Session Booklet
Osteology

Osteology is the study of bones. This chapter will look at both make up and function. Bones have many functions from support to locomotion. Bones are living structures that provide the framework for the horse. The horse's skeleton is divided into two.

The Axial skeleton:

The axial skeleton comprises of the bones of the skull, vertebrae and ribs, its essentially the main trunk of the horse.

The Appendicular skeleton:

The Appendicular skeleton comprises of the Thoracic (fore) and Pelvic (hind) limbs. They are attached to the axial skeleton via the pelvis in the hind limb and the Scapula in the forelimb, although it is worth noting that the appendicular skeleton does not directly attach to axial skeleton in the forelimb, it is held in place by large muscles and strong ligaments, and this type of attachment is known as a synsarcosiss.

Types of bone:

There are two types of osseous tissue that form bones, they are:

- ***Cortical bone***
- ***Cancellous bone***

A horse typically has a total of 205 bones. The vertebral column usually contains 54 bones

Cortical bone:

Cortical bone is also known as compact bone and is the dense hard matrix that forms the outer section of bones. Cortical bone supports the body, protects vital organs, provides levers for locomotion, it also stores and releases chemical elements and minerals, the main one being calcium. There are two types of cortical bone that can be found in the horse's body. They are lamellar bone and woven bone.

Lamellar bone is the preferred type of bone, it is highly organised and the strongest type of bone, the cells that produce bone (osteoblasts) produce tightly packed layers or lamella in an alternating spiral structure, the cells first produce the organic element of bone which is collagen, the osteoblasts meticulously lay down the collagen fibrils in parallel rows before they are mineralised with calcium phosphate, in each subsequent layer the collagen is laid down in the opposite direction, the tiny gaps or canals between the layers of bone are called canaliculi, mature bone cells known as osteocytes sit in these canals where they maintain connections with each other, they are largely responsible for maintaining homeostasis within the bone matrix and storing and releasing mineral elements when they are needed elsewhere in the body. The main drawback with this type of bone is that it takes a long time to produce.

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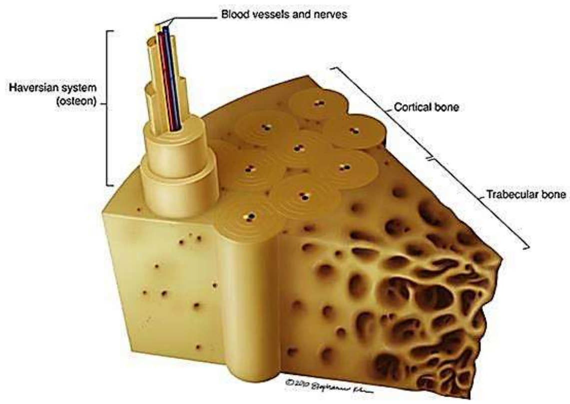
Woven bone is essentially the opposite of lamellar bone, it is very quick to produce but not nearly as organised or as strong as lamellar bone, the collagen in this bone type is laid down in a very haphazard and disorganised manner. The body produces it following a fracture to quickly stabilise the break, the body will then slowly replace the woven bone with the stronger lamellar bone.

Fig 1 the construction of bone highlighting an individual osteon



The primary anatomical and functional unit of cortical bone is the Osteon. The osteons are arranged along the long axis of the bone and are tightly packed together, parallel to the surface. Haversian canals are microscopic tubes found in cortical bone. They allow blood and nerves to travel through the dense bone matrix; this is where much of the minerals contained in cortical bone is stored. The Haversian canals are lined with a delicate vascular connective tissue which is a continuation of the endosteum and usually contain a few capillaries and nerve fibres. Coexisting with Haversian canals are Volkmann canals, these are small channels in the bone that transmit blood vessels from the periosteum into the bone and they communicate with the Haversian canals, they are usually perpendicular to Haversian canals. These canals provide energy and nourishing elements for the osteons. Around the osteons are 3 types of concentric lamellae. There is an outer circumferential layer which as the name suggests lines the outer most part of cortical bone and is the part of the bone where Sharpey's fibres enter into. There is an interstitial layer which surrounds the osteons. The final type of lamellae is called the inner circumferential layer and this layer is closest to the medullar of bone and the endosteum.

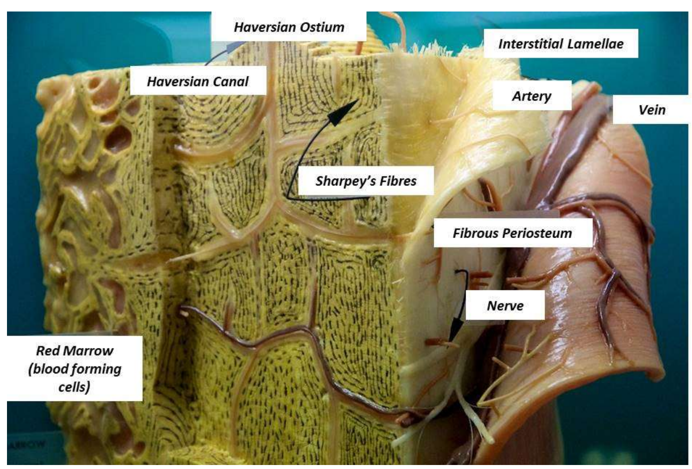


Fig 2 showing the structural architecture of lamellar bone also showing Haversian and Volkmann canals, lamella

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Cancellous bone:
The primary anatomical and functional unit of cancellous bone is the trabecula. Cancellous bone is found in all bones. Compared to compact bone, cancellous bone has a higher surface area to mass ratio because it is less dense. This makes cancellous bone suitable for metabolic activity e.g. exchange of calcium ions. Cancellous bone is highly vascular and frequently contains red bone marrow where the production of blood cells occurs. Cancellous bone appears as mesh or honeycomb like in appearance and has a spongy texture. The spaces between cancellous bone is often filled with bone marrow. The open structure of cancellous bone allows it to absorb and reduce stress during loading through the bone. Cancellous bone is nowhere near as strong as cortical bone so it more prone to fracture. The trabecula is tiny flat planes of cortical bone which connect with each other making the honeycomb appearance, the cancellous bone and bone marrow together with the tiny planes of cortical bone is the trabecula. The trabecula contains osteoblasts, osteoclasts and osteocytes which are all needed to keep it healthy and strong.

All types of bone contain both cortical (lamellar) and cancellous bone (trabecula) in various quantities. Long bones possess a medullary cavity, only cancellous bone is found in there.

Periosteum:
The periosteum begins life as dense layer of irregular tissue known as the perichondrium. It surrounds the cartilage models of the developing bone, this stage of the development of the periosteum happen before birth. Once the perichondrium starts to receive a blood supply it turns from the perichondrium to the periosteum. The periosteum is a layer of dense irregular connective tissue that covers the surface of all bones. Except at articular surfaces and where tendons and ligaments attach. The periosteum is divided into two layers.

The outer fibrous layer:
The outer layer of the periosteum is a protective layer containing fibroblasts. Its primary job is to protect the underlying cellular layer and the bone. The outer layer of the periosteum also contains Sharpey's fibres which anchor it to the bone.

The inner cellular layer:
This layer is as the name suggests highly vascular. The inner layer is responsible for the growth of bone in width. Contained in this layer are osteoblasts (see bone growth for a detailed explanation of osteoblasts) this layer of the periosteum is also anchored to the bone via Sharpey's fibres although they not originate or terminate in this layer.

Endosteum
The endosteum is a thin delicate membrane of connective tissue that lines the medullary cavity and also the Haversian canals. It is usually only one cell thick and highly vascular. It contains both osteoclasts and osteoblasts.

Sharpey's fibres:

Sharpey's fibres are a matrix of connective tissue consisting of bundles of strong collagenous fibres connecting periosteum to bone. They are part of the outer fibrous layer of the periosteum, entering into the outer circumferential and interstitial lamellae of bone tissue. Sharpey's fibres are also used to attach tendons and ligaments to the bone by merging with the fibrous periosteum and underlying bone as well. Sometimes this bond via Sharpey's fibres can be so strong that tension on a tendon or ligament can break the bone before the collagen fibres are pulled away from the bone. This type of break is known as an avulsion fracture.

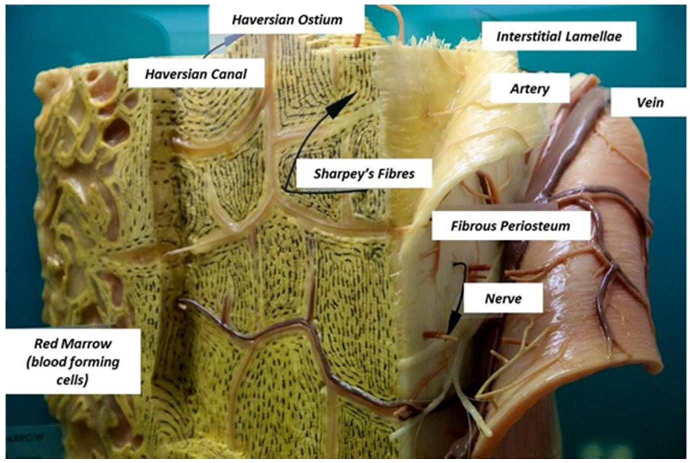


Fig 4 illustration of the construction of bone highlighting periosteum and Sharpey's fibres

Bone growth:

The growth or formation of bone is achieved by a process called Osteogenesis.
There are 3 main types of cell responsible for osteogenesis.

Osteoblasts: are a cell that creates bone. Osteoblasts arise from mesenchymal stem cells. These stem cells are found in abundance within the inner layer of the periosteum and also in bone marrow. These mesenchymal cells are known as osteoprogenitor cells and they develop into osteoblasts. They have only one nucleus and work in teams to form new bone. They first produce new bone called osteoid. The osteoid is an un-mineralized portion of bone made up mainly of collagen, this gives it great tensile strength. The osteoblasts then mineralise them with mainly calcium and phosphorous plus other elements this hardens them giving the new bone cell great compressive strength. This process is called bone deposition.

Osteoclasts: work by a process known as bone resorption. They derive from bone marrow and are related to white blood cells. They are large cells that are formed by two or more cells so they usually have more than one nucleus. They basically take apart bone by secreting acid and collagenase.
Osteocytes:

Osteocyte; is the most commonly found cell in mature bone. They are osteoblasts that have become surrounded by the bone matrix they have made and thus become intentionally trapped. They sit is spaces called a lacuna within the canaliculi of lamellar bone. Their function is to maintain the surrounding bone tissue dealing with the metabolic requirements of bone such as metabolic activity and mineral homeostasis. They are known as mature or resting bone cells. Osteocytes are relatively inert cells but they do maintain contact with other osteocytes as well as being able to transmit signals over long distances similar to that of the nervous system. Osteocytes are smaller and have a reduced cytoplasm compared with osteoblasts.

Inter membranous ossification:
This basically means the growth of bone between two membranes (periosteum – endosteum) and is how a bone grows in width. The process is a relatively simple one when you understand the role of osteoblasts and osteoclasts. The osteoblasts in the periosteum lay down new bone while the osteoclasts in the endosteum absorb bone. This process ensures that when a bone grows in length it also maintains its proportion by growing in width also. If a bone grew only in length it would lose proportion and become weak especially to tensile forces.

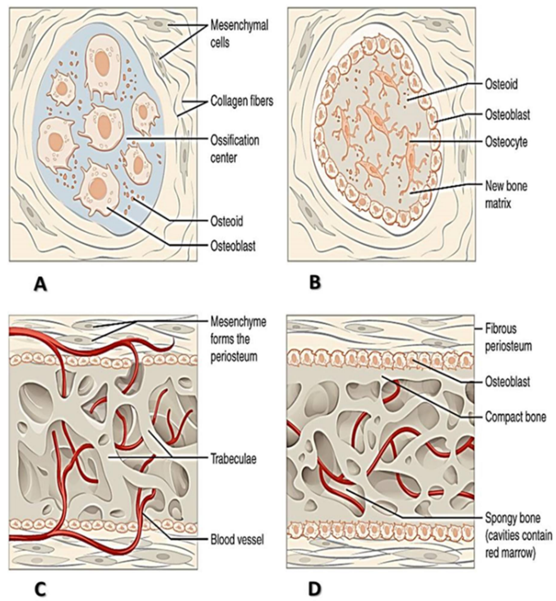
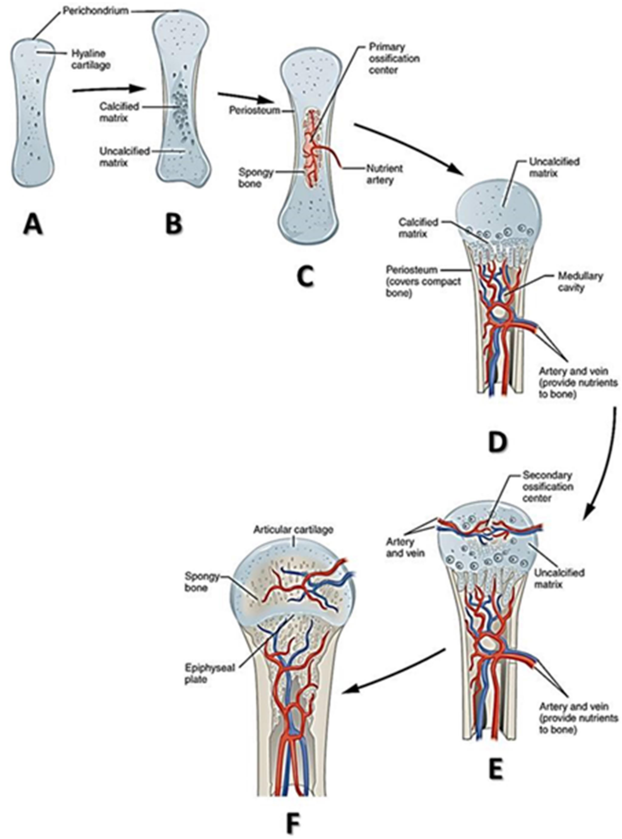


Fig 5 Showing the process of intramembranous ossification

Endochondral ossification:
Endochondral ossification is the second process of bone growth and is somewhat more complex than Intramembranous ossification. The process of endochondral ossification is involved in the formation of long bones, the growth of long bones and the healing of bones following injury. The formation and growth of long bones happen in 3 stages.
Stage 1
Bone growth begins before birth with the development of cartilage models. This cartilage model will eventually become bone but at this stage is made up of cells called chondrocytes. The cartilage model will grow in length by continual cell division of the chondrocytes. This process is known as interstitial growth.
Stage 2

The first place a long bone ossifies is known as the primary centre of ossification and it occurs in the Diaphysis. The perichondrium receives a blood supply and becomes the periosteum. Contained in the periosteum is a layer of osteoprogenitor cells, these cells later turn into osteoblasts. The osteoblasts secrete osteoid against the shaft of the cartilage model to give it some rigidity, once this is done the chondrocytes in the primary ossification centre begin to grow. They stop secreting collagen and protein and start secreting enzymes essential for mineral deposition, finally calcification occurs. When the matrix is formed osteoprogenitor cells that have entered into the cavity of the bone begin to secrete osteoid. This forms the trabecula. Osteoclasts formed by macrophages (a type of white blood cell) break down spongy bone. This forms the medullary cavity.



Stage 3

Around the time of birth at each end of the bone (epiphysis) a secondary centre of ossification appears. Blood and stem cells enter the epiphysis and the process described in the primary ossification centre is repeated. The cartilage left between the primary ossification centre (diaphysis) and the secondary ossification centre (epiphysis) is called the epiphyseal plate. The epiphyseal plate continues to create cartilage which slowly turns to bone. This causes the bone to grow in length. Eventually the epiphyseal plate will turn completely to bone joining the primary ossification centre to the secondary ossification centre. When this happens all that is left is a tiny line known as the epiphyseal line. At this point the final length of the bone is complete and no further growth is possible.

Fig 6 showing endochondral ossification

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Growth of the epiphyseal plate:

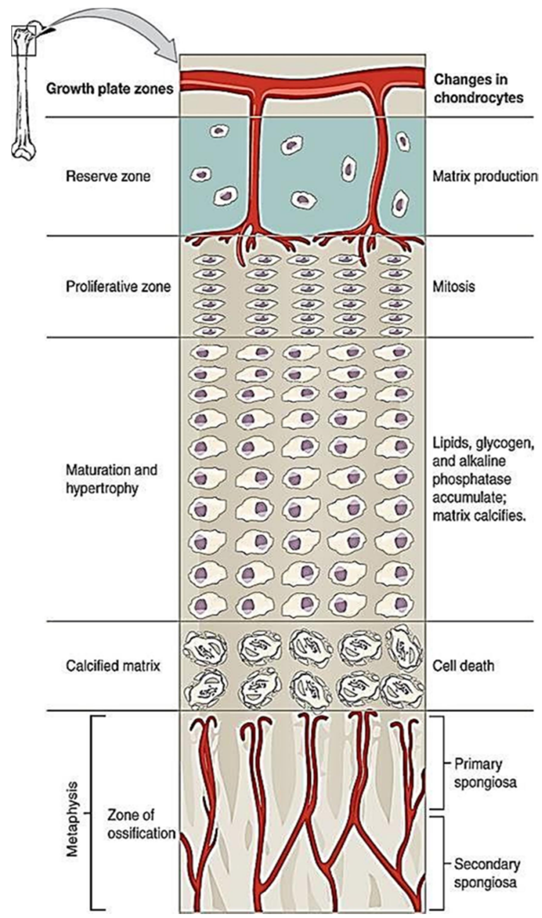
The process of ossification at a growth plate is complex, at histology level there are 5 distinct zones, we have broken this down into easy to understand and sanitised drawings. It's important to understand that in the real animal these zones are not quite as clear cut as the drawings suggest.

1. Zone of resting: This zone is found at the top of the epiphyseal plate and contains small scattered chondrocytes with large gaps between them. The chondrocytes are floating around the cartilage in no defined structure or purpose.

2. Zone of proliferation: The chondrocytes start to divide and arrange themselves into longer and longer columns in the direction of growth.

3. Zone of maturation: The cells in this zone are stacked into columns and enlarge even further; they are still affected by the growth hormone and become more and more tightly packed. They are still chondrocytes at this stage.

4. Zone of calcification: chondrocytes in this zone begin to degenerate and die. They die because they are tightly packed and can no longer receive nutrients or get rid of their waste. When they die, they leave spaces and cavities that will later become invaded by bone forming cells (osteoblasts).

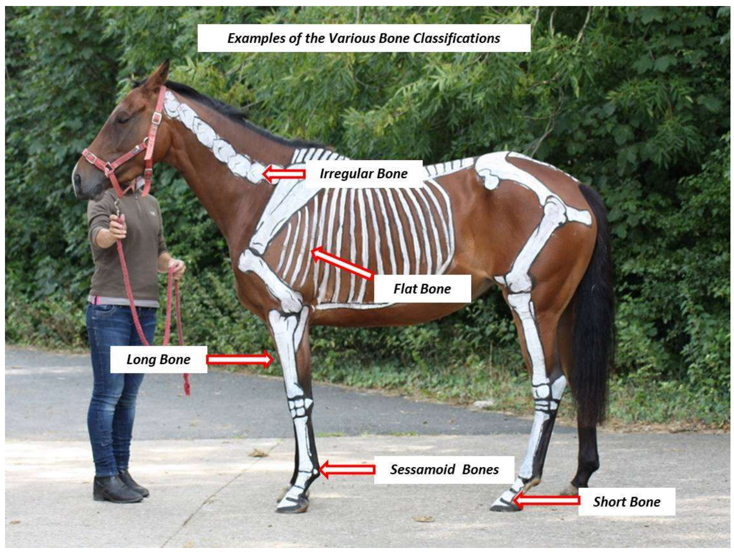


5. Zone of ossification: Blood enters the growth plate from the diaphysis (which is supplied from the periosteum via Volkmann canals). This blood contains osteoblasts. The osteoblasts exploit the spaces left from the chondrocyte death to lay down new bone matrix. The osteoblasts build new bone from the diaphysis to the epiphysis.
A growth plate in long bones ossifies from the diaphysis to the epiphysis.

As the chondrocytes run out, the zone of resting disappears, flowed by the other zones. It's essentially the same process in reverse, eventually only the zone of ossification is left and the diaphysis and epiphysis meet, at this point the bone becomes one complete bone and no more longitudinal growth is possible. Where the diaphysis and epiphysis meet there is a small microscopic line where they fuse called the epiphyseal line. It's in a region of the bone known as the metaphysis. Bones often break along this line.

Classification of bone:
Bones are classified into 5 categories:

- Long
- Short
- Flat
- Sesamoid
- Irregular



Long bones: are those that are longer than they are wide. They contain a medullary cavity. They grow primarily by elongation of the diaphysis, with an epiphysis at each end of the growing bone. The ends of epiphyses are covered with hyaline cartilage (articular cartilage). The longitudinal growth of long bones is a result of endochondral ossification at the epiphyseal plate. They grow in width via a process called inter-membranous ossification (ossification between two membranes, (the periosteum and the endosteum).

Short bones: are bones that are approximately as wide as they are long. Their primary function is to provide support and stability with little or no movement. They are also used to elongate a lever where a long bone is not suitable. In equine anatomy the perfect example of this is the pastern. Because of the angle of the pastern one long bone would undergo too much stress (mainly tensile) so it is replaced by two shorter, stronger bones more able to deal with the forces placed on them.

Flat bones: are bones whose principal function is either the extensive protection of vital organs such as the brain, heart, lungs etc. Or the provision of broad surfaces for muscular attachment these bones are expanded into broad, flat plates. Flat bones are composed of two thin layers of compact bone enclosing between them a variable quantity of cancellous bone.

Sesamoid bones: are embedded in a tendon. Sesamoid bones are usually present in a tendon where it passes over certain joints. The Patella is classified as a sesamoid bone because it is embedded in the quadriceps tendon.

Irregular bones: are bones which, from their peculiar form, cannot be grouped as long bone, short bone, flat bone or sesamoid bone. Irregular bones serve various purposes in the body, such as protection of nervous tissue (such as the vertebrae protecting the spinal cord). Affording multiple anchor points for skeletal muscle attachment (as with the sacrum), and maintaining pharynx and trachea support, and tongue attachment (such as the hyoid bone).

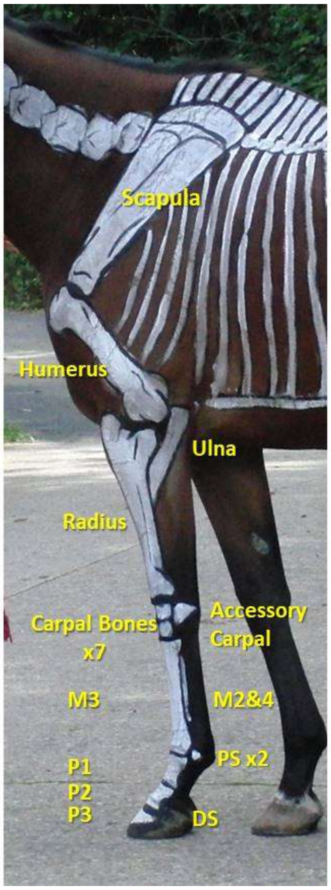
Composition of bone

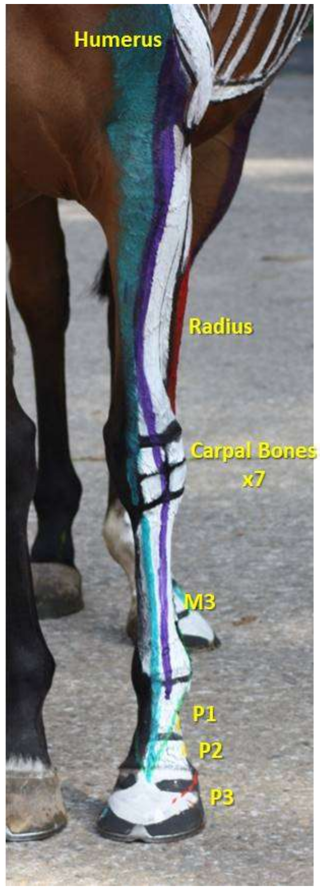
Bone consists of both organic and inorganic material. The organic matter is around 90% collagen and 10% protein and makes up around 35% of the overall composition of bone, the other 65% is made up of inorganic matter with the vast majority of this being calcium and phosphorous but the are also small traces of other elements such as carbon, magnesium, sodium and barium. A bones ability to withstand tension comes from its organic matter (collagen) and its compressive strength comes from its inorganic matter (calcium and phosphorous).

Wolff's law: States that bone in a healthy person or animal will adapt to the loads its placed under. If loading on a particular bone increases, the bone will remodel itself over time to become stronger to resist the new loading. The internal architecture of the trabecula undergoes adaptive changes, followed by secondary changes to the external cortical lamellar portion of the bone. The inverse is true as well, if the loading on a bone decreases, the bone will become less dense and weaker due to the lack of the stimulus required for continued remodelling. The bones of the horse's limbs are thicker medially than laterally, more weight is borne medially so, following Wolff's law the bones when viewed from the transverse plane will be thicker on the medial aspect.

Bones of the Appendicular Skeleton:

Thoracic limb



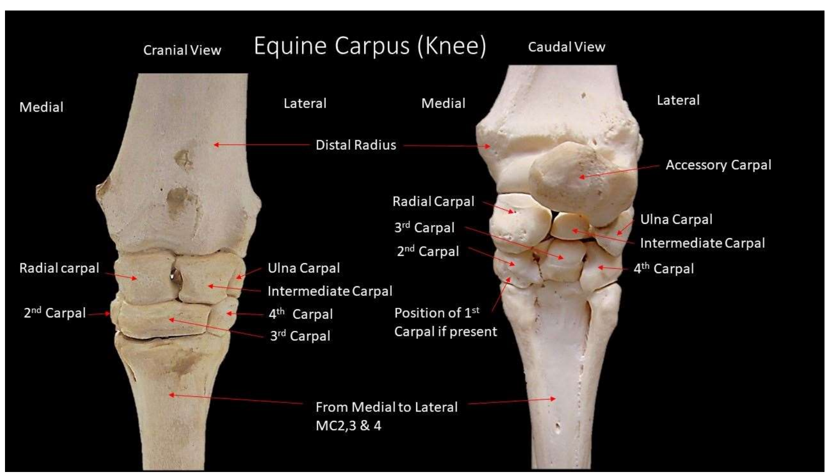


Scapula- The most proximal bone of the forelimb is the scapula; this bone attaches the Appendicular skeleton to the axial skeleton in the forelimb although it does not attach like a normal joint. It is held in place via strong muscles and ligaments, this attachment is known as a synsarcosiss and allows the horse a large range of movement. The dorsal edge points towards the spinal column and joins to the scapula cartilage. The scapula cartilage extends the scapula to the level of the withers enlarging its area for the attachment of muscles. It also helps to absorb concussion. The scapula has a raised spine which runs the entire length of the bone, various muscles attach to this ridge such as the supraspinatus muscle which runs down it's dorsal edge and the infraspinatus muscle the runs down it's ventral edge. At the distal end of the bone on its dorsal edge there is the supraglenoid tubercle (sometimes referred to as the scapular tuberosity), this is a rough projection and is where the tendon of the biceps brachii muscle attaches.

Humerus - The Humerus runs from the point of shoulder to the elbow. It is a long bone and is covered in large muscle masses responsible for locomotion. Most of the muscles involved in flexion of the carpus originate from the humerus. The proximal extremity of the humerus has a lesser and greater tubercle. The tubercles are separated by an intertubercular groove containing a sagittal ridge. This ridge is sometimes known as the intermediate tubercle. The tendon of the biceps brachii runs through this groove. The main body of the bone has the deltoid tuberosity laterally and the teres major tuberosity medially. The deltoid tuberosity is where the deltoid muscle inserts and the teres major tuberosity is where the teres major muscle inserts, both these muscles originate at the scapula. At the distal end of the humerus is a cylindrical condyle, this transfer's weight to the radius and ulna. On the lateral aspect of the condyle is a sagittal ridge, these form an articulation with the radius and ulna. On the caudal aspect (distally) there is a structure called the olecranon fossa which articulates with the olecranon of the ulna via a small process called the anconeal process (this plays a vital role in the elbow locking mechanism). There are two epicondyles at the distal extremity, one medial and one lateral these provide attachments for the extensor and flexor muscles of the carpus and digit.

Ulna- The ulna's more common name is the elbow. The part of the ulna that protrudes back to form the elbow is known as the olecranon process. The olecranon process, although part of the ulna, does not form from the ulna. In the unborn foal the ulna and olecranon process form from separate ossification centres. Just cranial and distal to the olecranon process is the Anconeal process; this is where the olecranon process articulates with the olecranon fossa of the humerus. On the cranial aspect of the ulna there is a trochlea notch, this is where the ulna articulates with the large trochlea of the humerus and forms the main elbow joint. The olecranon process has 2 bursas at its point. One is subcutaneous and lies between the skin and tendon, the other is subtendinous and occurs under the tendon of the triceps brachii muscle and is called the tricipital bursa.
Radius- The radius connects the elbow to the carpal bones (knee). It is a long bone and major weight bearing bone of the forelimb. The tendons of the forelimb turn from muscle to tendon at this bone. Situated at the proximocranial aspect of the radius is the radial tuberosity, this is the point where the short branch of the lacertus fibrosus inserts. At the distal end of the radius are the medial and lateral styloid processes. The medial styloid process is larger than the lateral Styloid process. The medial and lateral collateral ligaments attach to these processes and it's the point where the out fibrous layer of the knee joint capsule originates.

The carpus (knee) - The carpus is made up of 7 sometimes 8 bones, these bones collectively make up the carpus, they are essentially arranged in rows of three bones with the accessory carpal bone at the back.



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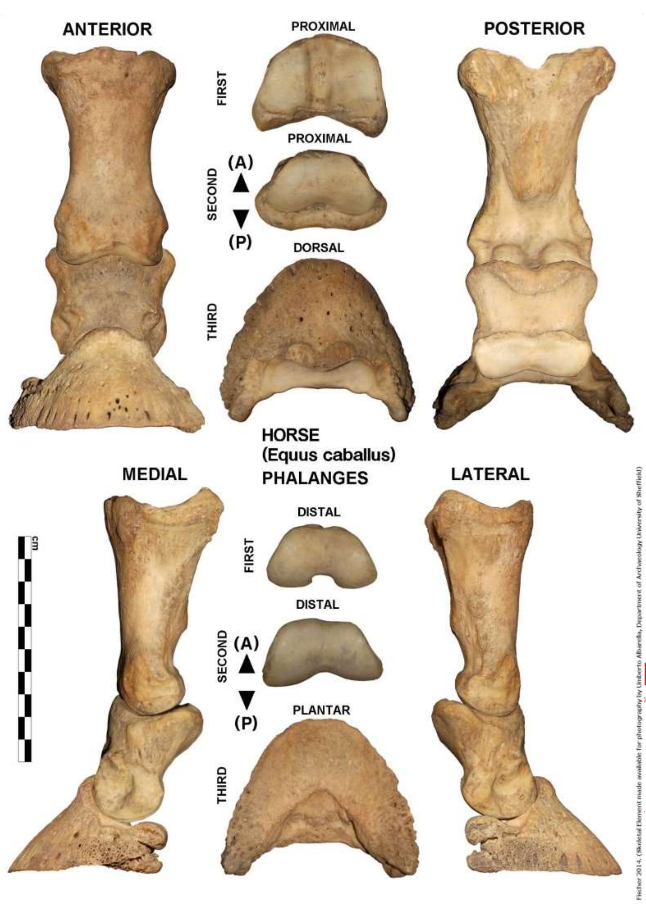
The 3rd Metacarpal - known informally as the cannon bone, is the largest and main weight bearing bone of the lower limb. It is located directly below the 3rd carpal bone. It is a long bone which is slightly thicker medially due to the extra weight borne down the medial aspect of the limb (Wolff's Law).

2nd & 4th Metacarpal - These are collectively known as the splint bones. They are located directly below the 2nd & 4th bones of the carpus respectively. They terminate ⅔rd of the way down the 3rd Metacarpal bone and are connected to the 3rd Metacarpal via strong interosseous ligaments. In growing bones, these ligaments can experience great strain especially if the two bones are growing at different rates, this can inflame of tear the periosteum stimulating the osteoblasts inside the cellular layer to lay down new bone, this would be known as a splint.

Proximal Sesamoid Bones - These are located palmar to the metacarpophangeal (fetlock) joint and act as a fulcrum for the flexor tendons. They give rigidity to the fetlock joint and are held in place by 5 separate sets of ligaments as well as the abaxial branches of the suspensory ligament. These small bones undergo a tremendous amount of stress and compression due to their position and the multiple attachments from ligaments. They are also subjected to tension from the flexor tendons. Proximal phalanx- This bone is the largest of the Phalanx bones and is informally known as the long pastern bone or P1. Its proximal extremity articulates with the 3rd Metacarpal forming the metacarpophalangeal articulation (fetlock joint). Its distal extremity articulates with the middle phalanx forming the pastern joint. Numerous sesamoidian ligaments from the proximal and distal sesamoid bones attach to the proximal phalanx as well as the collateral ligaments of the fetlock which insert onto the palpable tubercles of the proximal phalanx.

Middle phalanx- This bone is known informally as the short pastern bone or P2. It articulates proximally with the proximal phalanx and distally with the distal phalanx (P3) which together with the distal sesamoid forms the distal-interphalangeal joint. On the palmar/proximal aspect of the middle phalanx the complimentary fibrocartilage attaches to the transverse prominence, this fibrocartilage extends proximally to cover the pastern joint and blends in with numerous sesamoidian ligament of the proximal sesamoid bones.



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Distal Sesamoid- The distal sesamoid is known informally as the navicular bone. It is a small irregular shuttle shaped bone. It has two surfaces, an articular surface covered with articular cartilage and a flexor surface covered with fibro-cartilage. It is situated at the palmar aspect of the distal interphalangeal joint. It is the main component of a region in the palmar aspect of the foot known as the podotrochlear apparatus*. The distal sesamoid acts as a fulcrum for the DDFT.
*The podotrochlear apparatus comprises of the distal sesamoid, distal impar ligament, suspensory ligament of the distal sesamoid, navicular bursa and DDFT.

Distal phalanx- This bone is almost completely encased in the hoof capsule and is of an irregular shape. The bone has many unique features and functions and plays a huge part in any farrier's life.

Pelvic limb

Pelvis- attaches the appendicular skeleton to the axial skeleton in the hind limb. It is a flat bone. The Pelvis is primarily made up of 3 bones that develop from separate ossifications, within a single cartilage plate.
The bones that make up the pelvis are:

- Ilium
- Ischium
- Pubis

There are 2 main joints in the pelvis on either side.

Sacroiliac joints: These are two joints found on either side of the sacrum, they are formed by the wings of the ilium and the sacrum bone. It is classed as a synovial joint, however, there is little or no joint fluid present. They are more like a fibrous joint and are supported by large, strong interosseous ligaments (ventral sacroiliac ligaments). They help to transfer the weight of the horses' body to the hind limbs.

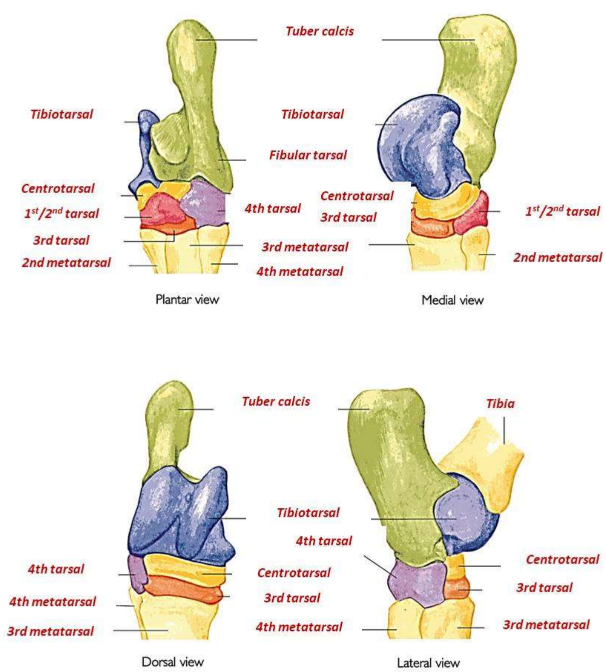
The Acetabulum: This is a concave surface that is made up of all 3 bones of the pelvis. The head of the femur sits in the Acetabulum forming the hip joint.

Femur- The femur is the largest bone in the horses' body. It provides surfaces and attachment points for many muscles and ligaments. The femur can be divided into 3 areas.
The femoral head: Proximally it forms a ball and socket joint with the pelvis known as the hip joint. The articular surface of this joint is hemispherical and sits in the acetabulum of the pelvis. Lateral to the head is a process called the greater trochanter; this provides attachment for the gluteal muscles.
The femoral shaft: The shaft contains the lesser trochanter medially and the 3rd trochanter laterally. The lesser trochanter provides attachment for the iliopsoas muscle and the 3rd trochanter provides an insertion point for the gluteus superficialis muscle's tendon.

The distal extremity: Distally it has a medial and lateral condyle. Both condyles are separated by an intercondylar fossa. The condyles expand to form a trochlea with the medial ridge being larger than that of the lateral. The larger medial protuberance plays a key role in the patella locking mechanism.

Patella- The patella is located on the dorsal aspect of the stifle joint. It can be lifted to sit on the Trochanter of the femur to lock the hind limb. The patella is classed as a sesamoid bone. The reason for this classification is because it is embedded within the quadriceps tendon. The articular surface of the patella is divided by a sagittal ridge; this sagittal ridge fits between the trochlea of the femur.

Tibia- The tibia is located between the femur and the hock joint. It is a long bone. On the proximal aspect the three tendons of the insertion of the quadriceps muscle attach. The tibia articulates with the fibula on its lateral condyle via a strong fibrous joint. Distally there are two grooves separated by a ridge called the tibial cochlea. There is a medial malleolus and lateral malleolus on the dorso-distal aspect of the tibia which articulates with the talus. The trochlea of the talus sits between the two malleolus. The angle of these ridges is about 12-15 degrees off the sagittal plane in a dorso-lateral direction. This angle arrangement causes the horse to have a slightly cow hocked and toe out appearance. This is to allow the lower hind limb to move slightly dorso-laterally. This unusual articulation causes the hind feet to miss the front feet in locomotion.
Fibula- This is a small rudimentary, irregular bone situated on the plantar aspect of the tibia. It is completely fused to the tibia. It tapers towards its distal end and terminates half way down the tibia.

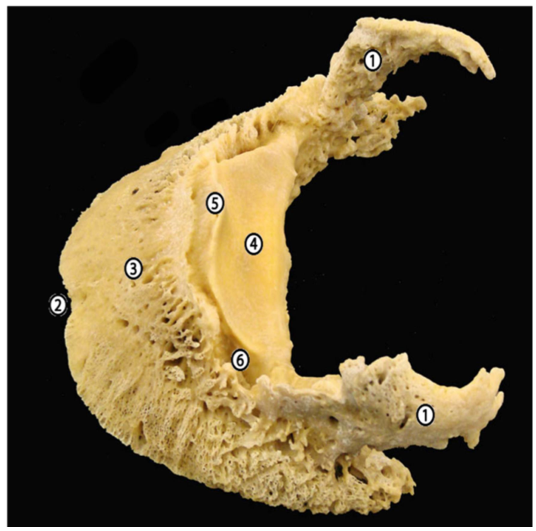


Tarsus- Informally known as the hock joint and consists of 7 bones and 4 main joints of varying degrees of motion.

Bones of the lower hind limb- The bones of the lower hind limb are the same as the fore limb with a few notable exceptions. The 3rd Metacarpal becomes the 3rd Metatarsal and it is slightly pointier than that of the fore limb and the dorsal angle of the distal phalanx is slightly steeper.

The Distal Phalanx:
The distal phalanx, known informally as the P3 or coffin bone is one of the most instantly recognised bones in the horses' body. It is unique in both design and function. As farriers we must fully understand its correct orientation with the hoof capsule and be able to recognise any abnormalities. The distal phalanx can be involved in many diseases, injuries and ailments and is the bone we farriers will see and deal with most often radiographically and in corrective farriery.

- **The Distal Phalanx**
- Dorsal lateral view of a third phalanx with extensive ossification of the collateral cartilages (1) a.k.a. sidebone.
- 2, Crena (marginal indentation of the toe region of P3);
- 3, parietal surface of P3;
- 4, articular surface;
- 5, extensor process;
- 6, space for attachment of the collateral ligament of the distal interphalangeal (dip) joint.



The distal phalanx's biomechanical importance is huge, largely due to the tendon and ligament attachments and the role it plays in breakover, this is covered in more detail in the biomechanics in a separate module however, anatomically speaking the distal phalanx is the most distal bone in the body and is almost completely encased in the hoof capsule, the distal phalanx can be classed as a long bone due to the 3 epiphyseal plates contained in the bone, one is just below the extensor process and the other two are anterior to the medial and lateral palmar processes. These epiphyseal plates ossify and close usually before birth; this bone could easily be also classed as an irregular bone also. It articulates with the middle phalanx and the distal sessamoid bone to form the distal interphalangeal joint. The parietal surface of the bone has a modified periosteum on which the sensitive laminae are attached, The Common Digital Extensor Tendon (CDET) attaches to the extensor process and on the solar surface the Deep Digital Flexor Tendon (DDFT) flattens out and inserts onto the semi lunar line.

The terminal arch is contained within the distal phalanx and is the point which the medial and lateral digital arteries anastomosis with each other. Another feature of the distal phalanx is the Crena Marginis Solearis. This is a notch at the dorsal solar border that is present in some but not all horses. It is a natural feature and not to be confused with pressure related atrophy of bone such as a keratoma. The bone is light and porous to allow the proliferation of blood through it. Attached to the palmar processes of the bone are the collateral cartilages of the distal phalanx, these form part of the anti-concussive mechanism covered module.