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## Managing Chronic Laminitis

### What Is It?

Laminitis is an inflammatory disease of the lamellar tissue of the foot, affecting the primary and secondary fingerlike extensions called laminae. Each hoof contains 600 primary laminae, and each of those consists of 150 secondary laminae. "These leafy projections form an intimate bond between the hoof wall and the coffin bone (or distal phalanx)," says James Orsini, DVM, Dipl. ACVS, associate professor of surgery and director of the Laminitis Institute at the University of Pennsylvania.

"When you think about it, it's amazing that a horse, galloping along at 30 miles per hour or more, can bear all its weight on one foot as it runs," he says. "The lamellar tissue is elastic and absorbs and distributes the energy, suspending the coffin bone within the hoof. When laminitis occurs, the laminae can fail and separate from the coffin bone and the hoof wall, resulting in a chronic problem."

If you hold up your hands and lace your fingers together, with your opposite hands' fingertips resting between fingers at their base, you can imagine how the laminae fit together and connect the coffin bone and hoof wall. Laminitic inflammation weakens that bond, and in serious cases the coffin bone rotates (with the tip pointing down), sinks (drops), or both within the hoof capsule.

James Belknap, PhD, Dipl. ACVS, a professor at The Ohio State University's Department of Veterinary Clinical Sciences who has been researching laminitis for more than two decades, explains that laminitis has four main causes:

"You could have the classic carbohydrate overload, where a horse eats too much grain or overloads on sugary spring or fall grass," he says. "Or, the horse could have a septic (blood or systemic infection) issue such as Potomac horse fever, a retained placenta, or an illness such as pneumonia."

Thirdly, "the horse could develop laminitis as a result of a supporting limb injury (in which the horse, by favoring the injured limb) forces all the weight to the noninjured limb, resulting in more of a vascular (blood-vessel-related) problem," Belknap adds. "Lastly, the horse could have insulin resistance as a part of an endocrine condition such as Cushing's disease (pituitary pars intermedia dysfunction) or equine metabolic syndrome, which also impact the laminae."

With a septic horse, the laminitis episode tends to come on quickly and intensely, Belknap notes. With a horse that has endocrine issues, the story is much different. "In these cases, it's usually a much more insidious disease," Belknap says. "But either can become a longer-term process to treat and manage."

Andrew Parks, MA, Vet MB, MRCVS, professor of large animal medicine at the University of Georgia College of Veterinary Medicine, notes, however, that veterinarians and researchers still can't always predict which horses will develop laminitis or how each horse will react to treatment.

### Going from Acute to Chronic

Veterinarians consider laminitis to be in the acute stage when it first develops. They generally consider the disease to be chronic when the coffin bone has displaced or rotated within the hoof capsule, says Belknap.

How the horse develops chronic laminitis impacts how the veterinarian and owner manage initial and long-term treatment. For example, if the horse has experienced laminitis due to carbohydrate overload or a septic issue, the laminae become considerably inflamed and swell, and the hoof becomes hot to the touch, Belknap notes. Initial treatment might include applying ice water to the affected feet during the first two to three days in those cases.

However, "in a horse that has laminitis due to equine metabolic disease or supporting limb issues, there is much less of an inflammatory response, so the cold therapy is not as effective," he says, though it still can provide some pain relief.

### Hoof Care

When the coffin bone rotates or sinks, the weight of the horse transferred down the limb to the bone compresses the sole, and the sole corium, which contains a rich supply of vessels and nerves.

"With the coffin bone sinking, the compression affects normal regeneration of the sole and the sole depth can decrease to as little as a few millimeters in thickness in many cases," Orsini says. "The normal foot ideally needs a sole thickness of 10-20 millimeters or more," to protect the inner structures.

Veterinarians typically use a combination of medical and surgical treatment with mechanical support to help stabilize the hoof capsule and encourage sole regeneration. Initial treatment goals include improving comfort, enhancing circulation to the sole and coffin bone, and encouraging more rapid hoof growth. This is accomplished, in part, by improving the coffin bone angle and alignment with the ground through hoof trimming and using a variety of external hoof support methods (e.g., special shoes, boots, clogs, or casts).

"There can be a lot of trial and error," says Belknap. "What worked on the last horse may not work on this one."

Parks' tactic when starting work on a horse with chronic laminitis is first determining whether the distal hoof capsule (the part toward the toe) is stable. "If the distal capsule is unstable, the bone could continue to rotate, cause the horse pain, and lead to complications," he says.

He considers himself a "reductionist" regarding hoof care for laminitic horses. In other words, he tries to reduce hoof care to the core concepts: "We basically have three goals: to stabilize the distal phalanx, make the animal more comfortable, and encourage the hoof to grow in the most normal way possible," he says.

To achieve these results, Parks suggests four possible therapeutic shoeing adjustments:

- "First, we can change the cushioning of the foot, which means the horse loads (bears weight on) its foot over a longer time period," he says. In other words, he's able to stand on it longer, spending less time favoring it or taking short and stabbing steps.
- "Next, we can change the center of pressure—for example, by moving the center of pressure towards the heels we can reduce the stress within the lamellae at the toe," he says.
- "Third, we can change the distribution of that pressure so that different parts of the ground surface of the foot are in contact with the ground—for example, we can reduce weight-bearing by the front part of the sole so it doesn't put pressure on the coffin bone.
- And finally, we can change the way the foot moves about the joints in the foot and pastern," typically by shortening the toe to change the mechanics of breakover (the moment the heel lifts off the ground) or using a wedge to raise the heel.

The veterinarian and farrier work together and use these methods to correct the coffin bone angle and improve comfort. To achieve these goals, they might use a variety of hoof support, including wooden shoes, glue-on shoes, pads, and casts. Orsini says a sling can also help reduce the weight a horse places on his healthy feet while his injured limb heals.

### Nutrition

When it comes to crafting a laminitic horse's diet, the condition's cause again is important. "For the horse that experienced laminitis due to a septic issue, there's usually no reason why it can't go back to its regular diet," Belknap says.

However, for the horse with endocrine-related laminitis, diet becomes an important part of managing the disease. "When a horse develops equine metabolic syndrome, it is similar to type 2 diabetes in humans," says Orsini. "The horse needs a formulated diet with low nonstructural carbohydrates as one of the components. A clinician, veterinary technician, or nutrition scientist ... can create the best feeding program for your horse and monitor it by studying the horse's progress, by reevaluation of body condition score and bloodwork."

Dietary changes also usually include limiting pasture grass consumption using a grazing muzzle, as Bednar does with her mare, or turning horses out on a drylot.

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### Drugs

Veterinarians can also manage chronic laminitis with medications. These might include the standby non-steroidal anti-inflammatory drugs (NSAIDs) phenylbutazone (Bute) or flunixin meglumine (Banamine), and newer NSAIDs such as firocoxib (Equioxx). Horses with equine metabolic disease might receive more specific medication such as thyroxine to improve insulin resistance and/or pergolide if they have Cushing's disease.

It is important to note that a horse with chronic laminitis can suffer another acute episode, and he can also be prone to complications such as hoof abscesses and bruises (due to thin soles) or coffin bone infections, says Parks.

Horses that continue to experience coffin bone rotation and do not experience pain relief from less-invasive approaches could require surgery to cut the deep flexor tendon, Parks notes.

However, there are no guarantees with laminitis. "There may come a point where the horse is so uncomfortable that despite our best efforts, the horse is humanely destroyed," Orsini says. Laminitis is the second most common reason for humane euthanasia of horses behind colic, he says.

### Research

Belknap has been examining laminitis on the molecular level for a number of his years at the research bench. "We've made some great advancements in the last 10 or 12 years or so, since the horse genome has decoded," he says.

Recently, he has been studying the behavior of protein complexes in the laminae in lean versus obese ponies fed high-carbohydrate and low-carbohydrate diets. "What we're finding is that an event such as a septic episode or a carb overload will trigger a signal to the protein cells," he explains. "These cells change shape and have a differentiation mechanism that operates very similar to cancer cells."

"The protein complexes have these 'spot welds' that come apart and they become less adhesive, which likely is leading to laminae failure. It will be another year or so before we know more about them and how we can apply what we've learned to treating laminitis."

Conferences where veterinarians, farriers, and horse owners can interact, have also helped improve the understanding and treatment of laminitis. New programs might also help horse owners like Bednar in the future—at the University of Pennsylvania, for instance, an equine home care nursing program for horse owners, called Equi-Assist, regularly helps people managing chronic laminitis cases.