How to Perform the Basilar Sesamoid Approach for Digital Flexor Tendon Sheath Injection in Horses

Sarah N. Sampson, DVM, PhD, Diplomate ACVS*; and R. Anthony Rocconi, DVM

1. Introduction
Access to the digital flexor tendon sheath (DFTS) is needed for synovial fluid sample collection, administration of local anesthetics or other medication, tendon sheath lavage, and creation of portals for tenoscopy. Because of intimate associations between the DFTS and various tendons and ligaments in the distal aspect of the limb, the DFTS is commonly involved in orthopedic problems in horses.1–5 Diagnosis of lameness can be facilitated by administration of local anesthetic solution within the DFTS, which can be necessary in horses that have little or no DFTS effusion. The distal sesamoidean ligaments, distal digital annular ligament, deep digital flexor tendon (DDFT), superficial digital flexor tendon (SDFT), palmar/plantar annular ligament, and intersesamoidean ligament are intimately associated with the DFTS, and these structures can be desensitized by deposition of local anesthetic solution within the sheath.6–4 Historically, collection of synovial fluid from the DFTS or injection into this structure has been difficult if little or no effusion is present.4,6 An efficient approach to the DFTS that simplifies performance of these procedures is needed.

The DFTS is a complex synovial structure that surrounds the DDFT and SDFT in the distal aspect of the limb.7 This sheath begins at the junction of the proximal two-thirds and the distal third of the metacarpus or metatarsus and extends distally past the metacarpophalangeal or metatarsophalangeal joint and pastern region, terminating just proximal to the collateral sesamoidean ligament within the hoof.8 The DDFT is completely enveloped by the DFTS in the fetlock and pastern regions; however, the branches of the SDFT exit the DFTS at midpastern level to insert on the proximopalmar or proximoplantar aspect of the middle phalanx.

Two sites typically accessed for DFTS synoviocentesis and injection in horses with effusion of this structure are the proximolateral pouch and the distal palmar or plantar pouch.9 When distension is present, fluid can accumulate in relatively large amounts in these locations. The proximolateral pouch is located abaxially at the proximal extent of the sheath between the suspensory ligament
branches and the DDFT. The distal palmar or plantar pouch is located at midline on the palmar or plantar surface at the distal aspect of the pastern between the proximal and distal digital annular ligaments. A third site used for DFTS synoviocentesis and injection, accessed through a palmar or plantar axial sesamoidean approach, has also been described. This approach, in which a needle is inserted into the DFTS from a location axial to the midbody of either proximal sesamoid bone, has been shown to be superior to the proximolateral approach in regard to the speed at which the DFTS is entered and decreased number of attempts to penetrate the DFTS in a study of equine cadaver limbs. These approaches can result in successful DFTS penetration, but the time it takes to enter the sheath and the ability to obtain fluid can be quite variable, indicating the need for development of a more reliable technique.

The proximal and distal collateral pouches of the DFTS are less commonly discussed in the literature. The proximal collateral pouch is found at the base of the proximal sesamoid bones between the distal aspect of the palmar or plantar annular ligament and the proximal aspect of the proximal digital annular ligament on either side of the palmar or plantar midline. The distal collateral pouch is found abaxially between the proximal and distal attachments of the proximal digital annular ligament. Neither of these pouches are easily visualized, even with DFTS effusion, but the proximal collateral pouch can be accessed by use of the base of a proximal sesamoid bone and the edge of the SDFT as landmarks.

The proximal collateral pouch has been used clinically for many years as an alternative approach for DFTS access, but the approach has not been fully described in the literature and the advantages and disadvantages of this approach have not been evaluated in a controlled study. Clinically, this basilar sesamoid approach (BSA) has been used in standing and recumbent horses for administration of local anesthetic or medication and as a site for gaining access for lavage and tenoscopy.

The objectives of the present study were to describe the BSA to the proximal collateral pouch of the DFTS and to evaluate the ease of injection and synovial fluid sampling with this approach in standing horses.

2. Materials and Methods

Twelve healthy adult mares from a university-owned breeding herd were included in the evaluation of the BSA. The horses had no evidence of lameness at a walk, no palpable effusion of the DFTS, and no obvious conformational abnormalities related to the distal aspects of the limbs. There were eight Quarter Horses, three Thoroughbreds, and one mixed-breed horse; median age was 12 years (range, 3 to 19 years) and body weight was 480 kg (range, 400 to 600 kg). One forelimb and one hind limb of each horse was randomly assigned for DFTS synoviocentesis and injection through the use of the BSA. This resulted in 24 limbs (12 forelimbs and 12 hind limbs).

For the BSA, hair is clipped from the lateral and palmar or plantar aspect of the fetlock region with a No. 40 blade (Fig. 1), resulting in a clipped area centered over the lateral proximal sesamoid bone. The clipped area is prepared for sterile injection. Horses in this study were sedated with detomidine hydrochloride (4 to 12 μg/kg IV), but restraint can also be achieved with the application of a nose twitch if the BSA is being used for local anesthetic deposition during lameness evaluation.

The metacarpophalangeal or metatarsophalangeal joint is held by an assistant in a mildly flexed position at an angle of approximately 200° to 220° from the dorsal surface of the third metacarpal or metatarsal bone (Fig. 1). This is accomplished most easily with the assistant facing the rear of the horse and holding the canon bone with the right hand and the hoof with the left hand when injecting the left forelimb or hind limb, and with the assistant holding the canon bone with the left hand and the hoof with the right hand when injecting the right forelimb or hind limb. This positioning provides easier access to the injection site. For hind limbs, the limb should be extended as much as possible toward the ground and behind the horse to decrease the spontaneous fetlock flexion that occurs when the limb is lifted off the ground. The injection site is then identified in the non–weight-bearing limb by palpating the depression created by the base of the lateral proximal sesamoid bone proximally and the lateral border of the SDFT axially (Fig. 2). This palpation can be facilitated by having the assistant...
slightly flex and extend the distal limb as the palpation is occurring. An 18-gauge, 3.8-cm needle is directed into the palpable depression at an angle of approximately 45° to the transverse plane (in a lateromedial direction) and 45° to the dorsal plane (in a distoproximal direction), to a depth of ≤1 cm (Fig. 3). Synovial fluid is commonly obtained with very superficial placement of the needle; therefore no further attempt should be made to advance the needle until it is determined that the initial needle placement is not successful, either by visualizing synovial fluid in the needle hub or by lack of resistance to injection.

Synoviocentesis and Injection
For this study, all synoviocentesis and injection procedures were performed by the same veterinarian who had no prior clinical experience with the technique being evaluated but had practiced the technique on cadaver limbs before beginning the live horse study. For each injection, 8 mL of sterile contrast material (iomeprol [300 mg of iodine/mL]) was injected, with confirmation of positioning on the basis of spontaneous appearance of synovial fluid in the needle hub or by lack of resistance to injection if no synovial fluid was obtained. Immediately after injection of each limb, a lateromedial radiograph was obtained under conditions of weight-bearing to determine whether the contrast material was delivered accurately. All procedures were recorded with a digital video camera to ensure accurate documentation of time required for the procedure, number of attempts to enter the DFTS, and presence of synovial fluid in the needle hub.

Assessment of Injection
For each injection in this study, the number of attempts needed to insert the needle into the DFTS was recorded. Any redirection of the needle constituted a new attempt to enter the DFTS. The presence of synovial fluid in the needle hub (yes or no) was recorded. All lateromedial radiographs were evaluated for the presence or absence of contrast material within the DFTS, and location of contrast material was recorded and described. Successful injection of contrast material was defined as obvious contrast material filling the DFTS throughout its proximal to distal extent of the sheath (Fig. 4). Elapsed time for DFTS injection was measured from needle insertion through the skin to the beginning of contrast injection into the sheath. The association between time to successful injection and horse was also assessed to determine whether the investigator gained proficiency with the technique during the course of the study.

Statistical Analysis
Visual assessment of the results for injection time and number of times the needle was redirected indicated the data were not normally distributed. Consequently, nonparametric methods of analysis that accounted for the hierarchic structure of the data were used. For each outcome, the data were ranked and analysis of variance was performed. An estimation of the covariance parameters with a repeated statement specifying horse identity as the subject, limb as the group, and an unstructured covariance structure was obtained. Limb interaction (front versus hind) was initially included in the model as a fixed effect but was found to have no significant bearing on the outcome. Linear regression was used to assess the association between

Fig. 2. Palmarolateral view of the left forelimb held in a mildly flexed position by an assistant. The palpable divot is identified with a finger at the base of the lateral proximal sesamoid bone. Proximal is to the left.

Fig. 3. Palmarolateral view of the left forelimb held in a mildly flexed position by an assistant and an 18-gauge, 3.8-cm needle is placed steriley into the digital flexor tendon sheath through the use of the basilar sesamoid approach. The needle is angled at 45° to the transverse plane and 45° to the dorsal plane. Proximal is to the left.
horse order and injection time. Values of $P < 0.05$ were considered significant.

3. Results

The median elapsed time for needle placement and injection of contrast material into the DFTS was 11.5 seconds (range, 4.2 to 114.9 seconds). The median number of times the needle was redirected for DFTS injection was 0.5 (range, 0 to 7). Synovial fluid was obtained spontaneously in 87.5% of limbs. There was no gross evidence of blood in synovial fluid obtained with any of the injections. Injection of contrast material into the DFTS was successful in 24 of 24 limbs. Comparison of results over time revealed that the time from initial needle insertion to injection decreased with increasing horse order ($R^2 = 0.30; P = 0.006$). There was no significant difference between front and hind limbs in any evaluated parameter.

4. Discussion

The BSA provided access to the DFTS with a high likelihood of synovial fluid retrieval in a relatively short period of time. Injection of contrast material into the DFTS was successful in all limbs. It is important to properly position the limb to expose the BSA in order to facilitate successful injection.

The anatomy of the proximal collateral pouch of the DFTS, the targeted entry point for the BSA, provides a superficial recess with an absence of overlying structures that makes this a practical alternative to conventional approaches and results in shallow needle penetration into the limb. It is likely that the ease of entry into the DFTS in the present study was in part because of the easily identifiable landmarks (specifically, the lateral border of the SDFT and the base of the lateral proximal sesamoid bone).

Clinically, an important aspect of this study was the ability to obtain a synovial fluid sample in 21 of 24 limbs. It was thought that the use of an 18-gauge, 3.8-cm needle was necessary to have the best chance of retrieving synovial fluid, and this size needle is commonly used for synoviocentesis. It is possible that a smaller diameter and shorter needle could be used for this approach, but other needle sizes were not evaluated in this study. On the basis of the depth of penetration needed for the approach in this study, a 2.5-cm needle is considered to be of sufficient length to enter the DFTS in horses with no swelling of the limb.

In the present study, synovial fluid retrieval was determined solely on the basis of visual detection of synovial fluid in the needle hub. This decision was made before beginning the study because the use of suction with a syringe to obtain fluid could result in tissue plugging the end of the needle and this could hinder subsequent interpretation of needle entry into the DFTS. When synovial fluid was not obtained in the hub of the needle, needle placement within the DFTS was determined by lack of resistance to injection.

A potential advantage of the BSA is the ability of a veterinarian unfamiliar with this approach to gain proficiency over time, although this was evaluated for only one veterinarian. Results of linear regression modeling indicated a significant association between horse order and time for DFTS injection. Given the number of other factors that could contribute to this outcome, the effect of horse order was shown to have a substantial effect by explaining 30% of the variation in time. Gaining efficiency quickly is particularly important to veterinarians who are attempting to learn a new procedure.

One important limitation of the present study was the inability to grossly or microscopically evaluate the limbs internally for trauma from needle penetration because none of the horses in this study were euthanized. However, it is theorized that the BSA may be a less traumatic means of entering the DFTS because the needle does not need to enter into deep structures of the limb and there is minimal interference to needle placement by surrounding structures.

Fig. 4. Lateral radiographic projection of the left front limb of a horse with contrast material filling the digital flexor tendon sheath immediately after injection through the use of the basilar sesamoid approach. Dorsal is to the left.

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In the present study, injections were performed in standing sedated horses, and there was some movement of the limb as there would be when performing the same techniques on standing non-sedated horses in a clinical setting. The BSA has been used by the author (SNS) in many equine patients for lameness diagnosis, medication administration, diagnosis of sepsis, evaluation of wound penetration, and tendon sheath lavage in nonsedated, sedated, and anesthetized horses as well as for tenoscopic portals in anesthetized horses. In the author's (SNS) experience, the BSA is no more difficult than a metacarpophalangeal or metatarsophalangeal joint injection and does not elicit more uncooperative behavior than the latter procedure; thus, it can be done with minimal restraint in many horses.

Results of the present study provide evidence that the BSA is a useful method for DFTS synoviocentesis and injection in forelimbs and hind limbs of normal standing horses and may be superior to other DFTS approaches in regard to ease of entry into the DFTS and the likelihood of obtaining a synovial fluid sample. Given the high frequency of obtaining a synovial fluid sample with the BSA in clinically normal horses (21/24 limbs), the use of the BSA should be considered when DFTS synovial fluid analysis is desired. Also, the use of the BSA should be considered when DFTS synoviocentesis is to be performed on limbs with minimal or no DFTS effusion.

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References and Footnotes


# Omnipaque 300, GE Healthcare Inc, Princeton, NJ 08550.