

Coping with brittle hoof walls

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DVM, DECVSMR (Equine), DABVP (equine practice), cert. ISELP, cVMA, cVSMT, CERT

More often than not, the condition of hooves is generally a reflection of the horse overall health. As such addressing the whole horse is key. Several factors affect hoof health (growth and quality) such as genetics, age, exercise, and metabolic rate, trimming and shoeing, nutrition, environment, and overall health status of the horse. Poor hoof health reflects in brittle, weak, thin, flaky hoof walls, laminar separation, and infections of the hoof. Below an overview of the main causes leading to poor hoof wall quality.

1. Causes:

- **Genetics:** Certainly, some horses grow stronger hooves than others. The durability and thickness of a horse's hoof walls can be an inherited trait, and very thin hoof walls tend to crack more than thicker ones. Despite the well-known saying, white hooves aren't necessarily any softer than dark ones, but the cracks may be more easily seen in lighter feet.
- **Metabolic disorders:** it is well known that the equine metabolic syndrome, a disorder associated with inappropriate blood insulin levels along with a combination of increased fat deposition and a reduced ability to lose weight, has a negative effect on hoof health and predisposes the horse to laminitis.
- **Diet:** The hoof needs certain nutrients to be able to produce sufficient horn of good quality. Adequate amounts of sulfur containing amino acids, B vitamins and minerals like Zinc are key nutrients. Not only a nutrient deficiency can cause hoof related problems but also excess (toxicity) and most commonly an imbalance between nutrients (ratio imbalance). Let's

have a look at the most common dietary issues impacting hoof health (growth and quality):

- **Amino acids (the building blocks for protein) and more specifically sulphur-containing amino acids** such as methionine and cysteine as well as **rate limiting amino acids** such as lysine (which is considered the first rate limiting amino acid in horses), followed by methionine and threonine. A deficiency is most common. Methionine, lysine and threonine are among the essential amino acids, i.e. they cannot be produced by the body itself, but must be ingested through food. Cysteine, in turn, is formed from methionine, but can also be ingested directly. The sulfur in methionine and cysteine is important so that enough disulfide bridges (= connections made up of two sulfur atoms) can form in the keratin of the hoof. The more disulfide bridges that are formed, the stiffer the horn that is formed becomes. If there is a lack of sulfur or sulphur-containing amino acids, the hoof becomes brittle. Typically, this results in hooves that do not tear at a single point, but become unstable overall and often become brittle in several places (crumbling). When the diet is deficient in essential amino acids, protein synthesis will be limited. As proteins have many functions in the body, horses that have inadequate protein or amino acid intake might experience other symptoms besides poor hoof quality, such as poor coat quality, persistent fatigue, and slow recovery from illness (due to compromised immune system and gut health) and loss of muscle mass. Sometimes an excess can cause a problem as well. Methionine excess causes depletion of iron, copper and zinc. In this situation the hoof shows clinical signs of white line disease without evidence of any microorganisms.
- **Minerals especially zinc, selenium, and iron.** Although zinc deficiency sometimes leads to rapid hoof growth, the growth is of poor quality, as such the hoof wall becomes brittle. The hoof also

becomes susceptible to canker. An oversupply of selenium and iron in particular can lead to cracked hooves. With a high selenium supply, selenium is stored in the hoof instead of sulfur, which reduces the disulfide bridges and the hoof loses stability. Other typical signs of selenium toxicity are lameness, horizontal hoof wall ridges or cracks, crusty coronary band, and hoof wall invasion by bacteria and fungi (white line disease (seedy toe)). A selenium deficiency can be just as harmful as selenium poisoning. Iron, on the other hand, serves as an antagonist to zinc, which means: if the concentration is too high, iron can displace zinc. Ideal iron:zinc:copper ratio is 4:3:1. Incidentally, high iron concentrations are not only found in the basic feed, but often also in the water. In the event of problems with hoofs breaking out, a water analysis is often worthwhile. In addition to high iron levels, nitrate levels can also be responsible for unstable hooves, cracks and hoof pain. No work has been done with horses but in people chronic exposure to nitrate at levels below the threshold for acute methemoglobin toxicity has hormonal effects including low thyroid function by interfering with iodine uptake and development of metabolic syndrome. If nitrate in your hay is detected over the 2500 ppm mark, iodine supplementation at 7 to 10 mg/day can be used to protect the thyroid or soaking can reduce the nitrate but you need to retest a soaked then dried sample to make sure it is safe. Another unbalance often seen is between calcium and phosphorus. A proper calcium:phosphorus ratio of 1.5:1 to 2:1 is ideal. An excess in phosphorus or a deficiency in calcium can lead to crumbling hoof wall especially around nail holes and weak heel structure prone to collapse. Analysis of your horse mineral status can be done through blood analysis.

- **Vitamins: more specifically vitamin A and B-vitamins including Biotin (vitamin B7).** Although studies have shown that biotin supplementation can improve hoof growth rate and quality, biotin deficiency is rare in horses. This is because much of a horse's

minimum daily B vitamin requirements are produced from their hindgut bacteria. If the horse has a healthy hindgut and is fed adequate amounts of high-quality forage to keep the gut flora happy, the microbes will produce enough B vitamins to meet a horse's minimum daily needs. It is therefore not only important that your horse takes in all the necessary nutrients, but that his digestive tract and metabolic organs are so healthy that the nutrients can also be utilized. Signs of biotin deficiency include thick layers of hardened tissue "peeling off" the hoof much like peeled layers of an onion. Like B-vitamins, Vitamin A deficiency is rare unless no pasture access is available, hay is deficient in carotene, or feed is deficient in vitamin A. Signs of vitamin A deficiency are shelly and flaky hoofs or hair-like projections growing from the hoof wall.

- **Environment:** A horse's living conditions can play a role in the quality of his hooves. Lots of ammonia from urine in stalls will damage the wall and may result in poor hooves. Very hard or rocky ground can cause mechanical cracks and chips. Very soft, wet environments do not allow the hoof to wear normally and may predispose the foot to infections. Moisture content does not seem to play a role in hoof horn strength and quality according to research. In dry environment, only the outermost horny layer of the hoof dries out and although some fine cracks can occur in dry conditions these are usually not a problem and only effects the outermost layer of the hoof wall. These cracks will disappear on their own when the surrounding area becomes humid again. The hoof also has a natural moisture barrier, so that moisture from the outside does not penetrate deep. For this reason, even in wet conditions, the horses do not have any stability problems. Rather than the hoof wall, it is primarily the sole that absorbs moisture from intensive watering.
- **Mechanical Leverage and pressure** are often an overlooked trigger for hoof cracks. When some structures in the hoof are not in balance, non-physiological forces develop through levers and uneven pressure

distribution. These then press on certain areas and cause bruises or strains there. These un-physiological forces sustained by the hoof wall can further lead to horn capsule tears. One then also speaks of “stress cracks”. A crack starting at the ground surface is usually caused by mechanical leverage, a crack starting at the coronet band is usually caused by pressure. Typical examples are toe cracks due to the fact that the hoof wall at the toe pillars gets too long, creating a lever arm. Another example is a quarter cracks due to uneven pressure distribution during loading of the hoof (usually medial part of the hoof) related to hoof imbalance or abnormal limb conformation. Levers or uneven pressure distribution typically develop from improper or infrequent hoof trimming (hoof balance problems), limb conformation issues or limb pathologies (the latter causing compensation in gait and posture due to pain)

- **Injury/trauma:** injuries can also lead to hoof walls breaking off or cracks. In the simplest case, your horse can step on a stone with the hoof wall at an unfavorable angle and therefore break off a piece of the wall. The worse the wall connection was previously, the more likely it is that a wall will actually break out in such an event. However, this is very rarely the case with healthy, compact hooves. Injuries can not only occur from below, but also from above: if, for example, there is a scar on the coronet, it may be that the corium there is restricted in the production of horn. This case is one of the few irreparable causes of hoof cracks, because the already scarred dermis cannot be cured again. However, such cracks are often unproblematic if the rest of the hoof is well nourished and balanced. Injuries to the hoof capsule also include nail holes from nailed horseshoes. These holes both mechanically weaken the hoof wall and provide entry points for bacteria and fungi. A healthy hoof usually copes with these artificial injuries for a while, just as it would with a natural injury. However, if the hoof is already weakened by leverage or nutritional problems, the nail holes are often the icing on the cake, leading to the final breaking off of the hoof wall.

2. Treatment:

- research suggests that nothing you can paint on the outside of a hoof will affect the moisture content or flexibility of the wall. The only thing hoof dressing can do is slow down the drying out of the outermost layer of the wall of the hoof. This means: if your horse has superficial cracks in the hoof wall in extremely dry times and you would like to eliminate them, you can first water the hooves and then seal them with hoof oil/fat. In this way you can slow down the evaporation of the moisture in the outer wall layer - but the hoof does not get any additional moisture from the hoof oil/fat. So, if you choose to use a hoof dressing, be aware that you are getting mainly a cosmetic effect.
- The most important thing to address brittle hoofs is to eliminate the cause e.g. unbalanced diet, improper stable management, and improper or insufficient hoof trimming. Apart from that, as the owner, you can provide the best possible support by ensuring that no bacteria or fungi can settle in the cracks during daily care. In many cases, your farrier will cleanly open up the existing gaps and show you how to keep things clean between trimming intervals
- Ask your veterinarian to review your horse's diet and recommend any changes that might improve the health of her hooves. Keep in mind that it take up to a year to grow a complete new hoof from coronet band down to the ground bearing surface, so it may be some time before you see results from dietary changes, especially at the level of the shoe/hoof interface.