

# Tutorial Article

## Comparison of diagnostic anaesthetic techniques of the proximal plantar metatarsus in the horse

J. M. GAYLE<sup>†</sup> AND W. R. REDDING<sup>\*</sup>

*Department of Clinical Sciences, College of Veterinary Medicine, North Carolina State University, 4700 Hillsborough Street, Raleigh, North Carolina 27606, USA.*

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### Introduction

Diagnostic anaesthesia is a technique commonly used in lameness evaluation in order to isolate more completely the source of pain causing lameness (Stashak 1986). Regional, local and intra-articular anaesthesia are all methods of performing diagnostic anaesthesia with increasing degrees of specificity, respectively (Stashak 1986). Regional anaesthesia is defined as the perineural injection of local anaesthetic solution. Local anaesthesia refers to direct infiltration of anaesthetic solution within the tissues of interest, and intrasynovial anaesthesia is achieved by injecting local anaesthetic directly within a joint or other synovial structure (Stashak 1986).

Proximal suspensory desmitis of the hindlimb is becoming more commonly recognised in performance horses as a source of lameness (Moyer *et al.* 1988; Dyson 1991, 1994, 1995; Dyson *et al.* 1995). Diagnosis based on physical examination findings can be difficult because of the anatomical relationship of the proximal suspensory ligament to the surrounding metatarsal bones. In particular, the large base of the fourth metatarsal bone makes palpation and localisation of pain to this area difficult (Moyer *et al.* 1988; Dyson 1991, 1994, 1995; Dyson *et al.* 1995). Therefore, accurate diagnosis of proximal suspensory desmitis in the hindlimb requires the use of diagnostic anaesthesia (Moyer *et al.* 1988; Dyson 1991, 1994, 1995; Dyson *et al.* 1995; Dyson and Genovese 2003).

The proximal aspect of the suspensory ligament of the hindlimb receives innervation from the tibial nerve (Shively 1984). Just proximal to the calcaneus, the tibial nerve branches into a lateral and medial plantar nerve. The lateral plantar nerve gives off a deep branch approximately 2–4 cm proximal to the base of the fourth metatarsal bone. The deep branch of the lateral plantar nerve then further branches into medial and lateral plantar metatarsal nerves, which ultimately provide innervation to the proximal suspensory ligament

(Shively 1984). This anatomy is somewhat similar to that of the forelimb in which the ulnar nerve receives a contribution from the median nerve before becoming the lateral palmar nerve (Muylle *et al.* 1998). The lateral palmar nerve then gives off a deep branch prior to branching into the medial and lateral palmar metacarpal nerves (Shively 1984).

In the forelimb there is a close association between the origin of the suspensory ligament, associated nerves and the palmar outpouching to the carpometacarpal joint (Ford *et al.* 1989). Three methods of diagnostic analgesia of the proximal metacarpal region were compared. Local infiltration of anaesthetic into the origin of the suspensory ligament was frequently associated with inadvertent injection of the carpometacarpal joint (Ford *et al.* 1989). In 68% of the specimens, the carpal canal was inadvertently penetrated when the palmar and palmar metacarpal nerves were anaesthetised at the level of the distal aspect of the accessory carpal bone (Ford *et al.* 1989).

A previous study in the hindlimb has outlined the plantar distribution of the tarsometatarsal joint using radiographic analysis after intra-articular injection of contrast medium (Dyson and Romero 1993). This study found significant amounts of contrast located plantar and distal to the tarsometatarsal joint following injection, and it was hypothesised that this may result in perineural anaesthesia of the plantar metatarsal nerves, and the proximal aspect of the suspensory ligament (Dyson and Romero 1993). Perhaps more importantly, these plantar outpouchings of the tarsometatarsal joints may allow for the inadvertent intra-articular injection of local anaesthetic following diagnostic anaesthesia of the proximal metatarsus in an analogous situation in the forelimb (Dyson and Romero 1993).

There are numerous reported methods of performing diagnostic anaesthesia of the proximal suspensory ligament of the hindlimb (Dyson 1991; Dyson and Romero 1993). The purpose of this study is to determine the frequency of inadvertent infiltration of the distal tarsal joints (tarsometatarsal and centrodistal joints) and tarsal sheaths when performing proximal plantar metatarsal anaesthesia.

<sup>\*</sup>Author to whom correspondence should be addressed. <sup>†</sup>Present address: New England Equine Practice, 310 Peach Lake Road, Brewster, New York 10509, USA.

## Materials and methods

Eighteen hindlimbs from the midtibia distally were collected from the cadavers of 9 horses within 24 h of death. One clinician (W.R.R.) performed all injections using a solution of 1:100 new methylene blue solution in sterile water as a marker substance. Nine hindlimbs were injected with *Method A* and 9 hindlimbs with *Method B*. Immediately after injection, all limbs were dissected by the other clinician (J.M.G.) and the location of the marker substance determined. The incision to perform the dissection was placed between the superficial digital and deep digital flexor tendon and the lateral splint bone from the calcaneus to midmetatarsus. Particular attention was paid to the area of diffusion of the dye, whether there was uptake of dye in the deep branch of the lateral plantar nerve, and the presence or absence of dye within the distal tarsal joints and/or tarsal canal.

### Injection techniques

#### *Method A - Subtarsal nerve block (Dyson 1991)*

An 18 gauge, 3 cm needle was inserted 2 cm distal and axial to the head of fourth metatarsal bone on the plantar aspect of the limb. The needle was advanced dorsally, perpendicular to the third metatarsal bone, and axial to the fourth metatarsal bone until it came in contact with the plantar surface of the metatarsus III where 3 ml of the dye solution was injected. The needle was redirected further dorsomedially and an additional 3 ml of local anaesthetic was deposited. If there was excessive resistance to injection, the needle was withdrawn slightly prior to injection.

#### *Method B - Deep branch of lateral plantar nerve*

An 18 gauge, 3 cm needle was inserted approximately 2 cm distal and plantar to the head of the fourth metatarsal bone, and directed proximodorsally and axial to this bone. The needle was directed to a depth of 1–2 cm (**Fig 1**) and 6–7 ml of the dye solution were injected. If resistance was felt, the needle was withdrawn slightly and the injection then made.

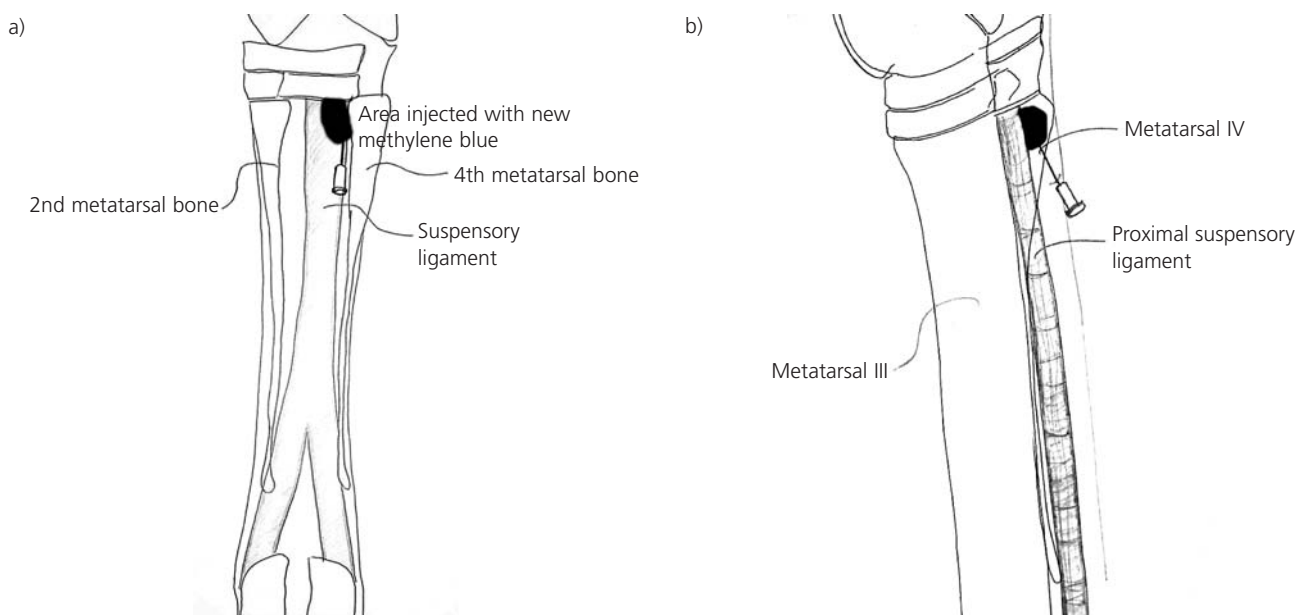
### Statistical analysis

The frequency of injection into the tarsometatarsal joint and tarsal sheath with each method was compared by Fisher's exact test (Snedecor and Cochran 1980). A probability of  $P < 0.05$  was considered significant for all statistical tests.

### Results

*Method A* was associated with inadvertent infiltration of the tarsometatarsal joint in 12.5% (1/9) of the limbs, and the tarsal sheath in 50% of the limbs. In one limb (12.5%) dye was found within a plantar metatarsal vein using *Method A*. Following *Method B*, only 12.5% of the limbs had evidence of inadvertent infiltration of the tarsal sheath, and there was no evidence of infiltration of the tarsometatarsal joint in any of the limbs. Although there was a trend towards increased frequency of inadvertent infiltration using *Method A* as compared to *Method B*, this difference was not significant ( $P = 0.28$ ).

The deep branch of the lateral plantar nerve was located approximately 2–4 cm proximal to base of the fourth metatarsal bone. The lateral and deep branch of the lateral plantar nerve would apparently be anaesthetised by both methods as there was dye solution completely surrounding the



**Fig 1:** Line diagrams from cranial (a) and axial (b) views to demonstrate the parallel direction of the needle placement just axial to the head of the lateral splint in a distal to proximal direction.

nerve tissue. *Method B* appeared to be more specific for the deep branch of the lateral plantar nerve, and the dye solution tended to be more localised within the fascial plane formed by the tarsal retinaculum and the superficial and deep digital flexor tendons. *Method B* was associated with less diffusion of the dye solution into the deeper surrounding tissues.

## Discussion

Two methods for blocking the origin of the suspensory ligament have been previously described (Dyson 1991; Dyson and Romero 1993). These methods include *Method A* as described above, and a variation of *Method A* in which the medial deposition of anaesthetic is made by making a separate injection plantar and axial to the second metatarsal bone instead of redirecting the needle medially. We chose not to evaluate this method, because we feel that it poses significantly more risk to the veterinarian as 2 separate injections must be made, and Dyson reported a higher risk of inadvertent infiltration of the tarsal sheath and tarsometatarsal joint (Dyson and Romero 1993). In this report, we describe a third technique that the investigators have found to be well tolerated by clinical cases. The technique reported in this paper as *Method B* is relatively simple to perform requiring only a single injection without redirecting the needle. By using this technique the deep branch of the lateral plantar nerve is selectively desensitised. When this technique was first developed the authors picked the leg off the ground and held the limb in a flexed position to insert the needle as well as to inject the local anaesthetic. When using this technique while holding the limb it was felt that it was important to use an 18 gauge needle in order to prevent shearing of the shaft of the needle should the animal suddenly flex or extend the limb. Currently, the authors perform this injection technique in the standing animal using a 3 cm, 20 gauge needle. We have found there to be minimal movement, reducing the fear of shearing the needle. However, the examiner should be careful to not place the needle into the flexor tendons or suspensory ligament as this shearing effect is still possible.

In a previous study, Dyson found that *Method A* was associated with inadvertent infiltration of the tarsal sheath in 3 of 20 limbs, and a second technique (variation of *Method A*) was associated with infiltration of 1 of 20 tarsometatarsal joints and 5 of 20 tarsal sheaths (Dyson and Romero 1993). In the present study, *Method A* was more frequently associated with inadvertent infiltration of the tarsal sheath than was *Method B*; however, this difference was not significant. Lack of statistical power is probably related to the low number of limbs used. Based on impressions gained by post injection dissection we believe that the increased incidence of inadvertent injection was associated with redirecting the needle medially.

Palmar outpouchings of the carpometacarpal joint are in close proximity to the palmar metacarpal nerves, and the origin of the suspensory ligament in the front limb (Ford *et al.* 1989). This anatomical association is utilised by some clinicians, who localise lameness associated with the proximal metacarpus by performing intra-articular anaesthesia of the middle carpal and

carpometacarpal joint by injecting the middle carpal joint. The presence of similar plantar outpouchings of the tarsometatarsal joints in horses has been shown by Dyson and Romero (1993). These plantar outpouchings may also explain why some horses with proximal suspensory desmitis show improvement following intra-articular anaesthesia of the tarsometatarsal joint (Dyson 1991, 1994; J.M. Gayle, unpublished data).

While this was a cadaver study utilising new methylene blue, there may be some discrepancy on the distribution of this product and local anaesthetic solution particularly in the live animal. Precise deposition of local anaesthetic is essential in understanding and correctly interpreting response to diagnostic anaesthesia. Based on the results of this study, *Method B* appears to provide more precise deposition of anaesthetic, and is associated with fewer inadvertent injections of either the tarsal sheath or the tarsometatarsal joints. There was one animal in which *Method A* was utilised that had inadvertent penetration of a vein. While blood in the hub of the needle may be noticed when placing the needle the possibility exists that local anaesthetic solution may be injected intravascularly. This may diminish the volume of local anaesthetic solution in the area of the nerve (and the possibility of a false negative result), create a systemic reaction to the injected solution or increase the possibility of a haematoma forming at the site of injection.

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