

## Healthy Hooves from the Inside Out

By Dr. Tim Kempton

*Without sound hooves and legs,  
horses cannot enjoy healthy lives.*

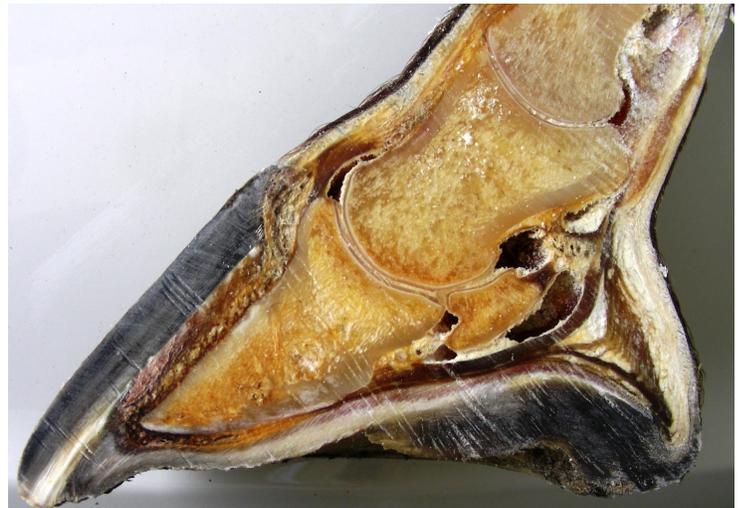
*Simply put...no hoof, no horse!*

### Hoof Structure

The hoof is understandably a complicated structure that must bear the entire weight of the horse. The hoof comprises three types of tissues:

1. The hard outer hoof, the frog and the sole (keratin)
2. The soft tissue tendons, cartilage blood vessels and nerves
3. The coffin (pedal), navicular and short pastern bones.

Sound hooves depend primarily on diet and blood supply. Blood supply depends on a balanced trim to avoid contracted hooves.



### Nutrition and Hoof Growth

The hoof wall grows continuously from the coronary band, taking about 6-8 months for cells to grow down to the ground contact-surface of the hoof. The hoof is made from a specific group of proteins called keratins, which also make hair and nails. Keratin is formed from the sulphur containing amino acids, in particular methionine and cysteine. Keratin cells are arranged in an extensive cross linking and a tubular structure, from the small, hard tubules in the hoof wall to the larger, more elastic, tubules that form the softer sole and frog.

The general health of the hoof can be determined from the appearance or absence of growth rings on the hoof, and the quality of the hoof wall, the sole and the frog. Hoof growth requires good nutrition and in particular a diet with adequate protein and a good supply of sulphur containing amino acids. Feral horses usually have good hooves because they can selectively graze a variety of plants that allow for a more balanced nutrient intake for hoof growth, and they move a lot. Modern horses however are fed processed feeds which often can be nutritionally unbalanced, and their movement is greatly restricted.

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**Moisture Retention**

Hooves can be brittle or soft depending on the amount of water in the hoof wall, sole and frog. Moisture content of the hoof is important; as such water may be referred to as nature’s hoof conditioner. The moisture is held in the cells and supplied through the blood vessels. The hoof wall is composed of very small, dense tubules, which are usually moisture resistant; the intertubular horn however is very soft. It is the glue that holds the horn tubules together and is very dependent on water.

Measurement (%)	Wall	Sole	Frog
Water	20 -25	33-36	42-50
Protein (keratin)	74- 87	60- 62	48 - 56

Dry brittle hooves, and a flaky sole and frog are a sign of impaired blood supply, and low moisture content.

The hoof must be pliable to allow the movement of the hoof capsule (heels and quarters and frog). The elasticity in the hoof wall causes pumping action in the hoof to increase the blood circulation within the hoof. Elasticity is directly influenced by water content.

**Nutrition and Hoof Conditions:**

**White line disease**

What is the white line? The white line is a fibrous, non-pigmented layer that connects the hoof wall to the sole. Hooves are prepared for shoeing, by trimming the hoof close to the white line. White line disease or Seedy Toe refers to a condition that affects the health of the hoof, evidenced by the stretching and separation of the connection between the hoof wall and the sole. The external hoof wall may appear brittle and dry, while the white line takes on a cheese like appearance or it recedes. There are many theories as to the cause of white line disease; however it seems that invasion of the white line by one or more fungi acting alone or in combination with bacteria may be the primary causal agents. These organisms can infiltrate and once they have destroyed the white line they feed upon and destroy the keratin tissue of the hoof wall.

White line disease is most likely to occur in horses that have had hoof problems in the past such as trauma, cracked hooves and previous infections or an imbalanced trim. Horses standing in muddy conditions are also prone to white line disease. The fungi and bacteria responsible for white line disease will not attack a healthy hoof. Horses with laminitis or Cushing’s disease are also susceptible to white line disease.

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It is reported that feeding oils which are high in medium chain triglycerides may assist in the control of white line disease through the antimicrobial & antifungal actions of the lauric and caprylic acids.

### **Laminitis/ Founder**

Laminitis is a complex disease which involves inflammation of the horse's hoof laminae (the structures which connect the pedal bone to the hoof wall). When hoof laminae become inflamed they lose their integrity, and allow the weight of the horse to drive the pedal bone downward towards the sole, damaging arteries, veins, the corium of the coronet and the sole corium. Once the pedal bone moves the condition is then referred to as founder. For a comprehensive review of laminitis and its causes, see Equine Laminitis (2003 & 2004) by Dr Chris Pollitt\*.

Laminitis and founder causes severe pain and in acute situations, euthanasia has been considered the only humane option. Laminitis is the second most common cause of death in horses worldwide.

The good news is that through research and a better understanding of this disease, there are many recommendations that responsible horse owners can follow. Adhering to these simple measures can reduce this risk. The key to prevention is understanding what causes laminitis, and avoiding those feeds and situations that may put your horse at risk.

### **Diet Selection Helps Prevent Common Hoof Problems**

Diets with high levels of NSC (>15%) (i.e. most grain based diets) can contribute to laminitis through carbohydrate (NSC) overload of the intestines and the hindgut.

#### **1. Acidosis in the hindgut**

Fructans and starch overload in the hindgut can cause acidosis, resulting in a rapid decline in pH and sudden death of the intestinal organisms. These organisms release highly toxic endotoxins, which contribute to the cause of laminitis.

#### **2. Carbohydrate overload of the intestines**

Too much soluble carbohydrate in the intestines causes increased uptake of glucose. This causes the horse to produce higher levels of insulin, and the horse becomes insulin resistant. High levels of insulin causes laminitis. High levels of circulating glucose also cause nutrient partitioning and storage of carbohydrate or fat leading to obesity. Obesity is recognized as a major contributor to laminitis.



Picture courtesy of Dr. von Horst

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Laminitis can usually be avoided by feeding low NSC feeds, together with exercise, to avoid obesity. Select feeds with a low NSC (<15%), reasonable protein and sulphur amino acid content, and oil to maintain hoof integrity and vascular function in the hoof.

Regular hoof trimming is also recommended to maintain a balance that allows the laminar attachments to be evenly loaded is essential to ensure adequate blood circulation into the hoof.

*\*References:*

*Pollitt, C.C., Kyaw-Tanner, M., French, K.R. van Eps, A.R. Hendrikz, J.R and Daradka, M. (2003) Equine Laminitis. American Association of Equine Practitioners 49th Annual Convention Proceedings, pp 103-115, Nov 21 – 25, New Orleans, Louisiana U.S.A.*

*Pollit, C.C., 2004, Equine Laminitis, Clinical Techniques in Equine Practice. Pp34-44.*

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