= Limbs of the horse =

The limbs of the horse are structures made of dozens of bones , joints , muscles , tendons and ligaments that support the weight of the equine body . They include two apparatuses : the suspensory apparatus , which carries much of the weight , prevents overextension of the joint and absorbs shock , and the stay apparatus , which locks major joints in the limbs , allowing horses to remain standing while relaxed or asleep . The limbs play a major part in the movement of the horse , with the legs performing the functions of absorbing impact , bearing weight , and providing thrust . In general , the majority of the weight is borne by the front legs , while the rear legs provide propulsion . The hooves are also important structures , providing support , traction and shock absorption , and containing structures which provide blood flow through the lower leg . As the horse developed as a cursorial animal , with a primary defense mechanism of running over hard ground , its legs evolved to the long , sturdy , light @-@ weight , one @-@ toed form seen today .

Good conformation in the limbs leads to improved movement and decreased likelihood of injuries . Large differences in bone structure and size can be found in horses used for different activities , but correct conformation remains relatively similar across the spectrum . Structural defects , as well as other problems such as injuries and infections , can cause lameness , or movement at an abnormal gait . Injuries to and problems with horse legs can be relatively minor , such as stocking up , which causes swelling without lameness , or quite serious . Even non @-@ fatal leg injuries can be fatal to horses , as their bodies are designed to bear weight on all four legs and serious problems can result if this is not possible .

= = Limb anatomy = =

Horses are odd @-@ toed ungulates , or members of the order Perissodactyla . This order also includes the extant species of rhinos and tapirs , and many extinct families and species . Members of this order walk on either one toe (like horses) or three toes (like rhinos and tapirs) . This is in contrast to even @-@ toed ungulates , members of the order Artiodactyla , which walk on cloven hooves , or two toes . This order includes many species associated with livestock , such as sheep , goats , pigs , cows and camels , as well as species of giraffes , antelopes and deer .

Equine hooves and legs have evolved over millions of years to the form in which they are found today . The original ancestors of horses had shorter legs , terminating in five @-@ toed feet . Over millennia , a single hard hoof evolved from the middle toe , while the other toes gradually disappeared into the tiny vestigial remnants that are found today on the lower leg bones . Prairie @-@ dwelling equine species developed hooves and longer legs that were both sturdy and light weight to help them evade predators and cover longer distances in search of food . Forest @-@ dwelling species retained shorter legs and three toes , which helped them on softer ground . Approximately 35 million years ago , a global drop in temperature created a major habitat change , leading to the transition of many forests to grasslands . This led to a die @-@ out among forest @-@ dwelling equine species , eventually leaving the long @-@ legged , one @-@ toed Equus of today , which includes the horse , as the sole surviving genus of the Equidae family .

= = = Legs = = =

Each forelimb of the horse runs from the scapula or shoulder blade to the navicular bone . In between are the humerus (arm) , radius (forearm) , elbow joint , ulna (elbow) , carpus (knee) bones and joint , large metacarpal (cannon) , small metacarpal (splint) , sesamoid , fetlock joint , first phalanx (long pastern) , pastern joint , second phalanx (short pastern) , coffin joint and third phalanx (coffin or pedal) bones . Each hind limb of the horse runs from the pelvis to the navicular bone . After the pelvis come the femur (thigh) , patella , stifle joint , tibia , fibula , tarsal (hock) bone and joint , large metatarsal (cannon) and small metatarsal (splint) bones . Below these , the arrangement of sesamoid and phalanx bones and joints is the same as in the forelimbs . When the horse is moving , the distal interphalangeal joint (coffin joint) has the highest amount of stresses

applied to it of any joint in the body , and it can be significantly affected by trimming and shoeing techniques . Although having a small range of movement , the proximal interphalangeal joint (pastern joint) is also influential to the movement of the horse , and can change the way that various shoeing techniques affect tendons and ligaments in the legs . Due to the horse 's development as a cursorial animal (one whose main form of defense is running) , its bones evolved to facilitate speed in a forward direction over hard ground , without the need for grasping , lifting or swinging . The ulna shrank in size and its top portion became the point of the elbow , while the bottom fused with the radius above the radiocarpal (knee) joint , which corresponds to the wrist in humans . A similar change occurred in the fibula bone of the hind limbs . These changes were first seen in the genus Merychippus , approximately 17 million years ago .

There are three main muscle groups of the forelimb . The triceps muscle straightens the elbow and foreleg , running from the elbow to the bottom of the shoulder blade . The muscles which extend the lower leg are called extensor muscles , while the flexion of the lower leg joints is achieved through movement of the flexor muscles . There are five main muscles and muscle groups in the hind legs . The vastus muscle flexes the hind leg and runs from stifle to hip , while the gluteal muscles , the large muscles in the hip , extend the femur . Forward motion and flexion of the hind legs is achieved through the movement of the quadriceps group of muscles on the front of the femur , while the muscles at the back of the hindquarters , called the hamstring group , provide forward motion of the body and rearward extension of the hind limbs . Extension of the hock is achieved by the Achilles tendon , located above the hock .

There are two apparatus in the limbs of the horse - the suspensory apparatus and the stay apparatus . The fetlock joint is supported by group of lower leg ligaments , tendons and bones known as the suspensory apparatus . This apparatus carries much of the weight of the horse , both when standing and while moving , and prevents the fetlock joint from hyperextending , especially when the joint is bearing weight . During movement , the apparatus stores and releases energy in the manner of a spring : stretching while the joint is extended and contracting (and thus releasing energy) when the joint flexes . This provides a rebound effect , assisting the foot in leaving the ground . This ability to use stored energy makes horses ' gaits more efficient than other large animals , including cattle . The suspensory apparatus consists of the suspensory ligament , the check ligament , the deep digital flexor tendon , the superficial flexor tendon , the common digital extensor tendon and the sesamoid bones .

Horses use a group of ligaments , tendons and muscles known as the stay apparatus to " lock " major joints in the limbs , allowing them to remain standing while relaxed or asleep . The lower part of the stay apparatus consists of the suspensory apparatus , which is the same in both sets of limbs , while the upper portion differs between the fore and hind limbs . The upper portion of the stay apparatus in the forelimbs includes the major attachment , extensor and flexor muscles and tendons . The same portion in the hind limbs consists of the major muscles , ligaments and tendons , as well as the reciprocal joints of the hock and stifle .

= = = Hoof = = =

The hoof of the horse contains over a dozen different structures , including bones , cartilage , tendons and tissues . The coffin or pedal bone is the major hoof bone , supporting the majority of the weight . Under the coffin bone is the navicular bone , itself cushioned by the navicular bursa , a fluid @-@ filled sac . The digital cushion is a blood vessel @-@ filled structure located in the middle of the hoof , which assists with blood flow throughout the leg . At the top of the hoof wall is the corium , tissue which continually produces the horn of the outer hoof shell , which is in turn protected by the periople , a thin outer layer which prevents the interior structures from drying out . The wall is connected to the coffin bone by sensitive laminae , a flexible layer which helps to suspend and protect the coffin bone . The main tendon in the hoof is the deep digital flexor tendon , which connects to the bottom of the coffin bone . The impact zone on the bottom of the hoof includes the sole , which has an outer , insensitive layer and a sensitive inner layer , and the frog , which lies between the heels and assists in shock absorption and blood flow . The final structures are the

lateral cartilages , connected to the upper coffin bone , which act as the flexible heels , allowing hoof expansion . These structures allow the hoof to perform many functions . It acts as a support and traction point , shock absorber and system for pumping blood back through the lower limb .

= = Movement = =

A sequence of movements in which a horse takes a step with all four legs is called a stride . During each step , with each leg , a horse completes four movements : the swing phase , the grounding or impact , the support period and the thrust . While the horse uses muscles throughout its body to move , the legs perform the functions of absorbing impact , bearing weight , and providing thrust . Good movement is sound , symmetrical , straight , free and coordinated , all of which depend on many factors , including conformation , soundness , care and training of the horse , and terrain and footing . The proportions and length of the bones and muscles in the legs can significantly impact the way an individual horse moves . The angles of certain bones , especially in the hind leg , shoulders , and pasterns , also affect movement .

The forelegs carry the majority of the weight , usually around 60 percent , with exact percentages depending on speed and gait . Movement adds concussive force to weight , increasing the likelihood that a poorly built leg will buckle under the strain . At different points in the gallop , all weight is resting on one front hoof , then all on one rear hoof . In the sport of dressage , horses are encouraged to shift their weight more to their hindquarters , which enables lightness of the forehand and increased collection . While the forelimbs carry the weight the hind limbs provide propulsion , due to the angle between the stifle and hock . This angle allows the hind legs to flex as weight is applied during the stride , then release as a spring to create forward or upward movement . The propulsion is then transmitted to the forehand through the structures of the back , where the forehand then acts to control speed , balance and turning . The range of motion and propulsion power in horses varies significantly , based on the placement of muscle attachment to bone . The muscles are attached to bone relatively high in the body , which results in small differences in attachment making large differences in movement . A change of .5 inches (1 @.@ 3 cm) in muscle attachment can affect range of motion by 3 @.@ 5 inches (8 @.@ 9 cm) and propulsion power by 20 percent .

" Form to function " is a term used in the equestrian world to mean that the " correct " form or structure of a horse is determined by the function for which it will be used . The legs of a horse used for cutting , in which quick starts , stops and turns are required , will be shorter and more thickly built than those of a Thoroughbred racehorse , where forward speed is most important . However , despite the differences in bone structure needed for various uses , correct conformation of the leg remains relatively similar .

= = Structural defects = =

The ideal horse has legs which are straight , correctly set and symmetrical . Correct angles of major bones , clean , well @-@ developed joints and tendons , and well @-@ shaped , properly @-@ proportioned hooves are also necessary for ideal conformation . " No legs , no horse " and " no hoof , no horse " are common sayings in the equine world . Individual horses may have structural defects , some of which lead to poor movement or lameness . Although certain defects and blemishes may not directly cause lameness , they can often put stress on other parts of the body , which can then cause lameness or injuries . Poor conformation and structural defects do not always cause lameness , however , as was shown by the champion racehorse Seabiscuit , who was considered undersized and knobby @-@ kneed for a Thoroughbred .

Common defects of the forelegs include base @-@ wide and base @-@ narrow , where the legs are farther apart or closer together on the ground then they are when they originate in the chest ; toeing @-@ in and toeing @-@ out , where the hooves point inwards or outwards ; knee deviations to the front (buck knees) , rear (calf knees) , inside (knock knees) or outside (bowleg) ; short or long pasterns ; and many problems with the feet . Common defects of the hind limbs include the

same base @-@ wide and base @-@ narrow stances and problems with the feet as the fore limbs , as well as multiple issues with the angle formed by the hock joint being too angled (sickle @-@ hocked) , too straight (straight behind) or having an inward deviation (cow @-@ hocked) . Feral horses are seldom found with serious conformation problems in the leg , as foals with these defects are generally easy prey for predators . Foals raised by humans have a better chance for survival , as there are therapeutic treatments that can improve even major conformation problems . However , some of these conformation problems can be transmitted to offspring , and so these horses are a poor choice for breeding stock .

= = Lameness and injuries = =

Lameness in horses is movement at an abnormal gait due to pain in any part of the body . It is frequently caused by pain to the shoulders , hips , legs or feet . Lameness can also be caused by abnormalities in the digestive , circulatory and nervous systems . While horses with poor conformation and congenital conditions are more likely to develop lameness , trauma , infection and acquired abnormalities are also causes . The largest cause of poor performance in equine athletes is lameness caused by abnormalities in the muscular or skeletal systems . The majority of lameness is found in the forelimbs , with at least 95 percent of these cases stemming from problems in the structures from the knee down . Lameness in the hind limbs is caused by problems in the hock and / or stifle 80 percent of the time .

There are numerous issues that can occur with horses ' legs that may not necessarily cause lameness . Stocking up is an issue that occurs in horses that are held in stalls for multiple days after periods of activity . Fluid collects in the lower legs , producing swelling and often stiffness . Although it does not usually cause lameness or other problems , prolonged periods of stocking up can lead to other skin issues . Older horses and horse with heavy muscling are more prone to this condition . A shoe boil is an injury that occurs when there is trauma to the bursal sac of the elbow , causing inflammation and swelling . Multiple occurrences can cause a cosmetic sore and scar tissue , called a capped elbow , or infections . Shoe boils generally occur when a horse hits its elbow with a hoof or shoe when lying down . Windpuffs , or swelling to the back of the fetlock caused by inflammation of the sheaths of the deep digital flexor tendon , appear most often in the rear legs . Soft and fluid @-@ filled , the swelling may initially be accompanied by heat and pain , but can remain long after the initial injury has healed without accompanying lameness . Repeated injuries to the tendon sheath , often caused by excessive training or work on hard surfaces , can cause larger problems and lameness .

Leg injuries that are not immediately fatal still may be life @-@ threatening because a horse 's weight must be distributed evenly on all four legs to prevent circulatory problems , laminitis , and other infections . If a horse loses the use of one leg temporarily , there is the risk that other legs will break down during the recovery period because they are carrying an abnormal weight load . While horses periodically lie down for brief periods of time , a horse cannot remain lying in the equivalent of a human 's " bed rest " because of the risk of developing sores , internal damage , and congestion .