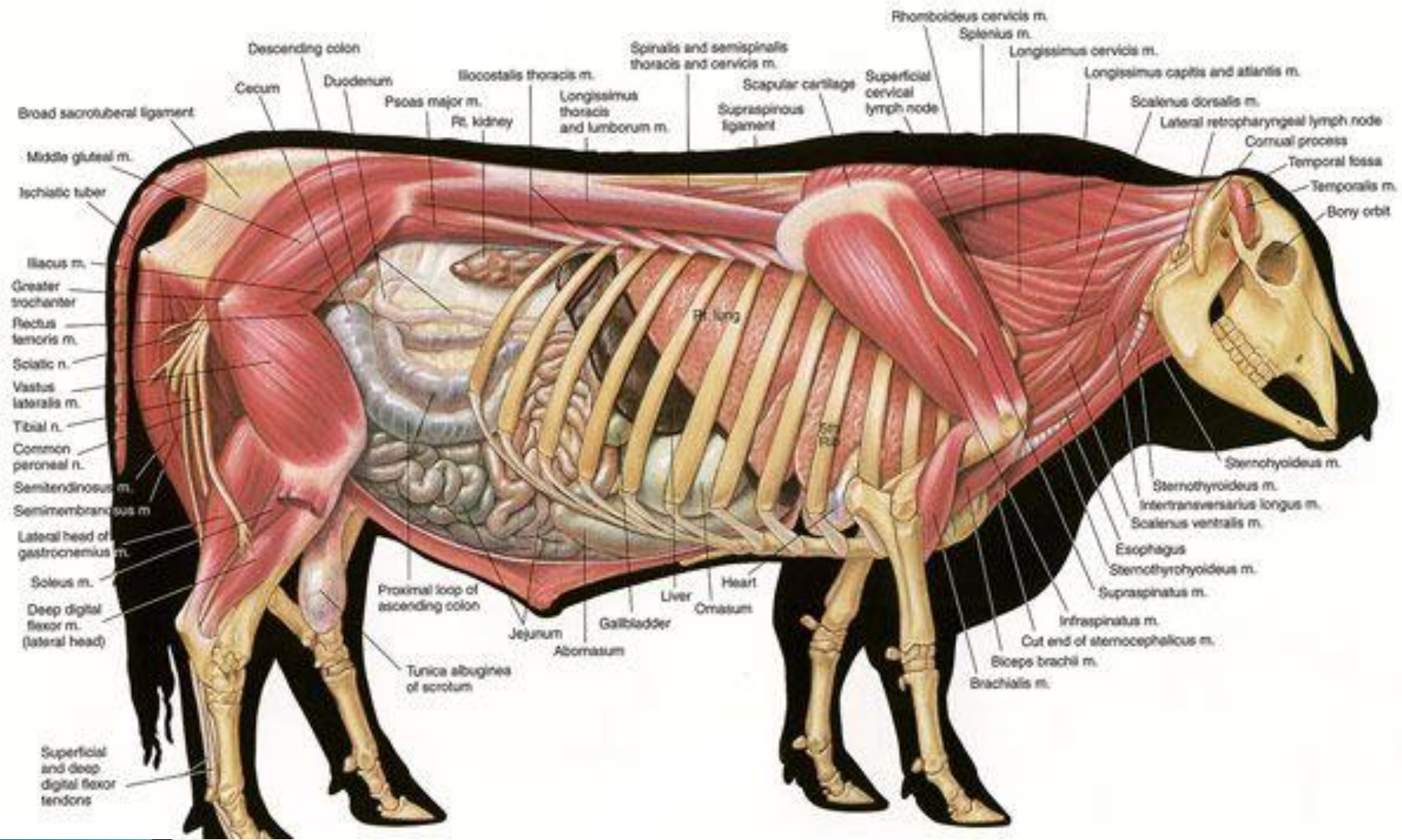
# **The Musculo-skeletal System**

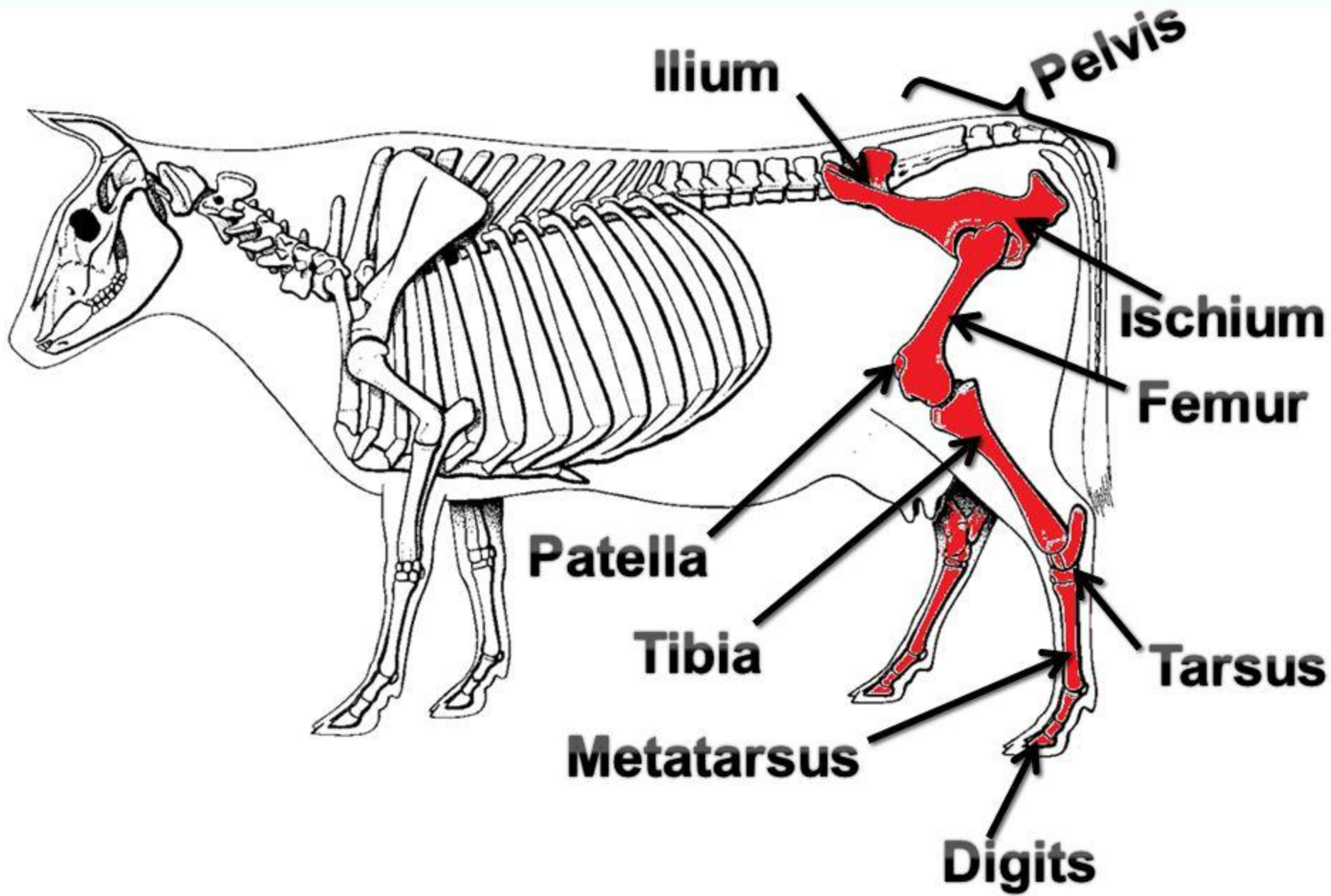
# The musculoskeletal system consists of:

- **Bones**
  - **Cartilage**
  - **Muscles**
  - **Ligaments**
  - **Tendons**
- 

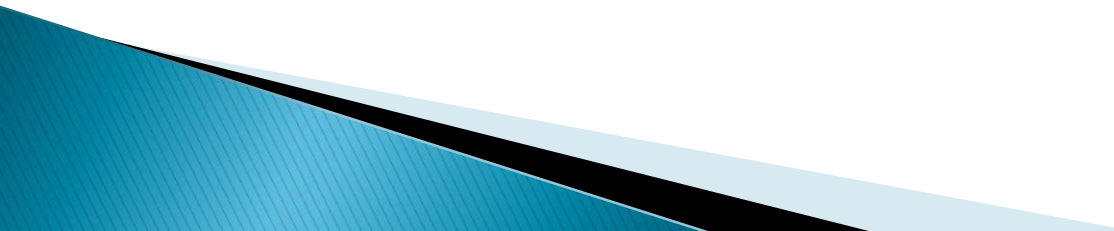


# Cow Skeleton

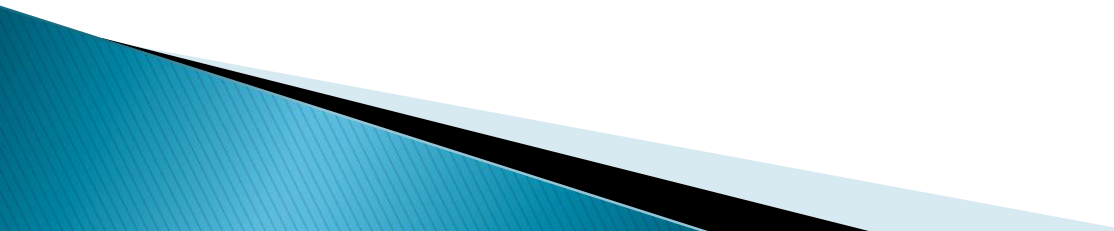




# Primary functions of the musculoskeletal system include:

- **Support of the body**
  - **Provision of motion**
  - **Protection of vital organs**
- 

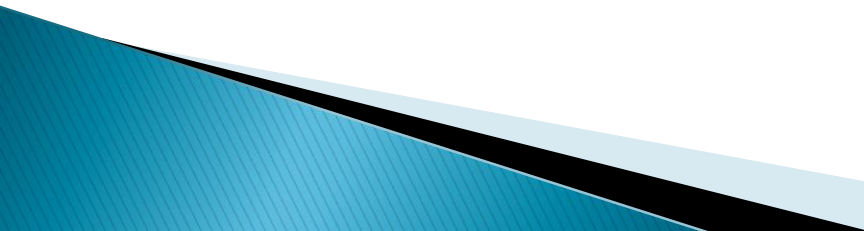
**The skeletal system serves as the main storage system for calcium and phosphorus and contains critical components of the hematopoietic system.**



# Principal manifestations of musculoskeletal disorders:

## **1- LAMENESS**

Lameness is an abnormal gait or locomotion characterized by inability to bear full weight on a leg, usually associated with pain in the musculoskeletal system.





## e.g: Causes of Lameness and Stiffness in Horses

<b>Common Causes</b>	
<b>Infections of the foot</b>	<b>Tenosynovitis</b>
<b>Bruised or punctured sole</b>	<b>Contracted tendons (flexural deformity)</b>
<b>Hoof wall defects</b>	<b>Ankylosis or arthrogryposis</b>
<b>Fractures</b>	<b>Osteochondrosis or bone cyst</b>
<b>Septic (infectious) arthritis</b>	<b>Cruciate or meniscal rupture</b>
<b>Laminitis</b>	<b>Luxation or subluxation (dislocations)</b>
<b>Secondary (degenerative) joint disease</b>	<b>Upward fixation of the patella (locking patella)</b>
<b>Navicular disease</b>	<b>Sesamoiditis</b>
<b>Osteomyelitis</b>	<b>Muscle injury, soreness, bruise, trauma, compartment syndrome</b>
<b>Fibrotic or ossifying myopathy</b>	<b>Subcutaneous abscess, cellulitis</b>
<b>Rhabdomyopathy (tying up)</b>	<b>Angular limb deformities</b>
<b>Sprain</b>	<b>Strain</b>

# Causes of Lameness and Stiffness in Horses

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## Common Causes

Infections of the foot  
Bruised or punctured sole  
Hoof wall defects  
Fractures  
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Luxation or subluxation (dislocations)  
Upward fixation of the patella (locking patella)  
Sesamoiditis  
Muscle injury, soreness, bruise, trauma, compartment syndrome  
Subcutaneous abscess, cellulitis  
Angular limb deformities  
Disruption of the suspensory apparatus (broken down)  
Postanesthetic equine myasthenia  
Tendon rupture, damage, tendonitis (bowed tendon)  
Osteomalacia, osteodystrophy (rickets)  
Bucked shins  
Epiphysitis (physeal injuries)  
Purpura hemorrhagica

## Less Common Causes

Shivers (shivering)  
Borreliosis (Lyme disease)  
Equine monocytic ehrlichiosis (Potomac fever)  
Chronic selenium toxicity

*Corynebacterium pseudotuberculosis*  
Hypothyroidism (goiter)  
Actinobacillosis  
Hyperparathyroidism  
Ulcerative lymphangitis  
Myotonia congenita  
Vesicular stomatitis  
Fistulous withers (*Brucella abortus* or other organisms)  
Sporadic equine lymphangitis  
Acute necrotizing equine vasculitis (with or without thrombocytopenia)  
Peripheral arteriovenous fistula  
Hypertrophic osteopathy or osteodystrophy

## Uncommon Causes

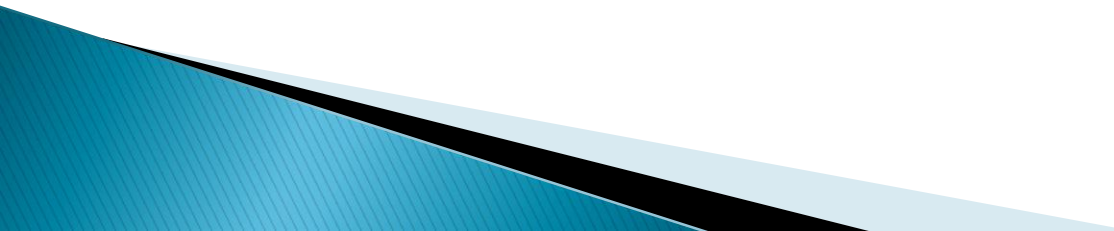
Nocardiosis  
Cutaneous blastomycosis  
Pemphigus foliaceus  
Tuberculosis  
Multisystemic postexhaustion syndrome  
Generalized steatitis  
Cutaneous vasculitis  
Sterile nodular panniculitis  
Multiple clotting defects in ill foals  
Salmonellosis  
Factor VIII deficiency (hemophilia A)  
Idiopathic equine aplastic anemia  
Idiopathic equine thrombocytopenia  
Hemimelia (radial, tibial, ulnar hypoplasia, agenesis)  
Lupus erythematosus (rheumatoid arthritis)  
Phycomycosis  
Bone fragility disorder

## Poisons, Toxins, Deficiencies, and Excesses

Moldy sweet clover poisoning  
Strychnine toxicity  
Tetrachlorodibenzodioxin (dioxin) toxicity  
Warfarin (dicumarol) toxicity

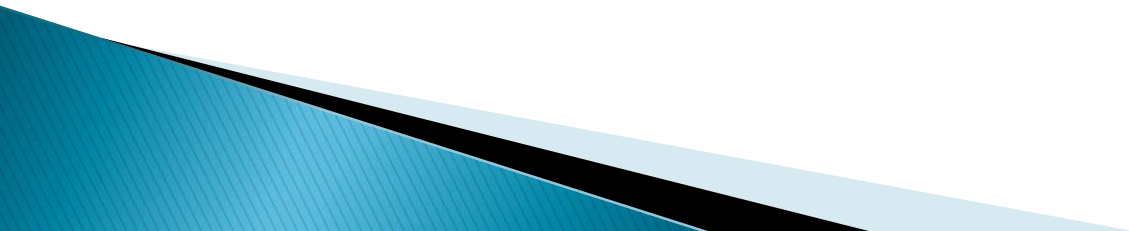
## **2- Abnormal posture and movement:**

**Diseases of the musculoskeletal system are characterized by reduced activity in standing up and moving, and the adoption of unusual postures.**



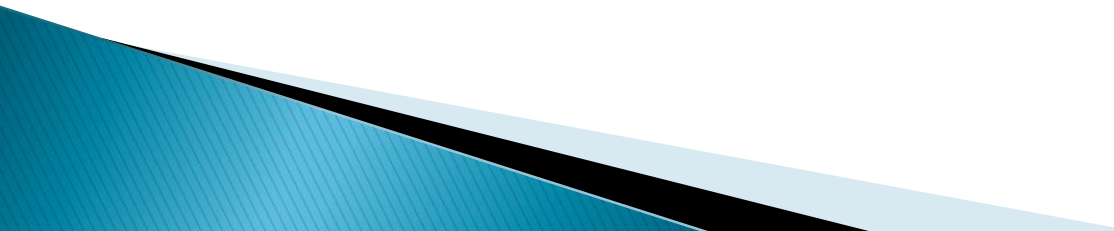
**Abnormal movements include **swaying,**  
**staggering** or **stiffness** and **lack of flexion.****

**Abnormal postures include persistent  
**recumbency,** including lateral recumbency.**



### **3- Deformity:**

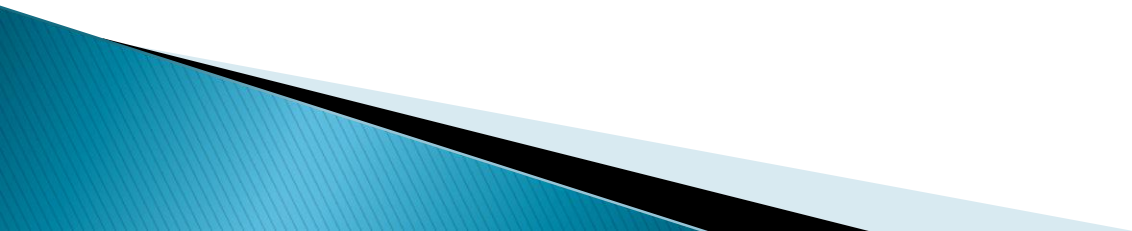
**Atypical disposition, shape or size of a part of the musculoskeletal system constitutes a deformity.**



**This may occur in a number of ways, and be caused by the following:**

**- Congenital flexed or stretched tendons of limbs causing contracture of joints or hyperextension.**

**- Joint enlargement of rickets and chronic arthritis.**



## **4- Spontaneous fractures:**

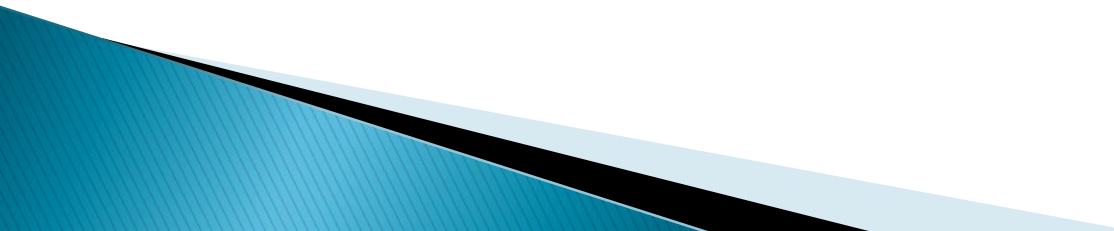
**Spontaneous fractures occur uncommonly in farm animals and pre-existing diseases are usually present, which include the following:**

- \* Nutritional excess of phosphorus causing **osteodystrophia** in horses.
- \* Nutritional deficiency of calcium causing osteodystrophia in pigs
- \* Nutritional deficiency of phosphorus or vitamin D in ruminants causing **rickets** and/or osteomalacia; hypervitaminosis A
- \* Nutritional deficiency of copper.
- \* Chronic fluorine intoxication.



# **EXAMINATION OF THE MUSCULOSKELETAL SYSTEM:**

**Before starting the clinical examination, a full details about the history of the case including full details about the nutritional history and housing is very important:**



## **Nutritional history:**

**Because the most important osteodystrophies and myopathies are nutritional in origin a complete nutritional history must be obtained. This should include an analysis of the feed and determination of the total amount of intake of each nutrient, including the ratio of one nutrient to another in the diet.**

# Environment and housing

When outbreaks of lameness occur in housed cattle and pigs the quality of the **floor** must be examined to evaluate the possibility of floor injuries.

**The clinical examination of the musculo-skeletal system and the feet of farm animals would include the following:**

**(1) Analysis of gait and conformation:**

**(2) Close physical examination:**

**(3) Radiography:**

**(4) Ultrasonography:**

**(5) Muscle biopsy:**

**(6) Arthrocentesis:**

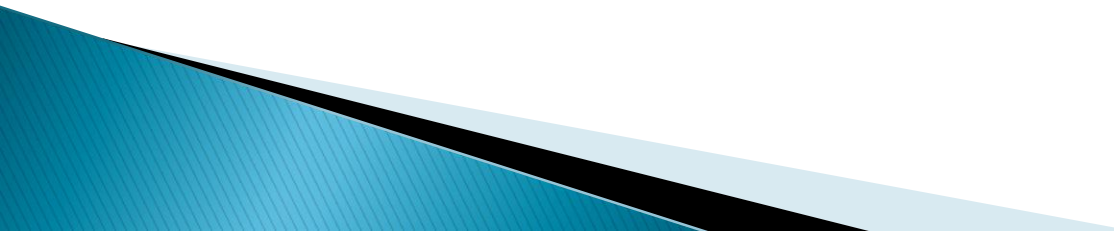
**(7) Arthroscopy:**

**(8) Serum biochemistry and enzymology:**

## **(1) Analysis of gait and conformation:**


**Inspection of the gait of the animal is necessary to localize the site of lameness.**

**Evaluation of its conformation may provide clues about factors that may contribute to lameness.**



## **(2) Close physical examination:**

**A close detailed physical examination of the affected area is necessary to localize the lesion. This includes passive movements of limbs to identify fractures, dislocations and pain on movement. Muscles can be palpated for evidence of enlargement, pain, or atrophy.**

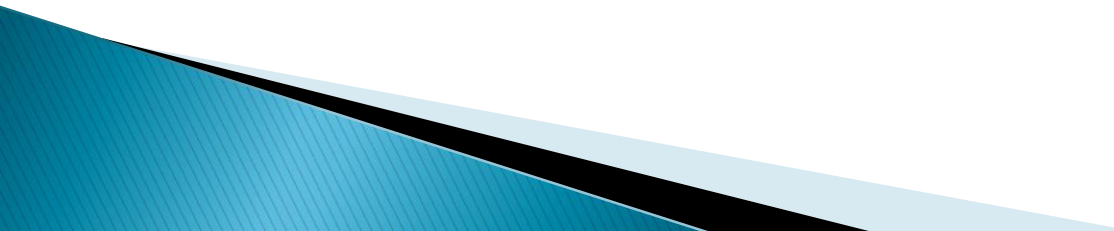


# **Examination of the animals**

## **A. Examination of the animal from a distance to evaluate**

- Size**
- Shape**
- Symmetry of all muscle**

## **B. The animal can then be walked to evaluate**

- Lameness, abnormal gait**
  - Weakness**
  - Stiffness and pain**
- 

### **(3) Radiography:**

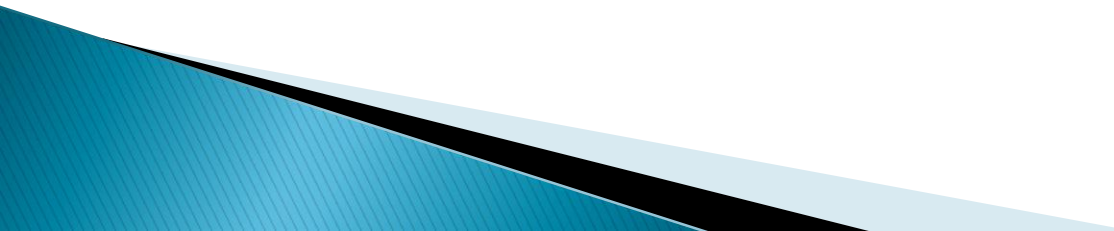
**Radiography is useful for the diagnosis of diseases of bones, joints and soft tissue swelling of limbs, which cannot be easily defined by physical examination. Detailed radiographic information about the joint capsule, joint cavity or articular cartilage can be obtained using negative (air), positive or double contrast arthrography.**



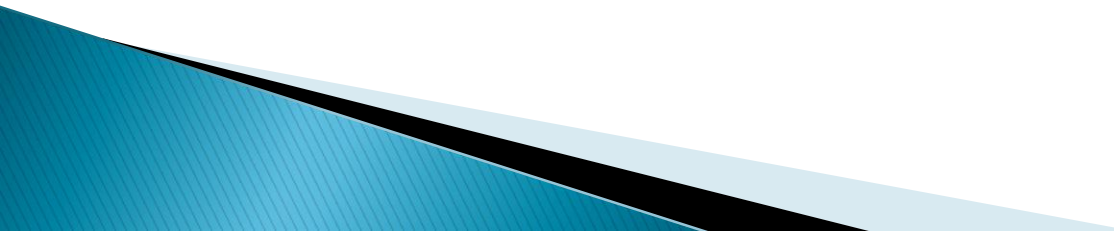
## **(4) Ultrasonography:**

**Ultrasonography is used extensively in dogs and horses for the visualization of soft tissue structures of the joint.**

**Ultrasonographic imaging can be used to differentiate the pathological changes in the soft tissue structures of digital flexor tendon sheaths of cattle.**



**Ultrasonography is a valuable diagnostic aid for septic arthritis. Joint effusion, which is one of the earliest signs of septic arthritis.**



## **(5) Muscle biopsy:**

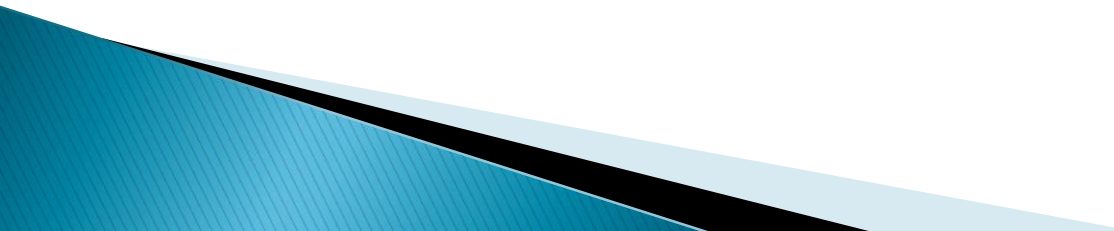
**A muscle biopsy may be useful for  
microscopic and histochemical  
evaluations.**

## **(6) Arthrocentesis:**

**Joint fluid is collected by needle puncture of the joint cavity (arthrocentesis) and examined for the presence of cells, biochemical changes in the joint fluid and the presence of infectious agents. The techniques and application of arthrocentesis for some of the joints commonly sampled in the horse have been reviewed.**

## **(7) Arthroscopy:**

**Special endoscopes are available for inspection of the joint cavity and articular surfaces (arthroscopy). Diagnostic and surgical arthroscopy is now commonplace in specialized equine practice.**

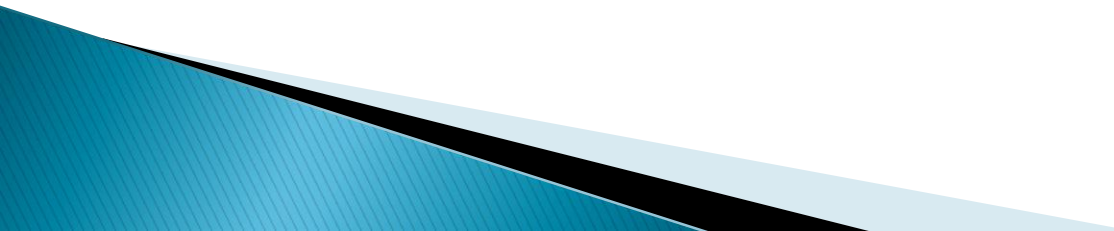




## **(8) Serum biochemistry and enzymology:**

**When disease of bone or muscle is suspected, the serum levels of calcium, phosphorus, alkaline phosphatase and the muscle enzymes creatinine phosphokinase (CPK) and aspartate aminotransferase (AST), also known as serum glutamic oxaloacetic transaminase (SGOT), may be useful.**

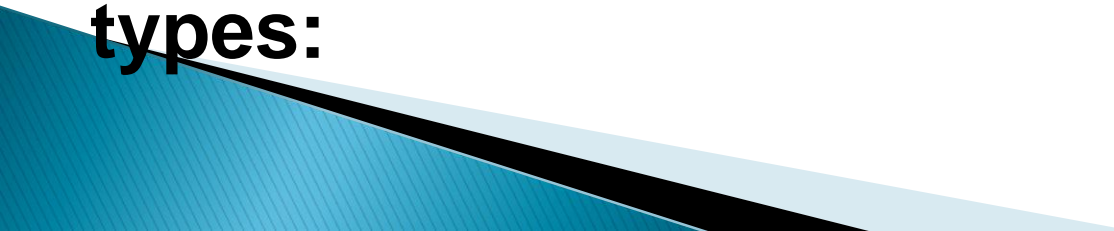
**The muscle enzymes are sensitive indicators of muscle cell damage; the serum levels of calcium, phosphorus and alkaline phosphatase are much less sensitive indicators of osteodystrophy.**





# **Diseases of the Musculo-skeletal system**

**Various classifications of the diseases of the musculoskeletal system, based on clinical, pathological and etiological differences, are in use, but the simplest is that which divides the disease into degenerative and inflammatory types:**



**(1) The degenerative diseases of muscles, bones and joints :**

**Myopathy, osteodystrophy and arthropathy, respectively.**

**(2) The inflammatory diseases are:**

**Myositis, osteomyelitis and arthritis.**

## **(1) MYOPATHY:**

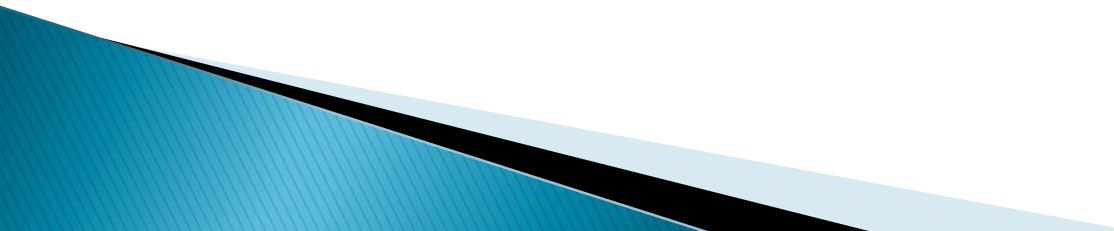
The term myopathy describes the non-inflammatory degeneration of skeletal muscle that is characterized clinically by **muscle weakness** and pathologically by hyaline degeneration of the muscle fibers.

The serum levels of some muscle enzymes are elevated and myoglobinuria is a common accompaniment.

## **Etiology and epidemiology:**

**The most important myopathies in farm animals are due to nutritional deficiencies of vitamin E and selenium and the effects of unaccustomed exercise.**

**The major causes of myopathy in farm animals and their epidemiological determinants are as follows.**

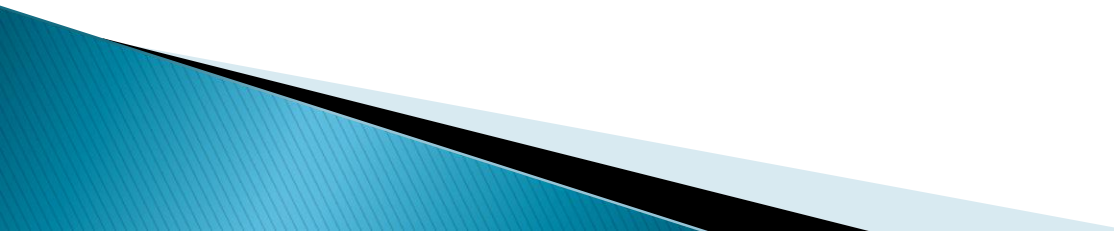
- 1- Enzootic nutritional muscular dystrophy.**
  - 2- Exertional or post-exercise rhabdomyolysis.**
  - 3- Metabolic.**
  - 4- Degenerative myopathy.**
- 

## **(2) MYOSITIS:**

**Myositis may arise from direct or indirect trauma to muscle and occurs as part of a syndrome in a number of specific diseases including blackleg, bluetongue, ephemeral fever, swine influenza, sarcosporidiosis and trichinosis.**

**Injection site clostridial infections in horses and cattle:**

**Clostridial myositis, myonecrosis, cellulitis, and malignant edema are terms used to describe a syndrome of severe necrotizing soft tissue infection associated with Clostridium spp.**



## **(1) OSTEODYSTROPHY:**

**Osteodystrophy is a general term used to describe those diseases of bones in which there is a failure of normal bone development, or abnormal metabolism of bone that is already mature. The major clinical manifestations include **distortion and enlargement of the bones, susceptibility to fractures and interference with gait and posture.****

# **ETIOLOGY**

**The common causes of osteodystrophy in farm animals include the following:**

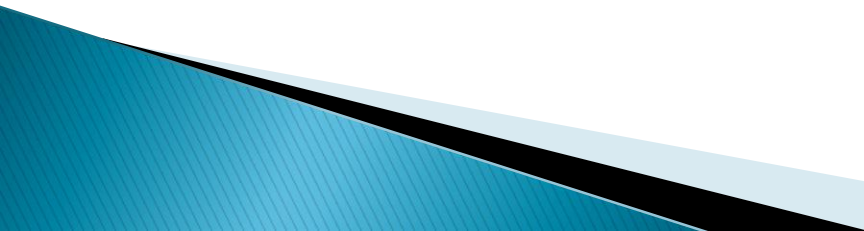
## **-Nutritional causes**

**\*Calcium, phosphorus and vitamin D**

**1- Absolute deficiencies or imbalances in calcium-phosphorus ratios in diets cause:**

- Rickets in young animals, e.g., growing lambs fed a diet rich in wheat bran**
- Osteomalacia in adult ruminants.**




- Osteodystrophia fibrosa in the horse occurs most commonly in animals receiving a diet low in calcium and high in phosphorus.**
  - Osteodystrophia fibrosa in pigs occurs as a sequel to rickets and osteomalacia, which may occur together in young growing pigs that are placed on rations deficient in calcium, phosphorus and vitamin D following weaning.**
- 

# **\*Copper deficiency**

- Osteoporosis in lambs**
- Epiphysitis in young cattle.**

## **\*Other nutritional causes**

- Inadequate dietary protein and general under-nutrition of cattle and sheep can result in severe osteoporosis and a great increase in ease of fracture.**
  - Chronic parasitism can lead to osteodystrophy in young growing ruminants.**
  - Hypovitaminosis A and hypervitaminosis A can cause osteodystrophic changes in cattle and pigs.**
  - Prolonged feeding of a diet high in calcium to bulls can cause nutritional hypercalcitoninism combined with replacement of trabecular bone in the vertebrae and long bones with compact bone.**
- 

## **\*Chemical agents**

**1-Chronic lead poisoning is reputed to cause osteoporosis in lambs and foals.**


**2- Chronic fluorine poisoning causes the characteristic lesions of osteofluorosis, including osteoporosis and exostoses**

## **\*Inherited and congenital causes**

**There are many inherited and congenital defects of bones of newborn farm animals.**

## **(2) OSTEOMYELITIS:**

**Osteomyelitis is an infectious inflammatory disease process of bone and its marrow cavity, causing bone destruction. Infection may be localized to a single region of bone or may involve several structures including marrow, cortex, periosteum, and surrounding soft tissue.**



If only bone is affected, it is classified as **osteitis**.

### Etiology :

Inflammation of bone is uncommon in farm animals except when infection is introduced by traumatic injury or by the hematogenous route.

Bacteria can reach bone by any of three routes:

- Hematogenously.
- By extension from an adjacent focus of infection.
- By direct inoculation through trauma or surgery.

# **(1) ARTHROPATHY (OSTEOARTHROPATHY, DEGENERATIVE JOINT DISEASE):**

**Non-inflammatory lesions of the articular surfaces of joints characterized by:**

- \* Degeneration and erosion of articular cartilage**
- \* Hypertrophy of bone surrounding the articular cartilage resulting in spur formation at the joint margins.**

## **(2) ARTHRITIS AND SYNOVITIS:**

**Inflammation of the synovial membrane and articular surfaces as a result of infection occurs commonly in farm animals.**



**It is characterized by varying degrees of lameness and a warm and swollen painful joint. The synovial fluid is usually abnormal, containing an increased leukocyte count and the pathogens causing the arthritis. The arthritis may be severe enough to cause systemic illness, and in some cases a draining sinus tract may occur.**

























Calf developed severe rickets while receiving ration deficient in vitamin D, and without sunlight.









2. Lamb of group II showing clinical signs of rickets on 0th day















