IT ALL Hinges On This

BY LES SELLNOW

There are 205 bones in the horse's skeleton. Twenty of these bones are in each foreleg and 20 in each hind limb, for a grand total of 80 bones in the four equine legs. The leg bones do not function independently. Each is connected or aligned with one or more other bones, allowing the horse to lift, bend, and flex its legs. This ability allows the horse to travel across the ground, absorbing concussion as it does so. The spot where one or more bones join is the joint. This installment of the anatomy and physiology series focuses on these critical areas of movement.

Types of Joints

There are three types or classifications of equine joints. They are:

Synovial joints—These are the movable joints and the ones most apt to sustain injury or be afflicted with disease. An example of a synovial joint is the carpus (knee), which actually contains three joints and multiple bones. In a manner of speaking, the synovial joints are the horse's ball bearings. A synovial joint consists of two bone ends that are both covered by articular cartilage. The cartilage within the joint is smooth and resilient, allowing for frictionless movement. Each joint capsule also contains an inner lining called the synovial membrane, which secretes synovial fluid to lubricate the joints.

Proper movement of the horse is dependent on proper functioning of his joints

Cartilaginous joints—These joints are slightly movable or immovable, depending on the bones involved. Cartilaginous joints are united by fibrocartilage (composed of collagen fibers), hyaline cartilage (translucent bluish white), or both. An example is the connective tissue between vertebrae.

Fibrous joints—These are immovable joints where the bones are bound by fibrous tissue that ossifies (hardens into bone) as the horse matures. An example would be joints within the equine skull.

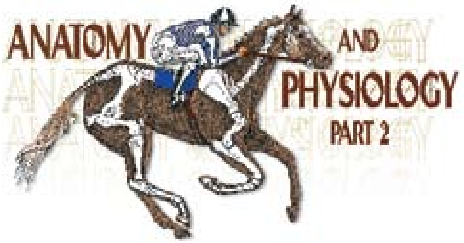
We'll concentrate on synovial joints because they are the most active and are more prone to problems than joints with little or no movement.

As in the opening article of this series in January, we will point out that information for this article is drawn from many textbooks and scientific papers that have been

Editor's Note

This is the second in a 12-part series of articles on equine anatomy and physiology. Future topics include the foreleg, the hind limb, the hoof, the head and neck, the back, muscles, tendons and ligaments, the digestive system, the circulatory and respiratory systems, and the reproductive system.

DR. ROBIN PETERSON ILLUSTRATIONS



published. However, we would be remiss in not calling attention to the three key sources for the information that follows. One is *Anatomy of Domestic Animals*, a textbook authored by Chris Pasquini, DVM, MS, and Tom Spurgeon, PhD, of the Department of Anatomy and Neurobiology at Colorado State University.

Two other key sources are C. Wayne McIlwraith, BVSc, PhD, MS, MRCVS, Director of Orthopaedic Research at the College of Veterinary Medicine and Biomedical Sciences at Colorado State University, and Jerry Black, DVM, a California veterinarian. Both are past presidents of the American Association of Equine Practitioners (AAEP) and both have lectured on the subject of joints and joint problems in horses. Information for this treatise has been taken from interviews and from presentations they have made at AAEP conventions and, in Black's case, Horseman's Day, an owner education event sponsored by AAEP.

First we'll look at how synovial joints are constructed, then we'll outline where they are located, the functions they serve, and some of the problems that can develop.

How It Works

The joint structure is designed to absorb concussion and permit leg movement. The two bone ends are encased in a fibrous capsule that helps provide stability. Collateral ligaments, comprised of very tough fibers, attach to the sides of each of the bones within the capsule, and this plays a major stabilizing role. Other ligaments, such as the cruciate ligaments, also help stabilize some joints, including the stifle. Other ligaments outside the joint cavity also lend support. A prime example would be the distal sesamoidean ligaments and suspensory ligaments that, together with the sesamoid bones, make up the apparatus that holds the fetlock in proper position.

The outer part of the joint capsule is the fibrous layer and the inner part is synovial membrane that lines the sides of the joint capsule. The joint is lubricated by synovial fluid, which is secreted by the synovial membrane. The ends of each of the bones within the fibrous capsule are covered with cartilage, which primarily is hyaline cartilage—a substance that is flexible and somewhat elastic. Beneath the cartilage in each bone end is subchondral bone.

We mentioned earlier that the synovial membrane secretes lubricating fluid that allows a healthy joint to have frictionless movement. In addition to being a lubricant, synovial fluid also supplies nutrients and removes waste from hyaline articular cartilage. Synovial fluid is described as having the consistency of raw egg white.

An important component in the makeup of synovial fluid is hyaluronic acid, also known as sodium hyaluronate or hyaluronan. It is primarily responsible for giving the synovial fluid its lubricating capability. When disease strikes a joint, there often is a depletion of hyaluronic acid. When that happens, the joint's ability to function properly—for movement and as a concussion absorber—is compromised.

There is a second method for lubricating cartilage in a joint. Fluid is stored within the cartilage and when weight bearing occurs, it is squeezed out of the cartilage onto the surface. When weight bearing ceases, the fluid is reabsorbed by the cartilage.

The Front Limb

Injury and disease to the front limb joints are more common than injury to the rear limbs. Why? A horse carries 60-65% of its weight on the front end. This means that the joints of the front limbs are subjected to a greater share of the concussion with each step the horse takes than are the rear limbs, especially during strenuous activities such as racing and jumping.

For the most part, construction of equine synovial joints is a wonder of nature, but there are exceptions. A key exception is the knee, which almost seems to have been constructed haphazardly. There are eight bones in the horse's knee and three main joints to keep them all aligned and functioning properly, which is no small task. The eight bones are arranged in two rows.

The three prime knee joints are located thusly: One between the radius and proximal (upper) row of four carpal bones; one between the two rows of carpal bones (usually there are four bones per row), and one between the distal (lower) row of carpal bones and the cannon and splint bones.

There also are tiny joints between the individual carpal bones.

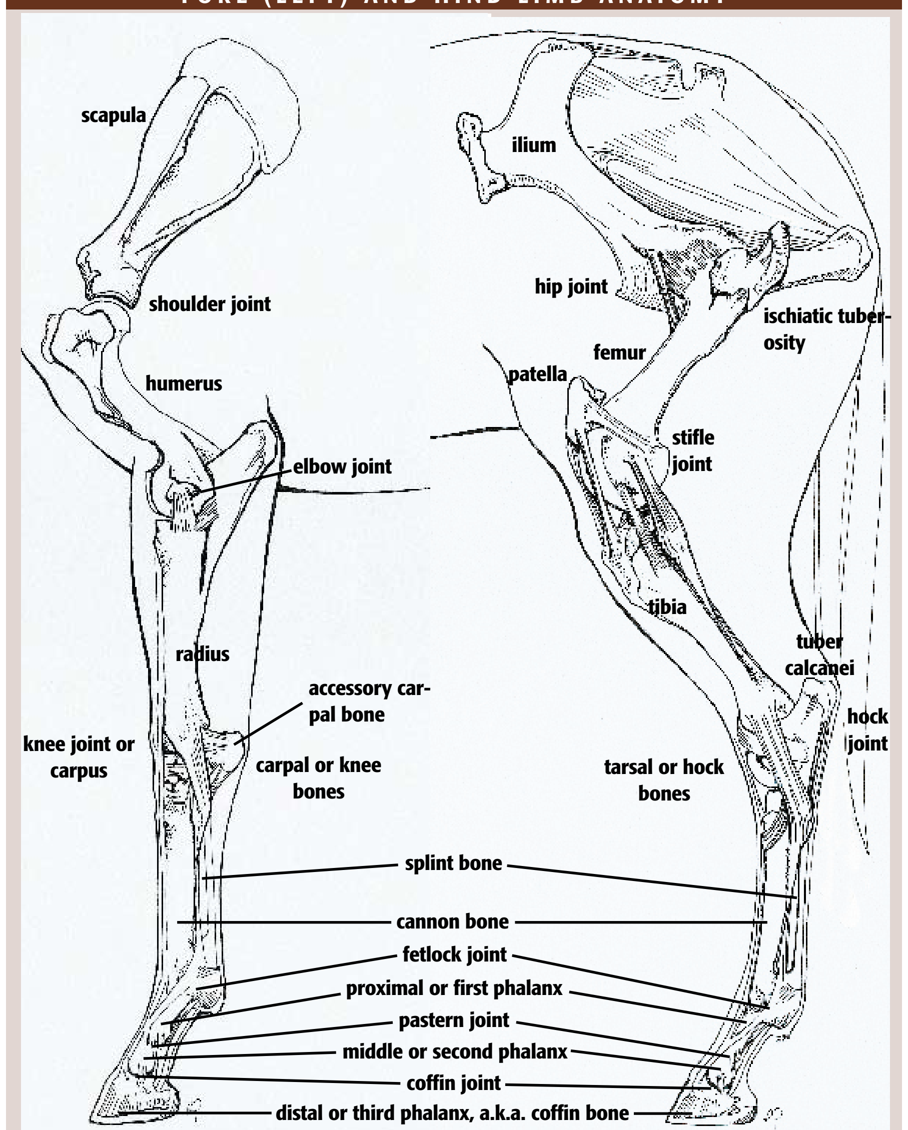
Because the knee is structured with multiple bones, it becomes immediately apparent that good conformation is a prime requisite in keeping this joint healthy and strong. Any deviation, such as being over or under at the knee, puts undue stress on the complicated knee joint and opens the door for a multitude of potential problems.

From the knee on down, the joint structure is slightly less complicated. The cannon bone continues downward from the knee until it joins the long pastern bone, or first phalanx (P1), at the fetlock joint. Also located at this junction are the medial and lateral proximal sesamoid bones. These bones are deeply imbedded in, and are supported by, the suspensory ligament. They are subject to injury and fracture, particularly if the horse interferes and strikes them with the opposing limb.

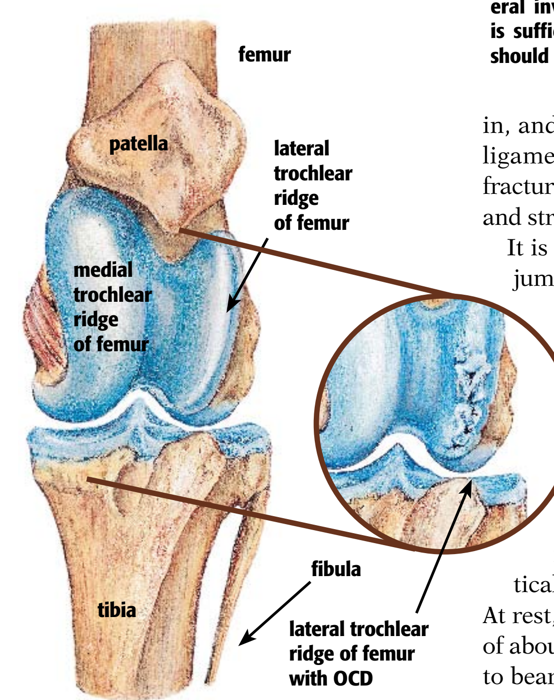
It is amazing that more racehorses and jumpers don't break down at the fetlock joint. To understand that statement, we must realize that when a racehorse runs at top speed, there is one point in every stride where its entire weight descends upon one front leg, with most of the concussion being absorbed and dissipated by the fetlock joint. The force of that concussion often drastically changes the angle of the fetlock. At rest, the fetlock generally is at an angle of about 50º. When all of the weight comes to bear on that one leg when a horse runs at speed, the fetlock is often almost level with the ground, or at zero degrees, placing tremendous stress on the fetlock joint.

The next joint below the fetlock is the

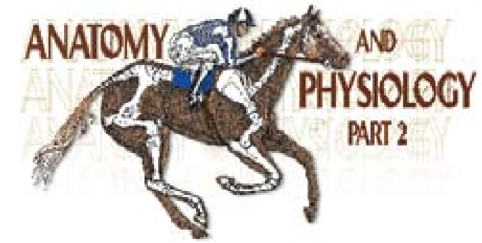
FORE (LEFT) AND HIND LIMB ANATOMY



LEFT STIFLE JOINT: NORMAL AND WITH OCD



Osteochondrosis might lead to OCD or subchondral cystic lesions. OCD normally shows up in one joint rather than multiple joints. However, bilateral involvement (of both front or hind limbs) is sufficiently common that the opposite joints should always be radiographed.



pastern joint. This is where P1 connects with the short pastern bone, or second phalanx (P2). This joint moves very little and does not absorb a great deal of concussion when compared to the fetlock joint.

We are now down into the foot where joints also play connecting and shock absorbing roles. The coffin joint is next in line as we travel downward, and it connects P2 with P3 (the coffin bone). This is a movable joint that plays a very important role in absorbing concussion.

Helping in the weight-transferring and shock absorbing roles at this location is the navicular bone, which is supported by the deep digital flexor tendon. The deep flexor tendon is closely fitted to the surface of the navicular bone with a navicular bursa, a fluid-filled sac that provides a smooth, lubricating substance that reduces friction.

Again, we can't get away from the importance of good conformation when considering the health and maintenance of these joints. When any of these joints are out of alignment, there is a great deal more stress on them, especially when the horse is exercising vigorously.

There are two other joints—shoulder joint and elbow joint—in the forelimbs, but they don't absorb much concussion because the concussion already has been absorbed and dissipated by the other joints as the first line of defense.

The shoulder joint is a hinge joint that is held in place by a strong web of ligaments, muscles, and tendons.

The elbow joint also works like a hinge, with movement on only one plane, and it is stabilized by medial and lateral ligaments.

The Hind Limb

The rear fetlock, pastern, and coffin joints correspond to their front leg counterparts, although they usually have steeper angulations because the back limbs are used more for propulsion than shock absorption.

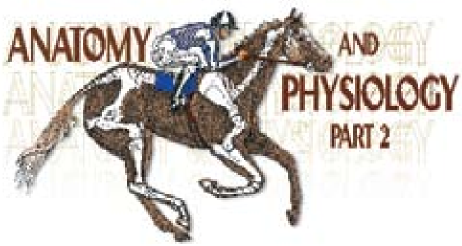
Two additional joints in the rear end deserve discussion because they are highly important in the horse's ability to perform properly. They are the hock joint and the stifle joint. The hock joint is a bit like the knee in that it is comprised of multiple bones—six, to be specific. However, these bones don't have the range of movement of the knee bones. Like the knee joint, strong ligaments stabilize the hock joint and facilitate movement.

The stifle joint has to be considered one of the key joints in the equine body. It is similar to the human knee, and when it becomes injured or diseased, the horse's ability to move can be severely compromised.

The stifle is the largest single joint in the horse. One of its functions is to cause the rear limb to become rigid when the foot is on the ground. This is controlled via contraction of muscles above the patella, which releases the stay apparatus, and is the equivalent of a human's kneecap.

Once again, we must call attention to the role of good conformation in keeping these key joints healthy. Deviations—such as being too narrow or too wide at the hocks—can result in undue stress, which can lead to a variety of hock joint problems.

A clear example of a ball and joint socket



is the hip joint. The head, or upper end, of the femur fits into the socket formed by the hip. The hip joint is stabilized by a strong band of ligaments. One of the ligaments stabilizing the hip joint is the accessory ligament, which does not occur in any domestic animal other than the horse.

Common Problems

All of the synovial joints are subject to injury or disease as the result of poor conformation or the ongoing wear and tear of heavy performance demands placed on the animal by its rider.

These conditions are categorized as follows:

Synovitis—Inflammation of the delicate synovial membranes.

Capsulitis—Inflammation of the fibrous joint capsule. This condition usually is present when synovitis occurs.

Osteoarthritis—The result of severe joint injuries and of injuries that are not treated adequately. Its signs include swelling and pain, plus the progressive loss of articular cartilage on the surface of the bone. This is a permanent condition that can render the horse unsound and unusable.

Others problems can include bone fragmentation or fracture in a joint and tearing of the ligaments that stabilize the joints.

Varying disciplines can produce different joint problems. For example, horses used for jumping will tend to have more problems in front leg joints, and horses used for cutting and reining will tend to have rear leg joint problems. Both will have more of a tendency for joint problems than the trail horse or even the endurance horse. The reason is that the joints are designed for straight-line movement and not for the concussive trauma of landing after a high jump or the torque delivered to hock and pastern joints from a sliding stop or spin.

With joint injury, there is inflammation that can stimulate the release of problem agents called free radicals, prostaglandins, and cytokines. These agents attack the basic components of articular cartilage and set in motion a degenerative process that can quickly compromise a horse's ability to perform if untreated. In the process, there often is a depletion of hyaluronic acid that might have to be replenished either via direct injection into the joint or intravenously.

When a joint is puffy and sore, this means joint damage or disease is present. A veterinarian should be summoned so that the proper treatment can begin immediately. Often a first-line treatment of choice is the application of ice to the injured joint in an effort to immediately reduce inflammation.

Take-Home Message

The movement of a horse is dependent on joints of various types. Proper conformation is a good deterrent to joint problems, but injury or stress from repeated or hard exercise can cause damage to joints. Unless they are diagnosed and treated early, these problems can cripple the horse and end his athletic career.

ABOUT THE AUTHOR

***Les Sellnow** is a free-lance writer based near Riverton, Wyo. He specializes in articles on equine research, and he operates a ranch where he raises horses and livestock. He has authored several fiction and non-fiction books, including* Understanding Equine Lameness, Understanding The Young Horse, *and* The Journey of the Western Horse, *published by Eclipse Press and available at www.ExclusivelyEquine.com or by calling 800/582-5604.*