



HAYGAIN<sup>®</sup>

# Keeping Ahead of Laminitis

*A review of the scientific literature and best practices in managing equine laminitis.*

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**THIS INFORMATION LEAFLET WILL LOOK AT:**

- ① THE LAMINITIC FOOT
- ② SUGAR AND OBESITY
- ③ EARLY WARNING SIGNS OF LAMINITIS
- ④ BALANCING DIET AND WELFARE IN LAMINITIS CASES
- ⑤ EASING LAMINITIC FOOT PAIN



## THE LAMINITIC FOOT

Horses' hooves might look hard and solid, but behind their slick capsule is a complex inner foot that functions through the impressive biomechanical interactions of multiple bones and soft, sensitive structures (*Pollitt, The Illustrated Horse's Foot: A Comprehensive Guide, 2016*).

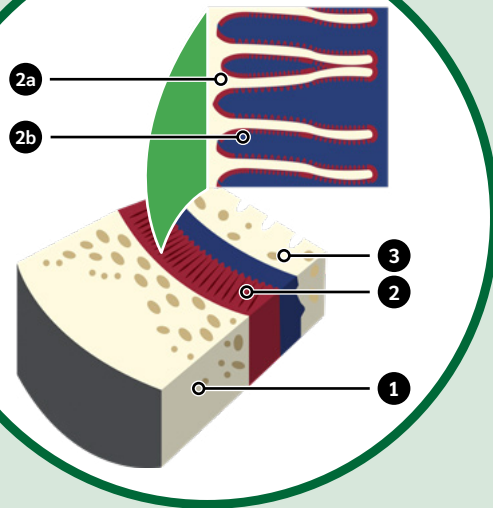
Tightly packed within that hoof space are ligaments, tendons, cartilage, nerves, a vast network of valveless blood vessels, and an entire square meter of interlocking connective tissue that binds the foot's main bone, the coffin bone, in suspension parallel to the hoof wall. All these pieces work together to hold up the full force of a horse's weight—plus that of the rider and equipment—which can almost triple on a single foot during a gallop.

That's a lot of force compacted onto such a small surface. But it's part of the striking single-digit foot design that's unique to equids and which evolved over millions of years to make the animals swift, streamlined, and—in theory—sure-footed (*McHorse, 2017*).

Unfortunately, that design isn't infallible, and one potential weak point is what's known as the suspensory apparatus of the distal phalanx—the previously mentioned square meter of connective tissue that fills the millimeters-wide space between the inside of the hoof wall and the long front surface of the coffin bone.

The suspensory apparatus's structure is made up of rows of highly vascularized tissue called lamellae that look like hundreds of pages of a microscopic book, with each page then branching out into its own set of hundreds of pages—thereby increasing the surface area of attachment. The ends of these “pages” insert into the coffin bone along multiple bony ridges across the whole front part of the hoof-shaped bone. On the hoof wall end, they interconnect with collagen fibers and fibrils in the basement membrane lining the inside of the wall (*Pollitt, The suspensory apparatus of the distal phalanx in normal horses, 2016*).

## HOOF WALL ANATOMY



- 1 HOOF WALL
- 2 LAMELLAE
  - 2a PRIMARY LAMELLAE
  - 2b SECONDARY LAMELLAE
- 3 COFFIN BONE

### SUSPENSORY APPARATUS

In healthy horses, the suspensory apparatus functions as a shock absorber, **DAMPENING ABOUT 67% OF THE VIBRATIONS**

when the foot first hits the ground, and thus protecting the bones and joints of the foot from getting damaged from jarring (Willeman, 1999). The laminae are somewhat elastic and provide a limited amount of stretch, which accommodates for hoof expansion and slight movement of the coffin bone when the horse bears weight on the foot, and for bringing the bone back in its rightful place when the foot is lifted (Pollitt, *The Illustrated Horse's Foot: A Comprehensive Guide*, 2016).

It's imperative that the laminae maintain the healthy level of tension necessary to keep the coffin bone front surface parallel to the hoof wall; otherwise, the internal structures of the foot could shift out of order, sustain damage, occlude blood vessels, and cause pain. A properly functioning suspensory apparatus is essential for equine well-being (Pollitt, *The Illustrated Horse's Foot: A Comprehensive Guide*, 2016).

Unfortunately, though, extreme weight bearing, high fevers, severe illness, and metabolic issues can cause the

laminae to weaken, overstretch, and bleed. The hoof wall and the coffin bone gradually spread apart in distances measurable via X-ray. Horses often become footsore, and sometimes their feet leak serum or blood from their coronary bands. Within a few hours, days, or weeks, the bone responds to the other forces pulling on it, like the horse's movement and gravity, and it starts to drop or rotate downwards towards the ground (Mitchell, 2015).

The lamellar tissues can become inflamed, causing significant pain, especially in the toe region. If the bone rotates, this shifting of tissues causes painful compression and compromises blood flow. Changes in the nerves and even spinal cord during laminitis can also create neuropathic pain—essentially a heightened sense of pain (Church, *How to Support Horses With Acute or Chronic Laminitis*, 2020). When the bone drops down and/or rotates at a steeper angle, it can even pierce through or force down the sole of the foot itself. Such cases cause excruciating pain, and euthanasia is usually recommended.

In early stages of the syndrome, laminitic horses might show few obvious signs. Eventually, they become footsore and develop shortened strides. Later, they can become reluctant to move at all. In severe forms, they adopt a back-slanting standing position that's telltale for laminitis pain as the horse tries to ease pressure off the front toes.

They're also likely spend much more time lying down, to the point of developing body sores.

Often depending on the angle of rotation or sinking, horses can recover from laminitis—to a certain extent. With good treatment and management, the laminae can heal and recover a highly functional level of tension, pulling the foot back together into a balanced structure again. The coffin bone won't rotate or rise back up; its downward position is permanent. But the hoof wall can follow that new position as it grows down over the next year, forming a better lineup with the bone (*Lesté-Lasserre, 2020*).

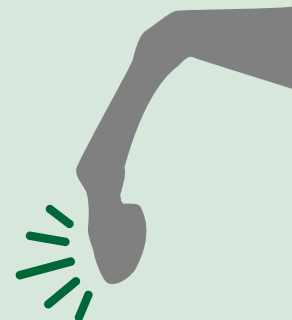
Therapeutic shoeing and anti-inflammatories can relieve pressure and pain in the toe, and many horses can become sound, even under saddle, if bone changes are minor and treatment is appropriate. Through proper management, farriery, and prevention strategies like a low-starch diet, the horse's soft tissues rearrange and adjust to the new position of the coffin bone. In some cases, horses can graduate to normal shoes or to being barefoot.

Even so, the lamellar structure will never recover all its original biomechanical properties. And when the cause of the laminitis is related to metabolism, horses will always need special attention to their feet and their diet to prevent a relapse (*Lesté-Lasserre, 2020*).

## Laminitis Symptoms:

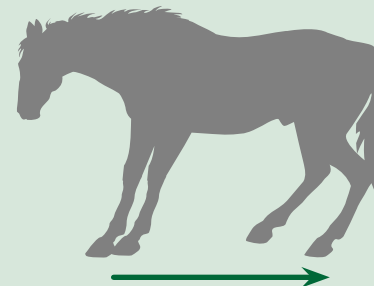
### FOOT SORENESS:

Laminitis can lead to foot soreness, progressing to shortened strides, and eventually they can become reluctant to move at all.



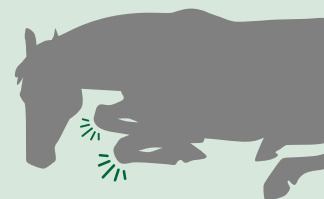
### BACK-SLANTING STANCE:

Severe forms of laminitis can cause them to adopt a back-slanting position to ease pressure off the front toes.



### EXCESSIVE LYING DOWN:

Laminitic horses are more likely to spend much more time lying down to the point of developing body sores.





## SUGAR, INSULIN, AND OBESITY

Laminitis has three major origins. In some cases, it results from mechanical issues with the foot, like when a horse is severely lame and shifts all his weight to the foot on the other side. This supporting limb laminitis (SLL) might result from loss of blood flow to the weight-bearing foot and is an unfortunate and tragic reality in horses treated for a significant leg injury, such as a fracture. About 12% of horses set with a cast and 16% of horses fitted with internal plates or screws develop SLL in the opposite leg that takes on the added weight bearing. Laminitis sets in so fast and so severely, the horses usually have to be euthanized (*Van Eps, 2021*). Veterinarians try to prevent SLL mainly by icing the supporting leg in ice slush water of less than 5°C. New research suggests that helping the horse shift weight between legs may also be beneficial (*Church, Control Your Horse's Weight and Other Ways to Prevent, Treat Laminitis, 2021*).

Laminitis can also result from systemic illness, usually with fever, like Potomac horse fever, placentitis, or salmonella, or from severe colic. In such systemic inflammatory response syndrome (SIRS) cases, laminitis often occurs rapidly—within two to three days—and can be severe enough to warrant euthanasia. Again, using cryotherapy—icing the limbs—as well as non-steroidal anti-inflammatories and anti-endotoxin medication can significantly reduce the risk that a horse will develop acute laminitis while recovering from full-body disease. But these therapies have little effect once laminitis actually begins (*Leise, 2021*).

In very rare cases, laminitis can occur following trauma to the foot or repetitive hard impacts like frequent intense work on roads and other very hard surfaces (*AAEP, 2022*).



THE VAST MAJORITY OF LAMINITIS CASES, **ABOUT 90%**, ARE NOT MECHANICAL OR ILLNESS-RELATED, **BUT METABOLIC** (Karikoski, 2011).

They result from the way horses' hormones respond to sugars in their feed, grass, and hay.

Like humans, horses produce insulin in their pancreas and release increasing amounts of the hormone into their bloodstream according to how much glucose they've consumed. Insulin helps these nonstructural carbohydrates (NSCs) get into cells throughout the body, where they can be used as an energy source or stored as fat.

Sometimes, though, the body overreacts to the intake of glucose and produces too much insulin, known as hyperinsulinemia. In humans, hyperinsulinemia leads to type 2 diabetes. In horses, it usually causes laminitis (De Laat, 2010).

Like in humans, obesity is related to insulin dysregulation, although scientists still don't understand all the links. It might be that high levels of insulin are signaling the liver to store more sugar as body fat (CDC, 2021).

At least in horses, it might also be a question of pro-inflammatory activities in fatty tissue, which could then spur insulin disorders. And in fact, obesity and insulin dysregulation could even be two consequences of the same root issue: equine metabolic syndrome. One potential link here is the production of various kinds of hormones in horses with metabolic syndrome, which could make them tend to put on weight and become insulin-dysregulated (Grenager, 2021).

Unfortunately about 40% of horse owners think their horses are slimmer than they actually are, which only contributes more to the equine obesity issue (Church, *Control Your Horse's Weight and Other Ways to Prevent, Treat Laminitis*, 2021). As many as 51% of American horses are overweight or obese, and this is probably linked to today's equine lifestyle wherein domestic horses are often overfed and kept for leisure activities (Grenager, 2021).

Whatever the link, obesity does seem to be strongly associated with hyperinsulinemia. And whether horses are overweight or not, hyperinsulinemia can be devastating for the suspensory apparatus.

Excessive insulin makes the secondary lamellae—the “pages stemming from the pages”—lengthen, and their cells spontaneously die faster than they should. These lamellae sometimes fuse together in an abnormal way and regrow with abnormal keratinous tissue that's linked to poor blood supply (Karikoski, *Pathology of Natural Cases of Equine Endocrinopathic Laminitis Associated With Hyperinsulinemia*, 2014).

Why exactly this happens, though, remain unclear. It's also somewhat confusing, since epithelial lamellar cells don't even have receptors for insulin. What these cells do have, however, are receptors for an insulin-like hormone—Insulin Growth Factor-1—which plays an important role in cell growth and survival. Insulin might bind to these receptors, but scientists still aren't sure to what extent (Grenager, 2021).

WHATEVER THE REASONS AT A MOLECULAR LEVEL, SCIENTISTS HAVE CONFIRMED THAT **HORSES WITH INSULIN DYSREGULATION ARE AT GREAT RISK OF LAMINITIS.**

Veterinarians can try controlling insulin regulation through medications like levothyroxine, along with weight loss, or metformin, given just before meals. Certain feed supplements like resveratrol might help, but science has yet to show that they do (Church, *Control Your Horse's Weight and Other Ways to Prevent, Treat Laminitis*, 2021).

The surest way to keep insulin-dysregulated horses laminitis-free is to prevent them from ever consuming significant amounts of glucose. That's not easy, though, since both concentrated feeds and forage can be very high in sugars and other nonstructural carbohydrates. A look at the energy ration on feed packages, for example, can show high percentages of energy content—often above 50 percent—coming from glucose and other fast sugars. That could provoke high insulin levels in insulin-dysregulated equids and lead to a laminitic episode. These animals should eat either special low-starch feeds or no concentrated feeds at all. Their owners should ensure they still get their daily doses of vitamins and minerals through a low-starch balancer.

As for forage, grasses can contain more or fewer carbohydrates depending on the species, the time of year, and even the time of day. Cool-season grasses like orchardgrass and Kentucky bluegrass can have up to twice the concentration of nonstructural carbohydrates than warm-season grasses like Bermuda and modified crabgrass, for example. And on average, concentrations are about 30% higher in the late afternoon to early evening compared to the early morning hours before 8 a.m. (*Weinert-Nelson, 2022*).

As such, horses can get more or less sugar in their pasture depending on multiple factors. And that's also true for hay and haylage: nonstructural carbohydrate concentrations in these stored forages also depend on the kind of grass and what time of year and day they were cut. What's more, those concentrations won't drop over time; hay and haylage still have essentially the same amount of sugars (glucose, sucrose, fructose, and fructans) after 18 months of storage as they do after 3 months of storage (*Müller, 2016*). So even hay that isn't as green as pasture grass, which been in a storage shed since the previous year, can still be high in glucose that could set off insulin levels and hence a laminitic episode in laminitis-prone horses.

It's virtually impossible to know how much carbohydrate content horses are getting when they're on pasture, but hay can be tested, before and after soaking, and before and after steaming. For laminitis-prone horses, this makes

for much more reliable management of nonstructural carbohydrate concentrations. Hay that's been soaked for nine hours and then steamed in a Haygain steamer is the most effective and consistent way to reduce sugar content as well as microbial contamination in horses' hay (*Moore-Colyer M., The Effect of Five Different Wetting Treatments on the Nutrient Content and Microbial Concentration in Hay for Horses, 2014*).

## How to Limit Glucose Exposure in Insulin-Dysregulated Horses:

### FEED LOW-STARCH FEED OR BALANCER:

Concentrated feeds can be very high in sugars and other nonstructural carbohydrates. Check the energy ration on your feed; often they show an energy content above 50% which comes from glucose and other fast sugars.



### CHOOSE PASTURES & TURN-OUT TIME WISELY:

Certain types of grass contain higher levels of nonstructural carbohydrates. And on average, concentrations are higher in the late afternoon to early evening compared to the early morning hours before 8 a.m.



### TAKE STEPS TO LESSEN FORAGE CARBOHYDRATE CONTENT:

Hay that's been soaked for nine hours and then steamed in a Haygain Hay Steamer is the most effective and consistent way to reduce sugar content as well as microbial contamination in horses' hay.







## 10 SIGNS OF IMPENDING OR EARLY STAGE LAMINITIS

Lame laminitic horses are already deep into the disease process, and some might never recover. But often, endocrinopathic laminitis—the kind that results from metabolic disorders—can creep up slowly well before it causes debilitating disease (*Tadros, 2019*). Watchful owners can be on the lookout for early warning signs and make efforts, like changing the diet, to try to divert laminitis from its full track of devastation, which may affect up to 34% of all horses in their lifetime (*Wylie, 2011*). Here are a few signs that horses should be evaluated for possible laminitis:

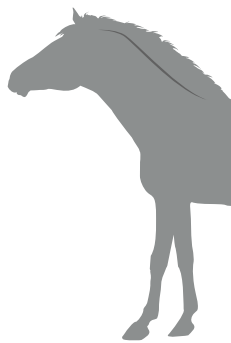
### AT-RISK BREED:

Ponies and miniature horses, Spanish breeds, Warmbloods, Arabians, Morgans, gaited breeds, and donkeys appear to have a genetic predisposition to equine metabolic syndrome, which may place them at a higher risk of laminitis (*Larson, 2022*).



### CRESTY NECK:

Horses and ponies can pile on extra fat in several key regions of the body. One of the easiest ones to recognize is the neck. When they start to show signs of a thick, cresty, fat neck, it hints at insulin dysregulation. Owners should measure and take photos of their horses' regional fat deposits, especially in the neck, every month to monitor changes that might flag hyperinsulinemia (*Traylor, 2022*).



### WEIGHT SHIFTING:

Horses that are starting to develop laminitis tend to shift their weight from one foot to the other up to five times more often than healthy horses. Normal weight-shifting should only be about two or three times per minute (*Lesté-Lasserre, 10 Early Warning Signs of Laminitis, 2016*). Owners can count shifts over a period of a few minutes on a regular basis to detect changes in weight-shifting habits.





### ABNORMAL ENDOCRINE TESTS:

Oral sugar tests and insulin tolerance tests can reveal critical information about insulin dysregulation, which is likely to lead to laminitis (*Grenager, 2021*). Many hormones affect the release of other kinds of hormones, including insulin, which is associated with laminitis. So any time a horse has abnormal hormone levels, it's worth investigating how those could impact insulin levels. In particular, horses with pituitary pars intermedia dysfunction (PPID)—which primarily affects older horses—produce too much of adrenocorticotrophic hormone (ACTH) and other related hormones which are known to alter insulin in the body. In a recent study, laminitis was detected in the X-rays of 76% of PPID-affected horses—although only half the owners had suspected it (*Tadros, 2019*). To stay ahead of disease processes, veterinarians recommend that all horses aged 15 and over have ACTH testing annually (*Traylor, 2022*).

### ABNORMAL GROWTH RINGS:

Growth rings on hooves can indicate changes in environment or diet and are usually horizontal and parallel to each other. But when they become uneven, spaced wider apart at the heel than at the toe, this could suggest low-grade, chronic laminitis (*Church, How to Support Horses With Acute or Chronic Laminitis, 2020*). The appearance of such abnormal rings without other obvious signs suggests the horse may have had a mild bout of laminitis about three months earlier (*Grenager, 2021*); such rings may offer a “window of opportunity” to treat the horse before the syndrome progresses further (*Patterson-Kane, 2018*).



### STRETCHING, BRUISING, OR BLEEDING OF THE WHITE LINE:

The white line, which runs along the interior edge of the hoof wall as seen from the bottom of the foot, covers the end of the lamellar structure running higher up the hoof. In early stages of laminitis, as the suspensory apparatus stretches, the white line can stretch as well. Because the laminae are so heavily vascularized, bleeding can occur—which is sometimes visible as small red spots in the white line (*AAEP, 2022*).



### RECURRENT HOOF ABSCESSSES AND/OR SOLE BRUISING:

Compromised blood flow and white line stretching can make it easier for bacteria to enter the foot and create abscesses (*Larson, The Never-Ending Hoof Abscess, 2022*). Recurrent abscesses might also reflect hormone abnormalities affecting healthy immune function (*Milner, 2011*). Bruises can also appear on the sole that look like the horse has frequently been injured by stepping on stones (*AAEP, 2022*).



### SUBTLE CHANGES ON X-RAY:

As the laminae weaken and stretch, the distance between the hoof wall and the coffin bone will gradually increase from around 18 millimeters to 20 or higher, and this should be visible on X-ray (*Lesté-Lasserre, 10 Early Warning Signs of Laminitis, 2016*). The front surface of the coffin bone might also show signs of remodeling (*Church, How to Support Horses With Acute or Chronic Laminitis, 2020*). Ponies and miniature breeds in particular are prone to having significant changes on X-ray without the owner having noticed any other signs of laminitis (*Grenager, 2021*).



#### BOUNGING PULSE IN THE FOOT:

Research has shown that horses consistently showed a more prominent digital pulse (foot pulse) in the day before they became footsore from laminitis (*De Laat, 2010*). Owners should check their horses' pulses regularly to become familiar with what's normal for them and what isn't (*Lesté-Lasserre, 10 Early Warning Signs of Laminitis, 2016*).

#### FOOT SORENESS AND/OR SHORTER STRIDES:

Horses might become mildly footsore without appearing actually lame. They may be more reluctant to pick up their feet for cleaning and farriery, and their normal strides might be slightly shorter than usual (*Larson, Laminitis, PPID, and Hyperinsulinemia: What's the Link?, 2017*). Owners should observe their horses' normal gaits and get a feel for each horse's typical stride length in order to recognize any subtle differences (*Lesté-Lasserre, 10 Early Warning Signs of Laminitis, 2016*).

*Laminitis can be excruciatingly painful and progress rapidly.*

*It should be considered an emergency that requires immediate veterinary attention*

(AAEP, 2022)





## BALANCING DIET AND WELFARE

Horses evolved to be all-day grazers, eating for as many as 16 hours per day. They have a physiological need to chew for the vast majority of each day, producing saliva that helps with digestion and keeps their digestive tracts healthy. The steady flow of nutrients is good for their bodies that are designed to function on such trickle-feeding. And they have a behavioral need to grab food with their teeth, chew it, and swallow it all day long. Horses deprived of that natural need can develop psychological problems, like aggression or stereotypies such as crib-biting (Ruet, 2020).

**BUT LAMINITIC AND/OR OBESE HORSES NEED RESTRICTIVE DIETS. THEY NEED LESS SUGAR AND, IN THE CASE OF OBESITY, FEWER CALORIES** (Durham, 2019).

Cutting the amount of time horses spend eating probably isn't the best way to manage laminitis cases. In general,

owners should ensure that their laminitis-prone horses can continue to consume forage for the majority of the day while reducing the intake of starches and, if needed, calories.

**OBESE HORSES SHOULD CONSUME HAY AT A RATE OF ABOUT 1.5% OF THEIR BODY WEIGHT PER DAY FOR HEALTHY GRADUAL WEIGHT LOSS** (Church, *Control Your Horse's Weight and Other Ways to Prevent, Treat Laminitis*, 2021).

Skilled forage producers can selectively choose low-carb grasses that they cut at specific times of the year and day when they contain more or less glucose. Laboratory testing of hay samples can provide critical information about their non-structural carbohydrate content and other nutrients. Owners should aim for a non-structural carbohydrate content of less than 10% for insulin-dysregulated horses (Grenager, 2021).

Hay and haylage can be placed into haynets to reduce how fast laminitis-prone horses eat their meals. But hay nets have been associated with musculoskeletal and dental issues, and horses can get their legs trapped in the cords if they're too close to the ground (*Lesté-Lasserre, Horse Slow Feeder Safety, 2021*).

## THE HAYGAIN FORAGER

A safer and healthier alternative is a plastic tub-form feeder like Haygain's Forager. Tipping-proof and easy on the teeth, the Forager has a dropping tray that allows horses to consume up to 12kg of hay through one of two grid sizes, depending on how much slower each individual horse should eat. Side slits allow both air and light to pass into the feeder for a more comfortable and natural eating experience more like outdoor grazing.

Studies show that, depending on the device and on the individual horse's ability to work the system, slow feeders can significantly increase the time it takes to eat a meal.

Horses eating from drop-tray tub feeders like the Forager, in particular, have more positive emotional states compared to horses eating hay off the ground or out of hay bags—including fewer abnormal repetitive behaviors and more pleasant interactions with humans (*Rochais, 2018*). They also reduce boredom and mitigate the risk of developing gastric ulcers (*Grenager, 2021*).



For insulin-dysregulated horses staying at pasture, owners can place a grazing muzzle over the mouth. Like slow feeders, these muzzles have openings that allow the horse to pull in forage at a slower rate—although some horses find ways to remove them or consume more grass than expected, and others cannot adapt to wearing them, which can have a negative impact on their welfare (*Grenager, 2021*).



When the non-structural carbohydrate content in hay and haylage is too high, owners can soak the forage to remove the sugars. Soaking in cold water for one to 12 hours can make hay and haylage release gradually rising percentages of carbohydrates into the water, which should then be discarded. The result is a low-carb forage—although ideally owners would get a sample of soaked hay lab-tested again to know exactly how low-carb it is (*Church, Control Your Horse's Weight and Other Ways to Prevent, Treat Laminitis, 2021*).



UNFORTUNATELY, HOWEVER, **SOAKING HAY ALSO DRAMATICALLY INCREASES THE PROLIFERATION OF PATHOGENIC BACTERIA AND MOLDS, AT A RATE OF 150 PERCENT IN ONLY 10 MINUTES (Moore-Colyer M. , 2012) AND UP TO 500% OVER NINE HOURS (Moore-Colyer M. , The Effect of Five Different Wetting Treatments on the Nutrient Content and Microbial Concentration in Hay for Horses, 2014).**

## HAYGAIN HAY STEAMERS

That's why Haygain Hay Steamers are of particular benefit for insulin-dysregulated horses. Because the special, patented design ensures optimal forage steaming conditions, **HAYGAIN HAY STEAMERS ELIMINATE 99% OF THE ALLERGENS NATURALLY FOUND IN HAY AND HAYLAGE**—including soaked forage—which can provoke hives and respiratory problems (*Moore-Colyer, 2016*). While those issues are undesirable in any horse, they can make laminitic horses even more uncomfortable as they battle multiple health problems and possibly reduced immunity.

Haygain's unique steaming technology also kills pathogenic bacteria that can cause both respiratory and dental disease—including those that proliferate during soaking—while preserving the kinds of microorganisms that promote good gut health in horses (*Daniels, 2020*). And that may be even more important in animals that are already dealing with metabolic disorders (*Tuniyazi, 2021*).

What's more, Haygain's high-quality steamers keep all the protein and minerals naturally found in your horse's forage (*Moore-Colyer, 2016*). That's good news for laminitic and/or obese horses, who need less starch and often fewer calories, but who shouldn't lose these vital nutrients that help them stay strong and fit as they overcome their metabolic disease.



As horses recover from the pain and lamellar weakness of laminitis with good management and feeding regimens, they may be allowed to start exercising again. Insulin-dysregulated horses can benefit significantly from about 30 minutes of work per day, including brisk trotting, five days per week. This not only helps keep weight down, but it also improves insulin sensitivity (*Grenager, 2021*).





Image courtesy of Esco Buff, PhD, APF-I, CF



## EASING LAMINITIC FOOT PAIN

The goal with laminitis is, of course, to recognize its early warning signs and prevent its occurrence altogether, such as through healthy and balanced low-starch diets based on Haygain-steamed forage fed in Haygain Forager Flow Feeders.

Unfortunately, however, laminitis does sometimes occur. And when it does, the goal becomes stopping the inflammation, relieving the pain, and getting the laminae back to their normal strength, usually by stabilizing the metabolism with the more appropriate low-starch diet.

Non-steroidal anti-inflammatories such as phenylbutazone in acute cases and firocoxib in chronic cases can reduce inflammation in the foot and contribute to pain relief, whereas gabapentin can help with neuropathic pain. Veterinarians can also add analgesics like opioids to kill pain when needed, although they tend to make horses sluggish (*Church, Control Your Horse's Weight and Other Ways to Prevent, Treat Laminitis, 2021*).

Therapeutic shoeing can include backward-placed shoes that ease breakover and relieve pressure on the toes, or heart-bar shoe that distribute pressure across the frog as well. Wooden, leather, or ethylene vinyl acetate clogs can also help by taking force off the hoof wall, reducing strain and leverage on the lamellae, limiting impact force oscillation, and providing central support. A hoof cast can increase the volume of the hoof wall, making it less elastic and therefore limit how much the laminae stretch. Farriers should trim the hoof so as to increase the surface area of the bottom of the foot across structures that can help distribute force, which might lead to less compression, and hence less pain, in the sole. And they should shape the hoof wall to be parallel with the front side of the coffin bone, using X-rays as a guide (*Aikens, 2018*).

Critically, horses should be kept on stall rest for one week for every day they were lame with laminitis in order to ensure proper healing and long-term pain relief (*Lesté-Lasserre, Life After Laminitis, 2020*).

## SAND BEDDING:

Sand, while inconvenient to clean and maintain, is the ideal bedding for laminitic horses because it conforms to the frog and sole, transferring the weight load away from the hoof wall onto these structures. It also reduces torsion on the hoof wall during turning, which is important given that the internal and external parts of the hoof are separating. Plus, it makes breakover—the moment the foot rotates over the toe during a step—less painful (*Church, How to Support Horses With Acute or Chronic Laminitis, 2020*).

## HAYGAIN COMFORTSTALL®

Below the bedding, though, is the important issue of the ground the horses are ultimately standing on. Hard concrete flooring, while easy to clean, makes an uncomfortable base beneath the bedding. Laminitis horses will find greater comfort standing—and getting up and down on—the Haygain ComfortStall Flooring System. Waterproof and insulated, the Haygain ComfortStall offers a safe, cushioned surface that's especially beneficial for horses with laminitis and other orthopedic issues. Its triple layer therapeutic padding lets horses' feet sink into the material, distributing their weight across their soles and stimulating their frogs. As a vascular cushion, the frog's stimulation may increase blood flow to the foot, which is significantly reduced when horses stand on concrete (*Bowker, 2017*).

Non-abrasive and non-slip, Haygain's ComfortStall is also easier on horses' skin and joints as they lie down and rise up—which is of particular importance for laminitic horses that need longer resting times off their sore feet. Laminitic horses kept on padded flooring have a reduced risk of developing skin ulcers due to so much contact with the ground compared to concrete and asphalt floors (*Ryan, 2020*).





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