How to Perform an Alternative Method to Anesthetize the Palmar/Plantar Digital Nerves

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1. Introduction
The palmar digital nerve (PDN) block is the most common diagnostic analgesic procedure performed for perineural analgesia in the forelimb. The plantar digital nerve (PDN) block is not used as commonly because the palmar digital nerve block; however, it is important in the isolation of pain in some rear-limb lameness.1

The referenced site for the injection of the local anesthetic agent for a palmar/plantar digital nerve block ranges from the proximal margin of the ungulate cartilages to mid pastern over the medial and lateral neurovascular bundles.1–5 However, one reference describes the block as being performed by inserting the needle on the palmar midline, placing the line of the local anesthesia solution in a proximal-dorsal direction to the sites of the medial and lateral palmar/plantar digital nerves.1

Recent literature indicates that the PDN block, by use of the commonly prescribed sites, anesthetizes several structures of the foot, the proximal interphalangeal joint (PIP) and other related structures.1–5 A recent publication described metacarpophalangeal joint lesions identified on magnetic resonance imaging with lameness that resolved through the use of palmar digital nerve analgesia.6 However, the precise site of the PDN block was not described. The recent published information underscores why the procedure should be done as distal as is possible and practical to achieve anesthesia of the PDNs and limit the proximal and dorsal anesthesia of the digit and fetlock.

The following procedure was first explored by the author as a result of discussion during the Internationales Symposium (Strahlbeinlahmheiten), International Symposium on Podotrolosis, Dortmund, Germany, 1993. The attending Swiss delegation stated that to maximize the diagnostic value of the PDN block, it must be performed much more distal than the sites commonly used. Since 1993, the author has used the following technique to achieve analgesia of the foot. It has provided more consistent information than that found when the block was administered in and around the neurovascular bundle at the proximal margin of the ungulate cartilages. Careful clinical assessment of this block has been that painful lesions proximal to the mid palmar/plantar pastern are not anesthetized. Lesions proximal from the dorsal coronet band are not anesthetized. On several occasions, after incomplete resolution of the lameness from a PDN, intra-articular anesthesia of the coffin joint eliminated the lameness. Lameness from lesions involving the PIP joint will improve but will not be eliminated by
the described method. Consequently, a pastern ring block eliminated the lameness.

Before a PDN block is administered, a thorough clinical examination of the lame leg must be performed. A careful, thorough, and methodical application of hoof testers is of paramount importance as a part of the clinical examination.

Application of the PDN block by this technique is very useful and reproducible because (1) the anesthetic can be administered more distal than the level of the proximal border of the ungulate cartilages, (2) only one painful event is experienced by the horse, (3) seldom is restraint necessary (ie, twitching), (4) there is less risk in breaking off a needle, (5) the PDNs can be displaced axially during administration, facilitating the placement of the anesthetic agent on or near the axial surface of the nerves, reducing the spread of the agent dorsally and proximally, (6) inadvertent synoviocentesis of the distal synovial sheath is not likely because the position of the distal digital annular ligament is deep to the site and the palmar distal limit of the distal synovial sheath is proximal to the site of the injection, (7) the results are more predictable in one’s hands than the commonly recommended site at the level of the proximal border of the ungulate cartilage, (8) the technique eliminates the sensation occasionally found in the region of the coronet band at the midline over the central sulcus of the frog and 1 to 2 cm abaxial to the midline when the anesthetic is deposited over the commonly recommended site (it is suspected that an aberrant nerve branch being more palmar than the neurovascular bundles is responsible for this persistent sensation), (9) the technique significantly reduces the possibility of administration of the anesthetic solution intravascularly in branches of either the digital artery or vein, and (10) the technique eliminates the use of anesthesia of the coffin joint as a method to anesthetize the PDNs.

2. Materials and Methods

A 1150-lb, 12-year-old Thoroughbred gelding scheduled for euthanasia because of atrial fibrillation was used to demonstrate the procedure and investigate proximal dorsal migration of injected agents from the injection site. The first block was done on the left front with a local anesthetic. The second was done on the right front with contrast media. Three days later, the right front digital synovial sheath was injected with contrast media, the right rear PDN site was injected with a 50/50 solution of contrast media and local anesthetic, and the right front PDN site was injected with dye. Before the procedure was performed on the right front and right rear, plantar/palmar nerve blocks were performed proximal to the fetlocks to alleviate discomfort from the procedures.

The site for the initial skin bleb is between the bulbs of the heels 2 to 4 cm proximal to the coronet band on the midline directly above the middle sulcus of the frog, where the dermis is flat over the distal digital annular ligament and the deep digital flexor tendon. The dorsal margin of the ungulate cartilages and the injection site were identified with radio-opaque markers taped and superglued to the skin.

![Fig. 1. Dorsal margin of the ungulate cartilages and the injection site are identified with radio-opaque markers taped and superglued to the skin.](image1)

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![Fig. 2. Tape is removed and the site is radiographed.](image2)

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skin (Fig. 1). The tape was removed and the site was radiographed (Fig. 2). Preparation of the site is accomplished by scrubbing with an antiseptic soap followed by a thorough application of chlorhexidine gluconate/alcohol solution on 4 x 4 sponges. Note: Excess hair is clipped away if the neurovascular bundles cannot be easily palpated, the initial site of injection cannot be well observed, or the evidence of subcutaneous distention from the anesthetic agent cannot be observed and/or palpated.

To administer the palmar digital nerve block, the front limb is picked up and held between the administrator’s knees (Fig. 3A). For the plantar digital nerve block, the rear limb is picked up, extended caudally, and held on the examiner’s thigh (Fig. 3B); 6 mL of 2% mepivacaine in a disposable 6-mL syringe with a 25-gauge 5/8-inch (1.6 cm) needle attached is routinely used (0.5–1 mL for the bleb and 2.75–2.5 mL directed from the bleb subcutaneously toward the nerve). The initial bleb, in the majority of cases, can be performed without restraint by applying pressure with movement with the use of the thumb or a finger of the free hand, just proximal to the site (Fig. 3A). Recently, lidocaine/prilocaine topical cream has been applied to the site before the initial injection on a hypersensitive horse. Also, the use of a 3-mL syringe (Fig. 3B) may facilitate the placement of the bleb in the rear limb. From the bleb, the needle is directed abaxially toward the palmar/plantar digital nerve (medial or lateral) in a slightly distal dorsal direction, injecting a small amount subcutaneously as the needle is being advanced toward the nerve the full length of the needle (Fig. 4). The needle is withdrawn and redirected toward the opposite PDN. Often this can be performed without removing the needle completely from the skin. If there is significant resistance to the flow of the agent, the needle should be slightly redirected until there is less resistance and the slight subcutaneous enlargement can be seen. As the agent is being injected, the thumb or a finger of the free hand displaces the neurovascular bundle toward the midline just proximal to the injection site (Fig. 4). This facilitates depositing the anesthetic near the axial surface of the nerve, avoiding intravascular injection, and assists in limiting the proximal and dorsal migration of the anesthetic (Fig. 4).

After the injection, the horse can be allowed to stand quietly until the effectiveness of the block is
evaluated 15 minutes after injection. The loss of skin sensation distal to the block is evaluated by applying pressure to the coronet band with a small, blunt instrument directed dorsally. It is important to start the assessment beginning at the coronet band directly above the middle sulcus of the frog, progressing dorsally toward the toe both medially and laterally at 1-cm intervals until a pain response is produced (Fig. 5). This is followed by the application of hoof testers to evaluate the loss of a positive reaction present before the block is given (Fig. 6). The next step is re-evaluation of lameness to determine whether pain is eliminated, or, if not, to what degree.

Initially, the PDN site of the right front was injected with 6 mL of iodinated contrast media, as outlined for the PDN block to evaluate migration of the media. Serial radiographs were taken: the first was 2 minutes after injection and the last was 1 hour after injection. Note the contrast media in the afferent lymph channels (Fig. 7).

Three days later, in the right rear limb, a plantar digital nerve block was performed with 3 mL of mepivicaine and 3 mL of iodinated contrast media to evaluate migration of diluted media. Radiographs were taken within 5 minutes (Fig. 8). There is evidence of more lymph drainage in the rear limb than in the front limb.

Three days after injection of the right front PDN site with contrast media, the right front digital synovial sheath was injected with 8 mL of iodinated contrast media. The lateral approach between the palmar annular ligament of the fetlock and proximal digital annular ligament was used. Radiographs at 2 and 30 minutes after injection demonstrated the palmar distal limit of the sheath to be at the level of the proximal border of the ungulate cartilage (Fig. 9).

After the tendon sheath study, 6 mL of methylene blue was injected at the described site of the PDN block and in the same manner. Fifteen minutes later, the horse was euthanized and exsanguinated. The right front leg was immediately disarticulated at the carpometacarpal joint. The skin was later removed from the carpus to the coronet band to evaluate the migration of the dye. The bulk of the dye remained subcutaneously at the injection site (Fig. 10A). The remainder diffused abaxially to and around the palmar digital nerve and digital artery. Very little dye was evident around the digital vein or the dorsal branch of the digital nerve (Fig. 10B). However, the dye was evident in the afferent lymph channel from the injection site to the transection site (Fig. 11). There was minimal dye deep to the superficial fascia of the digit (Fig. 12A) and no evidence of the dye in the distal synovial sheath or around the deep digital flexor tendon (Fig. 12B).

3. Results
This procedure has produced consistent results in eliminating pain causing lameness in the foot. It has been effective in differentiating sites of pain proximal to the foot, including the dorsal aspect of both the coffin and the PIP joints and the fetlock. This technique has eliminated occasional pain from an aberrant nerve between the palmar digital nerves supplying sensation to the skin between the bulbs of the heels and deep tissues of the caudal portion of the foot (eg, hoof tester response).
Since the information obtained from the International Symposium on Navicular Disease, Dortmund, Germany, 1993, this procedure has evolved in the author's hands. The number of cases in which the described procedure has been used during the 19-year time span of use is difficult to identify. However, a recently adopted record system tabulated the number of PDN blocks performed by the author from February 2010 to February 2013 to be 179. With the use of this information, it could be extrapolated that over the past 19 years, the author performed approximately 1000 PDN blocks.

4. Discussion

The procedure facilitates a consistent site for the administration of a local anesthetic agent to the medial and lateral palmar/plantar digital nerves. It is easily performed, and the results are highly predictable. With the described technique, in the majority of cases, the level of anesthesia, as determined by the lack of response to pressure at the coronet band from a blunt instrument, will be from the middle sulcus area of the coronet band dorsally to one fourth to one third of the distance to the toe.

Fig. 7. Contrast media in the afferent lymph channels.

Fig. 8. Plantar digital nerve block performed with 3 mL of mepivicaine and 3 mL of iodinated contrast media to evaluate migration of diluted media. Radiographs were taken within 5 minutes.
However, occasionally the anesthesia extends to the toe portion of the coronet band. In the author’s opinion, this does not materially affect the interpretation of the block, but it does support the statement made by G. Kent Carter, “Diagnostic anesthesia has limitations; although the majority of horses have a reliable response variations are occasionally encountered, and confusing or inaccurate results are obtained.”4 A positive response to the hoof testers after the PDN block is evidence that the block failed and must be repeated. The procedure eliminates sensation from the occasional aberrant nerve in the palmar portion of the pastern between the PDNs. Failure to eliminate sensation from such an aberrant nerve will compromise the interpretation of the PDN block and misdirect the focus on the site of pain producing lameness.

When lesions involving the dorsal aspect of the PIP have been identified by clinical examination, radiographs, and/or magnetic resonance imaging, the described technique will improve but not eliminate the degree of lameness, nor will a positive response to the flexion of the phalangeal joints be eliminated. Consequently, when a ring block of the pastern eliminates the lameness and the positive response to flexion of the phalangeal joints, the pain is likely to be from the PIP joint and/or adjacent soft
Fig. 12. Minimal dye deep to the superficial fascia of the digit (A) and no evidence of the dye in the distal synovial sheath or around the deep digital flexor tendon (B).

Fig. 13. Distal palmar limit of the digital synovial sheath is proximal to the site; the distal digital annular ligament is a barrier.
tissue structures. If there is little evidence of pathology in the PIP and the described PDN block improved the lameness but does not eliminate the lameness, intra-articular anesthesia of the coffin joint is the next step in an attempt to determine the site of pain. Often the lameness is eliminated. These findings indicate that the technique described does not routinely anesthetize the dorsal aspect of the distal interphalangeal joint or PIP joints, nor the fetlock region. This observation is similar to that of Bassage and Ross.\textsuperscript{1}

The proximal dorsal migration of the contrast media and dye was less than anticipated. The immediate uptake by the afferent lymph vessels was an unexpected finding. Clinically, the amount of anesthetic in the lymph vessels appears not to materially affect anesthetia of sites proximal to the PDN block.

Because the described technique will eliminate sensation from an aberrant nerve between the palmar digital nerves, it should not be used to predict the effective analgesia of a PDN neurectomy. The PDN block for this purpose should be done at the anticipated site of the neurectomy.

Care should be taken not to enter the distal portion of the digital synovial sheath of the flexor tendons. This has not been a problem when the type of needle described is used and the anesthetic agent is deposited subcutaneously. Also, the distal palmar limit of the digital synovial sheath is proximal to the site.\textsuperscript{7–9} In addition, the distal digital annular ligament is a barrier (Fig. 13). The possibility of breaking off a needle is reduced by the direction of the needle insertion being horizontal rather than being directed distally and parallel to the plane the horse’s leg will travel if jerked forward. The introduction of a contaminant is reduced with the use of the small needle and proper preparation.\textsuperscript{10}

Even though the specificity of the palmar/plantar digital nerve block has come into question, its use in the diagnosis of lameness remains a very important procedure to initiate the isolation of pain causing lameness. Also, the information is beneficial in determining the need for additional diagnostic modalities, selection of therapy, and providing a prognosis for the problem. The analgesic effect of the anesthetic migrating proximal in the afferent lymph channels poses a question that adds to the confusion as to what structures are anesthetized proximal to the PDN block. Clinically, this does not appear to be a problem because painful sites proximal to the PDN block routinely are eliminated by blocking sites proximally (ie, pastern ring block, four-point block, high suspensory block).

In summary, the technique described is relatively easy to perform and can be performed with minimal restraint; there is only one painful experience for the horse—the anesthetic is deposited on the axial margin of the PDNs; the invasion of the vascular portion of the neurovascular bundle is very unlikely; and the anesthetic agent is easily deposited below the level of the proximal limit of the ungulate cartilages. If aberrant nerves are present axial to the PDN, they will be anesthetized. The problem of anesthetizing sites of pain proximal to the PDN site is minimized. The results are reproducible.

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References and Footnotes

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