How to Perform Radiographic-Guided Needle Placement Into the Collateral Ligaments of the Distal Interphalangeal Joint

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1. Introduction

The diagnosis of abnormalities in the collateral ligaments of the distal interphalangeal (DIP) joint distal to the coronary band is occurring with increased frequency. This is likely due to the use of magnetic resonance imaging (MRI) as a diagnostic tool in cases with foot lameness. Collateral ligament (CL) injury proximal and immediately distal to the coronary band can be diagnosed using ultrasound. Osseous lesions of the distal phalanx at the CL insertions can be diagnosed on radiographs. However, visualization of abnormalities in the CLs of the DIP joint at the level of the insertion on the distal phalanx can only be diagnosed with MRI or computed tomography (CT). Lesions identified in the CLs of the DIP joint diagnosed on MR images consist of core lesions with fiber disruption, diffuse injury without fiber disruption, margin tears, and complete ligament disruption.

Intralesional therapy, such as platelet-rich plasma (PRP) and stem cells, is one of the possible treatment options in cases with a diagnosis of soft-tissue injury. Imaging modalities can be used to facilitate needle placement for injection of therapeutic agents. Soft tissue is best visualized with MR and ultrasound (US). Therefore, these modalities are often selected to facilitate needle placement into soft-tissue lesions. CT can be used in a soft-tissue window in conjunction with osseous landmarks for needle placement into soft-tissue injuries. MRI and CT require general anesthesia, whereas US and radiography can be performed in the standing horse. Radiography is commonly used to facilitate needle placement when reliable bony landmarks are available, such as injection of the navicular bursa using the navicular bone flexor surface as a landmark.

The CLs of the DIP joint insert on the fossae of the distal phalanx. The fossae of the distal phalanx can be reliably identified on radiographs and recognized on multiple views. The purpose of this paper is to provide a description of how to use radiography to facilitate needle placement into the distal aspect of the CLs of the DIP joint for injection of intralesion therapy.
2. Materials and Methods

This technique is performed after diagnosis of a lesion in the distal aspect of the CLs of the DIP joint using high- or low-field MRI. The MR images are used to determine the desired site of needle placement based on relative distance from the margins of the fossa and whether the lesion is dorsal, palmar, or centrally located within the ligament. A 3.5-in, 18-gauge needle placed into the fossa can be performed with the horse standing or under general anesthesia. It can also be performed in conjunction with an MRI exam or other procedure. This report will provide a description of the procedure in a standing sedated horse, but it can certainly be adapted to a patient under general anesthesia.

3. Patient Preparation

Before performing the procedure, an abaxial nerve block is performed, and the hair is clipped from the injection site. During the procedure, sedation is used at the discretion of the veterinarian to prevent movement of the limbs. To approximate the location of the CLs for clipping, the coronary band can be palpated for areas of dense tissue at the 10:00 and 2:00 positions on the dorsal aspect of the foot. If the CLs are not palpable because of diffuse swelling, US can be used to locate them. A region of approximately 10 cm extending from the coronary band centered over the CL of interest is clipped. Properly placing a needle in the CL fossa is dependent on being able to identify the fossa margins on radiographs. Three radiographic views that are useful in locating the CL fossae include the lateromedial (LM), horizontal or weight-bearing dorsopalmar (DP), and dorso 60° proximal palmarodistal (D60°P) views (Fig. 1). Therefore, the horse will need to be positioned with both front feet on foot blocks to allow proper radiographs to be taken after the needle is placed.

When taking radiographs, it is important that proper safety precautions be taken and protective equipment be worn. In general, sequential radiographs are taken with continued needle advancement toward the fossa. We use a LM view followed by a horizontal DP view and then a D60°P view. However, the sequence of radiographs could be adjusted as needed. When first learning this technique, it is helpful to estimate the required proximal to distal angle of the needle before beginning needle placement. Before taking radiographs, a capped spinal needle can be positioned at the estimated proper angle and then held in place with tape (Fig. 2A). A lateral radiograph can be taken to view the needle placement in relation to the fossa. At this angle, the needle can then be advanced to the desired depth (Fig. 2B).
point, the capped needle can be adjusted accordingly until the person performing the procedure is confident that it is properly angled. After the appropriate angle is determined on a lateral radiograph, this angle can be marked on the limb with correction fluid, pen, or white tape, and therefore, it can be repeated after sterile preparation of the injection site (Fig. 2B). Before removing the capped needle, a DP radiograph can be taken to approximate the medial to lateral angle needed to direct the needle to the fossa. This initial process will reduce the need for repositioning the needle after it has been inserted through the skin. After proficiency at this technique is obtained, initial marking of the limb for needle placement is often not necessary. However, this decision to mark the limb could be dependent on how exact the needle placement must be based on the size and shape of the lesion. The area of ligament injury is taken into account when positioning the needle. The lesion location in the ligament as identified on MR images should be taken into consideration when planning this procedure. The needle can be inserted dorsal, palmar, or peripheral (abaxial) to the proximal aspect of the CL. This placement will avoid passing the needle through the proximal aspect of the ligament and allow for placement of the needle in the affected area of the ligament.

After sterile preparation of the injection site, the needle is inserted approximately 3 cm toward the fossa. Angles determined by the LM and horizontal DP radiographs, if previously obtained, are used to direct the needle (Fig. 3). After the needle has been advanced approximately 3 cm, LM and horizontal DP radiographs should be taken to confirm that the needle is at the correct angle to enter the fossa. If needed, the needle can be readjusted by retracting it 1–2 cm and redirecting it (Fig. 4). If the angle and placement are correct, the needle should be advanced 1–2 cm, and then, a D60°P radiograph is taken to evaluate needle position. After the correct angles have been obtained, the needle can be advanced until it contacts the fossa of the distal phalanx (Fig. 5). After the spinal needle has

Fig. 3. (A) Lateral radiograph showing initial needle placement. (B) The needle has been inserted approximately 3 cm. The needle is correctly positioned and can be advanced to the fossa. At this angle, the needle will be placed in the dorsal aspect of the fossa.

Fig. 4. Horizontal DP radiograph of initial needle placement. This view allows visualization of the medial to lateral angle of the needle. The distal aspect of the needle is angled too far axially or toward midline. Additional advancement would place the needle in the DIP joint. The needle should be repositioned by placing the hub closer to the limb at the angle shown by the arrow. This placement will allow advancement of the needle into the center of the fossa.
reached the fossa, any additional views needed to confirm proper needle placement should be taken. Intralesional therapy is administered after correct needle placement has been confirmed. After the needle is removed, the injection site is bandaged.

4. Results
This technique was performed initially on cadaver limbs using MRI-compatible needles. The needle placement was confirmed on MR images. Subsequently, this technique was performed using spinal needles with contrast administration. The contrast agent was detectable on radiographs and MR images to confirm placement of the contrast into the CLs. This technique has been used on 18 horses for administration of intralesional therapy after diagnosis of a CL lesion located in the distal aspect of the ligament. Lesions were diagnosed on MR studies from high- and low-field systems. No adverse effects from this technique have been observed. Stem cells and platelet-rich plasma have been administered using this technique. Recheck examinations 6 mo after treatment have been performed in three cases, and these cases showed clinical improvement as well as improvement in the appearance of the ligament on MR images.

5. Discussion
The technique provides a method for intralesional therapy of distal CL lesions with equipment commonly available in veterinary practice and without the use of general anesthesia. Proficiency can be achieved with knowledge of anatomy and radiographic technique as well as practice on a limited number of cadaver limbs. Using multiple radiographic views is necessary to ensure proper needle placement. Additional views, such as lateral oblique radiographs, may also provide helpful landmarks. These views should be performed at the veterinarian’s discretion during the procedure such that needle placement is adequately confirmed. However, the needle could be consistently placed in the distal aspect of the CL using the three described views, which are confirmed on MR images.

Fine-tuning needle placement into specific areas identified on MR images, such as axial, abaxial, dorsal, or palmar aspects of the ligament, can be achieved, but it requires additional practice (Figs. 6 and 7). Contrast can be used to confirm needle placement when practicing this technique on cadaver limbs. However, the effect of contrast material on most intralesional therapies is not known, and therefore, contrast use is not recommended when performing this technique on clinical cases.

Axial lesions are the most challenging for needle placement, because they are in close proximity to the DIP joint. The needle will enter the DIP joint if it is placed axial to the ligament at the level of the joint or immediately distal to it. Furthermore, thinning of the ligament or margin tears often occurs on the axial surface of the ligament. This space is often occupied by synovial membrane and fluid extending from the joint, increasing the possibility of needle placement in the joint. However,
these characteristics of the lesion will be apparent on the MR images and can be considered when planning the needle path. In these cases, placing the needle abaxial to the peripheral margin of the tear is necessary to prevent placing the needle into the joint.

In conclusion, radiography-guided needle placement into the distal aspect of the CLs of the DIP joint can be used to facilitate injection of intralesional therapy.

References


