Comparative study of histological changes in the deep branch of the lateral palmar nerve (DBLPaN) in horses with induced proximal suspensory desmitis (PSD)

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Introduction

- Proximal Suspensory desmitis (PSD) is a common cause of equine lameness in pelvic or thoracic limb in competition horses. Several medical treatments are recommended but when desmitis is chronic, lameness can be persistent and treatments ineffective.
Predisposing Conformation

- Negative palmar angle of distal phalanx, long pasterns
Why the Increase in Diagnosis?

- Increased awareness
- Advances in imaging techniques MRI, US X-Rays
- Modern training demands
- Modern surfaces
In the forelimb, the suspensory ligament originates in the distal row of carpal bones and at the proximal palmar aspect of the third metacarpal bone (Denoix 1994). The proximal part of the suspensory ligament is innervated by the deep branch of the lateral palmar nerve, which contains fibers from the ulnar and the median nerves.
Function

• Supports fetlock
  • Prevent hyperextension

• Limits bending of 3rd metatarsal/metacarpal bone
  • Prevents cannon bone fxs

• Elastic
  • Contributes to fetlock elevation

• Swing phase
  • Relaxed

• Stance phase
  • Tensed
Equine rt. thoracic limb, palmar view
Lateral palmar nerve block

- Ulnar n.
- Lateral palmar n.
- Medial palmar n.
- Ulnar n., palmar br.
- Lateral palmar n., deep branch
- Lateral palmar n.
- Medial palmar n.
Diagnostic Analgesia PSL
Fore Limb

The origin of the suspensory ligament and the proximal end of the second and fourth metacarpal bones can be desensitized by anesthetizing the lateral palmar nerve at the level of the middle carpal joint before it gives off a deep branch that innervates these structures. The lateral palmar nerve originates proximal to the carpus and is formed by the lateral palmar branch of the median nerve and the palmar branch of the ulnar nerve. The lateral palmar nerve gives off its deep branch, which innervates the origin of the suspensory ligament and divides into the lateral and medial palmar metacarpal nerves, at the level of the proximal end of the fourth metacarpal bone.

The lateral palmar nerve can be anesthetized as it courses distal to the accessory carpal bone close to the accessorio-metacarpal ligament. The
Introduction

- Previous studies reveal that horses chronically lame because of PSD in pelvic limbs have been treated with good results by neurectomy of the deep branch of the lateral plantar nerve (DBLPIN), suggesting that persistent lameness in horses with PSD of pelvic limbs may be caused by compression of the plantar metatarsal nerves, which innervate the proximal suspensory ligament. (Toth, et al)
Introduction

- Tóth et al examined the DBLPIN of horses determined to be lame of one or both pelvic limbs because of PSD and found histological changes suggestive of chronic compression of these nerves.
Introduction

- In other study horses that were diagnosed with chronic PSD in thoracic limbs resolved by neurectomy of the deep branch of the lateral palmar nerve (DBLPaN) and suggested that chronical neural compression may also be a cause of chronic lameness of horses with PSD of a thoracic limb. (P Gay Gusco et al 2012)
**Treatment**

*Confinement & Shockwave Therapy*

- Confinement & shockwave therapy improves soundness for a short time
  - Rapid improvement from analgesic effect
  - Profound effect on collagen remodeling & turnover
- **41%** of 44 horses became sound & remained so for 6 mo
Treatment

Other Treatments

- Infiltration of a glucocorticoid around ligament
  - Triamcinolone
  - Betamethasone

- Injection of bone marrow aspirate, or platelet rich plasma

- Systemic or local administration of glucosaminoglycans
Treatment

Other Treatments

- Establish uniform weight distribution
  - Egg-bar shoes
- *Do not* elevate heels
  - Increases tension on SL
Objectives

- To determine if pathologic changes are present in the DBLPaN of horses affected with PSD that may explain the poor response to conservative therapy, compare to those controls.

- To determine how excision of a segment of the DBLPaN affects lameness of horses suffering from PSD of the thoracic limbs.
Methods

Adult mixed breed horses n= 8, clinically healthy, sound and with no evidence of PSD.
MATERIALS AND METHODS: PHASE 1
Using a body internal sensors system (BASELINE)
**Trial:** Straight line  
**Surface:** Concrete

**Analysis settings:**  
Delta = 0.1; Fore SD = 2.3;

**Stride Rate:** 1.511  
**Strides Evaluated (front/hind):** 24 / 25

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**Front Limb Evaluation**

- **MaxDiffHead:**
  - RF Pushoff
  - RF Impact
  - LF Pushoff
  - LF Impact

- **MaxDiffPelvis:**
  - LH Pushoff
  - RH Pushoff

**A1/A2:**  
- LF: 0.1713  
- RF: 0.4355

**Threshold = 0.50**

**Head Diff (Mean/SD):**
- Max: 1.611 / 6.98
- Min: 3.907 / 9.88

**Threshold = ±6mm**

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**Hind Limb Evaluation**

- **MaxDiffHead:**
  - LH Pushoff
  - RH Pushoff

- **MaxDiffPelvis:**
  - LH Impact
  - RH Impact

**A1/A2:**  
- LH: 0.0801  
- RH: 0.1288

**Threshold = 0.17**

**Pelvis Diff (Mean/SD):**
- Max: -0.306 / 4.239
- Min: 1.80 / 3.381

**Threshold = ±3mm**

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**Evaluator Notes (before and/or after data collection):**

- There is "no" evidence of LF lameness
- There is "no" evidence of RF lameness
- There is "no" evidence of LH lameness
- There is "no" evidence of RH lameness

prueba 1
METHODS. PHASE 2, ULTRASOUND.
COLLAGENASE type I INJECTION

17,100 U/2 mL
Sterile water

2500 UI/ 0.3mL
US GUIDED
DAY ONE, BEFORE INJECTION

DAYS 10, 21, 45 y 56 AFTER
**Blocks:**

Analysis settings: Delta = 0.1; Fore SD = 3.2;

**Stride Rate:** 1.606  **Strides Evaluated (front/hind):** 29 / 28

**Front Limb Evaluation**

![Graph showing front limb evaluation]

**Hind Limb Evaluation**

![Graph showing hind limb evaluation]

**A1/A2:** LF: 4.4529  **A1/A2:** LH: 0.006

Threshold = 0.50  RF: 0.00  **Threshold = 0.17**  RH: 0.4045

Head Diff (Mean/SD): Max: -41.736 / 21.228  **Pelvis Diff (Mean/SD):** Max: 10.448 / 3.868

Threshold = ±6mm  Min: -118.389 / 22.662  **Threshold = ±3mm**  Min: 5.428 / 4.719

**Evaluator Notes (before and/or after data collection)**

There is "strong" evidence of "moderate/severe" LF lameness
There is "no" evidence of RF lameness
There is "no" evidence of LH lameness
There is "strong" evidence of "moderate" RH lameness
Consider LF as primary
5dias post inyeccion
PHASE 3: Neurectomy, Induction
Preparation of the site
GRAPAS DE PIEL
Lab

- Resected nerve segments were submitted for histologic evaluation
  - Hematoxylin and eosin
  - Masson Trichrome
  - Alcian blue
  - Luxol fast-blue
SKIN STAPLES WERE REMOVED 14 DAYS AFTER
Results: Values obtained with body internal sensors

<table>
<thead>
<tr>
<th>Test condition</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time zero (baseline)</td>
<td>5.1 ± 0.643</td>
</tr>
<tr>
<td>8 weeks after PSD induction</td>
<td>91.3 ± 11.4 *</td>
</tr>
<tr>
<td>2 weeks after neurectomy of the DBPaLN</td>
<td>6.6 ± 0.82</td>
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* Means significantly different (threshold 8.5 mm)
Results

- Values would tell that collagenase created a lameness caused by proximal suspensory desmitis and the neurectomy of the DBLPaN was successful in resolving the lameness....
Histopathologic findings

- Expansion of the subperineum by a poorly cellular myxomatous matrix 8 neves, Renaut body formation 6 nerves.
Histopathologic findings

- Axonal swelling and necrosis with myelin degeneration
  8 nerves

Normal

Treated
LFB, TREATED 40 X
CROSS SECTION DBLPaN MT 100 X

TREATED

CONTROL
CROSS SECTION DBLPaN MT 100 X

TREATED

CONTROL
Discussion

- Persistence of thoracic limb lameness in horses with PSD may be caused by compression of the DBPaLN, which innervates the proximal aspect of the suspensory ligament and be the cause of pain causing lameness rather than pain originating within the proximal aspect of the suspensory ligament.
Discussion

- Excision of the DBLPaN enabled horses with PSD to return to the exercise.....
  - Interruption of sensory innervation to a painful suspensory ligament?
  - Removal of a painful segment of an entrapped nerve?
Discussion

• Future directions

  • Evaluate the importance of neurogenic atrophy of SL after DBLPaN resection – potential for failure
    (Pauwels et al)
Conclusions

- All nerves (DBLPaN) resected from PSL with induced desmitis had evidence of entrapment neuropathy.

- Chronic lameness in horses affected with PSD can be caused by compression neuropathy in forelimbs.

***The protocol was approved by the FMVZ-UNAM Institutional Animal Care and Use Committee.***
THANKS!!
Lameness of horses caused by chronic PSD can be resolved by neurectomy of the DBLPaN when horses are refractory to more conservative therapy*

DISCUSSION

- Why does excision of DBLPlN resolves lameness in the majority of horses
  - By interrupting sensory innervation to painful suspensory ligament?
  - By removing a painful segment of entrapped nerve?
DISCUSSION

• Should neurectomy be performed on both pelvic limbs even if horse is lame on only 1 limb?
  • Unilaterally affected horses sometime become lame on non-operated limb
Factors that Predispose to PSD

- Immaturity & poor conditioning
  - Strength is related to size & number of collagen fibrils
  - Increase in response to increase in physical demands
  - PSD occurs when physical demands surpass body’s ability to adapt