Dealing with seedy toe

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As early as the 1800's it was recorded that hooves may be affected by a condition which causes a separation within the horn layers. Descriptions through the years vary in name but all describe the invasion of pathogens into the inner layers of the hoof wall resulting in a mass of cheesy crumbling digested horn. These pathogens have been shown to consist of anaerobic bacteria and subsequent invasion by keratinophilic fungal spores. Seedy toe is a widely recognised term that can be used to accurately describe the condition. The addition of the classifications; structural - Type 1 and systemic - Type 2 clarifies in which form the condition manifests itself. The implications of the condition can also be more easily understood if these classifications are used. Greater understanding of the condition will lead to better management and treatment of the problem.

Anatomy

The hoof wall consists of three layers of horn:

- The *stratum externum* (periople) is the outer most layer of horn. It is produced from papillae on the perioplic corium and is a continuation of the epidermis of the skin. It provides a protective layer to the most juvenile portion of the wall.
- The *stratum medium* (wall) makes up the main mass of the hoof wall. It is produced from papillae on the coronary corium and consists of tubular and intertubular horn. The axial portion lacks pigment and is known as the *zona alba.*
- The *stratum internum* is found on the inner surface of the *stratum medium* and consists of the primary and secondary epidermal (insensitive) lamella. It is produced from the lower border of the coronary corium. This layer interdigitates with dermal (sensitive) lamella which cover the parietal surface of the distal phalanx and the abaxial surfaces of the collateral cartilages where they are contained in the hoof.

When observing the hoof from the solar surface the interdigitation of the wall and the sole is denoted by the white line. This portion of horn is produced by the terminal papillae on the distal border of the distal phalanx (Figure 1).

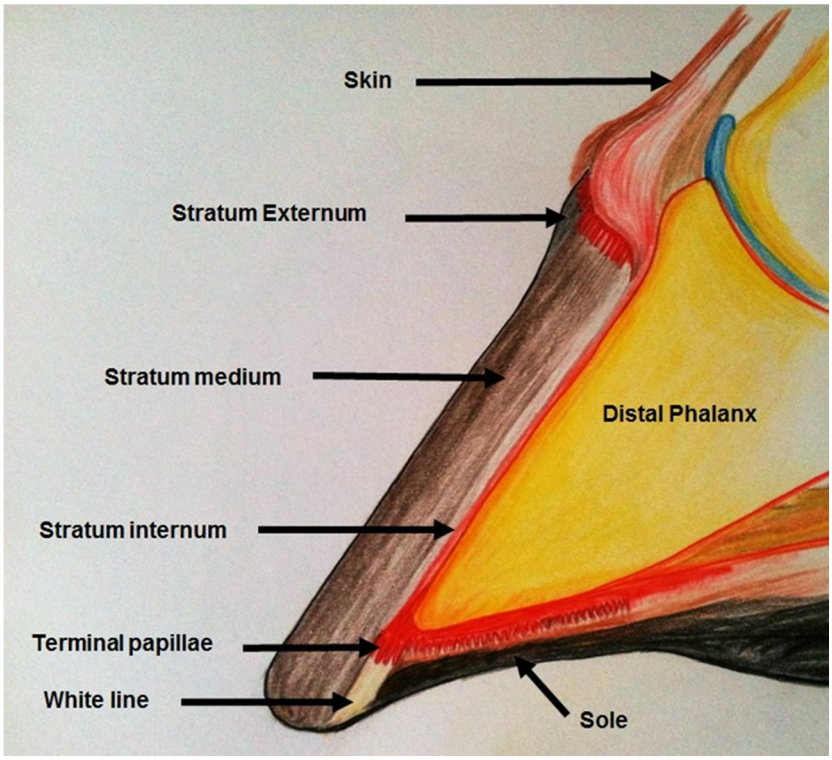

Figure 1. Hoof wall anatomy showing the different layers of the hoof wall and the white line.

The tubular horn found in the *stratum medium* consists of hard keratin cells. These cells are made up long chain fibrous molecules are held together by disulphide bonds which give it great strength. These molecules also contain the amino acids methionine and cysteine which contain sulphur. This is required in the final stages of keratinisation allowing the horn to harden fully as the cells die. Areas of horn such as the frog and the white line have less horn tubules and therefore less disulphide bonds so they are not as strong but they have a higher number of lipids and sulphydryl groups (proteins containing sulphur) which provide elasticity to those areas (Pollitt, 1998). The horn tubules are found in four distinct layers within the depth of the hoof wall. The outer most layer has the highest number of tubules and less tubules in each subsequent layer (Figure 2). This configuration of tubules means that the outer layer of the *stratum medium* is the hardest and most rigid and the horn gets softer and more flexible as they get deeper into the hoof (Reilly, 1998). This graduation of horn hardness and flexibility allows stress to be smoothly transferred across the wall onto the laminae and then the skeleton. Intertubular horn

is found between the tubules, it is produced from basal cells on the *stratum germinativum* (basal layer) between the coronary papillae. The cells of the intertubular horn are produced at ninety degrees to the direction of the horn tubules, creating a matrix of continually hardening keratin around the tubules (Goodman, 2008). This configuration gives the horn greater strength in all directions and more resistance to cracks (Bertram, 1986).

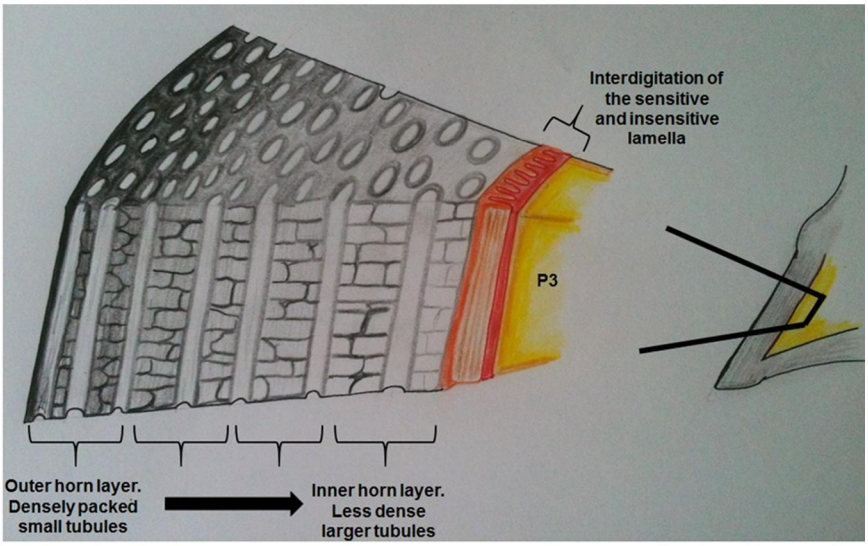

Figure 2. The four layers of tubular horn density found within the *stratum medium* (Reilly, 1998)

Organisms involved

Studies into the type of bacteria and fungi that are found in infected hooves, have mostly agreed that the main fungal species found are the *Genus Scedosporium* which are a known soil fungus found worldwide and also *Pseudallescheria boydii* (Kuwano, 1998). By contrast to the number of fungi there are numerous different bacteria found in affected hooves (Kempson, 2004)

The process is keratinolytic - disintegration of keratin – and is characterised by the damage and the subsequent separation of the *stratum medium* from the *stratum internum*. The pioneer organisms are sulphur reducing bacteria (Kempson, 2006) (Figure 3) which will cause distruction of the sulphur bonds between the keratin molecules - this leaves a visible blackening in the horn (Figure 4). These are followed by oppurtunistic keratinophilic species of fungus and bacteria which further digest the elements of the keratin which then leaves the wall weakened or absent depending on the severity of the condition (Moyer, 2003).

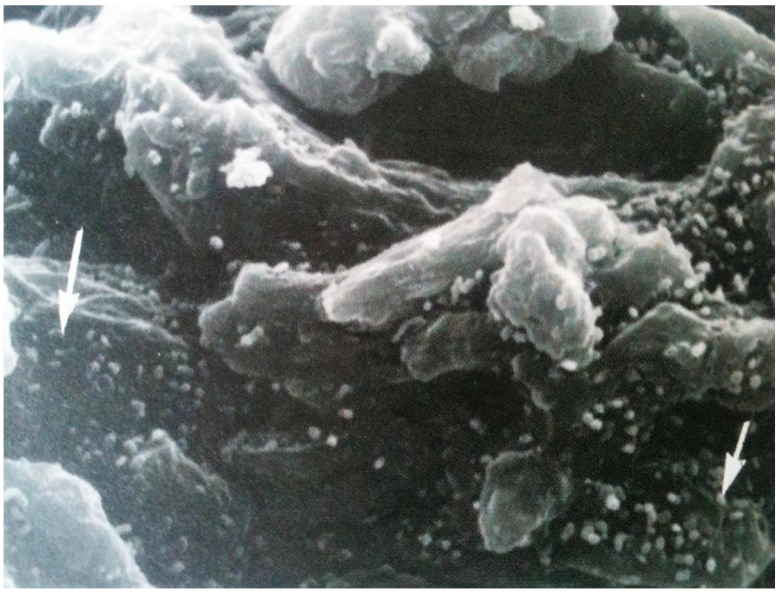

Figure 3.

An electron microscopic image showing bacteria on horn cells (arrowed)

(Curtis – Corrective Farriery Volume 2) with kind permission.

Figure 4.

Blackening around the old nailholes is indicative of bacteria in the horn.

(Curtis -Corrective Farriery Volume 2) with kind permission.

Occurrence

There are fundamentally two forms in which the feet present symptoms:

Type 1 - 'Structural'; where an insult or weakness occurs in the hoof, through a fundamentally isolated mechanical cause; cracks, a nail hole or an area of gravel pushing into the soft white line. The horses suffering from this may have recognisable good healthy horn in all other parts of the affected hoof and it may only affect one foot. That isolated area will have an obvious location and if untreated may

be seen to spread from that area as sulphur-reducing bacteria weaken the horn structure and fungal species follow (Kempson, 2006) (Figure 5).

Figure 5.

A crack is frequently associated with structural seedy toe.

Type 2 – 'Systemic'; this variation appears to have signs of a more environmental or systemic cause. These animals are observed to have generally poor quality hooves with brittle outer layers of horn and/or signs of blackening around most of the nail holes or around the white line in general. They may not retain shoes well or withstand being without shoes. They may be lame or 'footie' and/or they may have chronic laminitis (Figure 6).

It is possible for a horse to suffer from both types of the condition but in the authors experience this tends to occur when a horse with Type 2 then suffers a mechanical failure of the wall, a crack occurs and becomes infected -Type 1.

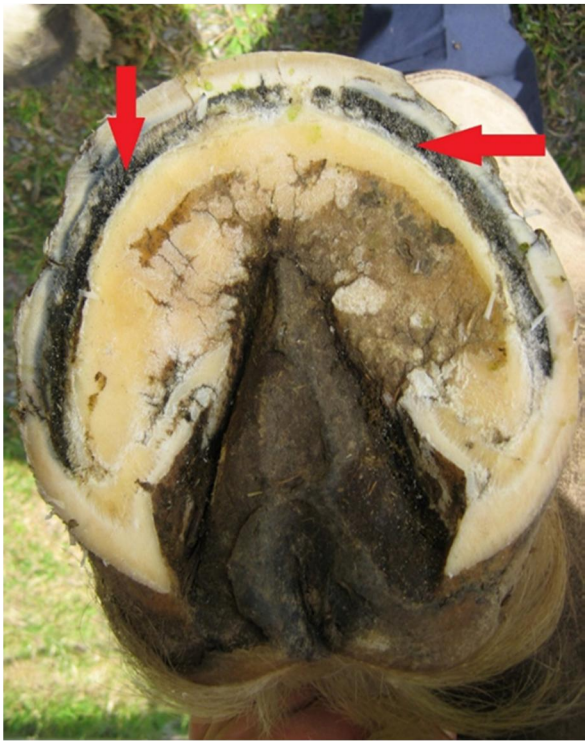

Figure 6. Signs of systemic seedy toe (arrowed).

A horse with Type 1 is less likely to develop Type 2 unless there is a change in environment, nutrition or hoof management.

It has been observed that horses with Type 2 may improve when moved into a different environment (Kempson, 2006). Although environmental factors affect all the feet in an individual but not all horses, there must be some underlying weakness in the affected individual.

Nutrition has a major role to play in the occurrence of the Type 2 weak feet. If the horn being produced is of poor quality and strength, opportunistic organisms can rapidly invade and digest the innermost layers of horn, leaving the outside layers to collapse (Kempson, 2006). Many chronic laminitics have poor quality horn and structurally weak feet, that and the long term damage to horn production, result in poor feet.

Recognition

As farriers, we need to recognise the difference between an isolated structural occurrence and a systemic occurrence. Then we are able to understand the problems we face, the implications for further management and treatment required. In the case of a structural failure (Type 1), and a resulting bacterial and fungal infection. The resulting cavity filled with cheesy crumbly horn can removed thoroughly cleaned, the hoof shod appropriately, and then managed accordingly. These cases tend not to have further effects on the horn or the horse, and are rarely more than an inconvenience until the area grows down.

In the systemic state (Type 2) where all the feet show signs of lesions; blackened areas in the wall around the nail holes, multiple areas of crumbly cheesy horn, and general poor quality hoof walls, the solution tends to be a far longer treatment period. In these cases it is important to identify the biggest influence and if possible reduce its effect. In cases of incorrect nutrition then the owner can be pointed in the direction of a nutritionist, and they should be able to also advise on sampling hay, soil and the horses grazing. If the horse is living in an area of poor wet ground that may be poached or described as ‘horse sick’ then the horse will need to be provided with an improved environment before the feet will have a chance to recover.

The Type 2 foot needs to be addressed from a more comprehensive approach after the cause or causes have been identified. Early recognition in these cases is very important and a proactive farriery approach to the early signs can make the condition more easily managed.

Proactive hoof care

Given that it seems the U.K. environment seems to becoming ever more changeable it seems prudent that those taking care of horses hooves should be trying to prevent problems before they need cured. Working in the Scottish highlands where the environment has always be a strong factor in hoof health, the author has noticed that during her studies, her increased awareness to the initial signs of bacterial invasion has led to a far more thorough treatment of the areas as they first occur. The application of topical disinfectants during trimming and prior to the application of shoes has reduced the progression of the problem. The use of antibacterial pastes to fill any voids or hollows in the solar surface of the foot, which will be covered by the shoe, has proven effective at preventing dirt, riding surfaces - and ultimately the bacteria - packing into these areas. In feet showing blackening around the nailholes the use of antibacterial dressing and copper coated nails has shown a slower deterioration of the horn over the shoeing cycle. These measures may not be the cure for Type 2 cases which as discussed are a complicated management issue but they have helped keep feet more intact from the farriery aspect.

Acknowledgements

The author is progressing towards sitting the Fellowship of the Worshipful Company of Farriers exam and is using Seedy toe as the topic for her dissertation.

Thanks to Simon Curtis FWCF BSc (Hons) for his guidance through the FWCF preparation course.

Photos where marked are courtesy of Simon Curtis.

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