

# Equine

## Laminitis and Feeding the Endocrine Pony

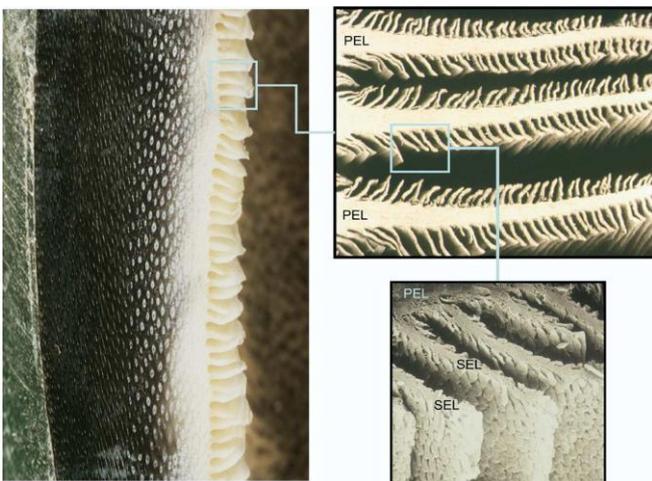
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You have a cracking little Welsh pony for your budding young equestrian rider. They go all day and they'll take on the world, but every Spring they get sore feet. Or you got a Shetland as your first kids' pony, but the thing can't look at green grass without becoming crippled. These scenarios sound familiar? Then you're probably aware of laminitis. But did you know that laminitis and founder are two different things? Or that lucerne hay is good for laminitic horses? If these things are surprising, then let me take you on a refresher of equine laminitis and what's really going on.



### What is laminitis?

First up let's deal with some definitions. Laminitis is inflammation (*itis*) of the lamellae. The lamellae are finger-like projections off the pedal (or coffin) bone and the inside of the hoof capsule. They link together to suspend the pedal bone in place.



**The equine hoof wall and its inner lamellar structure. There are matching projections off the pedal bone that interdigitate to hold the bone suspended in place.**

Once the lamellae become inflamed they begin to separate. Without its support system, the pedal bone begins to rotate with gravity. This is where the difference between laminitis and founder comes in. The proper definition of founder is rotation of the pedal bone. Hence you can have laminitis without founder (rotation), but you cannot have founder without laminitis.

The hoof capsule is a rigid structure with very little give in it. As the lamellae become inflamed (swollen) they don't have any space to expand. This puts massive pressure in the hoof capsule and is the source of pain in laminitis horses. They may develop laminitis in the fronts – as 60% of their bodyweight is borne by the front limbs – or all four feet.

This hoof pain often results in the traditional 'rocking horse' stance (see above picture). Affected horses try to rock their weight off their feet. They will usually be sore to walk and avoid hard ground. They may even lie down or seek soft bedding to try and alleviate the pain in the feet. The feet may be warm to the touch, but this is variable and not a reliable indicator of laminitis. More reliable is an increased digital pulse indicating increased blood flow.

## Out with the old, in with the new

The old theory behind the cause of laminitis has been challenged in recent years. The established progression was this; an excess of grain or grass lead to an overdose of sugar. This sugar supposedly created an overgrowth of bacteria in the hindgut. As the bacteria ran out of sugar, and died off, they created a toxic-shock syndrome which set off the laminitis.

The difficulty with this theory was accurately linking the toxic-shock syndrome to the inflammation of the lamellae, and the often lack of other sepsis signs in traditional laminitis cases. This theory also led to the development of products like Founderguard. This is actually low dose antibiotic, given daily, with the view to prevent bacterial overgrowth. Not only do we no longer think bacteria are involved in laminitis, but the fastest way to create deadly antibiotic resistance is overuse.

The new theory surrounds the role of insulin in the body and its ability – or lack thereof – on processing and storing glucose. Insulin's normal role in the body is to take up digested glucose and store it in the cells where it can then be used for energy. When insulin resistance occurs it goes from a glucose transport to an inflammatory protein. The new causative theory behind laminitis in endocrine disease is insulin resistance creating:

- Impaired glucose delivery to the hoof tissue
- Altered blood flow to the hoof
- Pro-inflammatory state

These factors combine to induce laminitis, allowing subsequent founder to occur. Endocrine disease is a hormonal imbalance, and can occur from a range of conditions and situations. Cushing's syndrome – or Pituitary Pars Intermedia Dysfunction (PPID) – is a benign enlargement of the pituitary gland and results in an over production of adrenocorticotrophic hormone (ACTH) which mainly produces cortisol. Constant cortisol production puts the body under a state of stress, and has a range of side effects including insulin resistance.

Equine Metabolic Syndrome (EMS) is the primary condition resulting in insulin resistance, and its main predisposing factor is obesity. The 'cute' fat pony with the cellulite deposits is actually just one step away from becoming a 'diabetic' who can't process sugar. Sepsis, trauma, and weight-bearing laminitis from other lamenesses are of course still risk factors for laminitis.

## Diagnosis

The first step in diagnosing the disease is a good clinical examination. Lameness due to the intense foot pain is often the first sign, with a reluctance to walk on hard

surfaces, or to move at all. Heat in the hoof is variable and is like trying to take your temperature through your fingernail. A more reliable indicator of inflammation in the foot is an increased digital pulse. The equine limb has a pair of nerve-artery-vein bundles that travel parallel down the leg. Normally a pulse cannot be felt in the digital veins, but when the foot is inflamed, these begin to pulse with blood and can be felt at the bottom of the fetlock.

Our next step may involve taking radiographs of the feet, especially the fronts. Xrays are to check to see if we have any separation of the lamellae and rotation of the pedal bone. These can then be used by your veterinarian-farrier team to perform sequential corrective farriery on your horses' hooves.



**Top: a normal xray of a horse's hoof in a lateral (side) view. Bottom: an xray of a horse with founder, showing separation of the lamellae and rotation of the pedal bone. There is also almost penetration of the tip of the pedal bone through the sole.**

Also useful may be some blood tests. These can help determine whether there is an underlying illness and/or endocrine disease that may have predisposed the laminitis. ACTH testing will help us to determine if the horse has Cushing's. Measuring resting insulin level can detect EMS in around 1/3 of affected horses. A more sensitive test involves measuring insulin response to glucose.

This test can be performed by taking pre-blood samples for glucose and insulin. Glucose powder can then be administered via a small feed or nasogastric tube. Glucose & insulin levels are then re-tested 2 hours later. Insulin will naturally increase a bit in response to the glucose, but a horse with insulin resistance will show a vastly elevated level. As the insulin doesn't work on the glucose, the body keeps trying to produce more and more, but with no effect.

Once a diagnosis has been made, the severity and range of complications determined, and any underlying conditions detected, a treatment plan can be formed.

## Treatment

There are two stages to laminitis treatment; immediate and ongoing. The immediate phase involves reducing the inflammation in the foot and providing interim hoof support. The ongoing phase involves endocrine medication as necessary, management (diet & exercise), and corrective farriery.

### Anti-inflammatories

Inflammation is targeted in two ways; cooling and anti-inflammatories (AI). The most common AI that you will all have heard of it bute (phenylbutazone) a non-steroidal anti-inflammatory (NSAID). It's the most common AI used in horses, and is a great first-line choice for laminitis. For horses that may be prone to intestinal ulceration, or need AI's for prolonged periods, there are other choices of NSAID's with less side effects. These are Metacam (meloxicam) and Previcox (firocoxib).

Some other treatments may be required for cases with severe inflammation or uncontrolled endocrine disease. Aspirin (acetylsalicylic acid) and paracetamol (acetaminophen) have been used for laminitis inflammation *but should never be used without the guidance of your veterinarian*. Gabapentin has also been used for neuropathic pain when the feet are 'better' but they've been painful for so long that the nerves are overstimulated.

### Cooling

Cooling is best done through frequent application of ice to the hooves but is usually not feasible in most settings. Therefore, frequent cold hosing for 10-20 mins at a time will help to conduct heat out of the foot and reduce inflammation.

### Other medications

Metformin and levothyroxine have been used in clinical practice to try and improve insulin sensitivity, while levothyroxine will also help shift the cellulite deposits on EMS ponies. Pergolide is used to treat Cushing's syndrome and comes in both a tablet and liquid form.



**An example of fluid bags filled with ice and duct taped to the legs to act as ice boots in a case of laminitis.**

### Hoof support & confinement

The feet are usually acutely painful, and require padding to make the horse comfortable to move. Hoof support and confinement lessen the impact forces on the feet, provide cushioning of thin soles, and decrease limb loading. Thick foam can be sourced, cut to the hoof size, and duct taped on for immediate comfort.

### Corrective farriery

Your veterinarian and farrier will usually work together with xrays and trimming to begin the slow process of correcting pedal bone rotation. The first hallmark of laminitic corrective trimming is to decrease toe breakover. Long toes act as a lever point, with every step pulling the inflamed and separating laminae away from the pedal bone.

Sole support is important and may be achieved through shoes and/or pads. The angle of the pedal bone needs to be corrected but without placing quick pressure on the deep digital flexor tendon (DDFT) which inserts onto the back of the pedal bone. 'Rocker' shoes or wedges – such as the NANRIC Ultimate Wedge – can achieve this by rounding the toe but keeping the heel up at the same time.

### Exercise

Once out of the acute phase, and once the pedal bone angle begins to correct, exercise is an important management strategy as it helps to increase insulin sensitivity. There was a great study done by Meredith de Laat et al. in 2015 that showed that sustained low-grade exercise induces weight loss and improves metabolic parameters in overweight ponies.

How they achieved this was by having two groups of ponies, one group had free choice access to hay. The other group had a hay feeder with two sides, that could be closed independently with a fence between them. When one side closed, the ponies had to walk up and around the fence to get to the other side. They found that insulin sensitivity was significantly increased in the forced-exercise group, vs. the sedentary group.

Feed Source	Energy (sugar & protein) (ME) (MJ/kg DM)	Protein (ME/kg DM)
Lucerne hay	9	15
Oaten hay	8	3
Wheaten hay	7	3

## Diet

Far and away the biggest factor to managing laminitic ponies and preventing recurrence of the disease is diet. No amount of anti-inflammatories or corrective farriery will help if you keep feeding these guys incorrectly. There are two aims of the endocrine pony diet; 1) reduce carbohydrate (sugar) intake, and 2) maintain dietary needs with respect to energy & fibre.

### Non-structural carbohydrates

Non-structural carbohydrates (NSC's) are directly digested by the horse and include glucose, sucrose, fructose, etc. Structural carbohydrates are those derived from the plant cell wall and need to be broken down by gut bacteria before they can be absorbed by the intestines. This is cellulose, and a 'good' sugar for horses. Feedstuffs for laminitic horses need to avoid NSC's as much as possible.

### Bulk feeds

Oaten and wheaten hays are cereal feeds, while Lucerne is a legume. The Agriculture Victoria website has some fantastic average nutritional values for a range of livestock feedstuffs, with oaten, wheaten & lucerne listed in the table above. You can see that overall, they have a fairly similar energy content; if they were lucerne 12MJ and wheaten 4MJ, that would be a significant difference. But 9 to 7 is pretty similar.

Hay doesn't contain any fats, so its overall energy is made up of sugar and protein. Now when we compare the protein level of lucerne it's vastly different to oaten & wheaten. Meaning for a similar amount of energy, the cereals are higher in sugar vs. protein. As we're wanting to avoid sources of sugar in laminitic ponies, lucerne hay (in moderation) is a better feedstuff. It's also naturally higher in calcium which can help as the pedal bone remodels.

Grass or pasture hay can be an acceptable mid-point, especially in years of poor hay supplies, and is generally lower in sugar vs. protein. However, it is highly variable from paddock to paddock depending on what plants have been seeded and harvested. Teff or Rhodes hay have been purported to be lower sugar grass hays. When selecting 'meadow' hay, make sure it's not an oaten/meadow mix.

Soaking hay, especially cereals, is also a great way to help remove excess NSC's. As they're directly dissolvable, some of the NSC content can be soaked out of hay. I generally have a three-step process on the go for hay soaking.

The drying step is often missed by owners but is vitally important as you want the dissolved NSC's to drain away. Otherwise you're just feeding them on the outside of the hay instead of the inside.



**Hay soaking steps: one batch soaking, one batch drying, and one batch ready to feed.**

### Concentrated bulk feeds

These are low sugar 'bulklers' designed to add large amounts of fibre in a compact form. The most common one is sugar-beet pulp (Speedi-Beet or Micrbeet). Despite having 'sugar' in the name, they're the extruded by-products of the beet pulp process, meaning almost all of the sugar has been taken out. Soya products (Maxisoy) is another legume source of energy and higher in fibre and protein.

### Concentrated feeds

These are proprietary preparations designed for higher protein, lower sugar energy sources. Some are specifically designed for horses with metabolic disease, while others are designed for conditions that benefit from low sugar (i.e. intestinal ulceration), and can therefore be used for laminitic horses.



## Diet Summary

There are two hallmarks of an endocrine horse diet. The primary step is to reduce non-structural carbohydrate intake. This can be achieved by avoiding cereal products (oaten & wheaten), and utilising legumes in the diet (lucerne).

The other is to maintain their dietary requirements in respect to energy & fibre. You want to aim for higher protein, lower sugar, feedstuffs. Try to feed hay/bulk where possible, or aim for proprietary feeds designed for endocrine horses.

## Laminitis Summary

Laminitis is a deadly disease. It's not a bacterial condition, it's an endocrine condition. Treatment involves immediate reduction of the inflammation in the hoof via anti-inflammatories and cooling. Long term management involves corrective farriery and addressing any/all underlying conditions. However, prevention is much better than cure, and is most readily achieved through correct dietary management.



Proprietary feed preparations designed to be low-sugar diets (clockwise from top left): Hygain Zero, Hygain Ice, Pryde's EasiSport, Mitavite Munga.



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