

Lecture Notes
The dorsal wall lifting theory of equine
laminitis & vertical grooving
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Background Concepts

The laminal interface

When researching laminitis, damage to the laminae has always been considered from the vascular side but in this presentation I would like to propose that the hoof capsule may be implicated in the destruction of the laminal bond.

Differential horn growth

When adjacent areas of horn grow at different rates the horn curves towards the slower area. Normally equine horn grows faster at the toe, this gives the hoof capsule a slight claw shape which strengthens it. In laminitis the heel grows faster—the reverse of the normal pattern.

Peeling

The process of peeling requires less force than what is needed to separate the total bond as it acts on a small area at any one time. Peeling laminae would be extremely painful.

Arches

The mechanical properties of an arch add strength to a structure. The dorsal hoof wall is an arch when considered from quarter-dorsal wall-quarter, so if both quarters are exerting a force forward towards the dorsal hoof wall, the arched dorsal wall will be capable of transmitting this force onto the dorsal laminae.

Horn does not compress

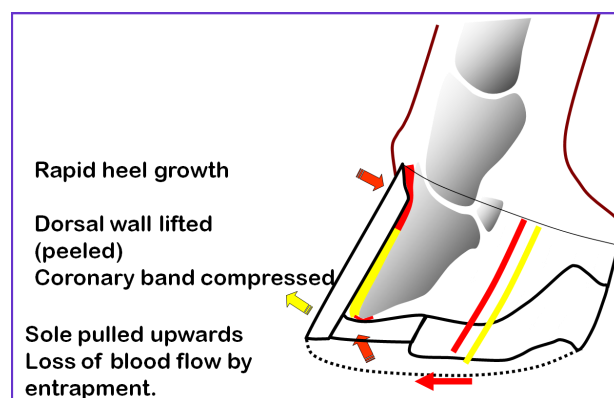
The whole weight of the horse must be carried by the hoof capsule, therefore horn has evolved to resist compression, when the hoof capsule grows abnormally it has to change shape to accommodate differential growth.

A new insight into laminitis

Existing theories place hoof capsule distortion after the acute phase but I would like to propose that rapid heel growth commences in the developmental phase. The duration of the development phase being the time it takes before hoof capsule distortion start to cause pain. The subsequent distortion induced in the hoof capsule traumatises the laminae via a peeling motion. As the dorsal wall is lifted the solar plate is also lifted toward the distal border of the distal phalanx. Blood flow is restricted by entrapment as the hoof capsule changes its shape around the distal phalanx.



Striped hoof capsules help to show the effects of differential hoof growth because they illustrate the changes in hoof shape over the lifetime of the hoof. Generally the distal hoof capsule is deflected dorsally by rapid heel growth.



Vertical grooving



The concept of early hoof capsule distortion provides an opportunity effective intervention in the laminitis cycle as the hoof capsule is an external structure.

Vertical grooving of the hoof wall creates a gap between the causal area at the quarters and the affected area in the dorsal wall, thereby alleviating

the lifting forces being exerted into the dorsal hoof wall by the faster growing quarters. Grooving is quick and easy to implement in the hands of a skilled farrier/vet but must extend through the full depth of the wall to be effective, it is not painful and even when the foot is occasionally made to bleed does not seem to cause pain. There can be a few complications, the distal hoof border may sometimes break in the unshod hoof and one groove has subsequently been the site of a foot abscess several months later. Digital pulses are usually reduced within a few days of grooving and the animal's gait improves.

Groove closure is interpreted as evidence that the groove is preventing the transmission of distortion



dorsally. Sometimes when the proximal border of the groove has grown down the hoof, lameness returns, it is then advisable to extend the groove proximad to it's original position. Grooving works less well in complicated chronic cases where there are multiple causes of pain—not just hoof distortion. (http://www.equinehoof.co.uk/how_to_groove.htm)

Unilateral Laminitis

Laminitis can be induced in equines with a history of flexural deformity of the DIP joint, this usually presents in the shod horse before the age of 10 years, it is caused when the heels are lowered to 'improve' the appearance of the upright foot. Grooving is contraindicated in equines with a history of flexural deformity of the DIP joint.

General Management

The application of an aluminium heart bar shoe in combination with quick setting pad products situated in the palmer 2/3 of the hoof helps to stabilise the distal phalanx within the hoof capsule.

Black mesh is nailed under the palmer 2/3 of the heart bar shoe, red play dough is used to fill the dorsal 1/3 of the sole, then the void is covered by duct tape. EquiPak soft sole pad material (Blue la-



bel) is pumped into the void. When the pad has set (approx. 1 minute) the duct tape and red play dough are removed. The shoe and pad should be replaced every four weeks until it's felt that the distal phalanx has stabilised.

The dorsal 1/3 should be left exposed to prevent pressure on the distal border of the distal phalanx and to aid medication in the event of the distal phalanx becoming prolapsed through the sole, in these cases iodine soaked pads are often used.

Risk factors

Known risk factors

Obesity is the most common cause of equine laminitis. Systemic diseases are also known to cause laminitis, EMS, Endotoxemia and Azoturia for example.

New high risk factors

Breeds with thicker than average hoof walls may have a greater risk of severe laminitis. Cobs, Arabs, warmblood and ponies all have relatively thick hoof walls. Strong straight sided hoof walls are less tolerant to rapid heel growth.

Hoof shape & movement of the distal phalanx

There is a relationship between hoof shape and the subsequent movement of the distal phalanx. Round hoof shapes are associated with 'sinker syndrome' and long narrow hooves with 'rotation' of the distal phalanx.

Hooves with asymmetric shapes where one side of the hoof is round and the other side is straight are associated with the distal phalanx sinking on one side of the hoof capsule.

New low risk factors

Thoroughbred types or animals with thin splaying heels may exhibit diverging growth rings at the heels but are often only mildly laminitic or not lame at all. The weak heels splay abaxially and are incapable of exerting force into the dorsal hoof wall in the short term, but over time if abnormal hoof growth continues the hoof capsule will become boxy and the foot more laminitic.

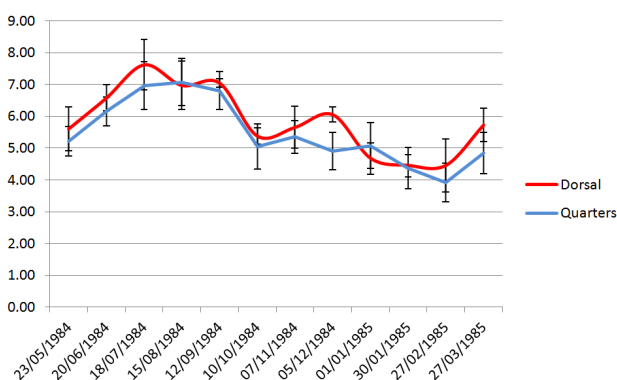


Evidence

(http://www.equinehoof.co.uk/hoof_growth.php) In 1984/5 I measured hoof growth in normal and laminitic hooves, this work gave an insight into the normal pattern of hoof growth though the seasons and also how differently chronic laminitic hooves were growing.

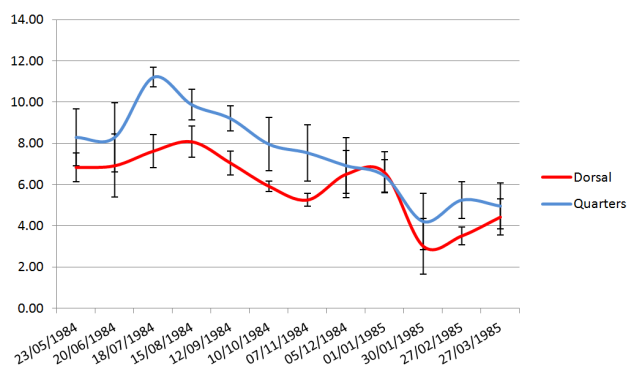
Normal hoof growth

In the normal hooves the toe grew slightly faster than the heels and the fastest time of year for overall hoof growth was July, while the slowest time of year was February.



Laminitic hoof growth

Laminitic hooves exhibited much faster rates of overall hoof growth with the heels growing even faster. It was the results from this work which started me thinking about how abnormal hoof growth may be acting on the internal structures of the equine foot.



Retrospective Study

Two groups of laminitic cases were compared, group 1 were cases of laminitis which were grooved. Group 2 were cases of laminitis which were seen in the two years before grooving was considered an option. Each group was sub-divided into acute, recurrent and chronic cases. A good to moderate outcome was considered a positive result, while a poor to no improvement was consid-

Positive result Percentage improved (improved/No. Cases)		
	Group 2 Not grooved	Group 1 Grooved
Acute	28.57% (2/7)	66.67% (4/6)
Recurrent	12.50% (1/8)	80.00% (8/10)
Chronic	57.14% (4/7)	91.67% (11/12)

ered a negative result.

Dorsal wall resections

For the last twenty years or so dorsal wall resections have been used when there has been a need to release trapped exudate, more recently their use has been in decline. Additional advantages of the procedure become evident in the light of the dorsal wall lifting theory, as removal of the lifting dorsal wall removes it's extension forces on the underlying laminae also the solar plate is released, removing compression of the solar corium.



Hoof stripes

Striped hooves help to illustrate the dynamic way horn is growing in both normal and laminitic hooves.

Orientation of the laminae



As the laminae become distended during an episode of laminitis the orientation of the laminae track the direction the hoof capsule has distorted. Generally rounder feet exhibit laminal distension extending into the quarter area, the laminae have a radial alignment, illustrating the whole hoof capsules circumference has enlarged.

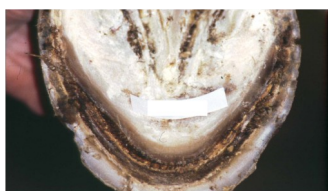
Long narrow hoof shapes tend to have a smaller area of distended laminae mostly at the toe, the laminal alignment being parallel.



The fact that distended laminae are present shows that the distortion process has been slow enough to allow the formation of distended laminae. In some cases there is an absence of distended laminae, a void exists between the hoof capsule and distal phalanx.



Hoof capsules with a void instead of distended laminae help to illustrate how devastating changes in the shape of the hoof capsule can be, could voids be evidence of the hoof capsule 'popping' from one shape to another?



Possible research topics

- Why does the laminitic hoof grow faster?
- Why is horn growth faster at the quarters than the dorsal wall in laminitis?
- When does rapid quarter growth commence?
- What effect would differential hoof growth have on the hoof capsule?
- Can the hoof capsule 'pop' shapes?
- How much force is required to pull apart laminae?
- How much force is required to peel apart laminae?
- Is there a relationship between hoof shape (round v narrow) and movement of the distal phalanx?
- What is the average hoof wall thickness?
- Is laminitis more severe in thicker than average hoof walled equines?
- How would the different hoof shapes distort in a computer modelled hoof?
- Is there another reason why grooved equines showing pain relief?

Summary

Research into laminitis has concentrated on the vascular side of the laminal interface and to date has ignored the possibility that changes in hoof capsule shape may be responsible for the destruction of the laminal bond. The realisation that the known triggering events may not be acting directly on the vascular laminal bond but instead altering how the hoof capsule is grown, offers a new insight into laminitis, the subsequent changes in hoof capsule shape being capable of destroying the laminal bond. Intervening in the distortion process with techniques like vertical grooves, offer new possibilities for the laminitic equine.

Heart bar shoes available from:-
The 3rd Millennium horseshoes
<http://www.the3rdmillennium.com/>

EquiPak soft sole pad material available from:-
Stromsholm LTD
<http://www.stromsholm.co.uk>

Further information at Tom's website:
www.equinehoof.co.uk
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