

# Beneath the Hoof Wall: Soft Tissue Injuries of the Foot

Even with improved diagnostics and treatments, don't take chances with these injuries

Lameness in ridden horses often stems from tendon and ligament injuries, along with arthritis, that can limit athletic ability for life. The equine foot is packed with delicate soft tissue structures that sustain the weight of the horse with every stride, making it a prime location for soft tissue strains and tears. Let's take a closer look at how these injuries happen, how veterinarians treat them, and tips for preventing them in the first place.

## Equine Foot Anatomy Review

Firstly, it's important to note there are no muscles below the knee and hock; all muscular contractions are transmitted from above those joints to the bones of the foot via tendons and ligaments. Here are the most important ones:

- The deep digital flexor tendon (DDFT) inserts into the underside of the coffin bone (P3). Injuries to the DDFT are common and can be severely limiting, with scientists on one study reporting only 25% of affected horses returning to their previous athletic levels within 18 months of diagnosis (Cillán et al., 2013). Prognosis depends on injury type and treatment, however. Some surgical repairs of DDFT tears in the foot result in 45-50% returning to work.
- The collateral ligaments connect the short pastern bone (P2) with P3, aligning and stabilizing both bones. These ligaments are especially prone to injury from repetitive twisting (which can occur during longeing, for example) and slipping.
- The navicular bursa lubricates the DDFT as the tendon glides over the navicular



The delicate soft tissue structures of the hoof sustain the horse's weight with every stride.

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bone. A bursa is a synovial structure and is therefore prone to synovitis (synovial membrane inflammation), just like joints.

- The four ligaments that hold the navicular bone in place—suspended under the coffin bone—are susceptible to desmitis (ligament inflammation) as part of the umbrella term podotrochlosis, aka navicular syndrome.
- The common digital extensor tendon merges with the suspensory ligament at the pastern and inserts into the dorsal aspect (front) of the coffin bone at the level of the coronary band. Horses injure it less than they do flexor tendons.

These relatively small soft tissue structures are intricately linked and work synergistically to ambulate a 1,200-lb animal. It's worth noting that if the horse's conformation

is less than ideal, he stresses his delicate tendons, ligaments, and bursa more than an animal with a "textbook" build would.

## Cloaked by the Hoof Wall

Soft tissue injuries within the hoof capsule present unique diagnostic challenges. Here's why: Ultrasound cannot penetrate the hoof wall to show us the structures beneath it. Additionally the hoof capsule in effect "hides" swelling, which is normally one of the first telltale signs of an injury, making foot injuries more difficult for owners to detect.

With suspected soft tissue injuries of the digit, veterinarians can rule out bony involvement—for example, coffin bone fracture or degenerative changes of the navicular bone—with radiographs. Beyond that, localizing and diagnosing the precise soft-tissue



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Localizing and diagnosing precise soft tissue injuries in the equine foot requires an MRI (shown).

injury requires an MRI, which can penetrate the hoof wall and show both bony and soft tissues. An early, accurate diagnosis can improve outcomes; if an MRI is a possibility, it should be done promptly if radiographs are normal and lameness is persistent.

“Advanced imaging modalities ... have become increasingly accessible,” says Santiago Gutierrez-Nibeyro, DVM, MS, Dipl. ACVS, ACVSMR, clinical professor of equine surgery in the Department of Veterinary Clinical Medicine at the University of Illinois College of Veterinary Medicine, in Champaign. “These tools are making it possible to not only diagnose problems, but also to evaluate the effectiveness of many novel treatments for equine foot injuries.”

### Soft Tissues Injuries Explained

Usually, chronic accumulations of small strains and microtears from exercise are what culminate in soft tissue injuries, and scientists have found a strong link between spikes in athletic workload and these injuries in elite eventing horses (Munsters et al., 2020). A tendon or ligament, by design, is made up of strong fibers running parallel to each other in an organized fashion. Their strength and flexibility rely on this arrangement. Collagen—the primary structural

protein of these fibers—provides tensile strength, allowing soft tissues to stretch and recoil without losing elasticity. Generally speaking, ligaments, which connect bone to bone, are tougher and less flexible than tendons, which connect bone to muscle. Once a horse injures a tendon or ligament, the torn collagen fibers regrow in a cross-linked pattern rather than a parallel layout, during an intricate multiphase healing process. What’s more, this scarlike mesh of collagen fibers isn’t as functional or flexible as the original pattern.

To add a layer of complexity, remember how many structures are packed into the hoof capsule. This configuration makes it more likely an injury has affected more than one structure. “A large proportion of horses with foot pain are diagnosed with both DDFT tendinopathy (tendon injury) and navicular bursitis (inflammation of the bursa),” says Gutierrez-Nibeyro. “The most common place for DDFT tendinopathy within the digit is at or just above the navicular bone.”

### Tendon and Ligament Healing

Therapeutic options for soft tissue injuries fall into two categories: conservative and surgical treatment. Veterinarians use nonregenerative conservative therapies to reduce pain and inflammation, giving the horse’s injury time to heal without directly influencing the quality of the healing process. The most common approaches include:

- **Non-steroidal anti-inflammatory drugs.** Phenylbutazone (Bute) is generally the drug of choice for acute lameness linked to soft-tissue injuries. Practitioners also commonly use firocoxib to manage foot pain.
- **Corticosteroids** can be injected into joints and tendon sheaths, or in the navicular bursa, to target inflammation at the source.
- **Rest and controlled exercise.**

■ **Therapeutic shoeing** is a key approach, with the goal of alleviating pressure on the navicular region and the DDFT in cases of podotrochlosis and DDFT tendinopathy. It doesn’t matter what you inject if the shoeing isn’t addressed, and hoof balance radiographs can be useful for making shoeing recommendations.

These nonregenerative therapies are available to virtually every horse owner, relatively affordable and conservative, and don’t require special blood processing.

With regenerative medicine—also referred to as biologics—vets focus on inhibiting inflammation and stimulating the body’s own healing capacities. In the context of biology, regenerative means “regrowing live tissue.”

Billy Hodge, DVM, is certified in equine locomotor pathology (ISELP) and focuses on sports medicine and regenerative therapies at Meadow Lane Equine Clinic, in Surrey, British Columbia, Canada. “Regenerative therapy initiates the body’s healing process, an intricate phenomenon that involves platelet activation, cytokine ... formation, improved blood flow, and also downregulation of the harmful effects of inflammation,” he says. “In essence, regenerative medicine allows reversible degenerative processes to be ‘unlocked,’ granting long-term improvements in tissue health.”

Gutierrez-Nibeyro agrees. “The main goal of regenerative medicine is to enhance regrowth of injured tissues that naturally regenerate poorly,” he says. “And equine tendons and ligaments are prime candidates! The poor response to conservative therapy of DDFT tendinopathies and collateral ligament desmitis has promoted the widespread intralesional (directly into the site of injury) use of biologic therapies.”

Indeed, more vets are turning to regenerative therapies for treating both arthritis and soft tissue injuries. The most common options include:

- **Interleukin-1 receptor antagonist protein (IRAP)** involves drawing and processing blood from the horse, isolating the anti-inflammatory protein interleukin-1 (IL-1) receptor antagonist, and



injecting the product directly into the soft tissue lesion to promote healing.

- **Platelet-rich plasma (PRP)** also entails collection and processing of the horse's blood, in this case to extract high platelet concentrations. Platelets contain growth factors and proteins that help tissue repair when injected intralesionally.
- **Autologous protein solution (APS)** is also derived from the horse's own blood and processed to extract cells, platelets, growth factors, and anti-inflammatory cytokines that help reduce inflammation in the soft tissue lesion.
- **Mesenchymal stem cells** are popular for their ability to regenerate and replace damaged cells. Stem cells possess the unique ability to either create identical copies of themselves or to differentiate (develop into different cells altogether), although their main therapeutic effect is attributed to their anti-inflammatory properties that stimulate healing. Veterinarians harvest them from the horse's bone marrow—a more time-consuming process than the three autologous conditioned serum (ACS) options mentioned.
- **Extracorporeal shock wave therapy** devices emit energy-carrying acoustic



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Shock wave therapy emits energy-carrying acoustic waves to stimulate healing.

waves to stimulate healing processes, classifying the approach as a regenerative modality (Simplicio et al., 2020).

Because regenerative therapies use the body's own healing products rather than pharmaceuticals, practitioners report they are generally safer. They don't contain steroids, making them safe to use in horses and ponies with metabolic and endocrine disorders, such as those with insulin resistance, pituitary pars intermedia dysfunction, or the hoof disease laminitis.

While regenerative therapies offer many advantages over their nonregenerative counterparts, don't consider them a magic bullet. "Many (soft-tissue) injuries are degenerative in nature," says Gutierrez-Nibeyro. "When the damage is too far advanced, response to these therapies is poor."

Equine surgeons might pursue bursectomy to debride tendon tears, which can improve outcomes in horses with DDFT injuries in the foot.

### How to Avoid These Injuries

When you consider the possibility that one tendon or ligament injury in your horse's foot could limit his soundness, comfort, and performance for life, it's easy to see why preventing such injuries altogether is well worth the effort. "In my experience, a severe soft tissue injury anywhere in the foot usually allows a return to work at 50% of the horse's former athletic abilities," says Hodge, adding that if an owner invests in extensive therapy and rehabilitation coupled with time and patience, this number can be bumped to roughly 65%.

Since many soft tissue injuries result from cumulative wear and tear, our sources say it's important to ensure your day-to-day riding and management practices do not put undue stress on these delicate structures. Here are a few starter tips:

- Warm up your horse gradually to avoid overstretching tendons and ligaments.
- Train and compete in moderation. Make sure to take your horse's current fitness level under consideration.
- Mind your footing. Excessively deep and wet footing exacerbates the strain placed



### Stretchy, to an Extent

A good analogy for tendon or ligament injury and healing is a rubber band breaking. You can stretch and stretch the band until it breaks. Then, you can try to fix it by tying the broken ends together. Stretch this patched-up band again, and you'll quickly notice it won't stretch as far and feels more likely to break again. That is also the predicament of injured tendons and ligaments.

DR. ROBIN PETERSON ILLUSTRATION

on soft tissue structures and increases the risk of slipping.

- Longe your horse safely and appropriately—and never excessively—to minimize the impact of circling on the foot's collateral ligaments.
- Work with a qualified, reputable farrier to maintain proper toe length. Every excess centimeter of toe increases force on the flexor tendons by 110 lbs (Weller, 2016).
- Finally, listen to your horse. If he shows even mild signs of lameness, get your veterinarian involved without delay.

### Final Thoughts

Veterinarians are constantly making strides when it comes to treatments for soft tissue injuries of the equine foot. They can diagnose and treat pathologies better than ever before, but the take-home message remains the same: You don't want to take chances with tendon or ligament injuries. Approaching these conditions with a combination of regenerative medicine, therapeutic modalities, sometimes surgery, and rehabilitation gives you the best shot at a successful comeback with your equine partner. 🐾