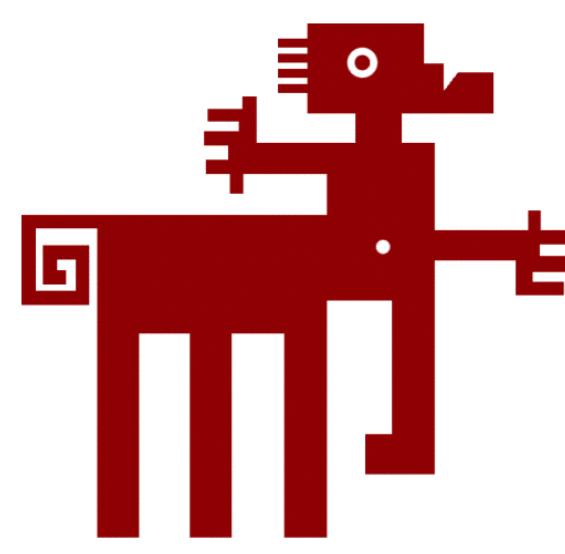


# Treatment of chronic laminitis from a multidisciplinary approach integrating traditional and complementary therapies



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## 1. INTRODUCTION

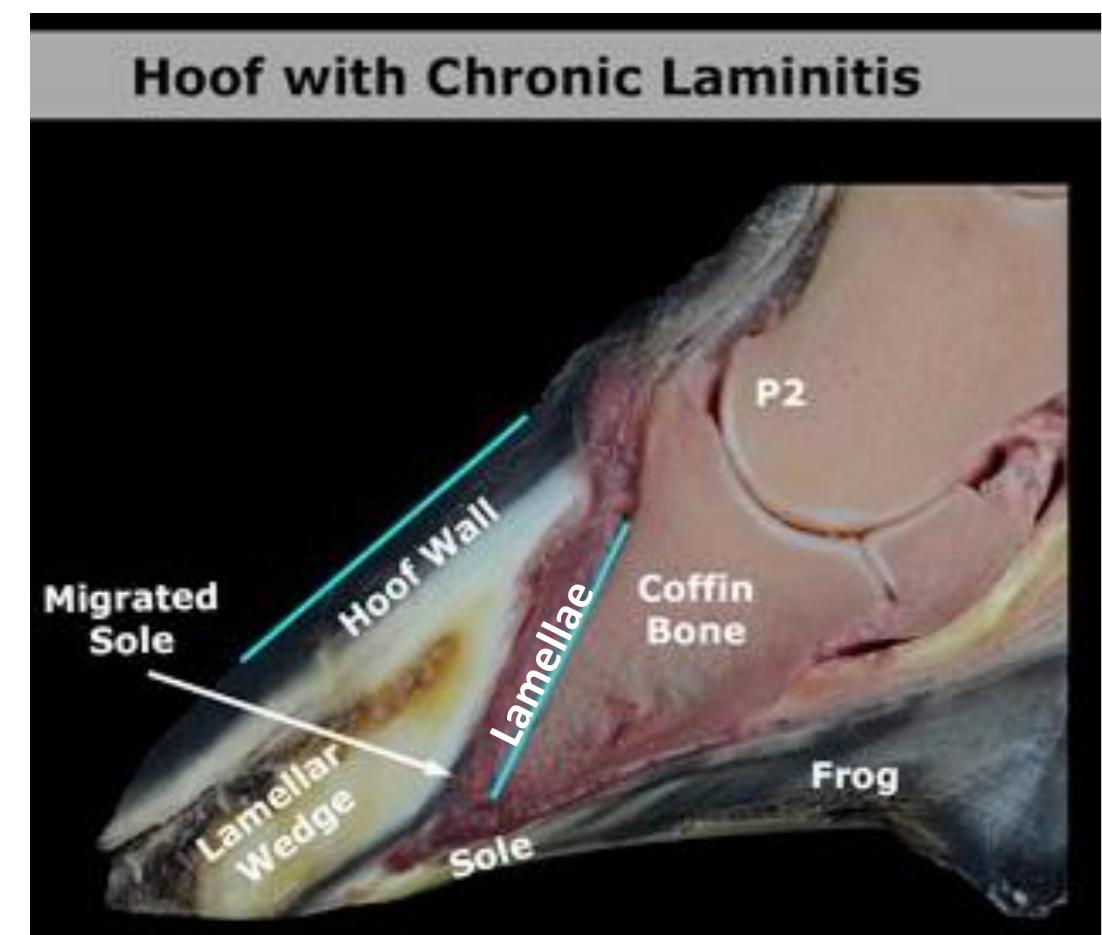


Figure 1. Anatomic appearance of chronic laminitis hoof. Adaptation from Anatomy of equine digit.com.

Laminitis is a very **painful** dermal disease with an acute inflammatory response, caused by systemic disorders than can target lamellar tissue with severe consequences resulting in separation and disorganization of the lamellae. The disease can proceed to a chronic phase where displacement of the third phalanx takes place. Laminitis, in US, affects 13% of horse population, 2% of all horses annually, of which 87% must be euthanized (Hunt and Warton 2010, Heymering 2010). There are lot of cases reported in Spain, but no prevalence studies have been published.

**OBJECTIVE:** To describe the integration of a broad range of **therapies to fight pain** and help general well being which may be combined so as to increase the chances and speed of recovery of chronic laminitis patients.

## 2. ANATOMY AND PATHOLOGY

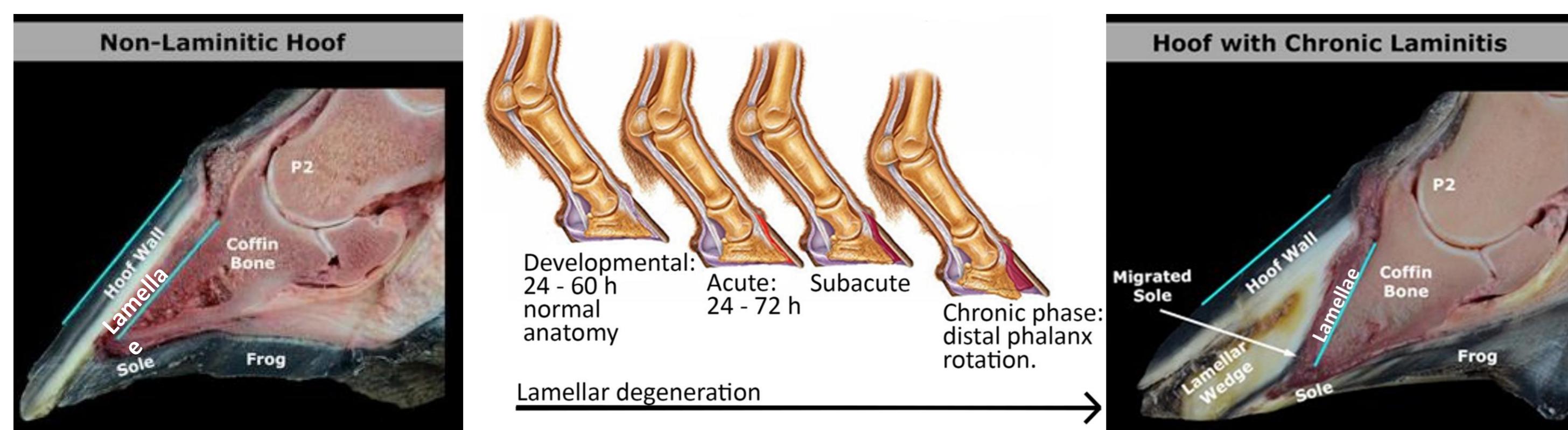
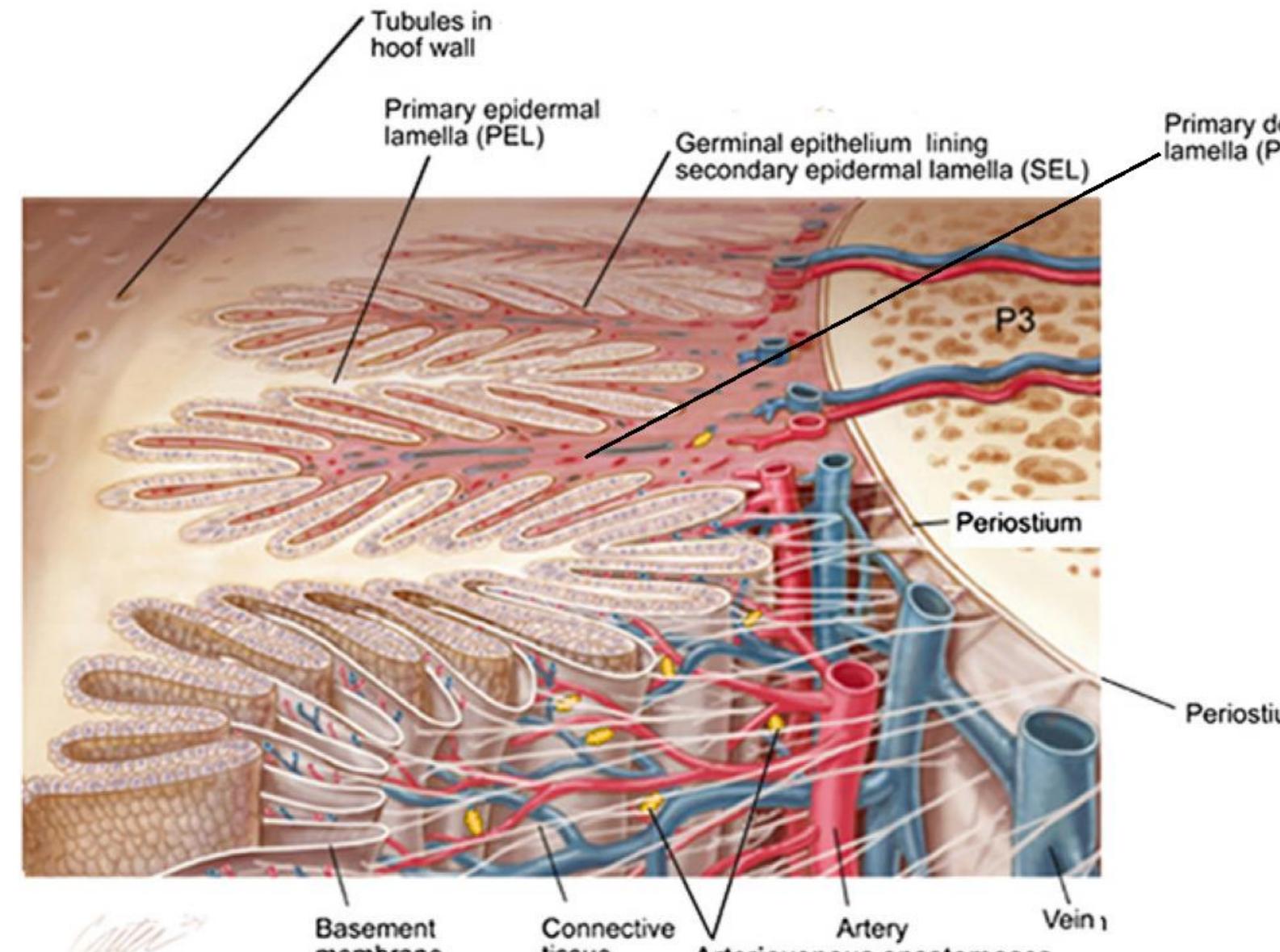


Figure 2. Anatomy of normal hoof (left), phases of laminitis (center) and anatomic appearance of chronic laminitis hoof (right). Adaptation from Anatomy of equine digit.com and Lake Forest anatomical educational models.



**Systemic disorders** can produce toxic factors such as mediators of inflammation (cytokines) or vasoconstrictive agents (endothelin-1, thromboxane, angiotensin II) which through bloodstream arrive to **dermal lamellae** and **basal membrane**. It will lead to **inflammation, ischemia and detachment** of the dermal and epidermal lamellae (Parks 2016, Pollit 2010). The microvascular flow interruptions lead to lamellar edema (Peroni et al. 2016).

Figure 3. Lamellae anatomy adaptation (Pollit 2004).

In normal conditions the basal membrane (BM) placed between dermal and epidermal lamellae requires lysis and reconstruction. Metalloproteinase (MMP), MM-2 and MMP-9 are the enzymes that are in charge of the lysis. This lysis is controlled by metalloproteinase inhibitors, making the process balanced. In a laminitis tissue, the mediators of inflammation increases MMP transcription producing their active forms and causing an imbalance in favor of lysis (Pollit 2007).

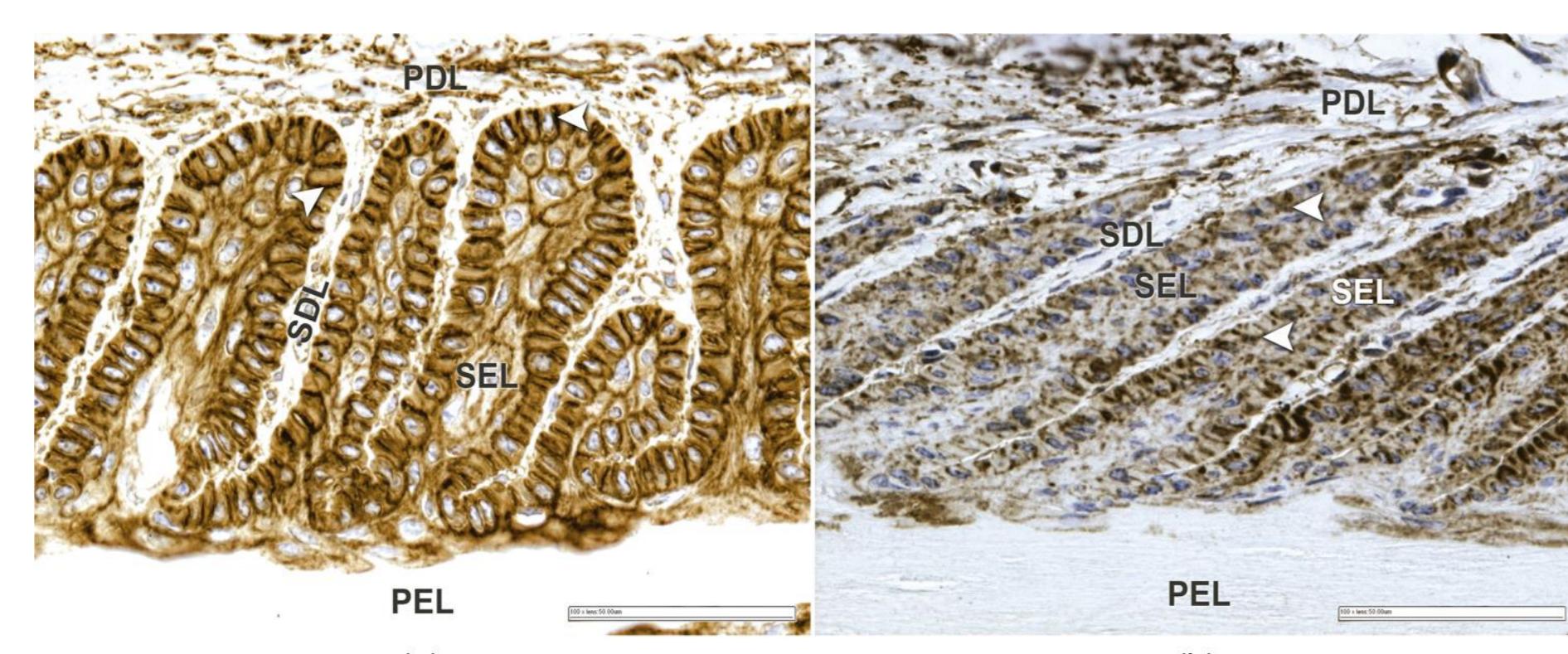


Figure 4. Cytokeratin 14 (K14) immunostaining of normal control (a) and laminitis (b), of the LBECS in transverse section. Arrowheads (a) shows actin localized to the zona adherens in the lateral plasma membranes of adjacent LBECS. Arrowheads (b), the boundaries between adjacent LBECS can no longer be distinguished by actin immunostaining, because they have been obliterated (Pollit 2016).

## 3. DIAGNOSIS AND MONITORING

The use of radiographs and venographs will help the clinician to monitor the effectiveness of the treatment (Parks 2016) and to guide the hoof trimming (O'Grady 2016).

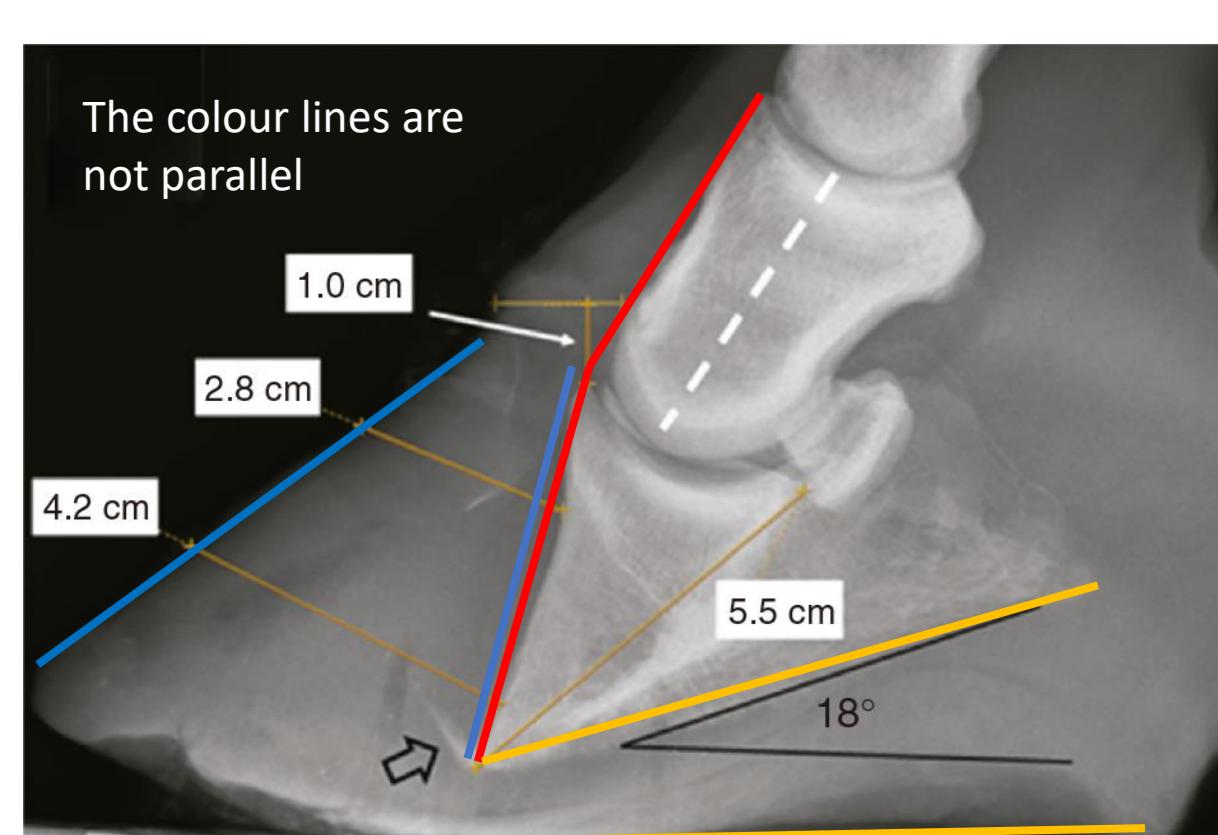


Figure 5. Radiograph of the third phalanx rotation, adaptation (Parks and Belknap 2016).



Figure 6. Venograph of the third phalanx rotation (Rucker 2016).

## 4. ANALGESIC THERAPIES

The combination of **drug therapy** is the most widely used for the laminitis pain treatment. However, sometimes its properties are not enough to fight pain (Driessen and Zarucco 2016), and it is necessary to know other therapies that could be combined with drug therapy.

Table 1. Drug therapy based on Driessen and Zarucco 2016.

ANALGESIA	DRUG	TYPE	NAME	ACTION
Conventional	NSAID	COX-2 selective	Firocoxib Meloxicam	Less adverse effects than non-selective. But IC <sub>50</sub>
	OPIOIDS + α <sub>2</sub> -agonists		Butorphanol Methadone Morphine Acetorphazine	Indicated in moderate to severe pain. Not for long term use, decreases motility.
Antihyperalgesia	Antagonist of NMDA receptor	Specificity for postsynaptic NMDA receptor	Ketamine Amitriptyline	Inhibits central hyperalgesia in persistent pain states.
Antineuropathic	α <sub>2</sub> -ligands	α <sub>2</sub> -ligands calcium channels	Gabapentine	Changes the release of SNC neurotransmitters as glutamate and GABA.

Some studies have showed that **acupuncture therapy** has been very useful in the treatment of the clinic signs of chronic laminitis. The Faramarzi et al. study showed that integrating acupuncture in two separate treatments of chronic laminitis horses for one week, decreased lameness scores 1 degree (Faramarzi et al. 2017).

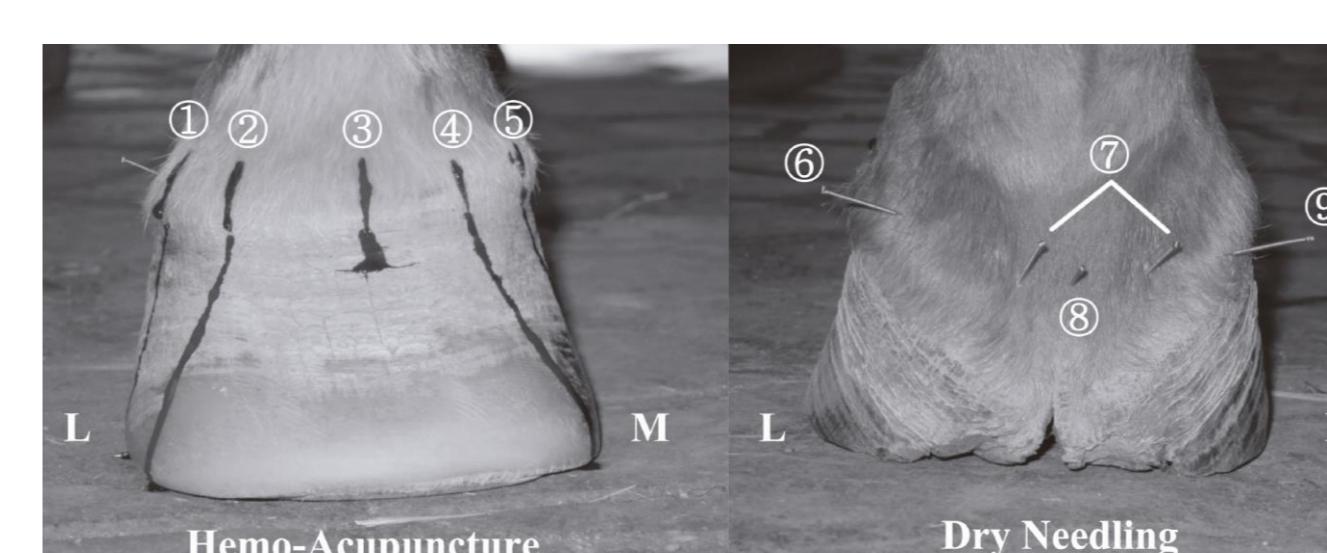


Figure 7. Acupoints used for the treatment (Faramarzi et al. 2017).

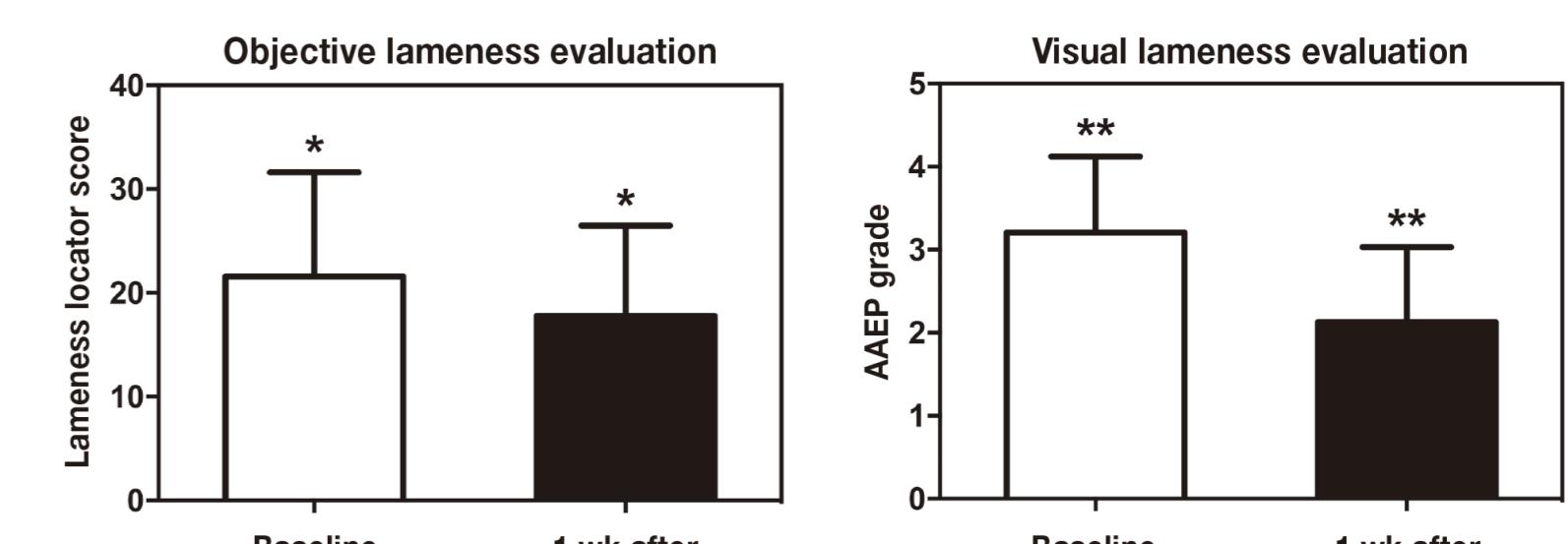


Figure 8. Evaluation of lameness degree before and after the acupuncture treatment (Faramarzi et al. 2017).

## Chronic laminitis

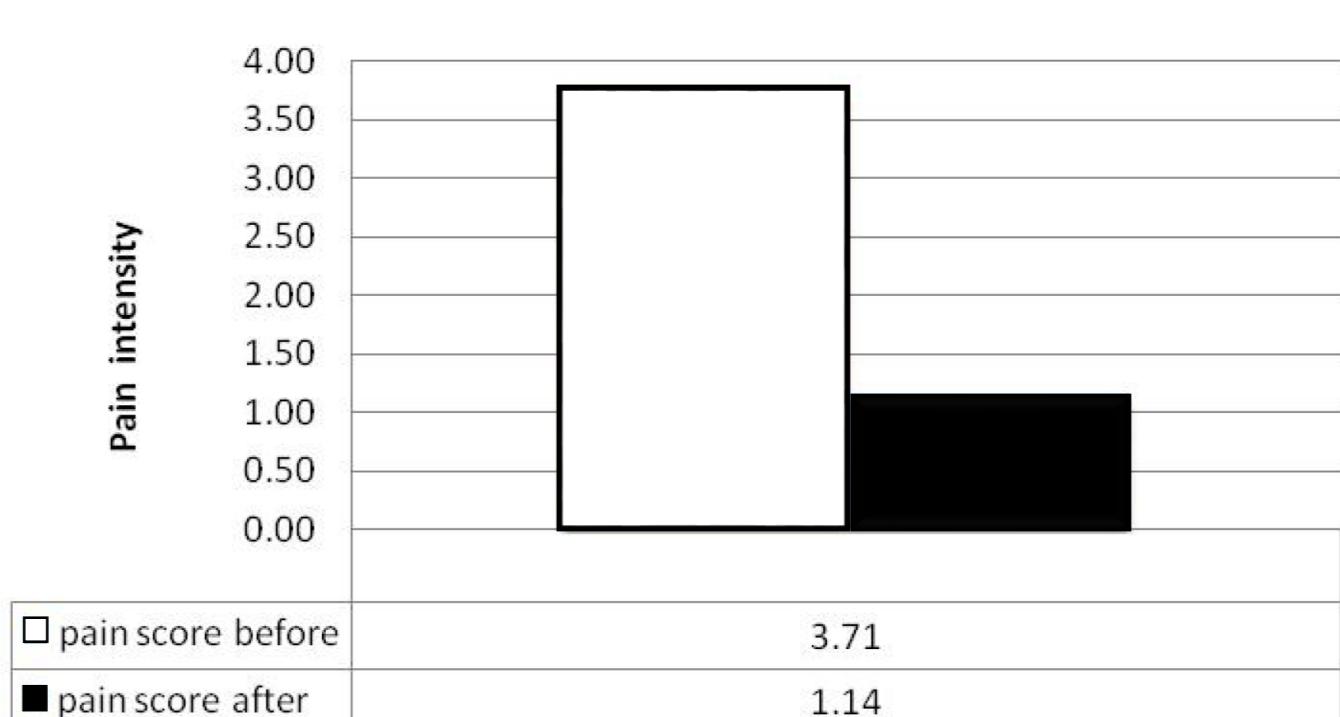


Figure 9. Graphic of the results of the pain scale pre and post treatment with laser acupuncture (Petermann 2011).

## 5. SUPPORTING HOOF THERAPY

It is the most important therapy that can really unload the hoof and physically relieve pain. The farrier try to return the hoof to its normal anatomy and biomechanics (Parks 2016), following some steps:

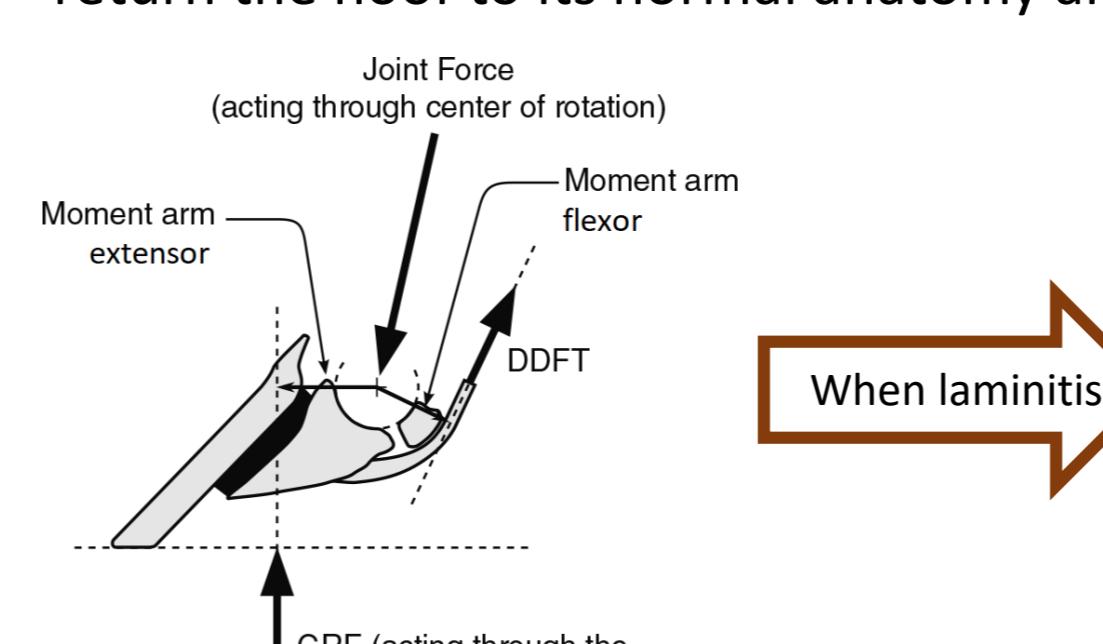


Figure 10. Biomechanics of the normal hoof (Merritt et al. 2016).

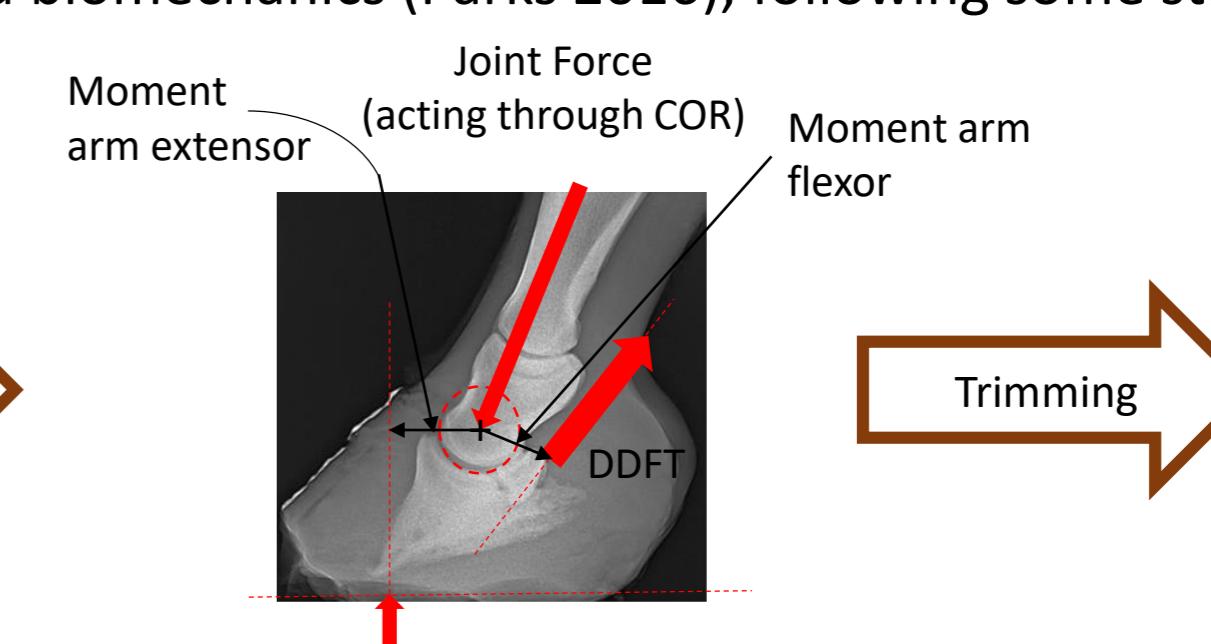


Figure 11. Biomechanics on a chronic laminitic hoof. Adaptation from Merritt et al. 2016 and Rucker 2016.



Figure 12. Line of the widest part of the hoof, it is used as a reference for hoof trimming (O'Grady 2016).

After trimming  
Shoes  
Breakover point in rounded shoes with different thickness (Parks 2016b)

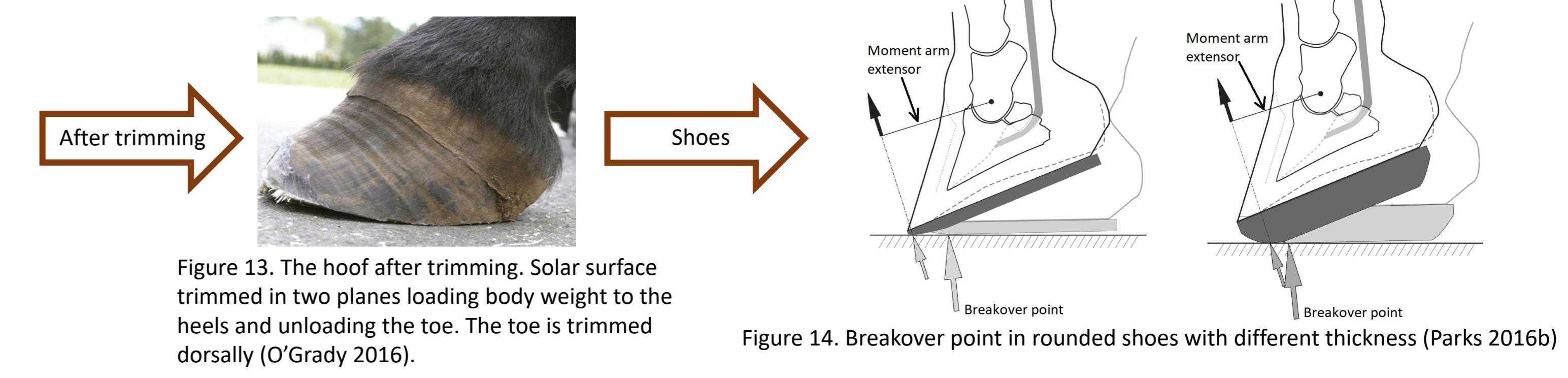


Figure 13. The hoof after trimming. Solar surface trimmed in two planes loading body weight to the heels and unloading the toe. The toe is trimmed dorsally (O'Grady 2016).

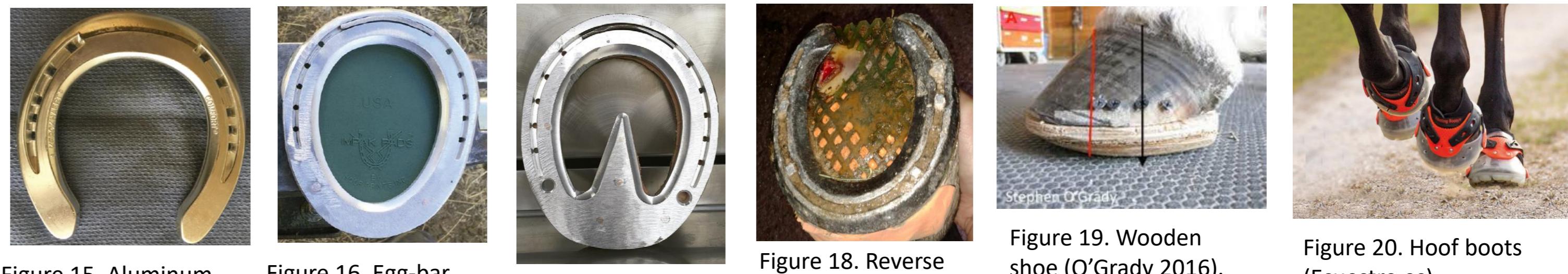


Figure 15. Aluminum shoe (O'Grady 2016). Figure 16. Egg-bar shoe (O'Grady 2016). Figure 17. Heart-bar Shoe (O'Grady 2016). Figure 18. Reverse shoe with silicon pad (own source). Figure 19. Wooden shoe (O'Grady 2016).

Figure 20. Hoof boots (Ecuestre.es)

## 6. NUTRITION

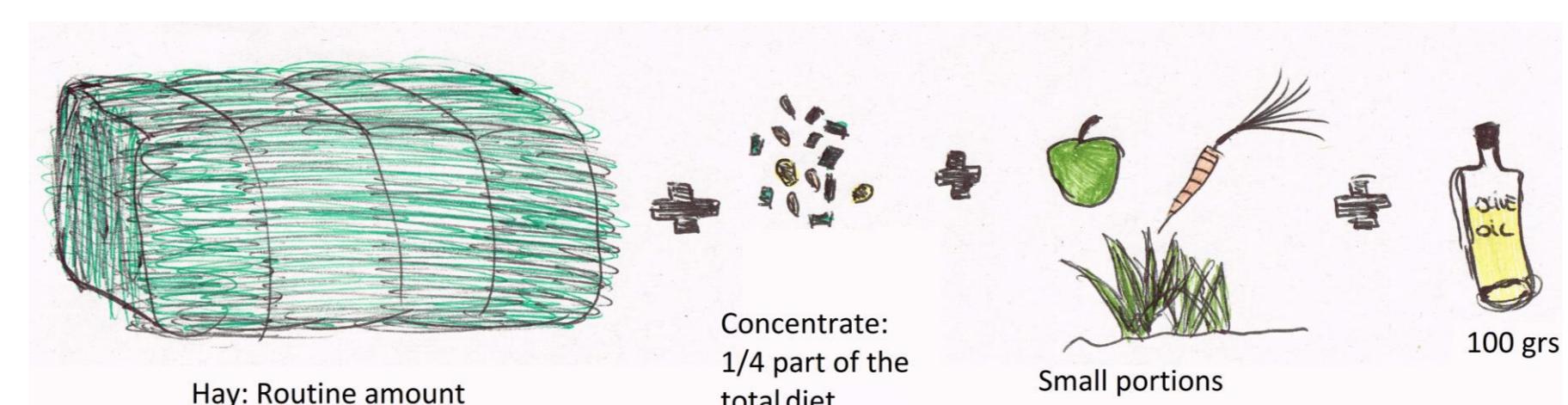


Figure 21. Recommended diet for a chronic laminitic horse (own source based on Menis 2009 and Bolger 2010).

Feeding 3-4 times a day is preferable. It would be more comfortable for the horse if the food is placed in an elevated area (Menis 2009, Bolger 2010).

## 7. CONCLUSIONS

Chronic laminitis is a very painful and multifactorial disease, where not one treatment protocol exists because of the complexity and individual variability. The integration of different types of therapies such as acupuncture to address amplified pain disorders can help decrease costs of therapy, analgesic drug dosage and decrease side effects. Even if supporting hoof therapy is probably the most important to help stabilize the hoof we must keep in mind that, every horse is different and the clinician has to observe carefully which type of shoe is best in every moment of the healing process.