A GUIDE TO

EQUINE

Joint Injection and Regional Anesthesia

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who have helped along the way

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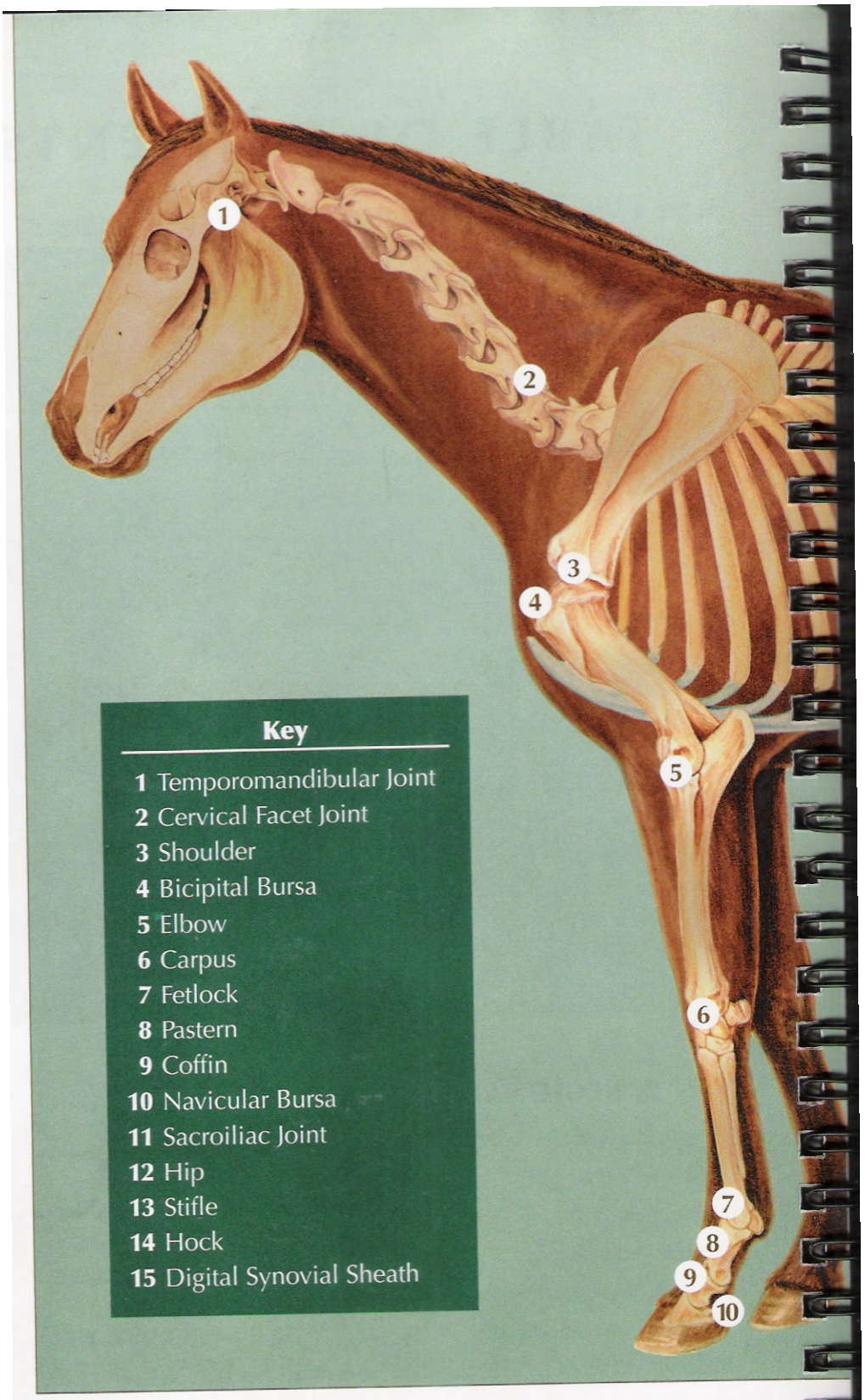
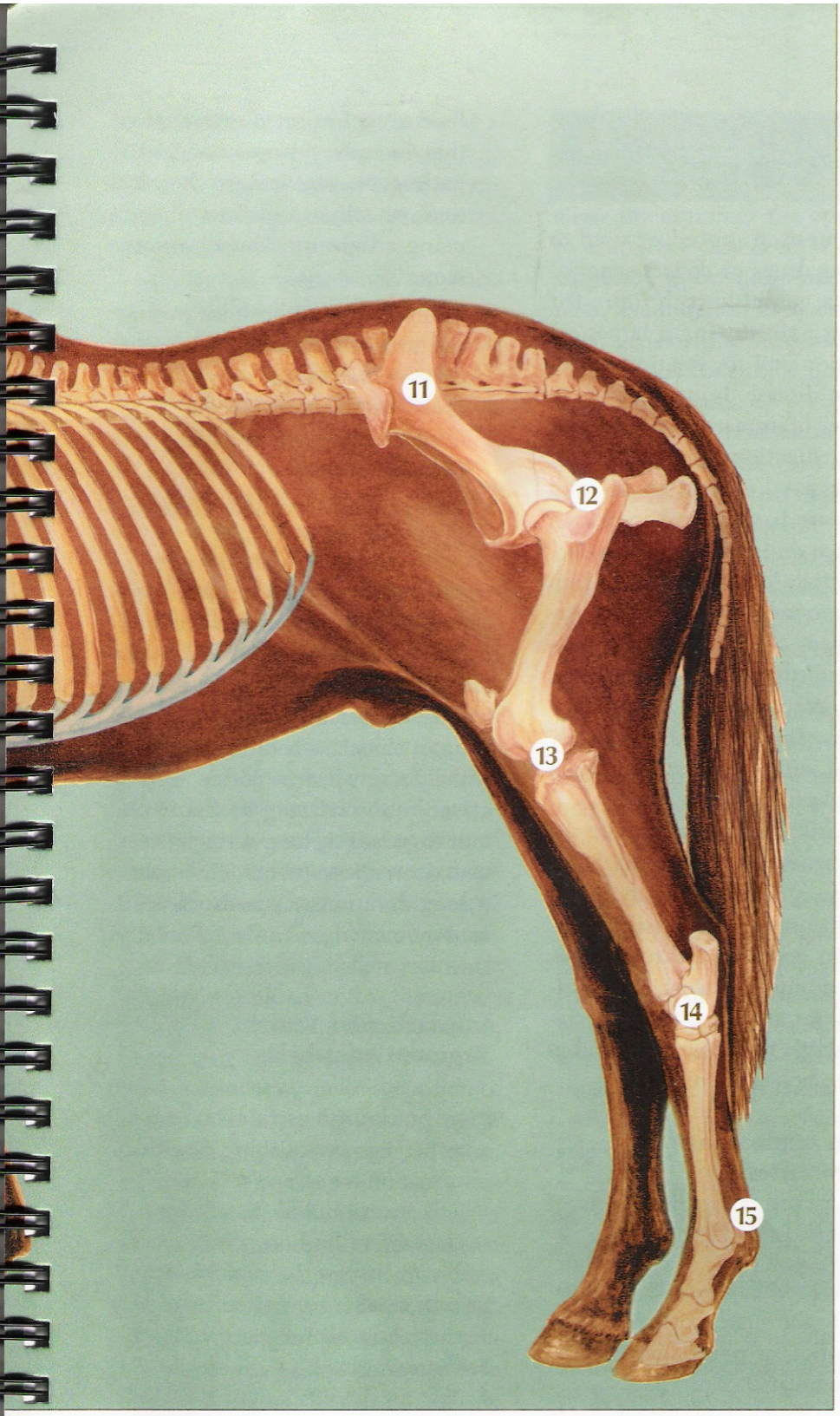


Key

1 Temporomandibular Joint
2 Cervical Facet Joint
3 Shoulder
4 Bicipital Bursa
5 Elbow
6 Carpus
7 Fetlock
8 Pastern
9 Coffin
10 Navicular Bursa
11 Sacroiliac Joint
12 Hip
13 Stifle
14 Hock
15 Digital Synovial Sheath

PART 1: JOINT



INJECTION

INTRODUCTION AND USES

Arthrocentesis, a procedure used to administer drugs or collect synovial fluid, is a valuable technique for localizing pain during a lameness examination and for treating horses with joint disease. Improvements in the efficacy of intraarticularly administered medications and in surgical techniques used to treat horses with joint disease have placed increased importance on intraarticular analgesia to precisely localize the site of pain during lameness examination. Although many clinicians may be reluctant to perform arthrocentesis because they fear introducing sepsis or causing injury, the procedure is rarely associated with complications when performed properly.

Using arthrocentesis to localize the site of lameness involves relatively little expense, and the results are usually straightforward and easily interpreted. To perform arthrocentesis, however, a thorough working knowledge of joint anatomy, an appreciation of aseptic technique, and skill in restraining horses are required.

Practical Applications of Arthrocentesis

Some practical applications of arthrocentesis in horses are to:

- Administer medication, such as sodium hyaluronate, corticosteroids, antibiotics, or polysulfated glycosaminoglycans.
- Verify or negate intraarticular pain as the cause of lameness. Intraarticular anesthesia is more precise than regional anesthesia in localizing pain.
- Collect synovial fluid for examination. Analysis of synovial fluid can range from gross inspection of the fluid to sophisticated examinations that include cultures to identify pathogens, physical or chemical tests, or microscopic examination using a light or electron microscope.[1,2]
- Administer a radiographic contrast medium or electrolyte solution to determine, by radiographic or visual examination, whether a synovial structure communicates with a nearby wound.
- Provide both entry and exit portals in joints requiring lavage.[3–6]

The most common of these applications of arthrocentesis is to administer a local anesthetic solution into the joint. Mepivacaine hydrochloride is the local anesthetic agent preferred by most clinicians because, compared with lidocaine hydrochloride, it is relatively nonirritating to tissue and induces relatively long-acting intraarticular anesthesia (about 90 minutes). A long duration of anesthesia is advantageous when multiple sites of lameness are being investigated.

Intraarticular Versus Regional Anesthesia

Intraarticular anesthesia is often more precise and useful than regional anesthesia in establishing diagnostic information for several reasons.

The location and distribution of sensory nerves in horses vary considerably; therefore, the clinician cannot be certain, after administering regional anesthesia, that a specific area has been anesthetized (i.e., blocked).

Testing the efficacy of a regional nerve block by testing for lack of skin sensation with a pointed instrument, such as a toothpick, ballpoint pen, or car key, is questionable because it verifies only that the skin has been desensitized. The clinician cannot be certain, therefore, that after administering regional anesthesia, a joint has

been blocked. Direct instillation of a local anesthetic agent into a joint, on the other hand, leaves little or no doubt that intraarticular structures are anesthetized.

A regional nerve block may not adequately localize the source of pain responsible for lameness. In addition to desensitizing articular structures, a successful regional nerve block desensitizes a multitude of extraarticular structures, such as ligaments, tendons, tendon sheaths, subcutaneous tissue, and extraarticular bone.

Intraarticular anesthesia is more useful than regional anesthesia when the clinician attempts to establish the significance of multiple clinical or radiographic findings on a limb of a horse. An excellent and common example is a horse that has radiographic evidence not only of disease of the fetlock joint but also of extraarticular disease of the proximal sesamoid bones and proliferative and degenerative changes of the pastern joint. The use of regional anesthesia in this horse does not allow pain to be selectively localized so that the contribution of each lesion to lameness can be accurately assessed. Without precise assessment of the contribution of each lesion to lameness, selecting an ideal therapy and establishing an accurate prognosis are difficult.

Regional nerve blocks occasionally create temporary gait abnormalities, which can cause injury by interfering with proprioception. For example, blocking the superficial and deep peroneal nerves and the tibial nerve in the gaskin region can cause a horse to stumble because the horse lacks proprioception in the blocked limb.

Extensive subcutaneous administration of local anesthetic solution can cause subcutaneous inflammation, swelling, and even skin necrosis.

Many horses resent a regional block more than a joint block because a regional block often requires multiple injections.

A regional nerve block does not allow the examiner the opportunity to examine synovial fluid of a joint suspected to be the source of lameness. Examination of synovial fluid, both grossly and microscopically, may provide "one more piece" to the diagnostic puzzle.

Even though instillation of a local anesthetic solution into a joint or bursa is more precise than regional anesthesia in pinpointing the site of pain, diffusion of local anesthetic solution from some joints or bursae into surrounding joints or adjacent nerves may make interpretation of the effects of intrasynovial administration of local anesthetic solution difficult. For instance, local anesthetic solution injected into the tarsometatarsal joint may result in perineural anesthesia of the dorsal metatarsal and plantar metatarsal nerves.[7] The plantar metatarsal nerves are often desensitized to diagnose disease of the proximal portion of the suspensory ligament. Anesthesia of the coffin joint also anesthetizes the navicular apparatus[8] and the toe region of the sole.[9] Anesthesia of the navicular bursa also anesthetizes the toe region of the sole.[10,11]

PREPARATION OF THE SITE

Most clinicians clip or shave the hair at the site of arthrocentesis, but we prefer not to unless the hair makes identification of landmarks difficult. The presence of hair does not appear to inhibit the ability of an antiseptic soap to effectively reduce bacteria to an acceptable concentration for arthrocentesis.[12] The site of arthrocentesis should be thoroughly scrubbed with an antiseptic soap,

such as polyhydroxydine solution (Xenodine), povidone–iodine (Betadine), or chlorhexidine (Nolvasan), for a total contact time of 7 minutes or longer. The last application of antiseptic soap should not be rinsed until the clinician is ready to insert the needle. At that time, the area should be liberally sprayed or wiped with 70% isopropyl alcohol until it is free of soap. Excess alcohol should be wiped away with a sterile gauze sponge or a gloved hand. If a relatively large-bore (e.g., 18-gauge) needle is to be used, subcutaneous injection of a small amount of local anesthetic solution using a small-bore (e.g., 25-gauge) needle may help diminish resentment by the horse when the large-bore needle is inserted.

MANAGEMENT OF THE HORSE

Methods of restraining the horse for arthrocentesis vary with the anticipated and actual behavior of the horse, the availability of experienced help, the environment, and the specific joint to be entered. The clinician should anticipate problems rather than assume that the procedure will be trouble free.

An experienced assistant should control the horse by using a lead shank and nose twitch. Usually, a needle-shy horse is identified as such because of its well-established history of behavior. A truly dangerous horse poses a risk to both the clinician and itself. By changing the environment, the veterinarian can usually provide conditions suitable for work on a dangerous horse. A slow, quiet approach is best. Some clinicians prefer restraining a fractious horse in a stock to minimize personal risk, but a stock can be a danger to the horse.

Chemical restraint, achieved by administering acetylpromazine, xylazine, detomidine, or detomidine or xylazine in combination with morphine or butorphanol, can help control horses that cannot be handled by physical restraint alone. Tranquilization or sedation of a lame horse may not affect the grade of lameness. If the joint is injected with a local anesthetic solution, the effects of which last longer than those of the sedative, the horse can be examined after the effects of sedation have dissipated.

Performing arthrocentesis in a poor environment can potentially complicate the procedure and increase the risk of error or injury. The environment in which the procedure is to be performed should be inspected carefully. A dusty area increases the likelihood of introducing an infection, and a crowded area, filled with distractions, such as people, equipment, extraneous noise, and other horses, increases the likelihood that an accident will occur.

GENERAL TECHNIQUE

The single most important factor for successful placement of a needle within a joint is an accurate appreciation of relevant anatomy. If the clinician infrequently performs arthrocentesis of a particular joint, the anatomy of the region of that joint should be reviewed. The clinician should strive for performance that is quick and successful at the outset because multiple attempts at arthrocentesis increase the likelihood of failure as well as injury to both the horse and the clinician. Adequate preparation helps prevent or minimize most problems.

The joint and the site of entry determine the position of the clinician

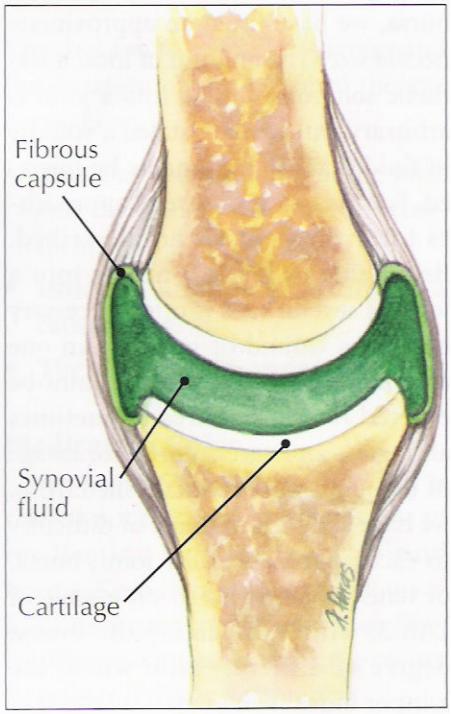
relative to the horse and whether the injection is performed with the limb bearing weight or held. The bore and length of the needle depend on the particular joint being injected and the size of the horse. Handling the shaft of the needle and palpating the site of injection may be necessary to ensure proper insertion; therefore, sterile gloves should be worn to reduce the risk of bacterial contamination.

To begin the procedure, the joint and surrounding structures within the scrubbed area are palpated to identify the landmarks. The needle is inserted with a quick thrust through the skin. The needle should be inserted without the syringe attached. A syringe can act as a lever, and sudden movement by the horse may cause the needle to damage tissue. To avoid broken needles, only disposable needles that are reasonably flexible should be used. A needle longer than the length required to enter the joint is more likely to bend than break when stress is applied.

The depth of needle penetration varies with the joint. To penetrate the carpal, tibiotarsal, and fetlock joints, the needle is inserted relatively superficially, but to penetrate the coffin, pastern, and elbow joints and the medial and lateral compartments of the femorotibial joint, the needle may need to be inserted 1 to 1.5 inches, depending on the size of the horse and the approach used. Because clinicians do not always enter the joint space with the initial thrust, the needle sometimes must be redirected; if possible, it should be redirected without being withdrawn back through the skin. Experience helps the clinician identify underlying tissue by its texture as the needle penetrates.

The most accurate indication of successful arthrocentesis is the presence of synovial fluid exiting the needle. Unfortunately, the clinician can place a needle correctly within a joint without being able to see or aspirate synovial fluid. The reasons for this are: Some joints normally contain a very small volume of synovial fluid (e.g., distal joints of the tarsus); the needle opening may be against synovial villi or cartilage; aspiration may have pulled villi into the needle opening; a chronically inflamed joint may contain a less than normal amount of synovial fluid; hypertrophied villi and joint capsular thickening caused by chronic inflammation may have reduced the volume of the damaged joint; or the needle may have become plugged with tissue.

After the needle is situated correctly within the joint, the syringe is attached to either inject medication or aspirate fluid. In some cases, the degree of resistance to pressure on the plunger of the syringe during injection may be the only way to determine if the joint was entered. If the needle is placed correctly, resistance to injection is slight, but for some joints, such as the shoulder joint, lack of resistance to pressure on the plunger



of the syringe is not a good indication that the joint has been entered. Syringes that lock onto the needle hub should be avoided because sudden motion may require that the syringe be detached quickly from the needle to prevent the needle from being pulled out or to prevent the syringe from acting as a lever, which may either result in injury to the horse or break the shaft of the needle.

A needle should not be inserted through inflamed tissue into a joint. Inflammation may be the result of a recent wound, subcutaneous infection, dermatitis, recent local cautery, or application of a counterirritant. Many joints can be entered using an alternative approach remote from the site of inflammation.

INJECTION STRATEGIES

Specific, step-by-step details of the injection techniques for 16 different joints, two bursae, and a tendon sheath are discussed and illustrated in the pages that follow. For each joint or bursa, we have listed an approximate needle size. The amount of local anesthetic solution instilled into a joint is arbitrary, but we have stated a volume of fluid that can reasonably be injected. For many joints, several approaches for arthrocentesis are described. Being able to insert a needle into a joint at several sites is often necessary because a wound or infection in one area may necessitate that the joint be entered in another area. Sometimes an ingress and egress portal for lavage of the joint must be established. Also, we have assigned a degree of difficulty to each approach to the joint, bursa, or tendon sheath based on a scale of 1 to 3, with 1 indicating the lowest degree of difficulty with which the joint or bursa is entered.

COMPLICATIONS

Occasionally, a clinician experiences problems resulting from arthrocentesis. These problems must be resolved promptly and thoroughly because they can quickly lead to serious problems. For instance, certain bacteria, when introduced into a joint, can rapidly cause irreparable damage.

The two most common serious complications of arthrocentesis are a broken needle and a postinjection reaction. Following are the immediate and follow-up steps the clinician should take when presented with one of these complications.

Broken Needles

The likelihood of breaking a needle in a joint is low, and properly restraining the horse and using flexible, disposable needles can further reduce the risk. Joints that are considered high risk in terms of broken needles—the hip, shoulder, and to some extent, the femoropatellar joint—should be injected or aspirated using a spinal needle because spinal needles are particularly flexible and usually bend to accommodate stress, rather than break. If a needle does bend, it should be removed slowly, following the curve of its bend. Even though needles usually break at skin level, broken needles are usually difficult to retrieve. Unless a needle appears to be readily accessible, it is best extracted while the horse is anesthetized. General anesthesia allows for more careful exploration and manipulation. Radiographic examination of projections taken at multiple angles, ultrasonography, or fluoroscopy may help identify the exact location of the needle. Arthroscopic retrieval of the needle and assessment of the joint may be necessary.

After the needle has been retrieved, the joint should be copiously lavaged

with a sterile, balanced, polyionic solution because the joint must now be considered contaminated. The degree of damage and the appearance of the internal environment of the joint determine the extent of aftercare.

Postinjection Reactions

Horses that suffer from a postinjection reaction can be difficult to manage because distinguishing between a local drug reaction and early infection caused by contamination is often impossible. Early signs of either problem include heat, pain, swelling, and lameness. In either case, the interval between the injection and the onset of clinical signs may be similar and, therefore, cannot be used to determine whether the inflammation is caused by infection. In either case, analysis of synovial fluid reveals inflammation of the joint, but determining whether the inflammation is caused by sepsis is often not possible unless bacteria can be isolated.

It is prudent to assume that a painful joint is infected, and, therefore, the horse should be treated accordingly. Initially, treatment should consist of copious lavage of the joint with a sterile, balanced, polyionic solution. This can often be accomplished, depending on the joint and the temperament of the horse, with the horse sedated rather than anesthetized. Lavage is performed as follows, regardless of whether the horse is sedated or anesthetized:

1. Prepare the skin over the joint for aseptic insertion of needles or catheters.
2. Use large-bore (i.e., 16-gauge or greater) needles or catheters for most joints.
3. If the procedure is to be performed with the horse standing, distend the joint with an appropriate, sterile, local anesthetic solution. Allow enough time for the anesthetic solution to anesthetize the joint.
4. With the first needle in position and the joint distended with fluid, insert a second needle into the joint at another site. Lavage the joint with copious amounts of fluid. Distend the joint maximally two to three times during the lavage.[4–6] Distension allows the cleansing fluid to circulate into the deep crevices and folds of synovial tissue. If the procedure is performed with the horse anesthetized, lavaging the joint using arthroscopic cannulas may be beneficial because the joint can be visually examined and a large quantity of fluid can be forced through the joint.
5. Administer an appropriate antibiotic directly into the joint at the end of lavage.
6. Systemically administer an appropriate antibiotic.
7. Administer regional antimicrobial perfusion of the affected region of the limb, if possible and appropriate.
8. Confine the horse and support the joint with a suitable bandage (if the area can be bandaged).

The decision to repeat joint lavage and the duration of antimicrobial therapy depend on:

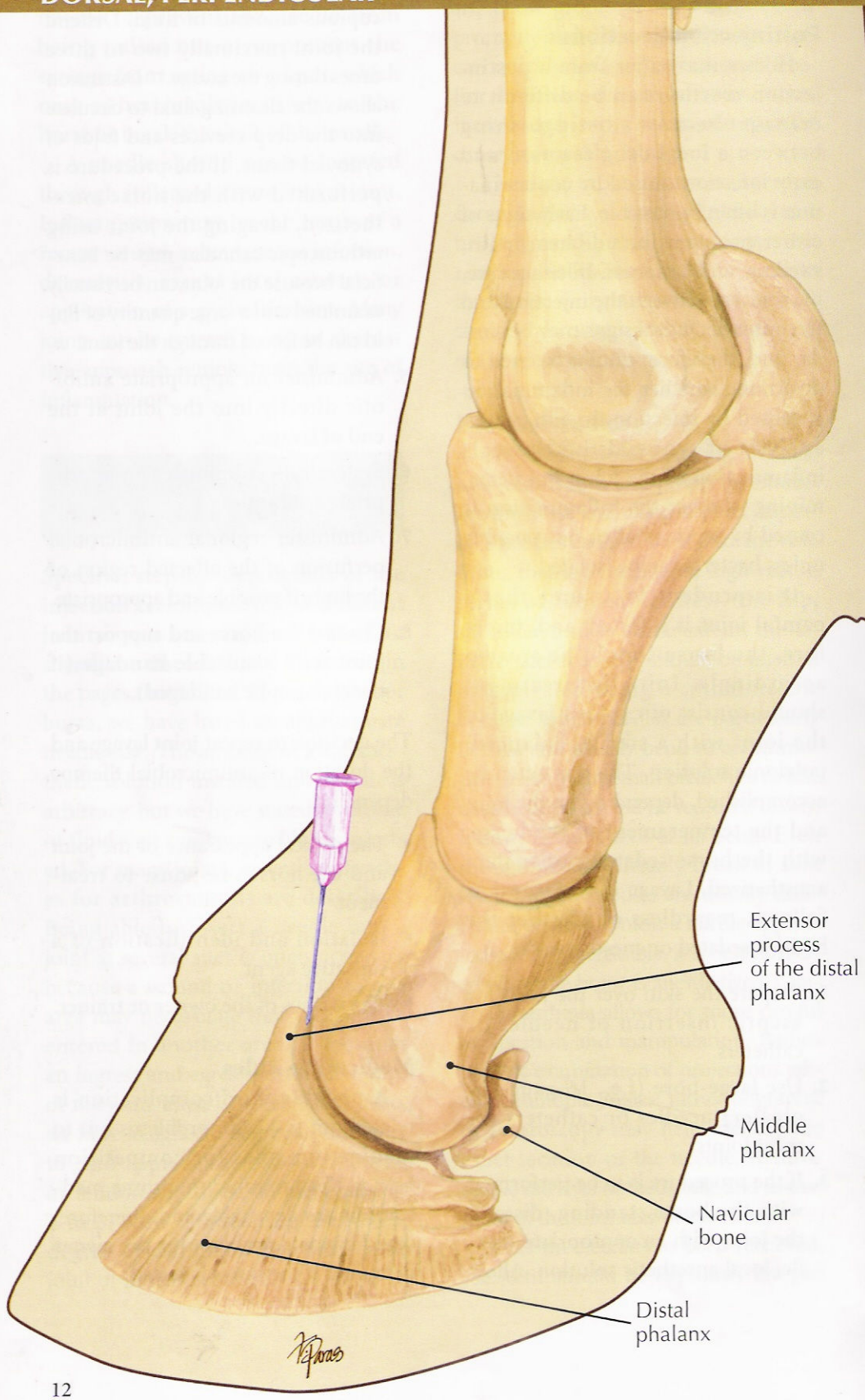
- The clinical appearance of the joint and the horse's response to treatment.
- Isolation and identification of a causative agent.
- The wishes of the owner or trainer.

Medication Rules

A possible third complication is related not to health problems but to medication rules for competition horses. Keep in mind that some medications are detectable and, therefore, could create a problem for the owner or trainer if the horse is tested.

Coffin

DORSAL, PERPENDICULAR



Needle: 1.5 inch (3.81 cm), 20 gauge
Volume: 4 to 6 mL
Degree of difficulty: 2

The **coffin joint** (P2–P3, distal interphalangeal or coronopedal joint) is most easily entered with a needle, using a dorsal approach, with the limb bearing weight. Consequently, the dorsal approach may be more dangerous than the lateral approach in which the foot is held.

Insert the needle into the dorsal pouch of the joint at the point where the pastern meets the proximal edge of the coronet. For most horses, this point is approximately 0.5 to 0.25 inch above the edge of the hoof wall, approximately 0.75 inch lateral or medial to an imaginary line drawn vertically through the center of the phalangeal bones. Direct the needle *perpendicular* to the bearing surface of the foot. The size of the foot determines the depth of penetration, but generally this depth is about 1 to 1.5 inches. The procedure can be performed with the foot held, but it is generally easier to accomplish with the limb bearing weight. Synovial fluid usually appears in the needle hub, but accuracy of needle placement can also be ascertained by ease of injection. After injection, the syringe may refill when pressure on the plunger is released.

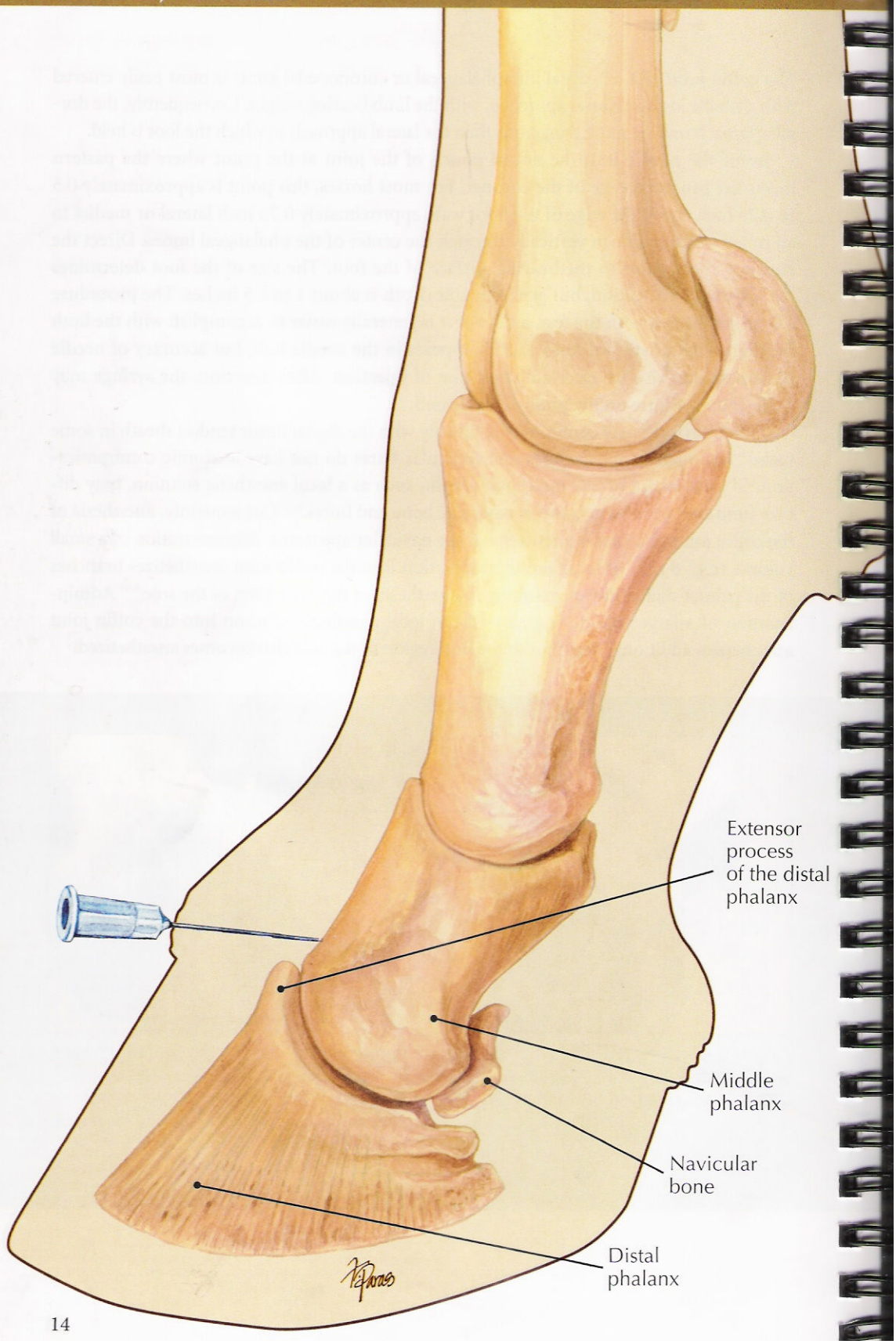
The coffin joint may communicate directly with the digital flexor tendon sheath in some foals.[13] Although the coffin joint and navicular bursa do not have anatomic communication,[13,14] a substance of low molecular weight, such as a local anesthetic solution, may diffuse from the coffin joint into the navicular bone and bursa.[8,15] Consequently, anesthesia of the coffin joint also causes anesthesia of the navicular apparatus. Administration of a small volume (e.g., 6 mL) of local anesthetic solution into the coffin joint anesthetizes branches of the palmar digital nerves, resulting in anesthesia of the toe region of the sole.[9,10] Administration of a large volume (e.g., 10 mL) of local anesthetic solution into the coffin joint anesthetizes additional branches so the heel region of the sole also becomes anesthetized.

Palpate the proximal edge of the coronet, approximately 0.75 inch lateral to the dorsal, longitudinal midline of the pastern.

Insert the needle into the joint by directing the needle perpendicular to the bearing surface of the foot, through the coronet, on or slightly medial or lateral to the dorsal, longitudinal midline of the pastern, to a depth of approximately 1 to 1.5 inches.

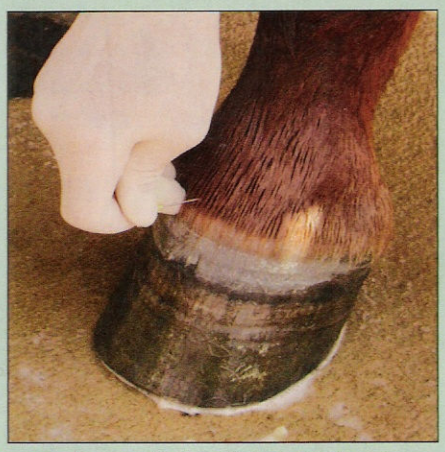
Coffin

DORSAL, PARALLEL

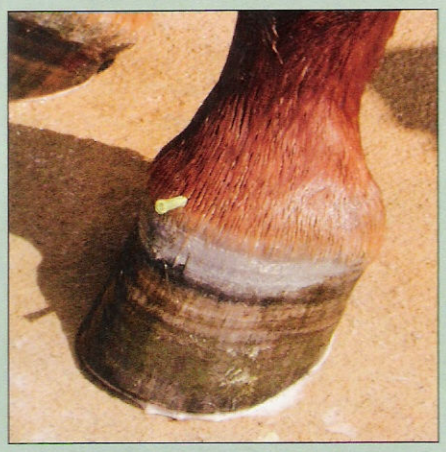


Needle: 1 inch (2.54 cm), 20 to 22 gauge
Volume: 4 to 6 mL
Degree of difficulty: 1

The dorsal pouch of the **coffin joint** can be entered by inserting the needle through the coronary band, just above the proximal edge of the hoof, parallel to the bearing surface of the foot or perpendicular to the slope of the pastern on the dorsal midline. Insert the needle until the dorsal aspect of the middle phalanx is encountered. The depth of penetration is less than 0.5 inch. The procedure is most easily performed with the limb bearing weight and consequently may be more dangerous than the lateral approach, in which the foot is held. Applying a nose twitch to the horse increases the safety of the procedure. Synovial fluid usually appears in the needle hub, but accuracy of needle placement can also be determined by ease of injection and return of injected fluid back into the syringe when pressure on the plunger is released.



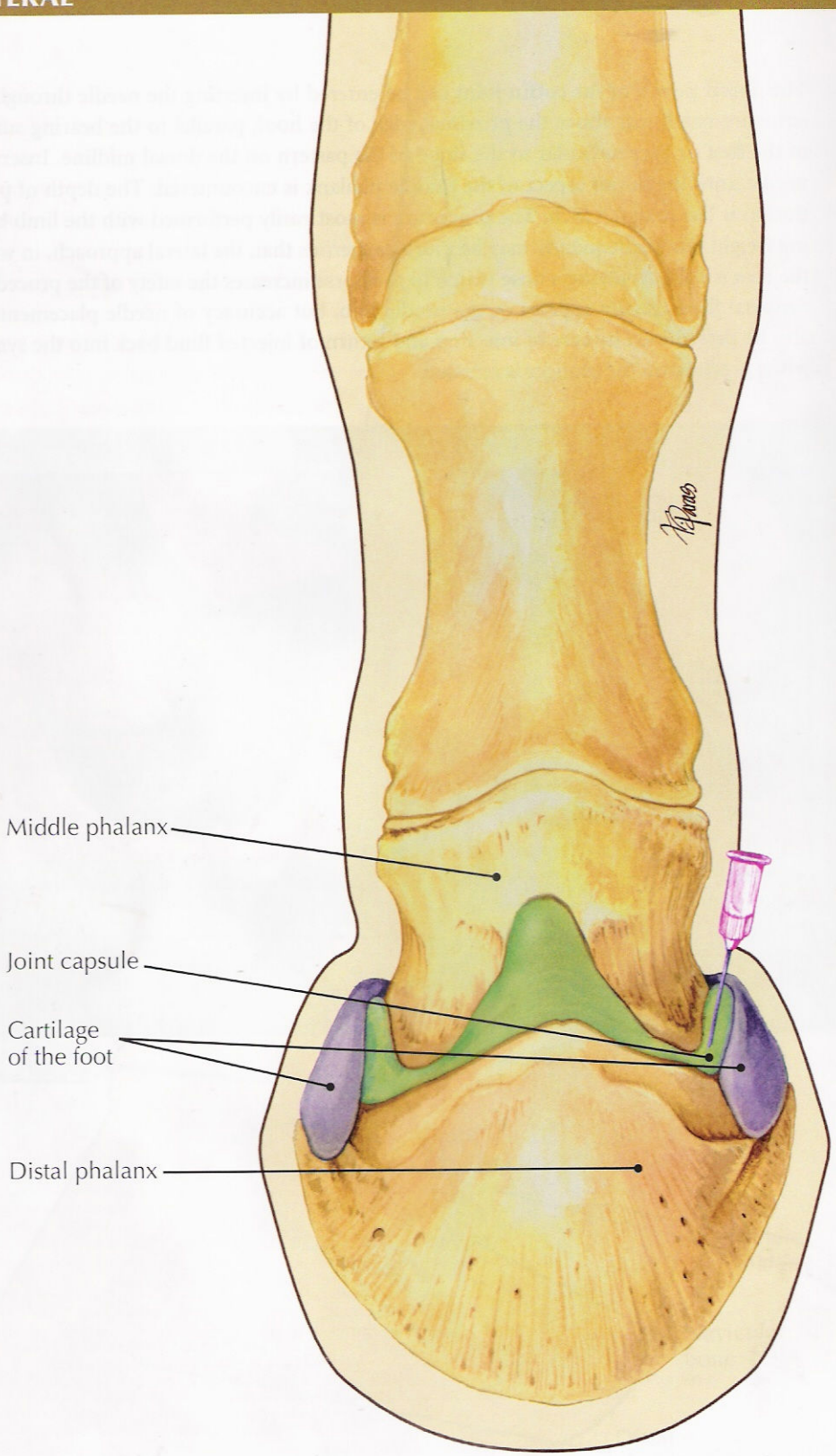
Insert the needle parallel to the bearing surface of the foot or perpendicular to the slope of the pastern, through the coronary band, until the dorsal aspect of the middle phalanx is encountered.



Insert the needle until it strikes the middle phalanx.

Coffin

LATERAL



Needle: 1 inch (2.54 cm), 20 to 22 gauge
Volume: 4 to 6 mL
Degree of difficulty: 1

The **coffin joint** can also be entered from the lateral aspect of the joint.[16] Insert a 1-inch, 20- to 22-gauge needle through the skin, just above the palpable, proximal edge of the lateral cartilage of the foot, approximately midway between the dorsal and palmar/plantar aspects of the middle phalanx. Angle the needle downward toward the medial aspect of the bearing surface of the foot. The procedure can be performed with the limb in either the weight-bearing or non–weight-bearing position. The depth of successful penetration is usually less than 1 inch. We find this technique to be apparently less discomforting to the horse than the dorsal approaches.

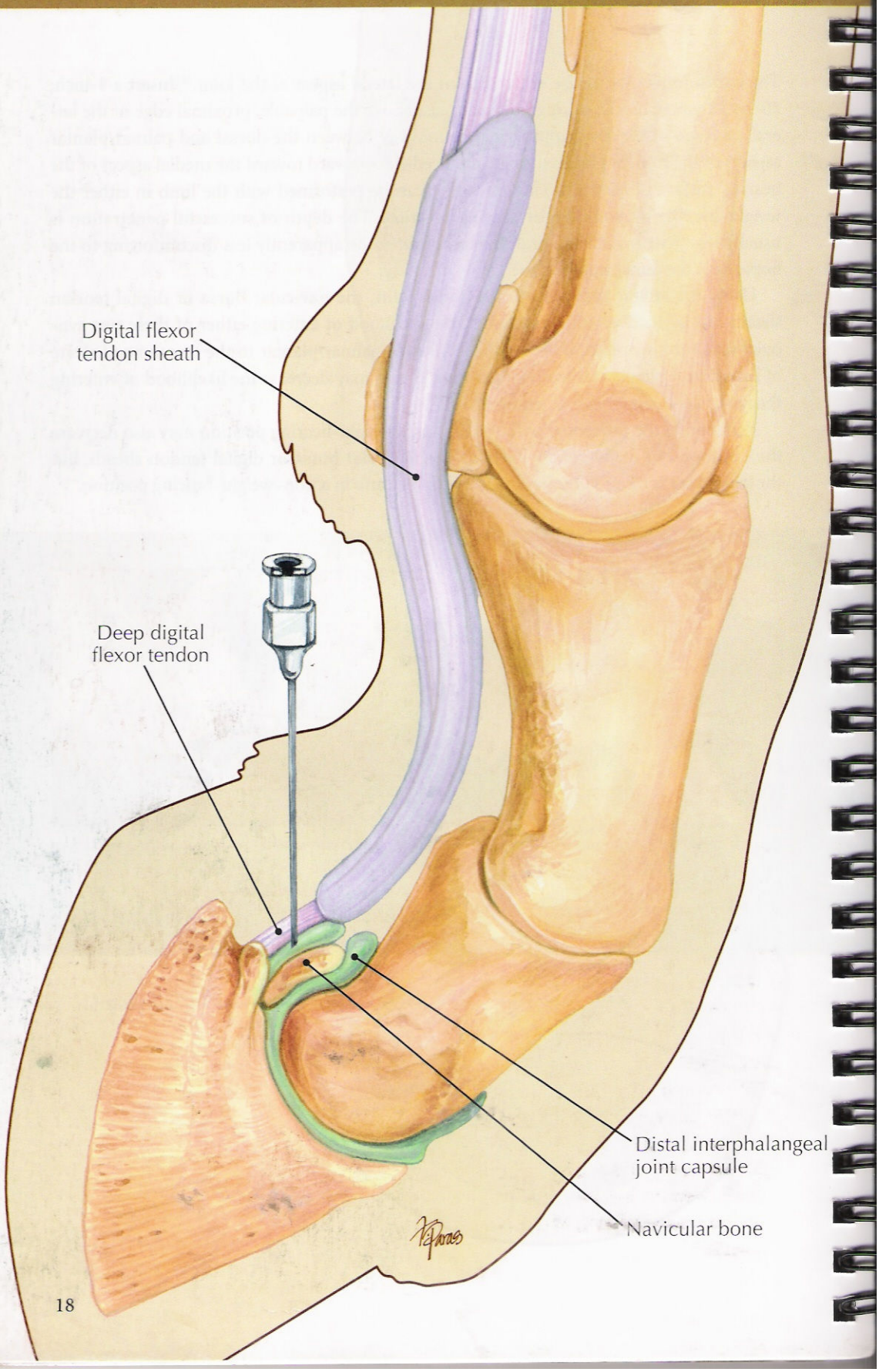
Using the lateral approach to the coffin joint, the navicular bursa or digital tendon sheath can be inadvertently entered.[16] The likelihood of entering either of these two synovial structures increases if the needle is inserted palmar/plantar to the recommended site of insertion. Using a needle no longer than 1 inch may decrease the likelihood of entering the navicular bursa or digital tendon sheath.

Performing the procedure with the limb in a weight-bearing position may also decrease the likelihood of inadvertently entering the navicular bursa or digital tendon sheath, but the procedure is more safely performed with the limb in a non–weight-bearing position.

Palpate the proximal edge of the lateral cartilage of the foot, approximately midway between the dorsal and palmar/plantar aspects of the middle phalanx.

Insert the needle at a downward angle, aiming toward the medial aspect of the bearing surface of the foot.

Navicular Bursa



Needle: 3.5 inch (8.89 cm), 18 to 20 gauge, spinal
Volume: 2 to 4 mL
Degree of difficulty: 2

The **navicular bursa** *(bursa podotrochlearis manus)* can be entered using several approaches. We prefer the approach described by Schramme.[17] To inject the bursa, insert an 18- to 20-gauge, 3.5-inch, disposable spinal needle midway between the bulbs of the heel, immediately proximal to the coronary band, with the limb positioned in a Hickman block. Advance the needle along the sagittal plane of the foot toward the bisecting point between the sagittal plane and the long axis of the navicular bone. The long axis of the navicular bone is assumed to be halfway between the most dorsal and the most palmar/plantar aspects of the coronary band, about 0.5 inch distal to the coronary band. Advance the needle until the tip contacts bone. Depth of insertion is about 1.5 to 2 inches for most horses. Fluid is seldom obtained. The needle is determined to be within the navicular bursa by low resistance to injection and the ability to aspirate the injected contents of the syringe.

If resistance to injection is encountered, the distal portion of the limb should be flexed more rigorously to enlarge the bursal space. To confirm that the needle is within the bursa, the foot can be radiographically examined immediately before injecting the bursa. Radiologic identification of contrast medium (which can be included with the fluid injected) within the bursa after injection is evidence of a successful bursal injection.

Whereas anesthesia of the coffin joint desensitizes the navicular apparatus, anesthesia of the navicular bursa has little effect on pain originating in the coffin joint.[18,19] Anesthesia of the navicular bursa also causes anesthesia of the toe region of the sole.[11]

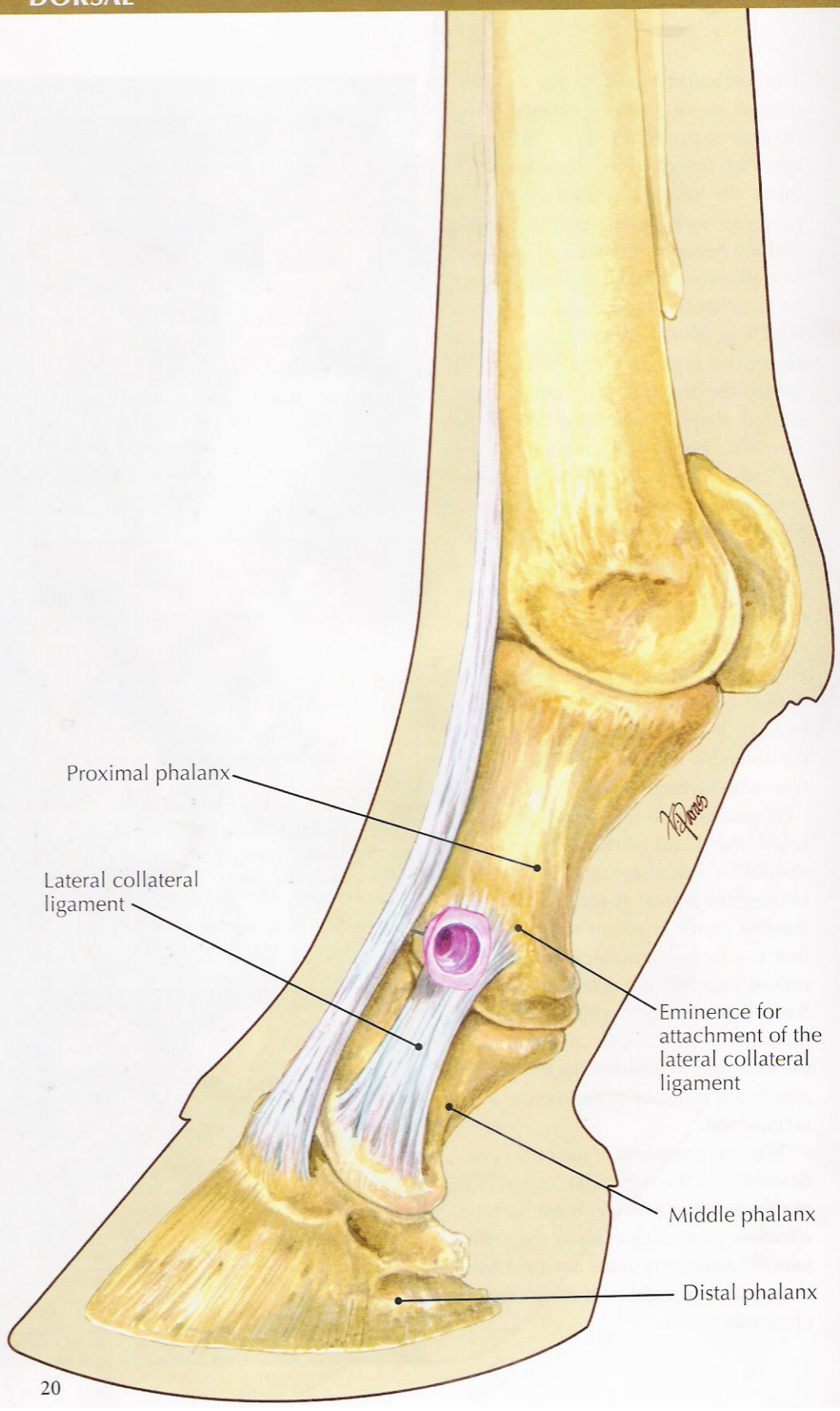
Insert a 3.5-inch spinal needle through desensitized skin on the midline immediately proximal to the coronary band (red tack shows the approximate location of the navicular bone).

Advance the needle along the sagittal plane, aiming for a point halfway between the most palmar and most dorsal aspects of the coronary band and 0.5 cm distal to the coronary band. Advance the needle until it hits bone.

It may be easier to inject medication into the navicular bursa if the lower portion of the limb is flexed.

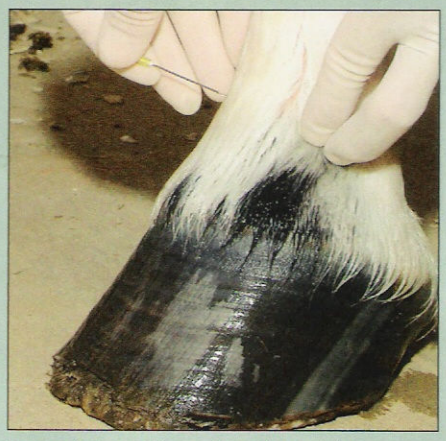
Pastern

DORSAL



Needle: 1 to 1.5 inch (2.54 to 3.81 cm), 20 gauge
Volume: 8 to 10 mL
Degree of difficulty: 2

Palpate the medial or lateral bony eminence on the distal aspect of the proximal phalanx.



Insert the needle at the edge of the common digital extensor tendon, 0.5 inch distal to the level of the lateral eminence on the distal end of the proximal phalanx, and position it parallel to the ground. Usually, the needle penetrates the joint at a depth of approximately 0.5 inch.

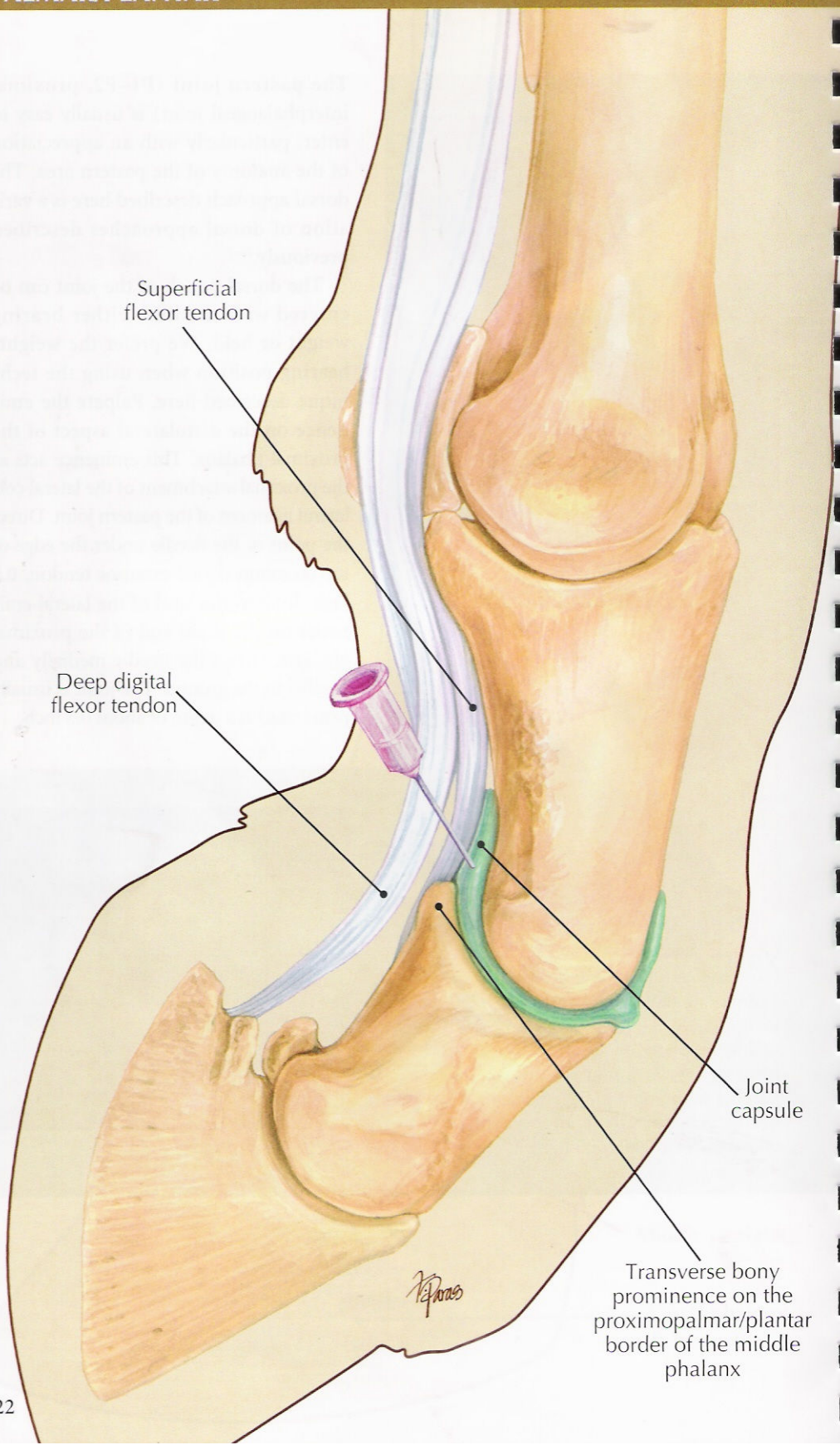
The **pastern joint** (P1–P2, proximal interphalangeal joint) is usually easy to enter, particularly with an appreciation of the anatomy of the pastern area. The dorsal approach described here is a variation of dorsal approaches described previously.[20–22]

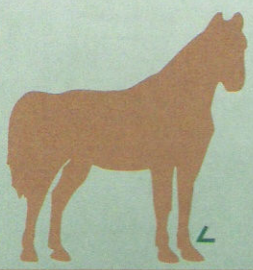
The dorsal pouch of the joint can be entered with the limb either bearing weight or held. We prefer the weight-bearing position when using the technique described here. Palpate the eminence on the distolateral aspect of the proximal phalanx. This eminence acts as the proximal attachment of the lateral collateral ligament of the pastern joint. Direct the point of the needle under the edge of the common digital extensor tendon, 0.5 inch distal to the level of the lateral eminence on the distal end of the proximal phalanx. Direct the needle medially and parallel to the ground. The joint is usually penetrated at a depth of about 0.5 inch.

The needle in place.

Pastern

PALMAR/PLANTAR





Needle: 1.5 inch (3.81 cm), 20 gauge
Volume: 8 to 10 mL
Degree of difficulty: 2

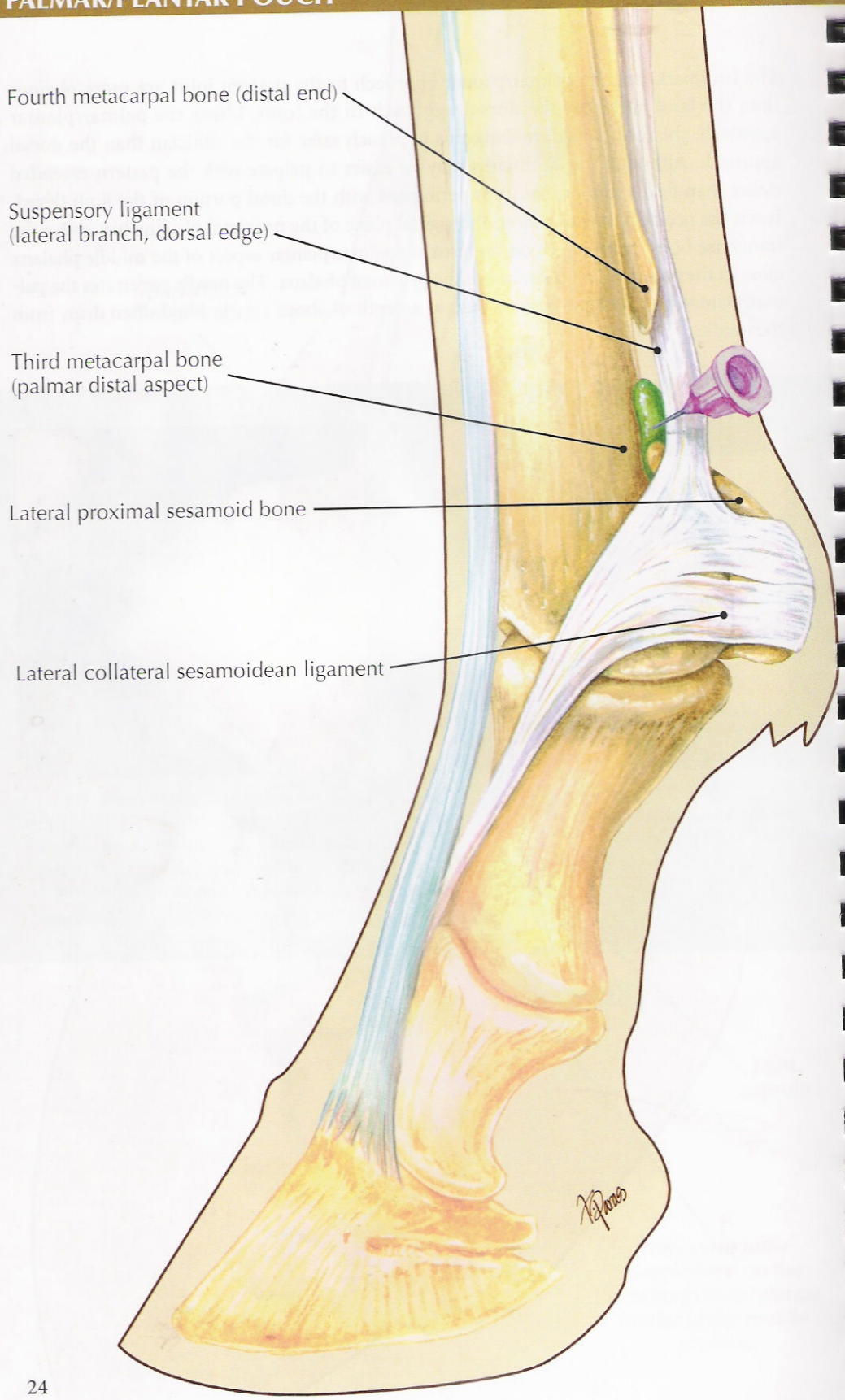
The landmarks for the palmar/plantar approach to the **pastern joint** are more obvious than the landmarks for the dorsal approach to the joint. Using the palmar/plantar approach, the foot is held, making this approach safer for the clinician than the dorsal approach. Although the landmarks may be easier to palpate with the pastern extended rather than flexed, the procedure is performed with the distal portion of the limb flexed. Insert the needle perpendicular to the sagittal plane of the proximal phalanx just above the transverse bony prominence on the proximopalmar/plantar aspect of the middle phalanx close to the palmar/plantar surface of the proximal phalanx. The needle penetrates the palmar/plantar pouch of the pastern joint at a depth of about 1 inch. Fluid often drips from the needle.

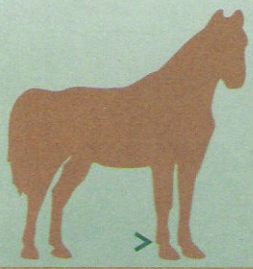
Palpate the transverse bony prominence on the proximopalmar/plantar aspect of the middle phalanx.

Insert the needle perpendicular to the sagittal plane of the proximal phalanx just above the transverse bony prominence on the proximopalmar/plantar aspect of the middle phalanx close to the palmar/plantar surface of the proximal phalanx.

Fetlock

PALMAR/PLANTAR POUCH





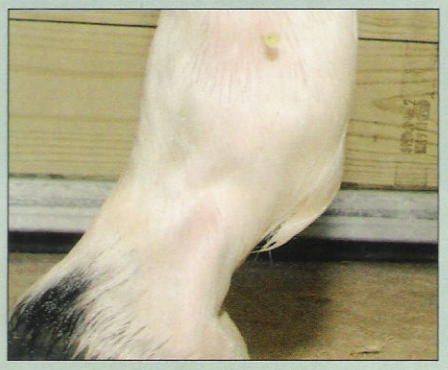
Needle: 1 inch (2.54 cm), 20 gauge
Volume: 8 to 12 mL
Degree of difficulty: 1

The **fetlock joint** (MCIII/MTIII–P1, metacarpophalangeal/metatarsophalangeal joint, ankle) is one of the most easily and commonly injected joints. The decision to inject it with the limb bearing weight or held depends on the preference of the clinician and the behavior of the horse. The joint capsule is most easily visualized, however, when the limb is bearing weight.

The joint can be approached through the lateral aspect of the palmar/plantar pouch (proximal extension of the joint capsule), which is located between the following palpable structures: 1) the palmarodistal/plantarodistal aspect of the cannon bone (third metacarpal/metatarsal bone); 2) the dorsal edge of the lateral branch of the suspensory ligament; 3) the distal end of the lateral splint bone (fourth metacarpal/metatarsal bone); and 4) the lateral, proximal sesamoid bone and the lateral, collateral sesamoidean ligament. The pouch can be distended at the site of entry, making it more obvious, by applying digital pressure to the medial side of the palmar/plantar pouch before inserting the needle.

Direct the needle at a slightly downward angle into the middle of the lateral aspect of the palmar/plantar pouch. The joint capsule is usually very superficial and is often penetrated at a depth of 0.25 to 0.5 inch.

Palpate and identify the lateral aspect of the palmar/plantar pouch of the fetlock joint. The pouch is bordered by the palmarodistal/plantarodistal aspect of the third metacarpal/metatarsal bone; the dorsal edge of the lateral branch of the suspensory ligament; the distal end of the fourth metacarpal/metatarsal bone; and the lateral, proximal sesamoid bone.

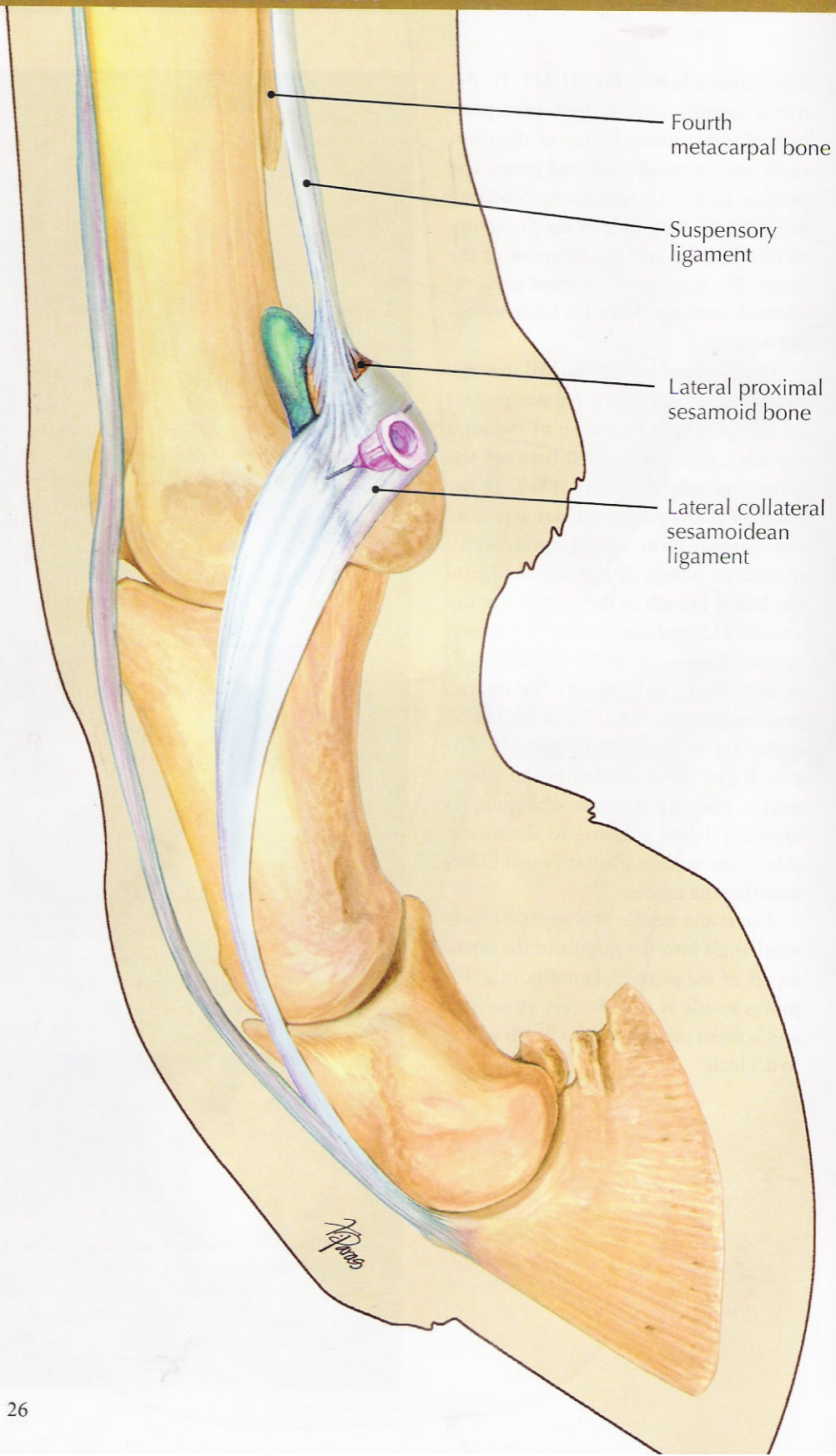


Insert the needle into the lateral aspect of the palmar/plantar pouch of the fetlock joint. Usually, the joint capsule is superficial.

An alternative method of injecting the fetlock involves holding the limb in flexion. Insert the needle into the lateral aspect of the palmar/plantar pouch.

Fetlock

COLLATERAL SESAMOIDEAN



Needle: 1 inch (2.54 cm), 20 to 22 gauge
Volume: 8 to 12 mL
Degree of difficulty: 1

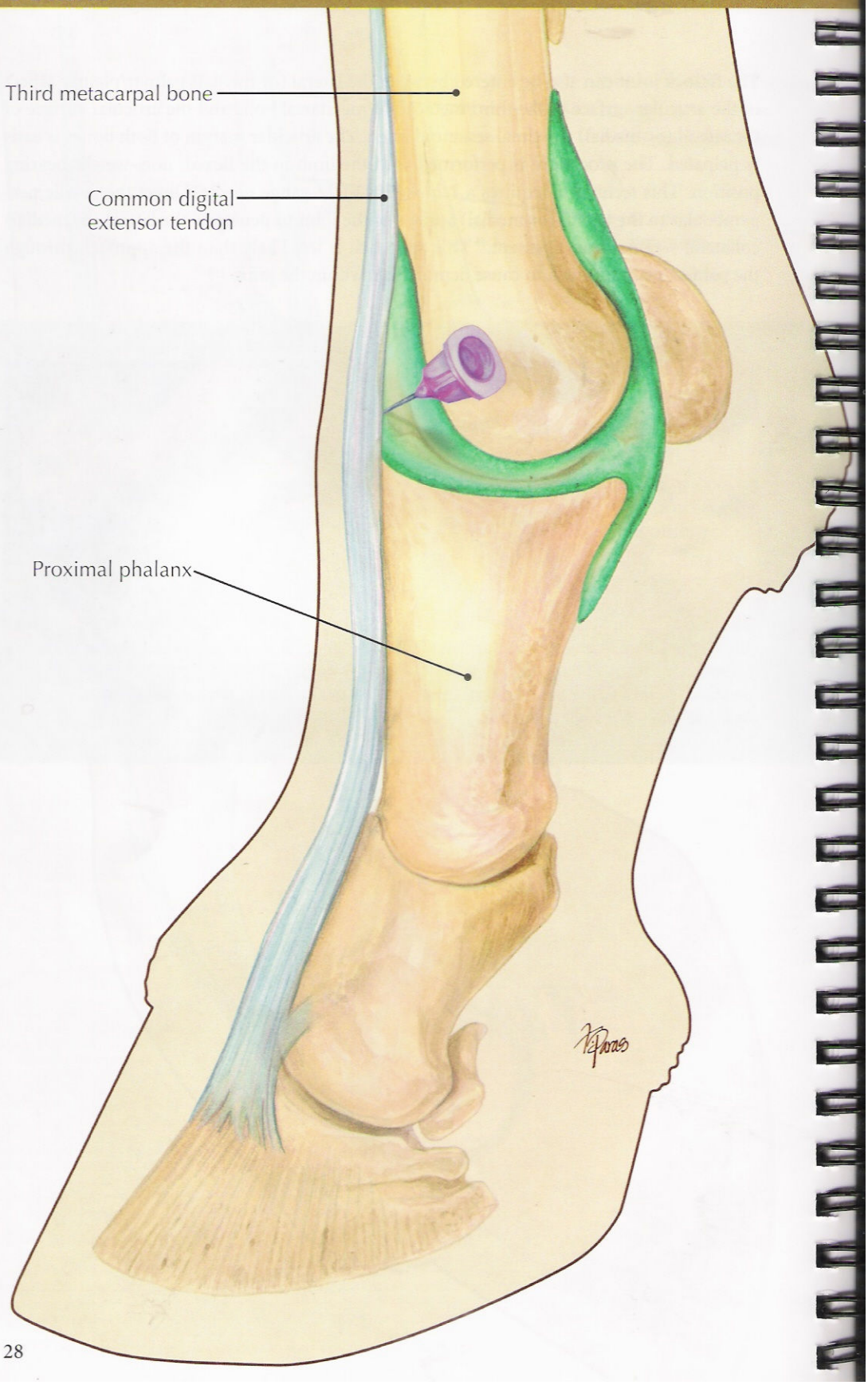
The **fetlock joint** can also be entered between the lateral (or medial) palmar/plantar aspect of the articular surface of the third metacarpal/metatarsal bone and the articular surface of the lateral (or medial) proximal sesamoid bone. The articular margin of both bones is easily palpated. The procedure is performed with the limb in the flexed, non–weight-bearing position. This technique requires a 1-inch, 20- to 22-gauge needle. Direct the needle perpendicular to the lateral (or medial) surface of the joint to penetrate the lateral (or medial) collateral sesamoidean ligament.[23] This approach is less likely than the approach through the palmar/plantar pouch to cause hemorrhage within the joint.

Palpate the lateral, palmar/plantar aspect of the articular surface of the third metacarpal/metatarsal bone and the articular surface of the lateral proximal sesamoid bone.

Direct the needle perpendicular to the lateral surface of the fetlock joint, and penetrate the lateral collateral sesamoidean ligament.

Fetlock

DORSAL



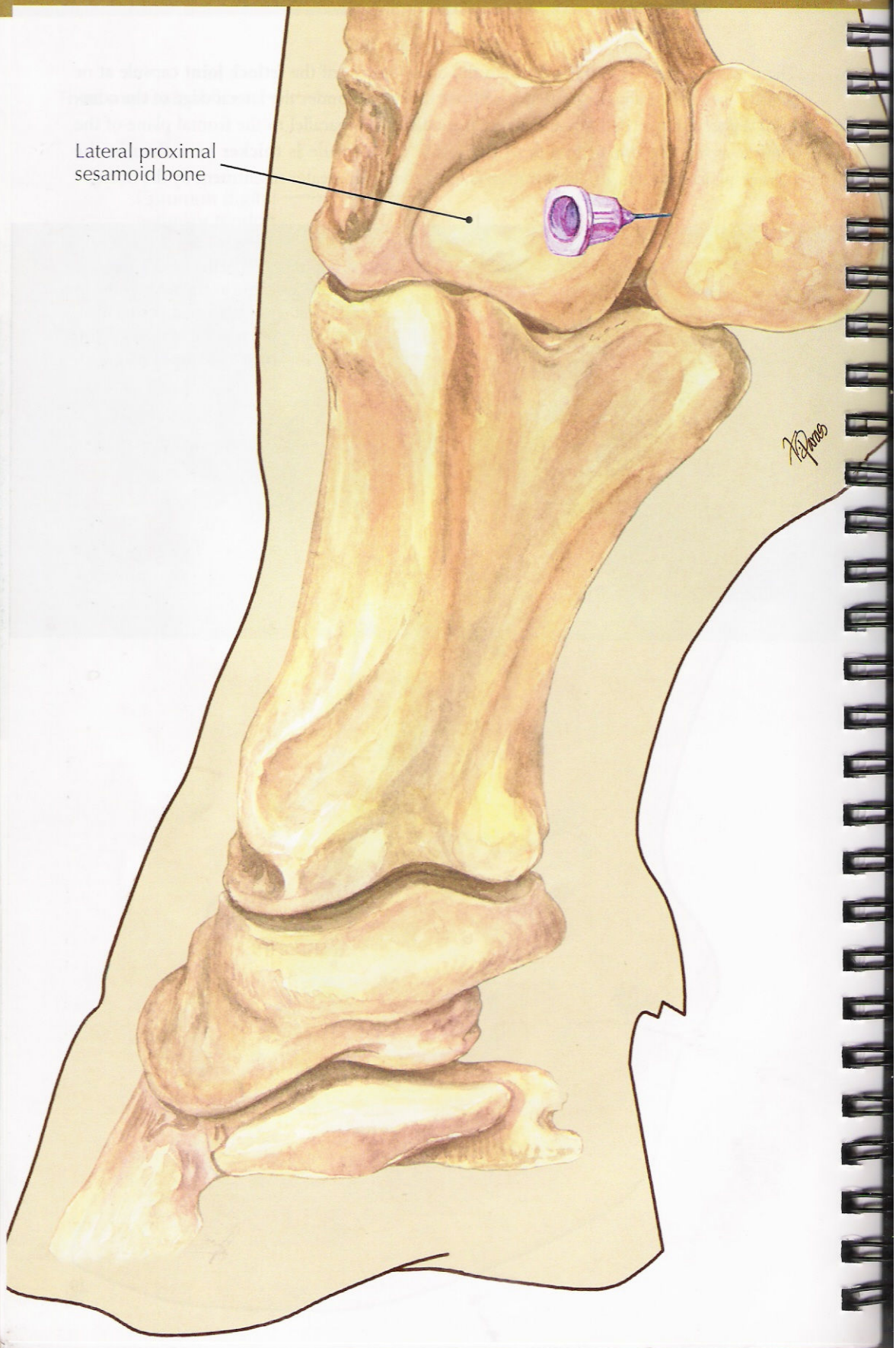
Needle: 1 inch (2.54 cm), 20 to 22 gauge
Volume: 8 to 12 mL
Degree of difficulty: 1

The alternate route of entry is through the dorsal aspect of the **fetlock joint** capsule at or slightly above the palpable joint space. Insert the needle under the lateral edge of the common digital extensor tendon and direct it medially and parallel to the frontal plane of the joint to enter the dorsal pouch of the joint. The capsule is thicker here than in the palmar/plantar pouch, and penetration is often met with greater resentment by the horse.

To enter the dorsal pouch of the fetlock joint, insert the needle under the lateral edge of the common digital extensor tendon at or slightly above the palpable joint space and direct the needle medially and parallel to the frontal plane of the joint.

Joint Injection

Digital Synovial Sheath



Needle: 1 inch (2.54 cm), 20 to 22 gauge
Volume: 8 to 12 mL
Degree of difficulty: 2

The **digital synovial sheath** can be entered in one of the sheath's pouches, which are located in places where the sheath is not encased by annular ligaments. When the sheath is distended, the site for centesis is the most prominently distended pouch; but when the sheath is not distended, the clinician must have good knowledge of the location of the pouches.

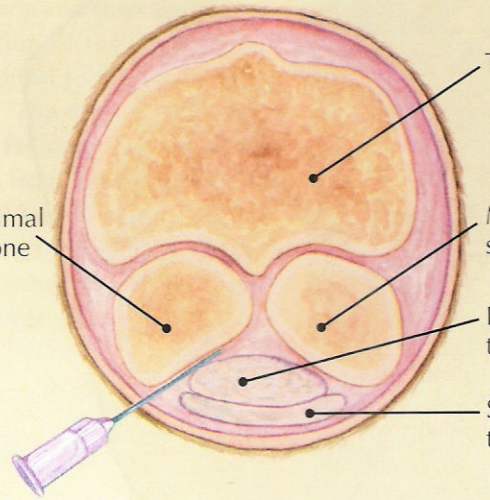
The digital synovial sheath can be entered proximal to the annular ligament of the fetlock joint about 1 inch proximal to the proximal aspect of the proximal sesamoid bone between the deep digital flexor tendon and the medial or lateral branch of the suspensory ligament. Centesis of the sheath at this location is difficult unless it is distended with fluid.

The sheath can be entered on the palmar/plantar aspect of the pastern between the proximal and distal digital annular ligaments and between the diverging branches of the superficial flexor tendon, where the deep digital flexor tendon lies close to the skin. The point of the needle must remain superficial to the deep digital flexor tendon.

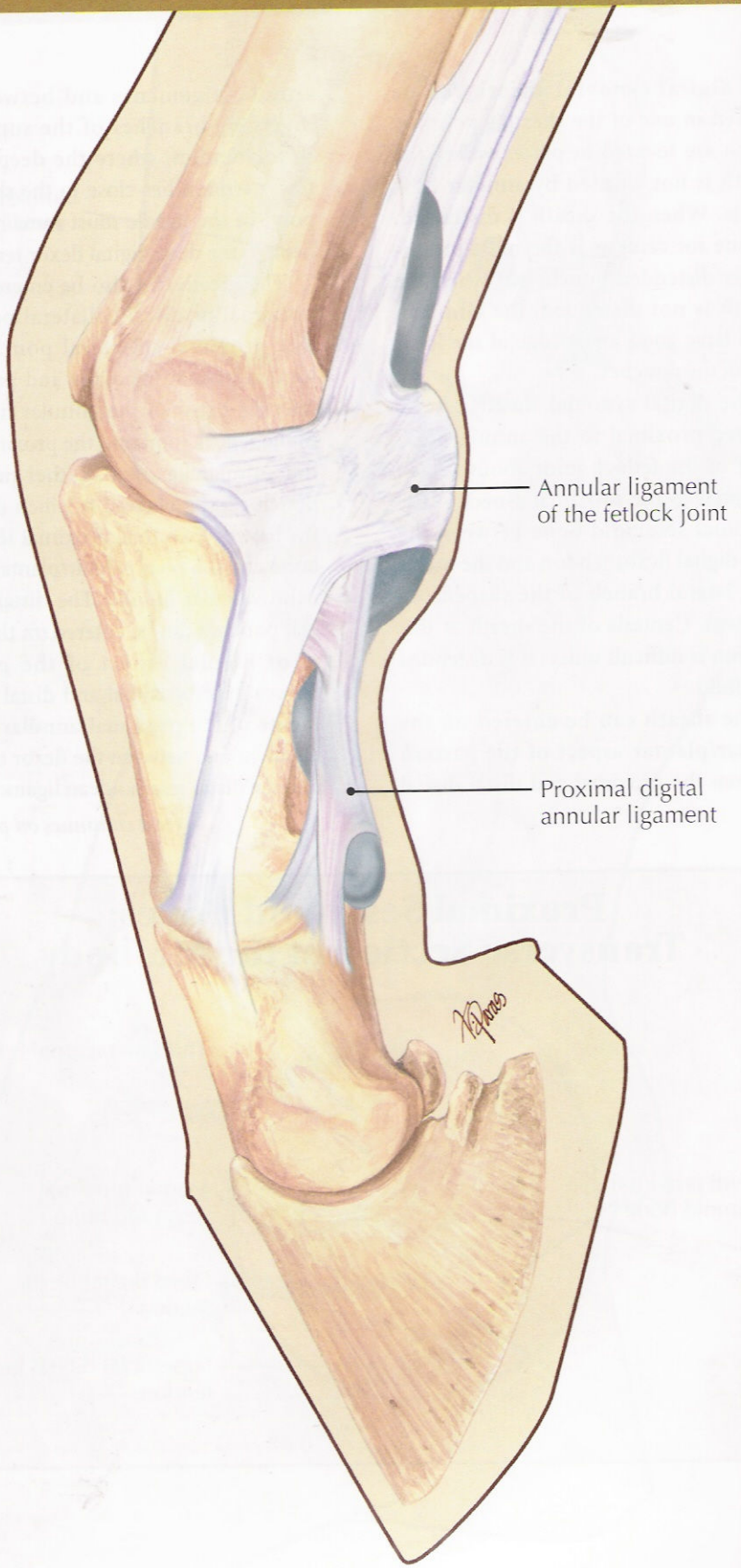
The sheath can also be entered at its proximal or distal collateral pouches. The proximal collateral pouches are located palmaromedially and palmarolaterally between the annular ligament of the fetlock joint and the proximal digital annular ligament. Either proximal pouch can be entered 0.5 inch distal to the base of ipsilateral proximal sesamoid bone and 0.5 inch palmar/plantar to the neurovascular bundle. The distal collateral pouches can be entered on the lateral or medial aspect of the pastern between the proximal and distal attachments of the proximal annular digital ligament and between the flexor tendons and the distal sesamoidean ligament.

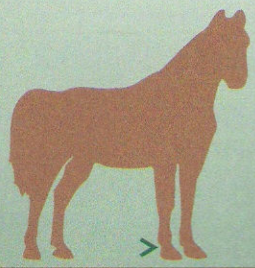
(text continues on page 33)

Proximal Sesamoid Bones: Transverse Section at the Midbody



Digital Synovial Sheath (continued)





Needle: 1 inch (2.54 cm), 20 to 22 gauge
Volume: 8 to 12 mL
Degree of difficulty: 2

(continued from page 31)

Using the palmar axial sesamoidean approach for centesis of the digital synovial sheath, insert the needle through the palmar/plantar annular ligament of the fetlock.[24] With the limb flexed, place the needle through the skin at the level of the midbody of the lateral proximal sesamoid bone, and advance it through the palmar/plantar annular ligament 3 mm axial to the palpable palmar/plantar border of the lateral proximal sesamoid bone and immediately palmar/plantar to the palmar/plantar digital neurovascular bundle. Insert the needle in a transverse plane and advance it at an angle to the sagittal plane, aiming toward the central intersesamoidean region to a depth of about 0.5 to 0.75 inch. The palmar axial sesamoidean approach is reliable for consistent synoviocentesis of the digital flexor tendon sheath, even when the sheath is not distended with fluid, and is less likely than other approaches to result in synovial hemorrhage.

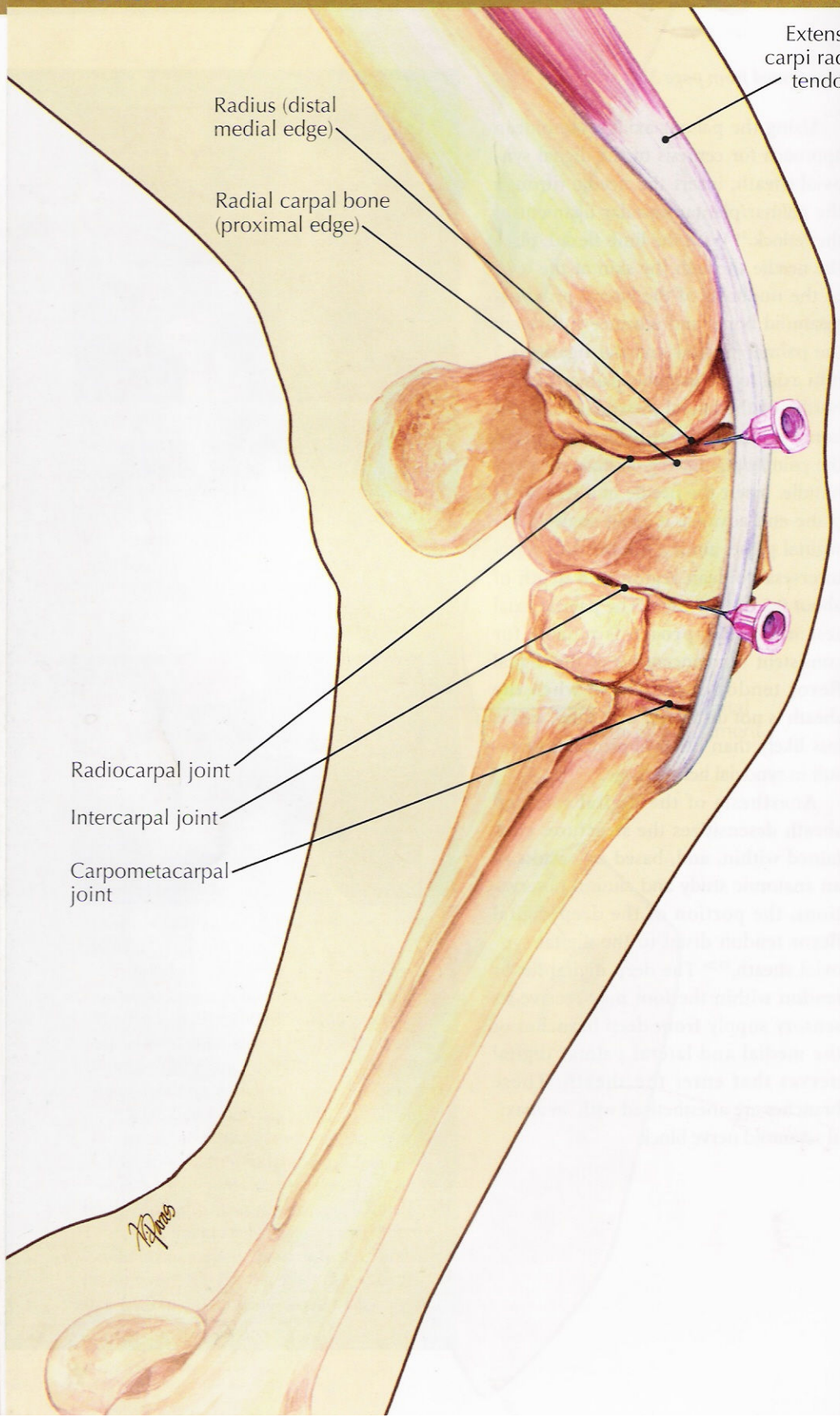
Anesthesia of the digital synovial sheath desensitizes the structures contained within, and, based on results of an anatomic study and clinical observations, the portion of the deep digital flexor tendon distal to the digital synovial sheath.[25,26] The deep digital flexor tendon within the foot may receive its sensory supply from deep branches of the medial and lateral palmar digital nerves that enter the sheath. These branches are anesthetized with an abaxial sesamoid nerve block.

The digital synovial sheath can be entered on the palmar/plantar aspect of the pastern between the proximal and distal digital annular ligaments and between the diverging branches of the superficial flexor tendon, where the deep digital flexor tendon lies close to the skin. The point of the needle must remain superficial to the deep digital flexor tendon.

To perform the palmar axial sesamoidean approach for centesis of the digital synovial sheath, insert the needle through the palmar/plantar annular ligament of the fetlock. With the limb flexed, place the needle through the skin at the level of the midbody of the lateral proximal sesamoid bone, and advance it through the palmar/plantar annular ligament, 3 mm axial to the palpable palmar/plantar border of the lateral proximal sesamoid bone and immediately palmar/plantar to the palmar/plantar digital neurovascular bundle. Insert the needle in a transverse plane and advance it at an angle to the sagittal plane, aiming toward the central intersesamoidean region, to a depth of about 0.5 to 0.75 inch.

Carpus

DORSAL



Needle: 1 to 1.5 inch (2.54 to 3.81 cm), 20 gauge
Volume: 7 to 10 mL for each joint
Degree of difficulty: 1

The **radiocarpal** and **intercarpal joints** can be entered with ease. The **carpometacarpal joint** communicates with the intercarpal joint and, therefore, does not require separate entry.

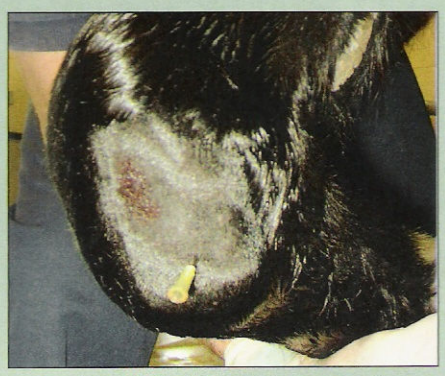
Using the dorsal approach, enter both the radiocarpal (antebrachiocarpal) and intercarpal joints with the limb held and the carpus flexed. Locate the radiocarpal joint by palpating the medial aspect of the distal edge of the radius and the proximal edge of the radial carpal bone. Insert the needle midway between these two structures and medial to the medial edge of the palpable tendon of the extensor carpi radialis muscle. The joint capsule is penetrated at a depth of about 0.5 inch.

Locate the intercarpal joint by palpating the distal edge of the radial carpal bone and the medial aspect of the proximal edge of the third carpal bone. The technique of needle insertion is similar to that for the radiocarpal joint.

It is important to point out that Ford et al[27] and Moyer et al[28] showed that the palmar outpouchings of the carpometacarpal joint capsule extend into the fibers of the proximal portion of the suspensory ligament. Therefore, one should assume that after injecting local anesthetic solution into the intercarpal joint, the solution enters the carpometacarpal joint and anesthetizes the origin of the suspensory ligament.

Palpate the radiocarpal and intercarpal joints medial to the palpable tendon of the extensor carpi radialis muscle.

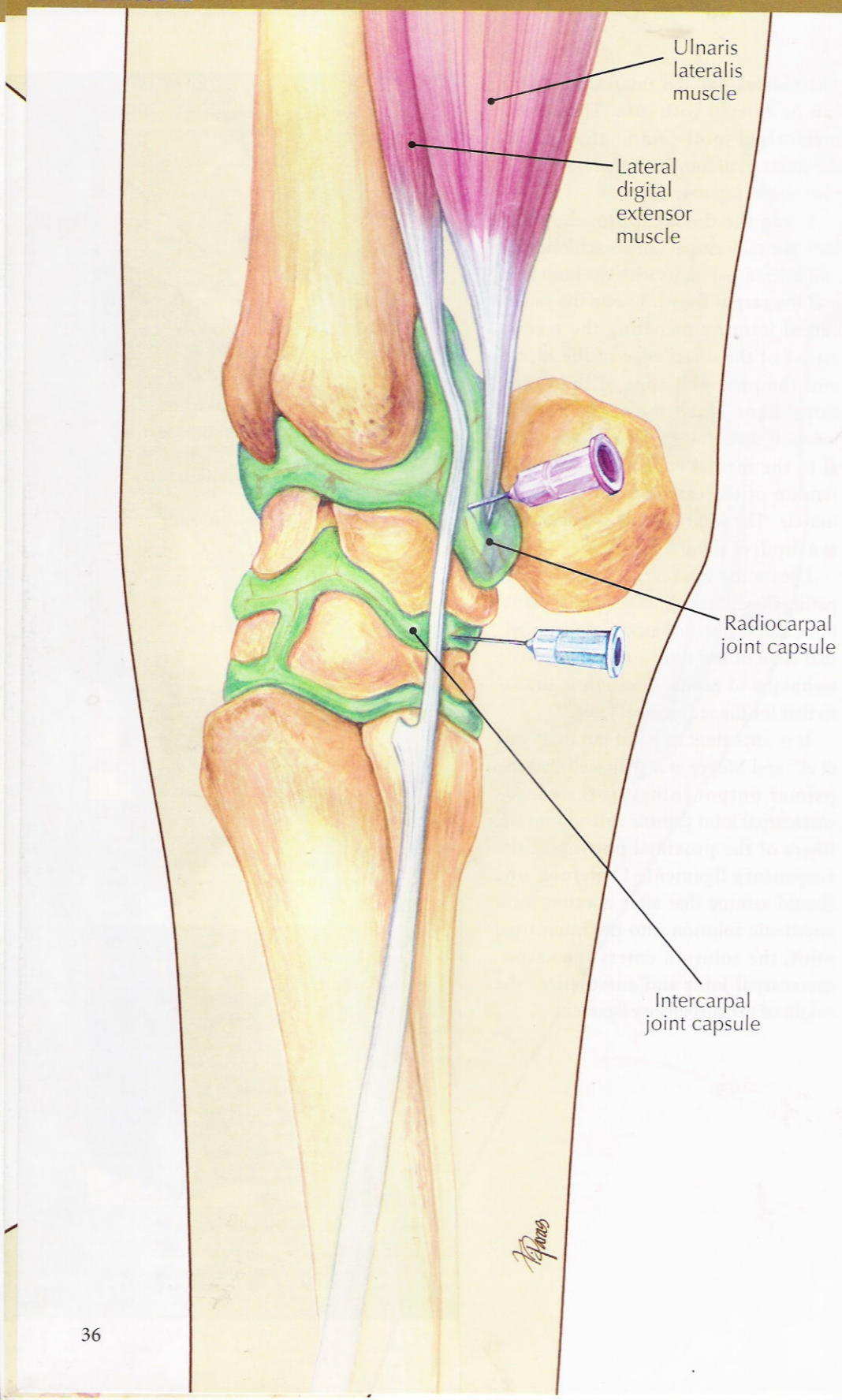
Insert the needle into the radiocarpal joint, medial to the palpable tendon of the extensor carpi radialis muscle.

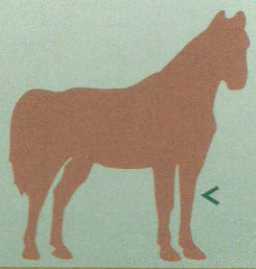


Insert the needle into the intercarpal joint, medial to the palpable tendon of the extensor carpi radialis muscle.

Carpus

LATERAL





Needle: 1 inch (2.54 cm), 20 to 22 gauge
Volume: 7 to 10 mL for each joint
Degree of difficulty: 2

The lateral approach for entering the **carpal joints** is preferred by some veterinarians because the limb does not need to be held when using this approach, and the risk of lacerating articular cartilage with the needle during insertion is less than that with the dorsal approach.[29] The lateral approach is relatively easy if the joint is distended by effusion.

With the horse bearing weight on the limb, palpate the tendons of the ulnaris lateralis and lateral digital extensor muscles on the palmarolateral aspect of the limb, above the carpus. As these structures are followed distally, they converge to form a V. A small depression that can be palpated 0.5 to 1 inch distal to the V is the site of insertion of the needle for arthrocentesis of the radiocarpal joint. Insert the needle perpendicular to the skin surface. The joint is penetrated at a depth of about 0.5 inch.

The intercarpal joint can be entered on the palmarolateral aspect of the carpus, with the horse bearing weight on the limb, in a slight depression located about 1 inch directly distal to the site of injection of the radiocarpal joint. Insert the needle perpendicular to the skin surface to a depth of about 0.5 inch.

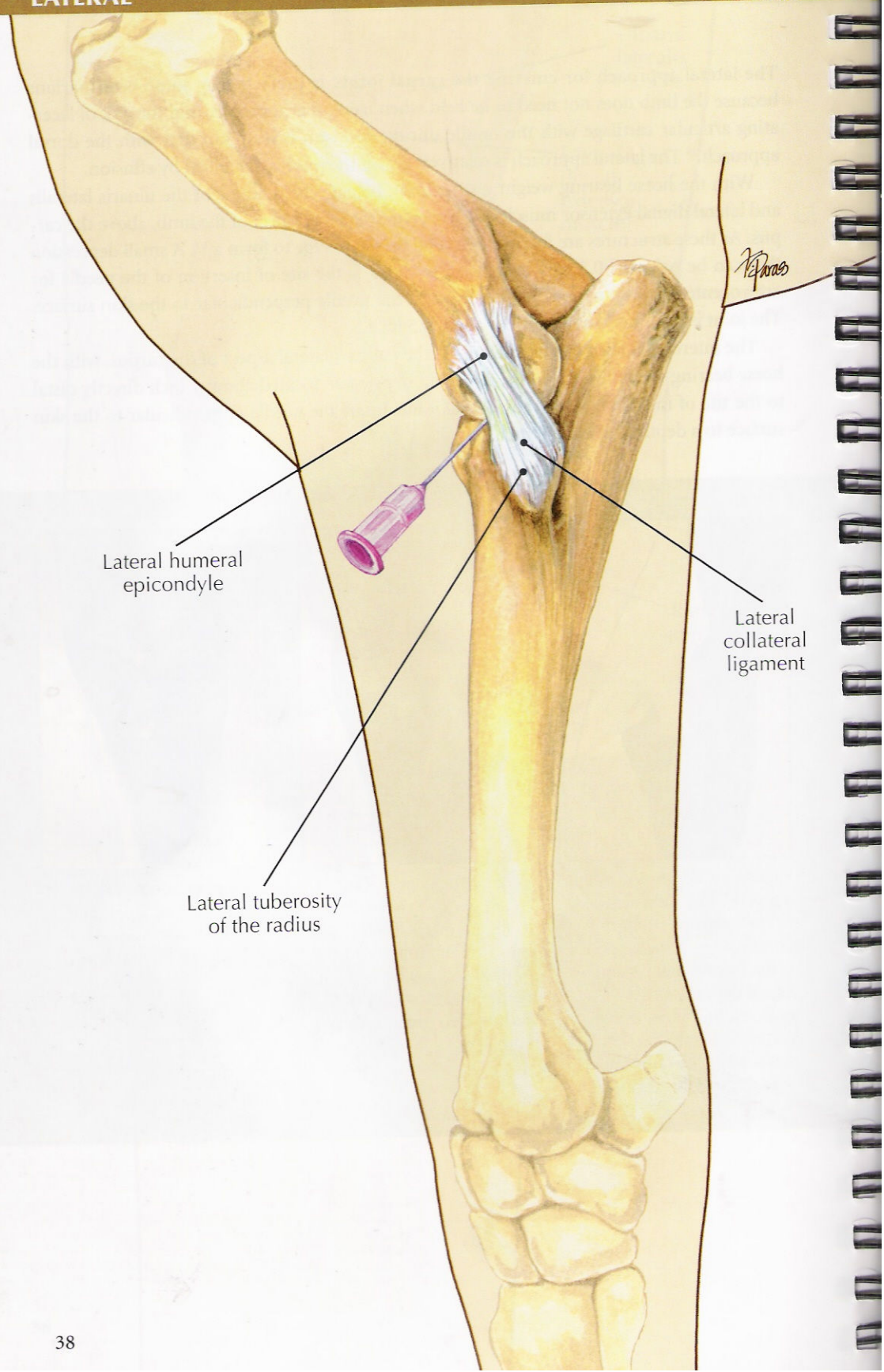
Palpate the depression found about 0.5 to 1 inch distal to the V created by the convergence of the tendons of the ulnaris lateralis and lateral digital extensor muscles. Insert the needle perpendicular to the skin surface into the radiocarpal joint through this depression.

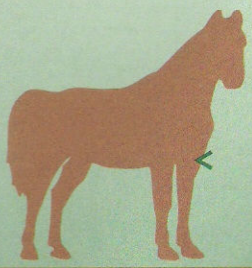
Palpate the depression found about 1 inch distal to the palmarolateral site of injection of the radiocarpal joint. Insert the needle perpendicular to the skin surface into the intercarpal joint.

The upper needle is placed into the radiocarpal joint, and the lower needle is placed into the intercarpal joint.

Elbow

LATERAL





Needle: 1.5 inch (3.81 cm), 20 gauge
Volume: 20 to 30 mL
Degree of difficulty: 2

The **elbow joint** (the combined humeroradial, humeroulnar, and radioulnar joints, or cubital joint) is not usually a source of lameness and, therefore, is rarely injected. With careful palpation, it is not a difficult joint to inject. The joint capsule of the elbow has cranial and caudal pouches. The palpable landmarks of the cranial pouch are the lateral humeral epicondyle, the radial tuberosity, and the lateral collateral ligament of the elbow.

Using a lateral approach, insert the needle either cranial or caudal to the palpable edge of the lateral collateral ligament. The joint margin is approximately two-thirds of the distance, measured distally, from the lateral humeral epicondyle to the radial tuberosity. The depth of penetration is usually 1 inch.

The elbow joint communicates with the bursa of the ulnaris lateralis muscle in about one-third of horses.[30]

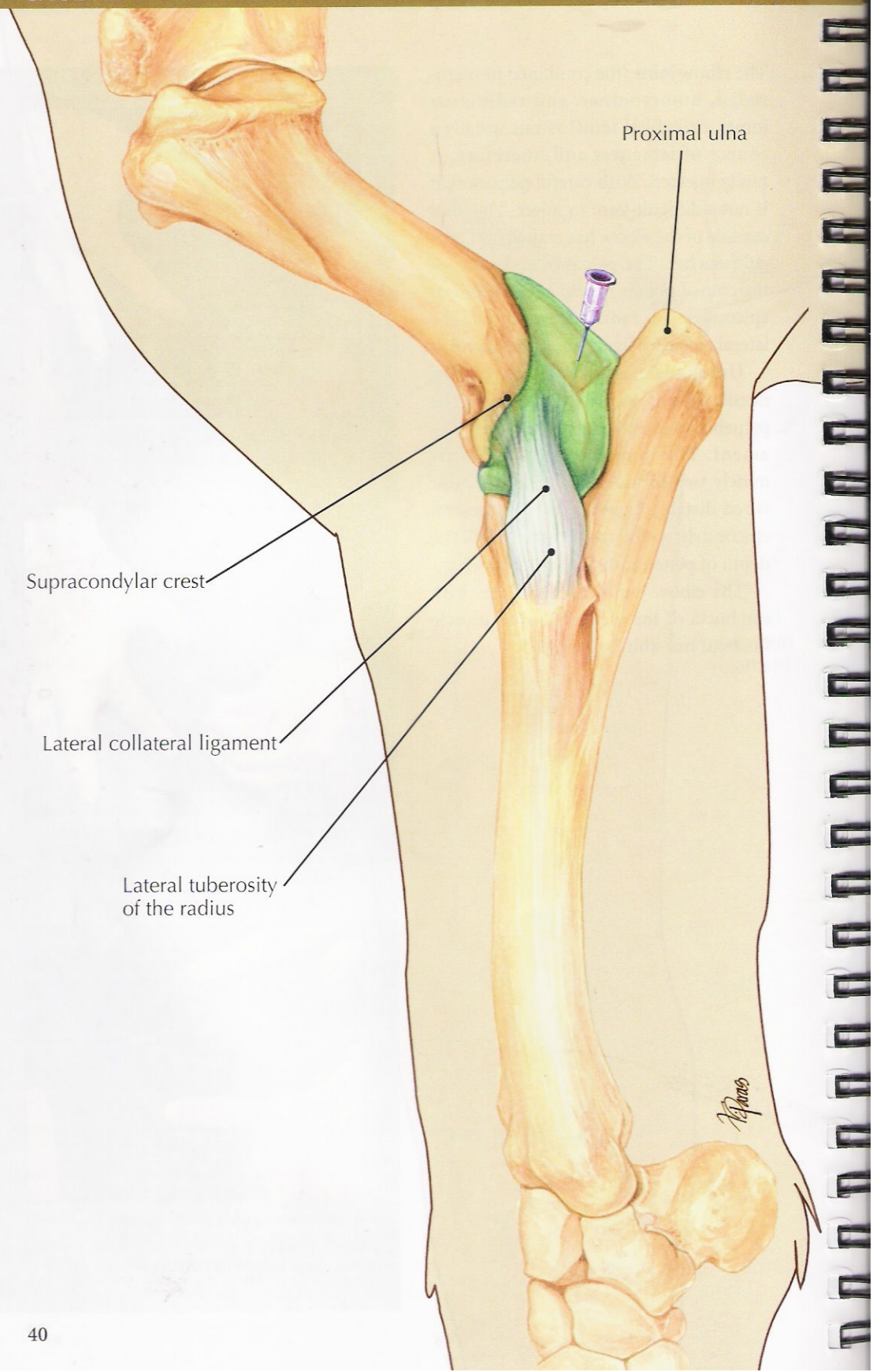
Palpate the lateral humeral epicondyle and the lateral tuberosity of the radius.

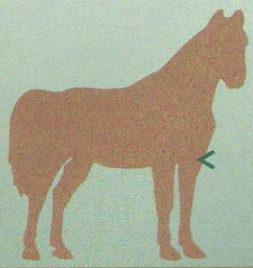
Insert the needle cranial to the palpable edge of the lateral collateral ligament of the elbow.

Alternatively, the needle can be inserted caudal to the palpable edge of the lateral collateral ligament of the elbow.

Elbow

CAUDAL





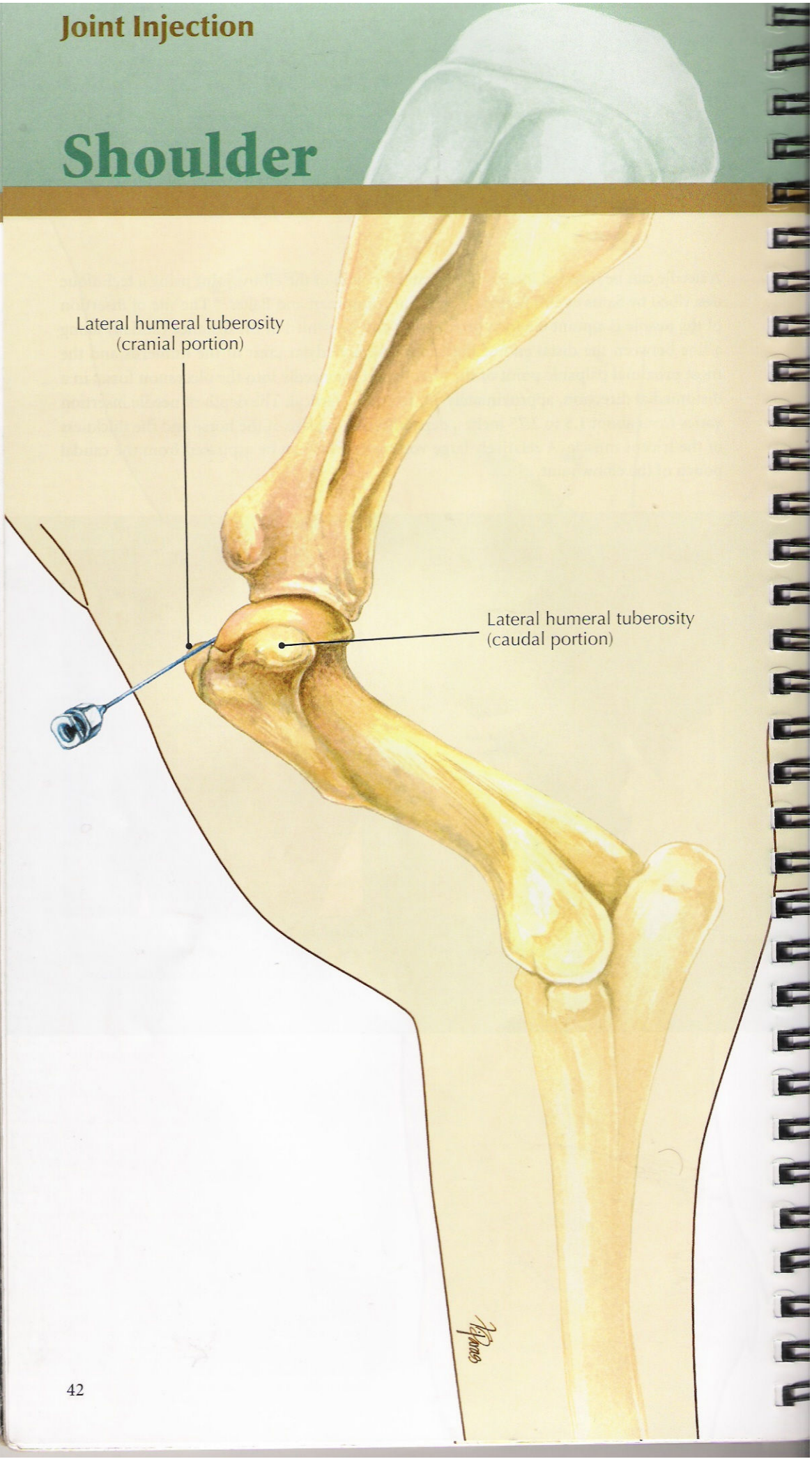
Needle: 3.5 inch (8.89 cm), 20 gauge
Volume: 20 to 30 mL
Degree of difficulty: 2

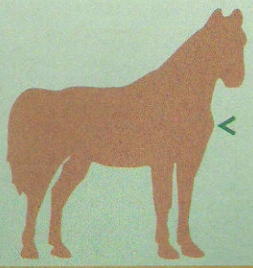
A needle can be inserted into the large caudal pouch of the **elbow joint** using a technique described by Sams et al,[30] Bertone et al,[31] and Goodman and Baker.[32] The site of insertion of the needle is a point 0.5 inch proximal to and one-third of the distance caudally along a line between the distal end of the lateral supracondylar crest of the humerus and the most proximal palpable point of the ulna. Insert the needle into the olecranon fossa, in a distomedial direction, approximately 45° from the vertical. The depth of needle insertion varies from about 1.5 to 2.75 inches, depending on the size of the horse and the thickness of the triceps muscle. A relatively large volume of fluid can be aspirated from the caudal pouch of the elbow joint.

Palpate the distal end of the lateral supracondylar crest of the humerus and the proximal end of the ulna.

Insert the needle at a point 0.5 inch proximal to a line between the two points and one-third of the distance caudally along the line.

Shoulder


Lateral humeral tuberosity
(cranial portion)
Lateral humeral tuberosity
(caudal portion)



Needle: 3.5 to 5 inch (8.89 to 12.7 cm), 18 gauge, spinal
Volume: 20 to 40 mL
Degree of difficulty: 3

The **shoulder joint** (scapulohumeral joint) is difficult to enter because of its relative depth. The landmarks, however, are easily identified.

The point of the shoulder (the lateral humeral tuberosity) is large and divided into cranial and caudal portions. A notch can be palpated between the cranial and caudal portions, and this notch is where the needle is inserted. Direct the needle parallel to the ground and somewhat caudally, aiming toward the opposite elbow. The depth of penetration varies with the size of the horse, but it may be as deep as 4 to 5 inches. Lack of resistance to pressure on the plunger of the syringe is not a good indication that the joint has been entered. The best indication that the joint has been entered successfully is the appearance of synovial fluid in the needle hub or the ability to aspirate synovial fluid or the injected contents of the syringe.

Flexible needles that bend easily should always be used when performing arthrocentesis of the shoulder joint to prevent the needle from breaking or damaging underlying tissue. Commonly, limb motion or muscle contraction may bend a positioned needle. The shoulder joint of some horses communicates with the bicipital bursa[33,34]; local anesthetic instilled into to the shoulder joint can, therefore, improve lameness associated with the bicipital bursa.

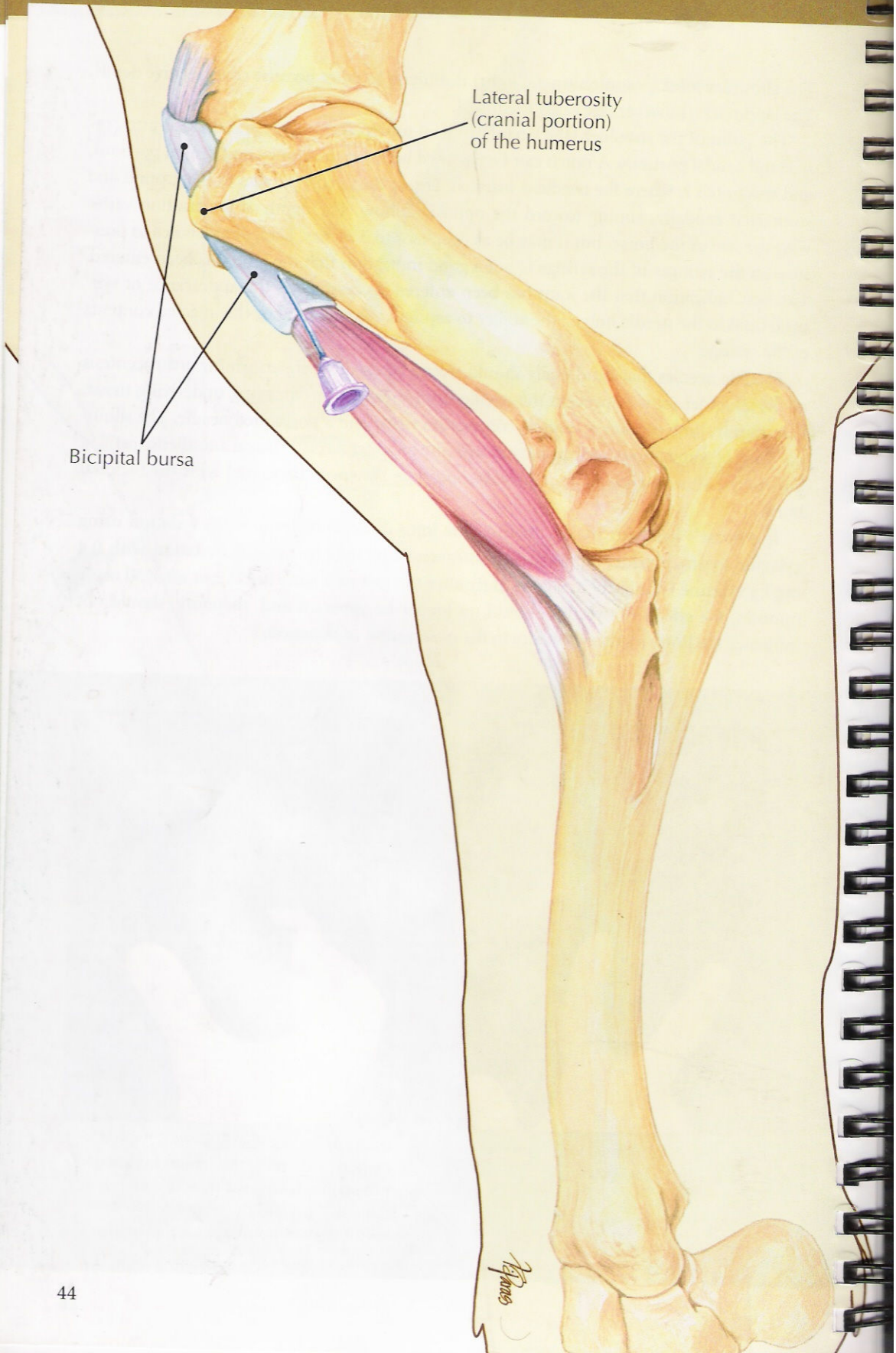
If a horse's behavior makes entering the joint difficult or impossible, sedation using xylazine hydrochloride, administered intravenously, may be helpful. Sedation with 0.4 mg/kg xylazine is unlikely to significantly alter the gait of a lame horse, but after 30 or 40 minutes, the effects of xylazine should no longer be apparent and, therefore, should not influence the horse's gait as it relates to the observation of lameness.

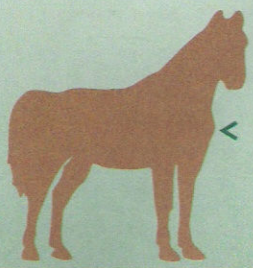
Palpate the cranial and caudal portions of the lateral humeral tuberosity.

Insert the needle between the cranial and caudal portions of the lateral humeral tuberosity. Direct the needle somewhat caudally (toward the opposite elbow) with the shaft parallel to the ground.

Bicipital Bursa

DISTAL



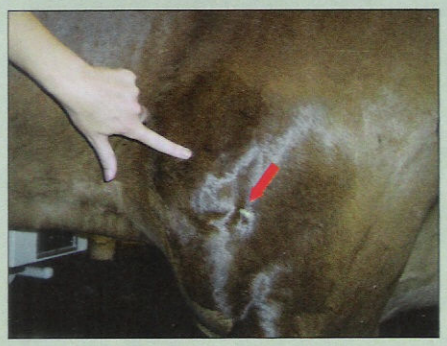


Needle: 3.5 to 5 inch (8.89 to 12.7 cm), 18 to 20 gauge, spinal
Volume: 20 to 30 mL
Degree of difficulty: 3

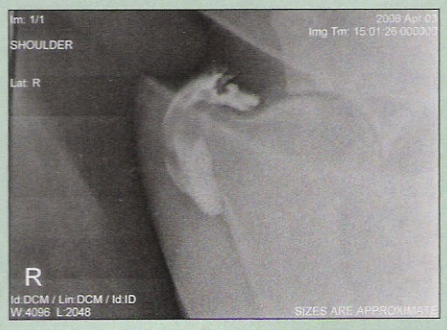
The **bicipital bursa** (intertuberal bursa) lies beneath the tendon of origin of the biceps brachii muscle as it passes through the intertuberal groove medial to the lateral tuberosity of the humerus. To insert a needle into the bicipital bursa, introduce a 3.5- to 5-inch, 18- to 20-gauge spinal needle at a point 2.5 inches distal and 3 inches caudal to the cranial prominence of the lateral tuberosity of the humerus. Direct the needle medially and proximally until it contacts bone aiming for the intertuberal groove. For a 1,000- to 1,400-pound horse, a 3.5-inch needle is usually inserted to its hub. Radiologic identification of radiopaque contrast medium, which can be included with the fluid injected, within the bursa is evidence of a successful bursal injection.

Another method of inserting a needle into the bicipital bursa is to insert an 18- to 20-gauge, 3.5-inch spinal needle 1.5 inches proximal to the distal aspect of the deltoid tuberosity and advance it dorsocranially for 2 to 3 inches (aiming for the opposite ear of the horse).[35] Advance the needle until there is a distinct change in resistance. This technique may be more accurate when attempting centesis of the bicipital bursa of horses that are smaller or larger than the average-sized quarter horse or thoroughbred.

Palpate the cranial portion of the lateral tuberosity of the humerus.



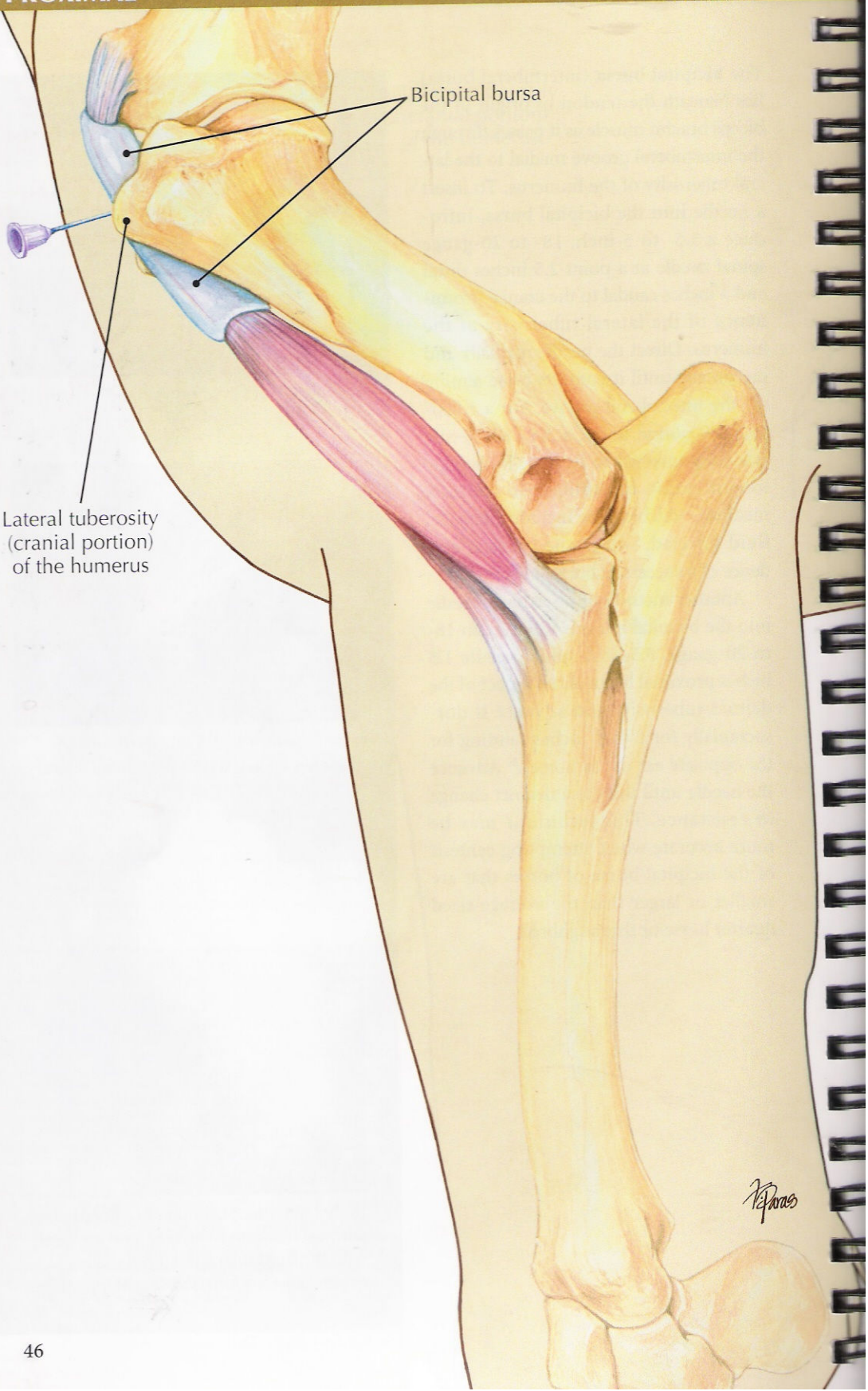
Insert the needle 2.5 inches distal and 3 inches caudal to this prominence, and direct the needle medially and proximally, beneath the bicipital tendon, until it contacts bone. A finger is pointed at the cranial prominence of the lateral tuberosity of the humerus. The *arrow* indicates the site of needle insertion.

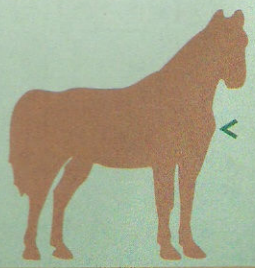


Radiologic identification of radiopaque contrast medium (which can be included with the fluid injected) within the bursa is evidence of a successful bursal injection.

Bicipital Bursa

PROXIMAL





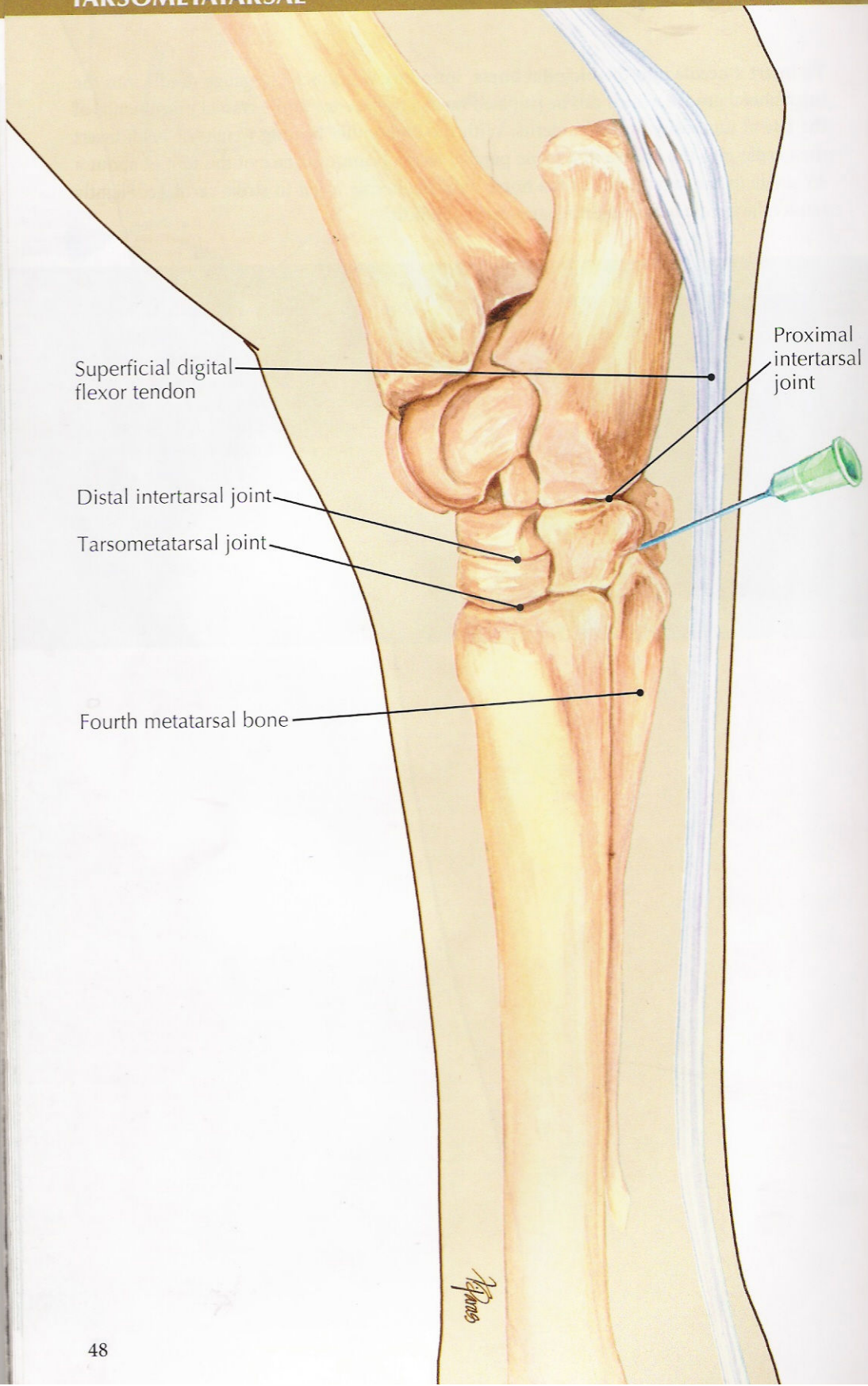
Needle: 1.5 inch (3.81 cm), 20 gauge
Volume: 20 to 30 mL
Degree of difficulty: 2

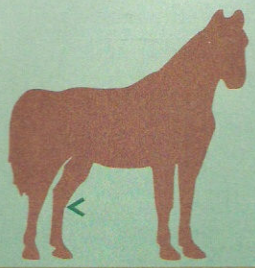
To insert a needle into the **bicipital bursa**, introduce a 1.5-inch, 20-gauge needle into the intertuberal groove, which can be palpated medial to the edge of the cranial prominence of the lateral tuberosity of the humerus. With the limb either bearing weight or held, insert the needle into the groove in a plane parallel to the bearing surface of the foot at about a 45° angle to the sagittal axis of the horse until the needle is felt to strike cartilage. Slightly retract the needle before injecting anesthetic solution.

With the limb either bearing weight or held, insert the needle into the intertuberal groove in a plane parallel to the bearing surface of the foot at a 45° angle to the sagittal axis of the horse until the needle is felt to strike cartilage. Slightly retract the needle before injecting anesthetic solution. A finger is pointed at the cranial prominence of the lateral tuberosity of the humerus.

Hock

TARSOMETATARSAL





Needle: 1.5 inch (3.81 cm), 19 to 20 gauge
Volume: 3 to 5 mL
Degree of difficulty: 1 to 2

The **hock** is composed of four joints: the tibiotarsal (tarsocrural), proximal intertarsal (talocalcaneocentral), distal intertarsal (centrodistal), and tarsometatarsal joints. Because the hock is a common site of pain causing lameness, arthrocentesis for both diagnosis and treatment is common. The tibiotarsal and proximal intertarsal joints communicate directly, but how commonly the distal intertarsal joint communicates directly with the tarsometatarsal joint is controversial.[2,36–39]

The **tarsometatarsal joint** is entered most easily when the joint is approached from the caudolateral aspect of the hock. The palpable landmarks are the head of the lateral splint bone (i.e., the fourth metatarsal bone) and the lateral edge of the superficial digital flexor tendon.

Insert the needle about 0.25 inch above the head of the lateral splint bone and 0.5 inch lateral to the lateral edge of the superficial digital flexor tendon. Direct the needle toward the dorsomedial aspect of the hock and slightly downward to a depth of 0.5 to 1 inch. The joint is usually entered with the limb bearing weight, but it can be entered with the limb being held when dealing with known "kickers." The technique for needle placement is the same. Generally, the first 3 to 5 mL of fluid is easily injected. Forcing more fluid into the joint is thought by some to cause fluid to enter the distal intertarsal joint,[37,38] but arthrographic studies show that injecting fluid into the tarsometatarsal joint under pressure causes the fluid to accumulate subcutaneously rather than in the distal intertarsal joint.[40]

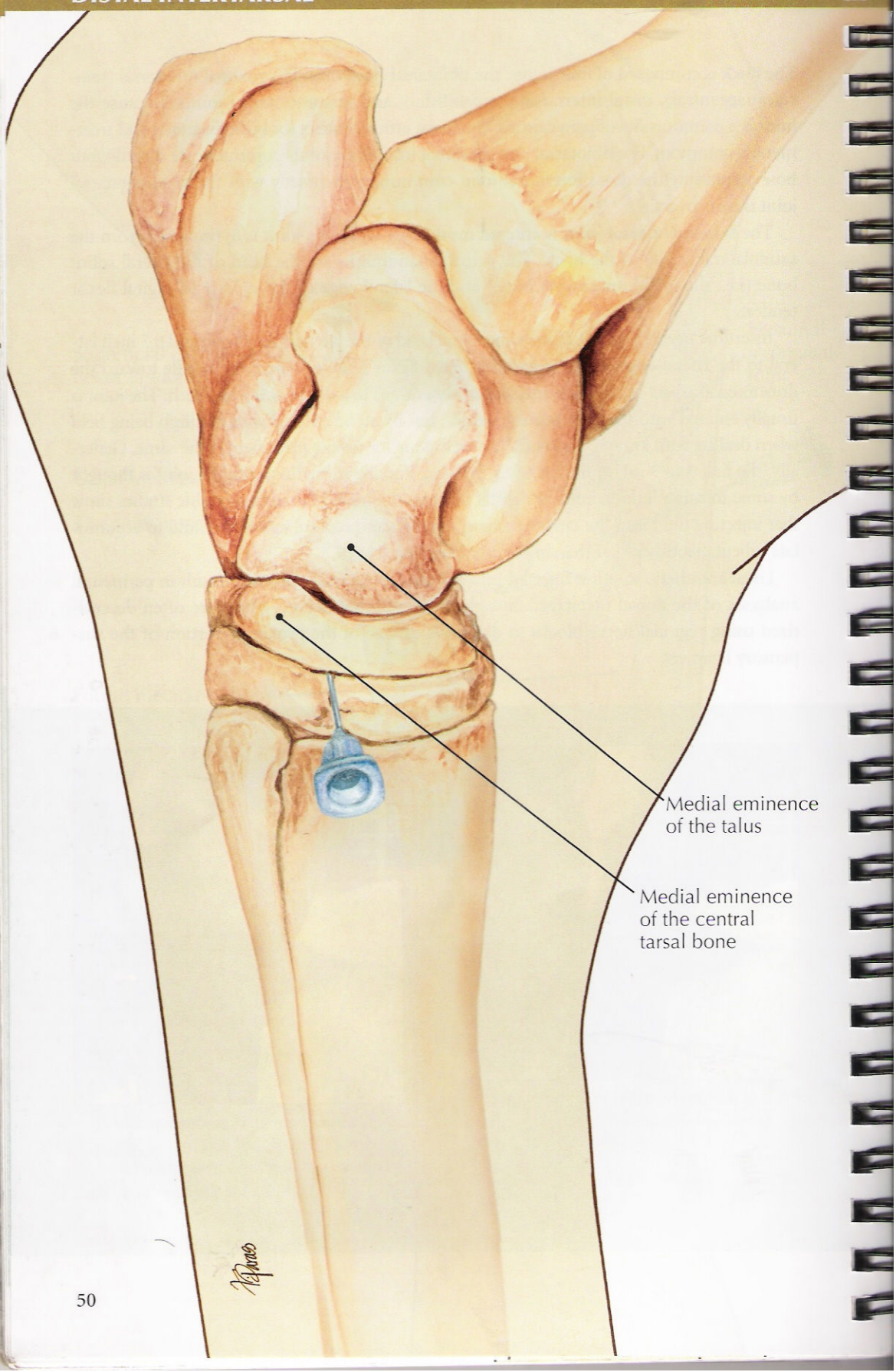
Local anesthetic solution injected into the tarsometatarsal joint may result in perineural analgesia of the dorsal metatarsal and plantar metatarsal nerves, which are often desensitized using regional nerve blocks to diagnosis disease of the proximal portion of the suspensory ligament.[7]

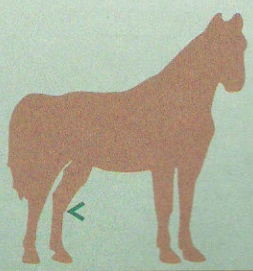
Palpate the proximal edge of the head of the lateral splint bone.

Insert the needle just proximal to the proximal edge of the head of the lateral splint bone. Direct the needle slightly downward and toward the dorsomedial aspect of the hock.

Hock

DISTAL INTERTARSAL



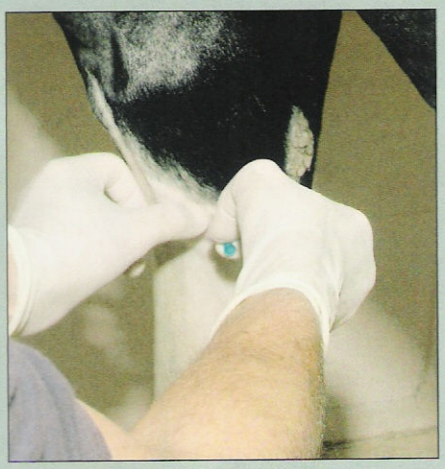


Needle: ⅝ to 1 inch (1.58 to 2.54 cm), 23 to 25 gauge
Volume: 3 to 5 mL
Degree of difficulty: 1 to 2

Centesis of the **distal intertarsal joint** (centrodistal joint) is technically more difficult than arthrocentesis of the tarsometatarsal joint and, because of its medial approach, presents more danger to the clinician. The distal intertarsal joint is entered on the distomedial aspect of the hock, midway between the plantar and dorsal aspects of the distal portion of the tarsus, with the limb bearing weight. The site of centesis can be found by first identifying the easily palpated medial eminence of the talus. Distal and plantar to this tuberosity is a less discernible eminence of the central tarsal bone. Halfway between these landmarks and 0.5 inch distal to the eminence of the central tarsal bone is the site for needle insertion.

Insert a ⅝- to 1-inch, 23- to 25-gauge needle into the proximal part of the small, T-shaped gap formed by the junction of the fused first and second tarsal bones, the third tarsal bone, and the central tarsal bone. This gap can usually be palpated using a fingernail. The needle should be inserted as proximal as possible in this gap to avoid entering the tarsometatarsal joint, which occupies the distal portion of the gap.[41] The site may be difficult to find, especially if the joint has severe degenerative disease. The needle is determined to be within the distal intertarsal joint by low resistance to injection without development of subcutaneous swelling and the ability to aspirate the injected contents of the syringe. The distal intertarsal joint frequently communicates with the cunean bursa.[15]

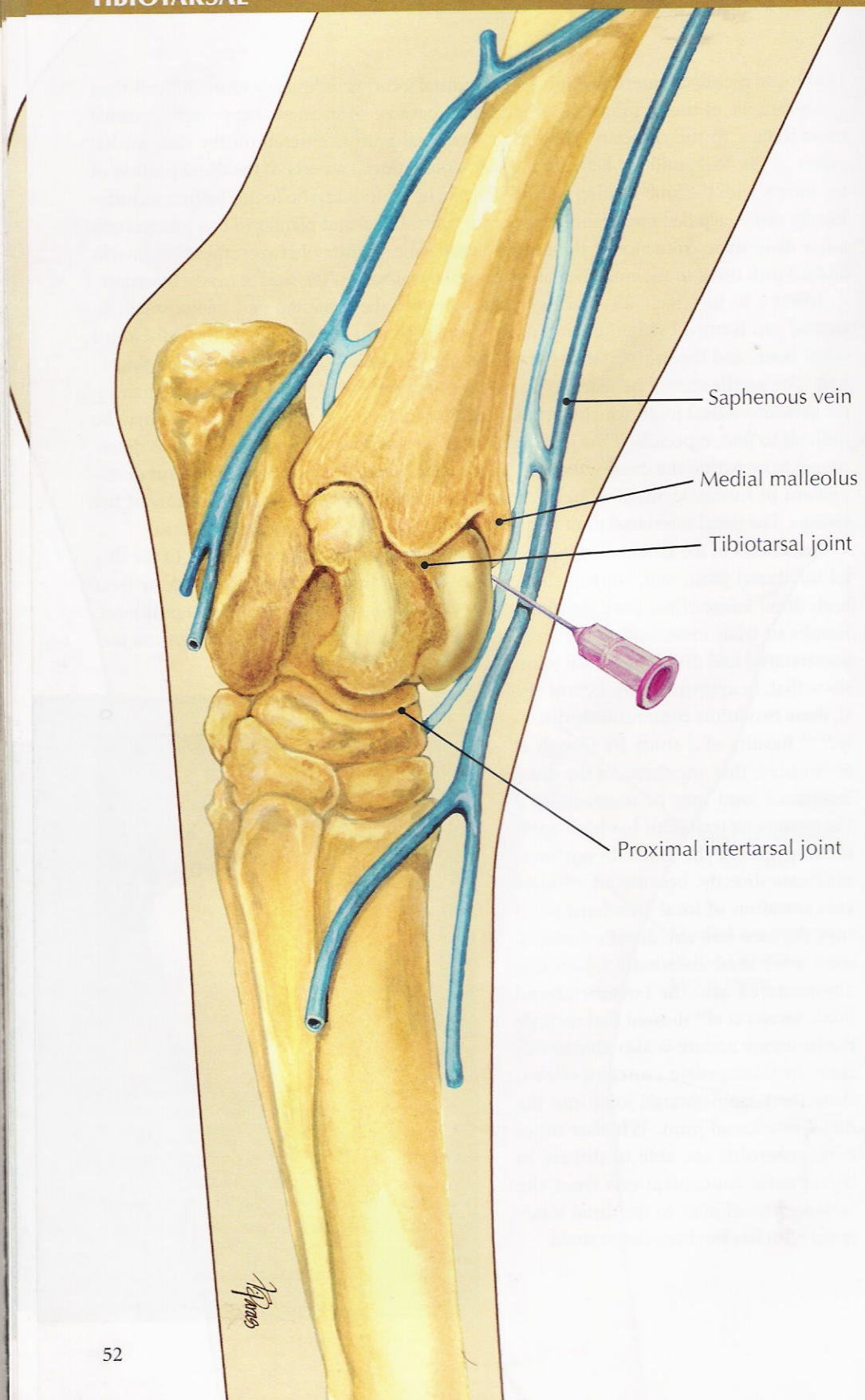
Anesthesia of the tarsometatarsal joint is often assumed to cause anesthesia of the distal intertarsal joint, and, consequently, some clinicians attempt to either block or treat both distal joints of the hock simultaneously by injecting only the tarsometatarsal joint. Results of trials investigating the frequency of direct communication between the tarsometatarsal and distal intertarsal joints show that, in approximately 25% of tarsi, these two joints communicate directly.[40–42] Results of a study by Gough et al[15] indicate that anesthesia of the distal intertarsal joint may be unnecessary if the tarsometatarsal joint has been anesthetized, even if the joints do not communicate directly, because an effective concentration of local anesthetic solution diffuses into the distal intertarsal joint after local anesthetic solution is administered into the tarsometatarsal joint. Serena et al[43] showed that methylprednisolone acetate is also able to diffuse, in therapeutic concentrations, from the tarsometatarsal joint into the distal intertarsal joint. Whether other corticosteroids are able to diffuse in therapeutic concentrations from the tarsometatarsal joint to the distal intertarsal joint has not been determined.

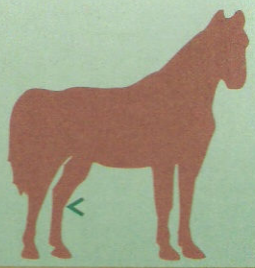


Insert the needle into the distal intertarsal joint, midway between the plantar and dorsal aspects of the distal portion of the tarsus. Insert the needle below the distal edge of the cunean tendon into the T-shaped gap formed by the junction of the fused first and second tarsal bones, the third tarsal bone, and the central tarsal bone.

Hock

TIBIOTARSAL





Needle: 1 inch (2.54 cm), 20 gauge
Volume: 10 to 20 mL
Degree of difficulty: 1

The **tibiotarsal joint** (tarsocrural joint) is the easiest of all joints to inject. The joint capsule is thin and superficial, and the landmarks are obvious and discernible.

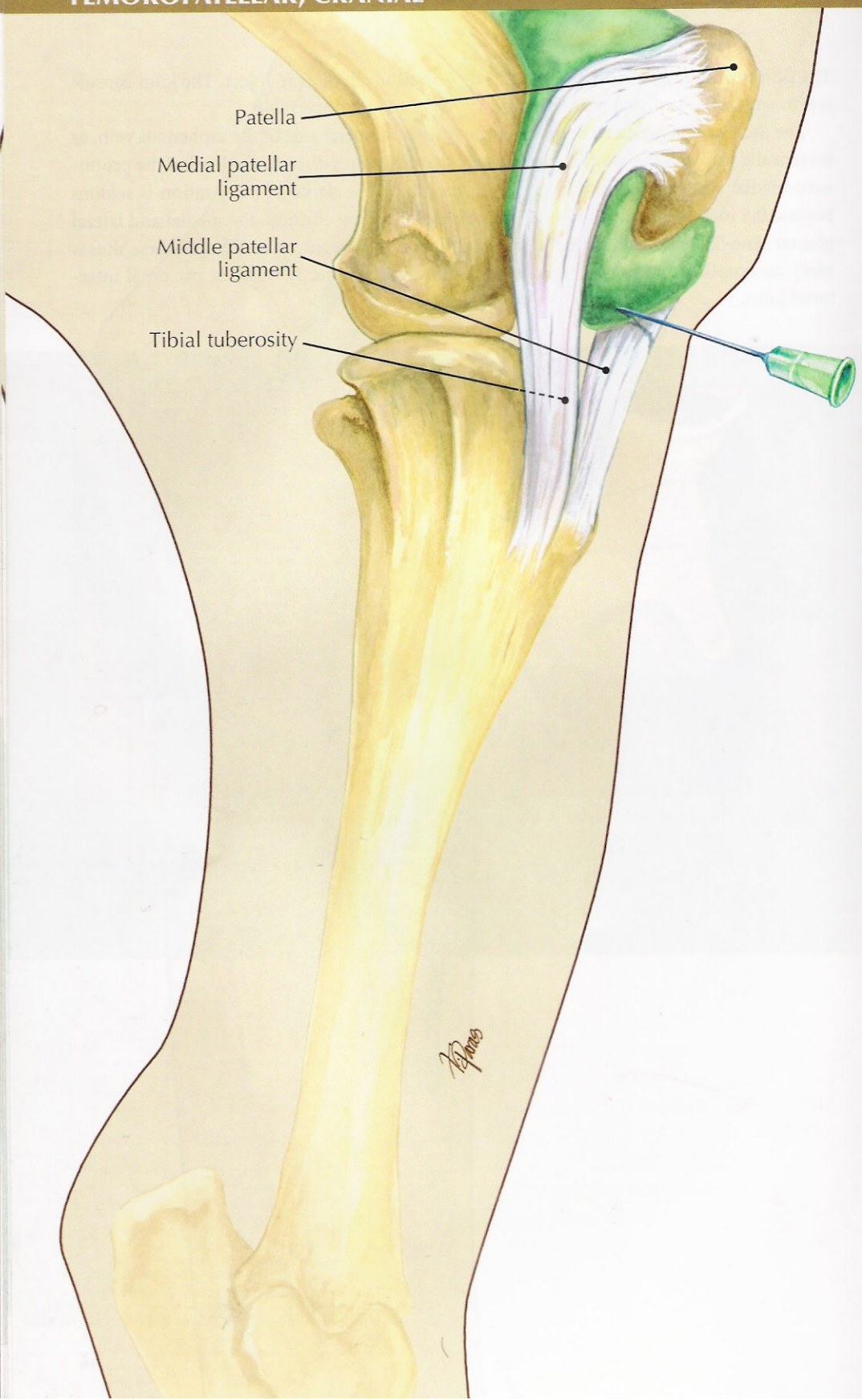
The joint can be penetrated on either the medial or lateral side of the saphenous vein, as it vertically traverses the joint, approximately 1 to 1.5 inches distal to the level of the prominent medial malleolus at the distal end of the tibia. The depth of penetration is seldom beyond 0.5 inch. When the tibiotarsal joint is distended by effusion, the medial and lateral plantar synovial pouches are readily discernible, and arthrocentesis at either of these sites is easily accomplished. The tibiotarsal joint communicates directly with the proximal intertarsal joint.

Palpate the tibiotarsal joint distal to the level of the medial malleolus of the tibia.

Insert the needle just medial or lateral to the visible saphenous vein, 1 to 1.5 inches distal to the level of the palpable medial malleolus. The joint capsule is superficial and thin.

Stifle

FEMOROPATELLAR, CRANIAL



Needle: 1.5 to 3 inch (3.81 to 7.62 cm),
18 to 19 gauge, spinal
Volume: 20 mL+
Degree of difficulty: 2 to 3

The **stifle** is a large and complex structure consisting of two joints, the femoropatellar and the femorotibial. The femorotibial joint is composed of the lateral femorotibial and medial femorotibial compartments. Intraarticular anesthesia is often required to diagnose stifle problems; therefore, the techniques for injecting the compartments of the stifle joints are important. With some horses, difficulty in locating the anatomic landmarks can be reduced by clipping the hair or palpating the structures with the limb flexed. Standing the horse squarely can facilitate palpation of the medial and lateral patellar ligaments.

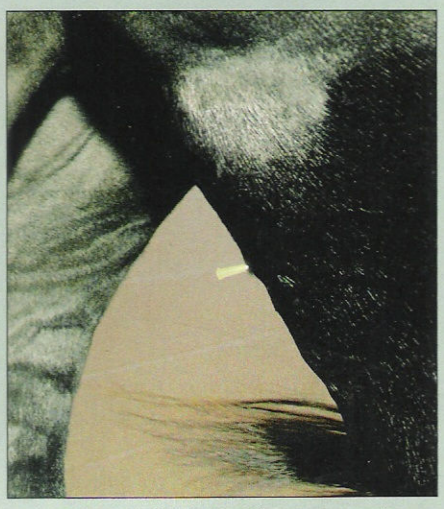
Results of a study by Gough et al[15] show a greater diffusion of local anesthetic solution between compartments of the stifle than previously assumed from results of anatomic, latex-injection, and contrast arthrographic studies. Blocking a specific compartment of the stifle may produce anesthesia of the other two compartments not blocked directly.

The **femoropatellar joint** is the largest of the three compartments of the stifle. It communicates directly with the medial compartment of the femorotibial joint in about 65% of horses,[44] but it seldom communicates directly with the lateral compartment. The joint can be difficult to enter and is, we believe, the compartment of the stifle that horses most resent having penetrated.

The landmarks that are easiest to locate are the proximal aspect of the tibial tuberosity, the patellar ligaments, and the patella. The most uniformly successful technique of insertion is to direct the needle 1 to 1.5 inches above the palpable proximal aspect of the tibial tuberosity, between the middle and medial patellar ligaments. Direct the needle parallel to the ground.

Obstacles that may prevent needle entry are the large fat pad between the patellar ligaments and joint capsule and limb motion during penetration. The procedure can be carried out with the limb either bearing weight or flexed,[45] but performing the procedure with the limb flexed requires an additional assistant. The recommended volume of local anesthetic solution for injection varies from as little as 10 mL[22] to as much as 100 mL.

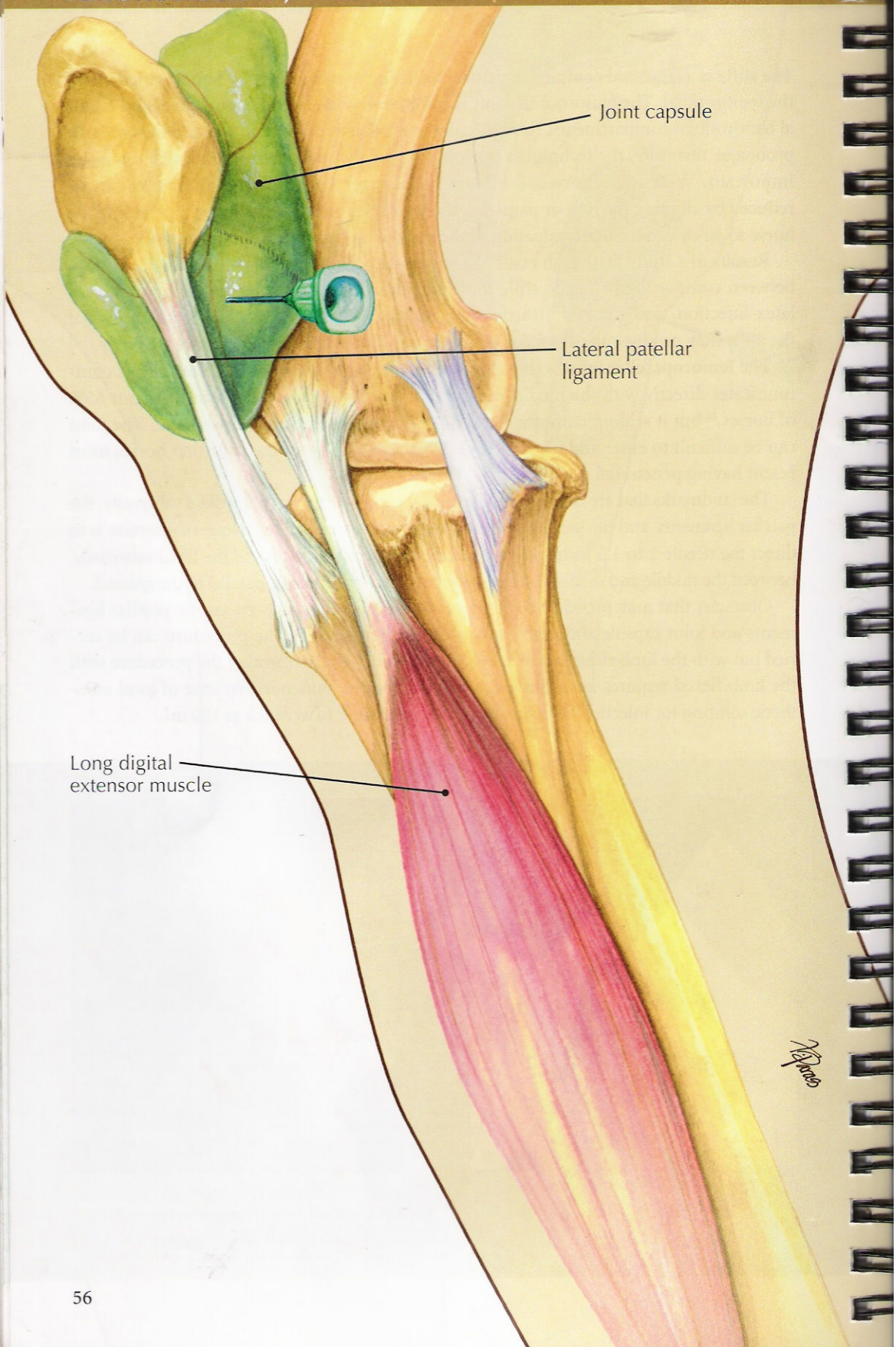
Palpate the tibial tuberosity and the middle and medial patellar ligaments.

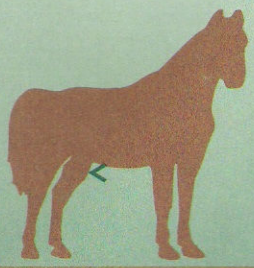


Insert the needle 1.5 inches proximal to the tibial tuberosity between the middle and medial patellar ligaments.

Stifle

FEMOROPATELLAR, LATERAL

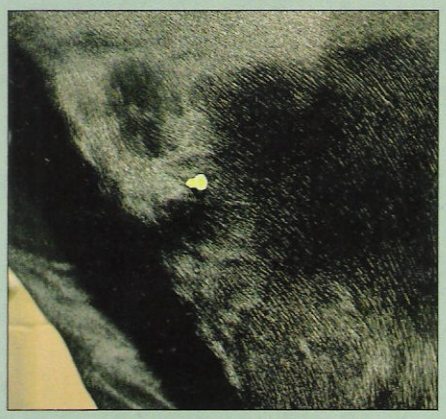




Needle: 1.5 inch (3.81 cm), 18 to 19 gauge
Volume: 20 mL+
Degree of difficulty: 2

An alternate approach to the **femopatellar joint**, described by Hendrickson and Nixon,[46] is to insert the needle into the lateral cul-de-sac of the joint. Direct an 18- to 19-gauge, 1.5-inch needle perpendicular to the long axis of the limb, approximately 2 inches above the palpable lateral edge of the lateral tibial condyle, just behind the caudal edge of the palpable lateral patellar ligament. Insert the needle until bone is contacted, and then slightly withdraw it. Fluid can usually be aspirated.

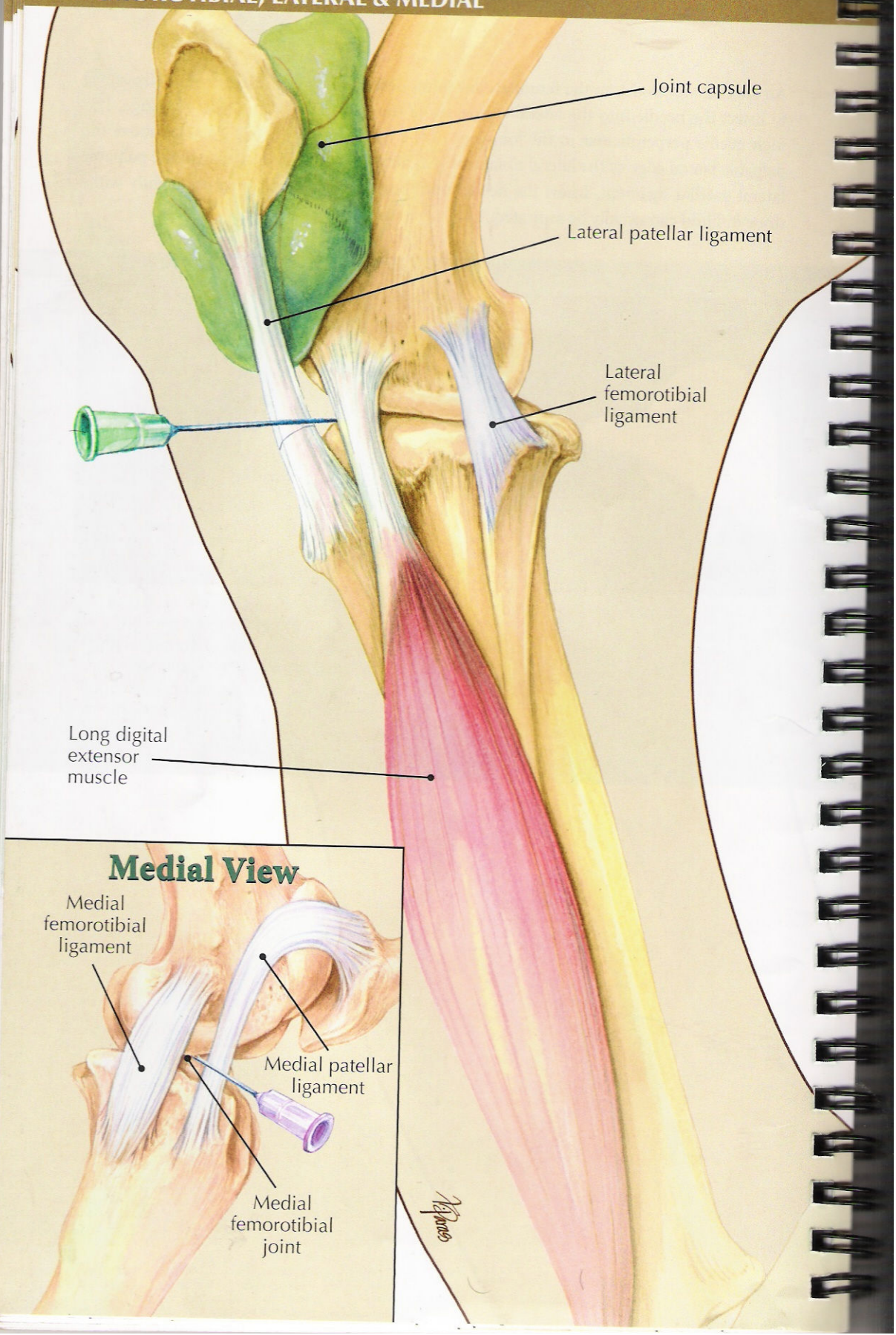
Palpate the lateral edge of the lateral tibial condyle.

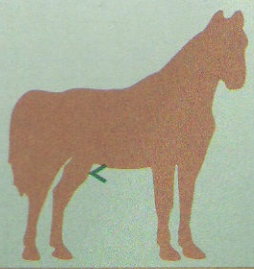


Insert the needle perpendicular to the long axis of the limb, about 2 inches above the lateral edge of the lateral tibial condyle, just behind the caudal edge of the palpable lateral patellar ligament until bone is contacted; then slightly withdraw the needle.

Stifle

FEMOROTIBIAL, LATERAL & MEDIAL

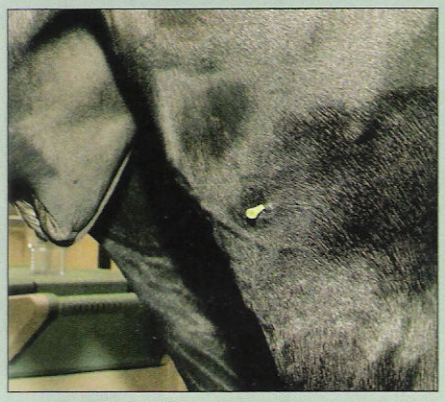




Needle: 1.5 inch (3.81 cm), 18 to 19 gauge
Volume: 20 to 30 mL
Degree of difficulty: 2

The **lateral compartment of the femorotibial joint** can be entered in two ways. We prefer the method that involves inserting the needle slightly caudal to the palpable lateral patellar ligament, just above the proximolateral edge of the tibia. Depth of penetration is generally about 1 inch. The alternative technique is to enter through the space between the lateral femorotibial ligament and the origin of the long digital extensor muscle.[45] The palpable head of the fibula helps to identify these structures. The depth of penetration is usually 0.75 to 1 inch.

The **medial femorotibial joint** is not difficult to enter, and because this compartment communicates with the femoropatellar joint in the majority of horses,[44–47] some clinicians choose to inject it rather than the femoropatellar joint in an attempt to either block or treat both this compartment and the femoropatellar joint. The injection site is located between the medial patellar ligament and the medial femorotibial ligament just above the palpable proximomedial edge of the tibia. Generally, the penetration depth is 0.75 to 1 inch.

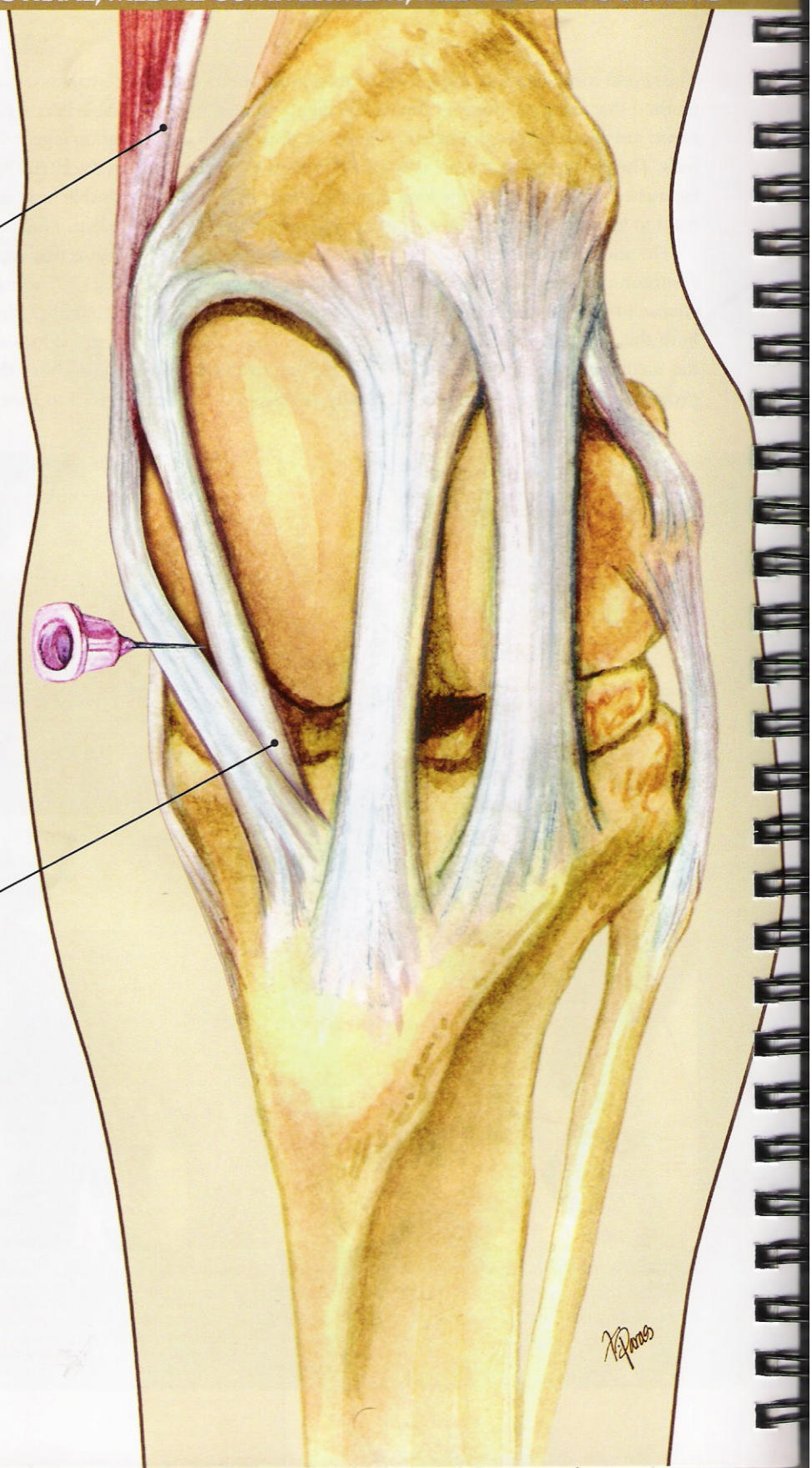


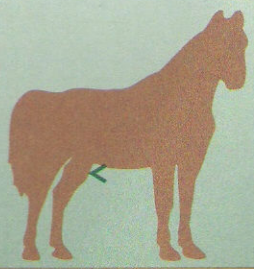
Palpate the **lateral patellar ligament** (*left*). The lateral femorotibial ligament is caudal to the lateral patellar ligament. Insert the needle behind the lateral patellar ligament, just above the proximolateral edge of the tibia (*right*).

Palpate the **medial patellar ligament** and the medial femorotibial ligament (*left*). Insert the needle between the palpable medial patellar ligament and the medial femorotibial ligament, just above the proximomedial edge of the tibia (*right*).

Stifle

FEMOROTIBIAL, MEDIAL COMPARTMENT, MEDIAL OUTPOUCHING

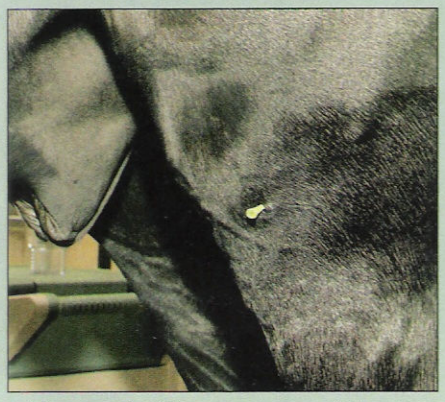




Needle: 1.5 inch (3.81 cm), 18 to 19 gauge
Volume: 20 to 30 mL
Degree of difficulty: 2

The **lateral compartment of the femorotibial joint** can be entered in two ways. We prefer the method that involves inserting the needle slightly caudal to the palpable lateral patellar ligament, just above the proximolateral edge of the tibia. Depth of penetration is generally about 1 inch. The alternative technique is to enter through the space between the lateral femorotibial ligament and the origin of the long digital extensor muscle.[45] The palpable head of the fibula helps to identify these structures. The depth of penetration is usually 0.75 to 1 inch.

The **medial femorotibial joint** is not difficult to enter, and because this compartment communicates with the femoropatellar joint in the majority of horses,[44–47] some clinicians choose to inject it rather than the femoropatellar joint in an attempt to either block or treat both this compartment and the femoropatellar joint. The injection site is located between the medial patellar ligament and the medial femorotibial ligament just above the palpable proximomedial edge of the tibia. Generally, the penetration depth is 0.75 to 1 inch.

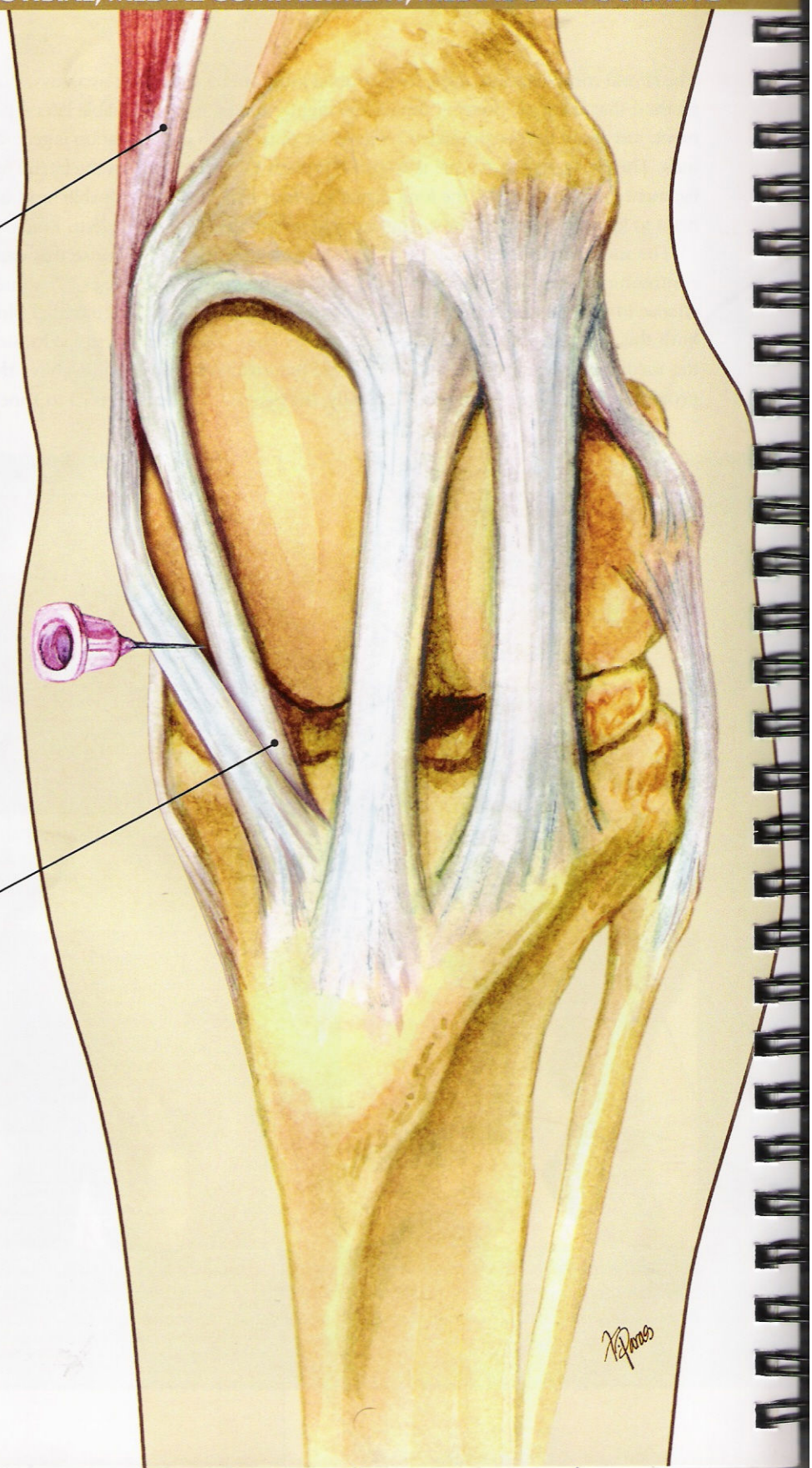


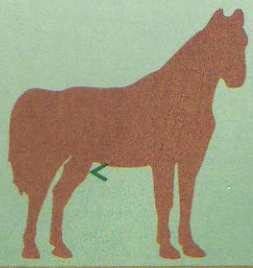
Palpate the **lateral patellar ligament** (*left*). The lateral femorotibial ligament is caudal to the lateral patellar ligament. Insert the needle behind the lateral patellar ligament, just above the proximolateral edge of the tibia (*right*).

Palpate the **medial patellar ligament** and the medial femorotibial ligament (*left*). Insert the needle between the palpable medial patellar ligament and the medial femorotibial ligament, just above the proximomedial edge of the tibia (*right*).

Stifle

FEMOROTIBIAL, MEDIAL COMPARTMENT, MEDIAL OUTPOUCHING





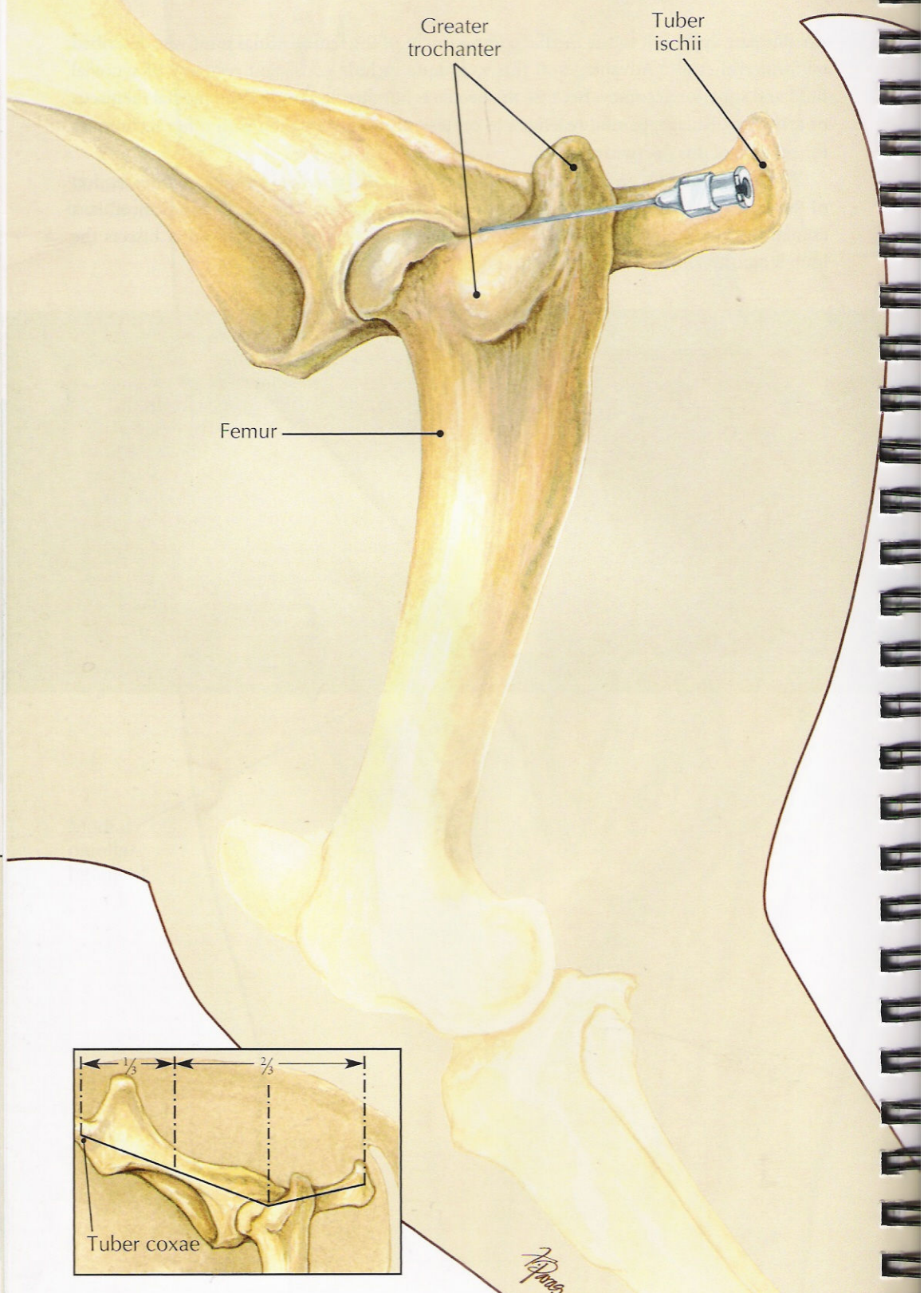
Needle: 1.5 inch (3.81 cm), 18 to 19 gauge
Volume: 20 to 30 mL
Degree of difficulty: 2

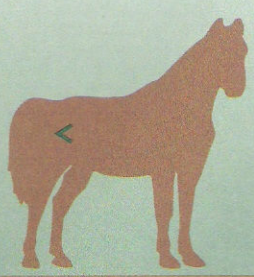
An alternate approach to the medial compartment of the **femorotibial joint** was described by Swiderski et al.[48] Advantages of this technique include consistent recovery of synovial fluid and superior accuracy. Because the needle is not directed toward the medial meniscus or articular cartilage, painful reactions to centesis are less likely than with other techniques for centesis of this compartment.

The injection site is an indentation between the medial patellar ligament and the tendon of the sartorius muscle about 1 inch above the tibial plateau. The needle is advanced in a cranial to caudal direction parallel to the ground and parallel to a plane that bisects the limb longitudinally. Penetration depth is generally about 1 inch.

The injection site for the medial outpouching of the medial compartment of the femorotibial joint is an indentation between the medial patellar ligament and the tendon of the sartorius muscle about 1 inch above the tibial plateau. Advance the needle in a cranial to caudal direction parallel to the ground and parallel to a plane that bisects the limb longitudinally.

Hip





Needle: 3.5 to 6 inch (8.89 to 15.24 cm), 18 gauge, spinal
Volume: Approximately 40 to 60 mL
Degree of difficulty: 3

The **hip joint** (coxofemoral joint) is the most difficult joint to enter. It is located deep beneath heavy muscle and situated well away from the lateral aspect of the proximal end of the femur. The landmarks are difficult to identify. The procedure described here is a variation of previously described methods.[20–22]

The important landmarks to palpate are the paired summits of the greater trochanter of the femur. They are located (measured from cranioproximal to caudodistal) two-thirds of the distance between the palpable tuber coxae and the tuber ischii. The greater trochanter is approximately 4 inches wide, and there is a notch between the cranial and caudal parts of this structure. In our experience, this notch is generally not palpable.

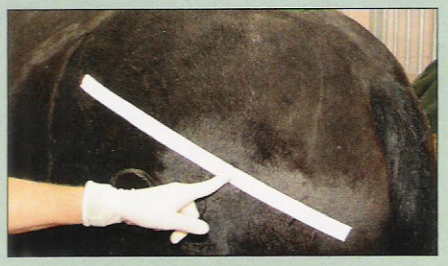
Insert a spinal needle, equipped with its stylet, about 0.5 inch above the middle of the proximal summit of the trochanter. The skin is thick in this area, and penetration may require more force than is needed when inserting a needle elsewhere on the horse. A stab incision, made with a #11 or #15 scalpel blade, may aid insertion. Needle insertion usually requires holding the shaft of the needle close to its tip. Direct the point slightly downward so that after the needle has been inserted to a depth of about 3 to 4 inches, the point of the needle is about 0.5 inch lower than the point of entry. Direct the needle perpendicular to the long axis of the vertebral column.

If the needle does not enter the joint, withdraw it to within 0.5 inch or less of the skin before correcting the insertion angle. Redirect the needle without repenetrating the skin because horses often resent repenetration and become uncooperative.

Alternatively, place a 1.5- to 2-inch, 14-gauge, disposable needle at the correct angle of penetration. Then insert the longer 18-gauge needle through the wider-bore needle. This is particularly useful for entering the hip joint of large, well-muscled horses.

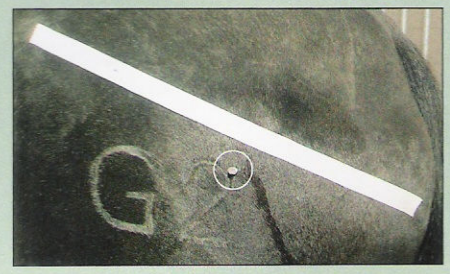
For both techniques, use a flexible spinal needle that bends easily to prevent the needle from inflicting damage to underlying tissue. Needles bend commonly during injection of the hip joint as a result of limb motion or muscle contraction.

If the horse is difficult to restrain, an appropriate dose of xylazine may be useful.



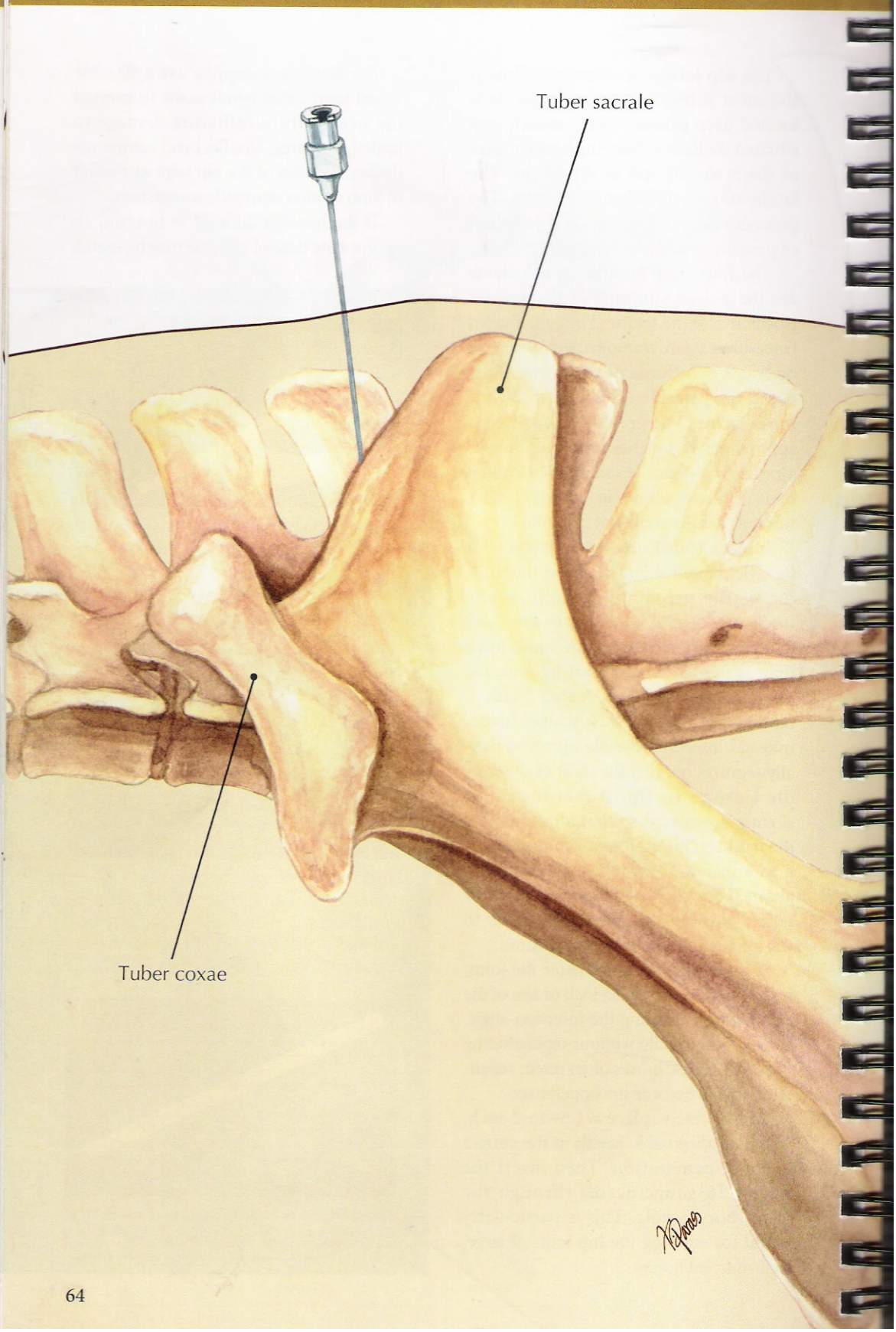
The tape represents an imaginary line drawn from the palpable tuber coxae to the tuber ischii. The greater trochanter is situated approximately two-thirds of the distance between the tuber coxae and tuber ischii.

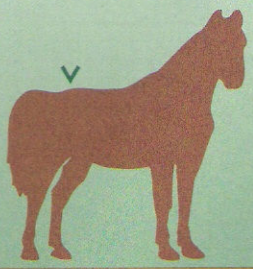
Insert the needle approximately 0.5 inch above the palpable edge of the trochanter, and direct it perpendicular to the vertebral column. The joint is usually penetrated at a depth of about 4 to 6 inches.



The tape has been reapplied to demonstrate the site of needle insertion (*circled*).

Sacroiliac Joint





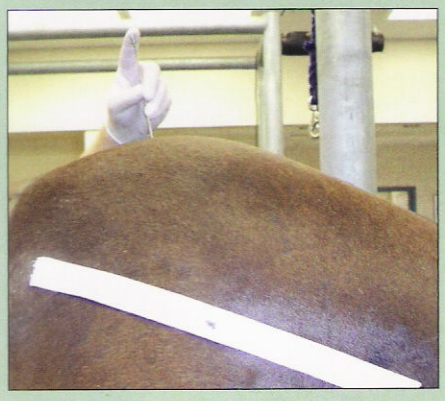
Needle: 10 inch (25 cm), 15 to 16 gauge, spinal
Volume: Approximately 8 to 9 mL
Degree of difficulty: 3

The **sacroiliac joint** injection technique is performed as described by Engeli and Haussler.[49] Sedation of the horse and subcutaneous anesthesia of the injection site are recommended. The horse should bear weight equally on the rear limbs. Before being inserted, the needle should be bent to an angle of about 40° in the direction of the needle's bevel. Insert the needle at a 60° angle to the vertical plane with the bevel facing upward through a stab incision created about 1 inch (2 cm) cranial to the contralateral tuber sacrale. Advance the needle across the midline, aiming for a point midway between the ipsilateral tuber coxae and the greater trochanter of the femur until the needle shaft encounters the medial aspect of the ipsilateral tuber sacrale. The needle hub is lifted, and the needle is advanced at a steeper angle (i.e., 50°), allowing it to slide along the medial aspect of the ilial wing until it engages the dorsal surface of the sacral wing at about 15 to 20 cm.

The point of the needle encounters the caudomedial aspect of the sacroiliac joint and is invariably placed periarticularly. Needles smaller than 15 gauge may not be rigid enough to maintain the bend applied before injection. Occasionally, motor nerves may be inadvertently anesthetized, resulting in temporary paralysis of the limb.

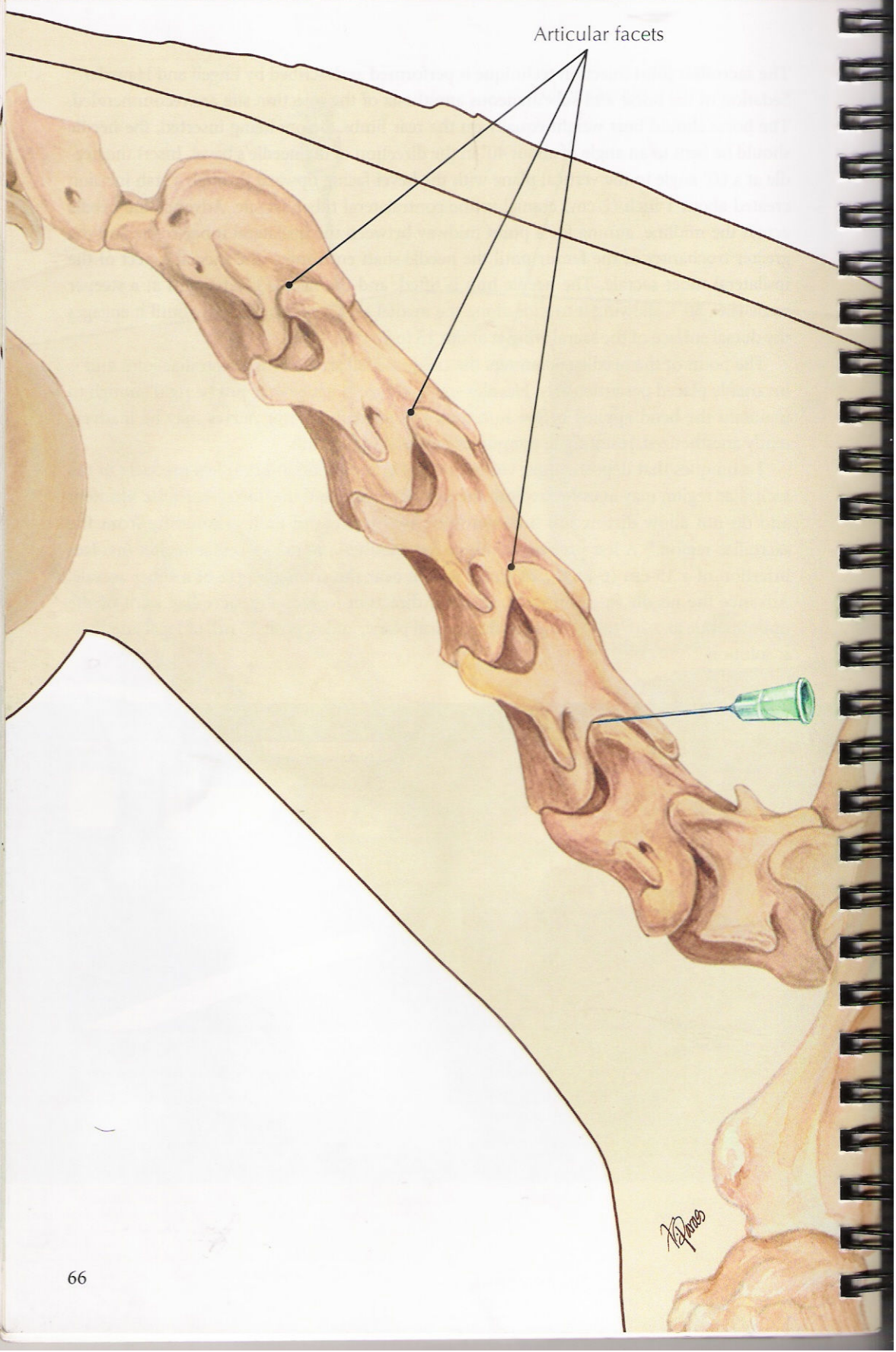
Techniques that deposit larger volumes of local anesthetic solution less precisely in the sacroiliac region may anesthetize both the sacroiliac joint and the dorsal sacroiliac ligament and do not allow distinction between these two sources of pain originating from the sacroiliac region.[49] A less precise technique for anesthesia of the sacroiliac region involves insertion of a 15-cm (6-inch), 18-gauge needle near the cranial aspect of a tuber sacrale. Advance the needle in a ventrocaudolateral direction toward the sacroiliac joint of the opposite side at a 20° to 40° angle to the vertical plane, and deposit 20 mL of local anesthetic solution.[50]

Advance the needle at a 60° angle to the vertical plane with the bevel facing upward through a stab incision created about 2 cm cranial to the contralateral tuber sacrale.



Advance the needle across the midline, aiming for a point midway between the ipsilateral tuber coxae and the greater trochanter of the femur.

Cervical Facet Joint



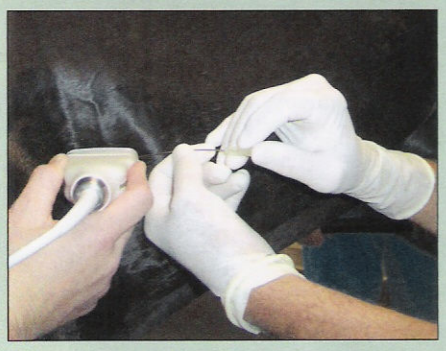
Needle: 3.5 inch (8.9 cm), 18 to 20 gauge, spinal
Volume: Approximately 2 to 3 mL
Degree of difficulty: 3

Centesis of a **cervical facet joint** is generally performed to administer a corticosteroid into the joint of a horse with signs of neck pain and radiographic, ultrasonographic, or scintigraphic evidence of disease of a facet. Lesions are most commonly found in the facet joints joining cervical vertebrae 5 to 6 and 6 to 7.[51]

The cervical vertebrae affected by facet arthropathy are identified using diagnostic imaging, and the approximate site of centesis is found by placing one hand over the other (the width of each hand corresponding to the length of a cervical vertebra) from the poll along the cervical spine until the approximate location of the diseased facet is located. The region of the site of centesis is scrubbed, and the diseased joint between two adjacent articular facets is identified ultrasonographically using a 7.5-MHz linear probe shrouded in a sterile glove in the center of the imaging field.

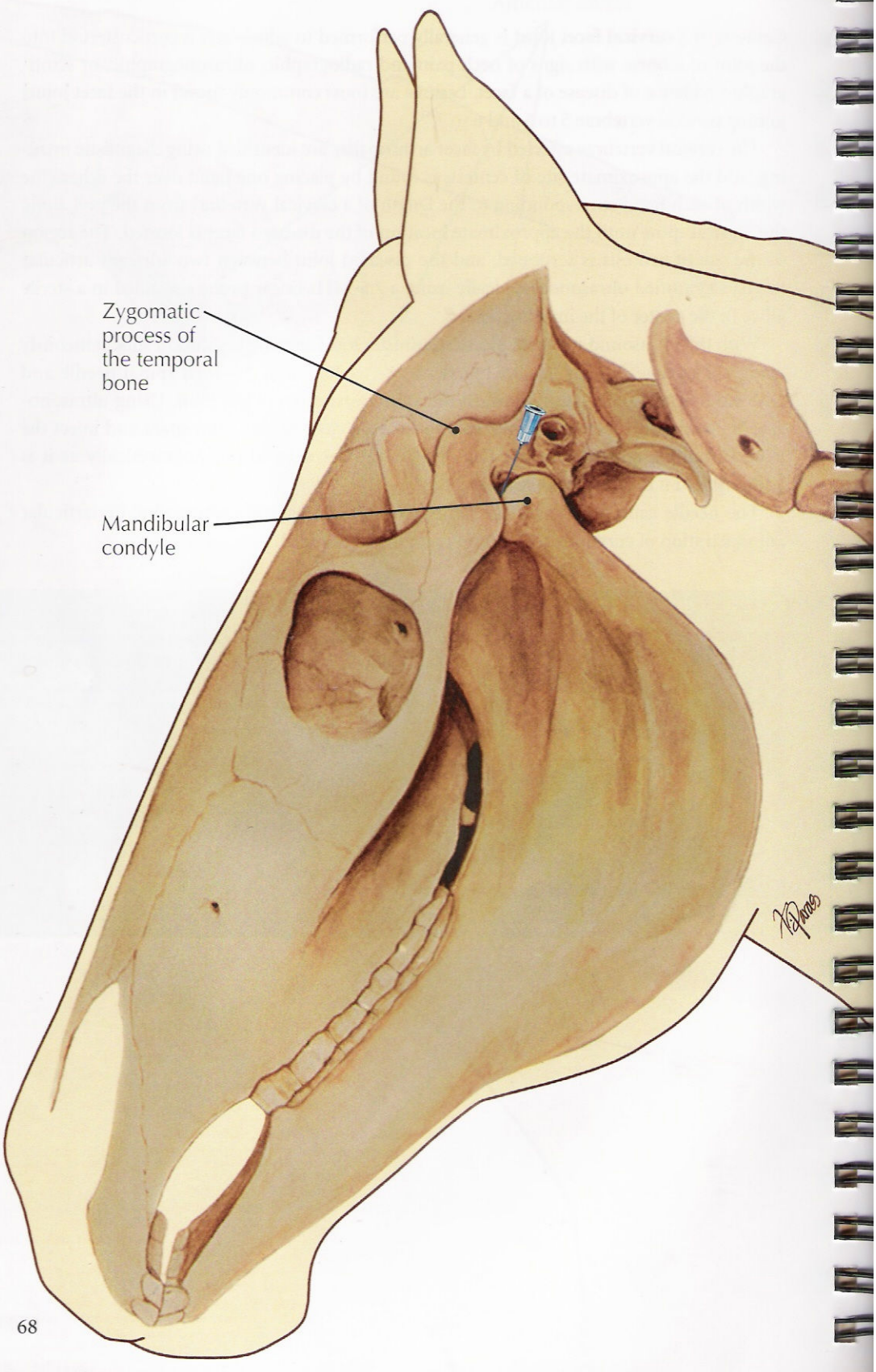
With the ultrasound probe in place, administer local anesthetic solution subcutaneously using a 25-gauge, ⅝-inch needle. Insert an 18- to 20-gauge, 3.5-inch spinal needle and advance it at an angle, aiming toward the approximate site of the joint. Using ultrasonographic guidance, direct the needle into (or at least close to) the joint space and inject the drug (usually a corticosteroid). The drug cannot be seen ultrasonographically as it is administered if the needle is within the joint.

The needle cannot be placed in some joints with advanced arthropathy. Periarticular administration of corticosteroid, however, may be beneficial.



With an ultrasound probe in place, insert an 18- to 20-gauge, 3.5-inch spinal needle and advance it at an angle, aiming toward the approximate site of the joint.

Temporomandibular Joint



Needle: 1 to 1.5 inch (2.54 to 3.81 cm), 20 to 22 gauge
Volume: Approximately 2 to 3 mL
Degree of difficulty: 2

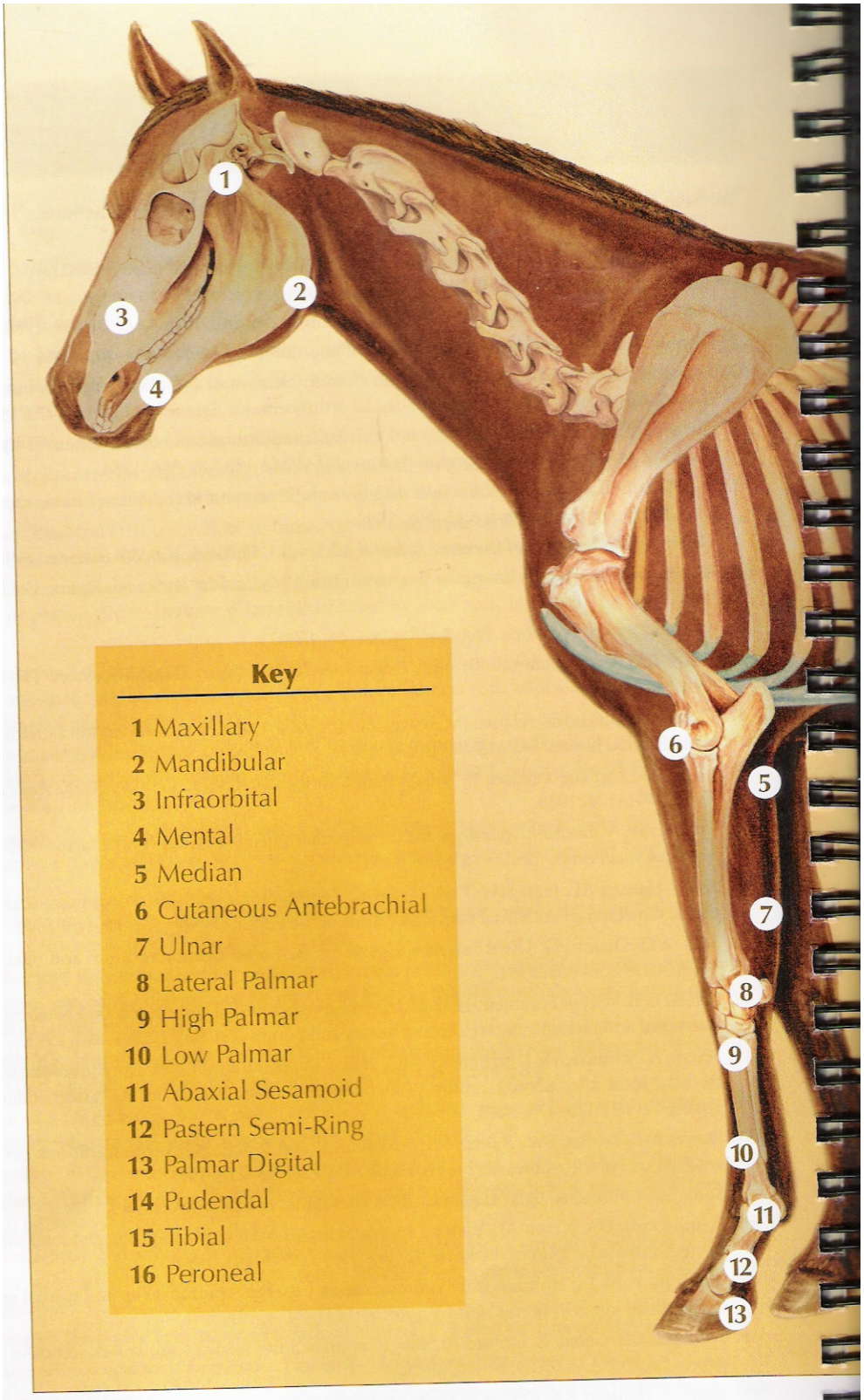
The **temporomandibular joint** is the articulation between the condylar process of the mandible and the base of the zygomatic process of the temporal bone.[52] It is composed of a small ventral compartment and a larger dorsal compartment, which are separated by a fibrocartilaginous disk. The dorsal compartment is composed of a rostral and a caudal pouch. Whether or not the dorsal and ventral compartments of the joint communicate is disputed.[52,53]

Disease of the temporomandibular joint of horses is uncommonly reported, perhaps because imaging this joint is difficult. Recognition of disease of this joint may increase as the use of sophisticated imaging systems (e.g., digital radiography, computed tomography, magnetic resonance imaging, ultrasonography) to examine various regions of the horse increases.

The temporomandibular joint is entered with the horse sedated. The mandibular condyle is identified as a smooth protrusion about midway between the lateral canthus of the eye and the base of the ear. Its identity can be confirmed by palpating the structure while an assistant manipulates the mandible from side to side. The zygomatic process of the temporal bone is palpated several centimeters dorsal to the mandibular condyle, and a line is imagined between these structures. The site of centesis is midway between these structures and 0.25 to 0.5 inch behind the imagined line.[53]

Insert the needle into a depression in a rostral ventral direction to a depth of approximately 1 inch. Fluid may fill the needle hub. If the needle strikes bone, it should be partially withdrawn and directed more ventrally. If the needle is directed too far ventrally, it may become embedded in the articular disk and should be partially withdrawn. The joint is infused with 2 to 3 mL of local anesthetic solution.

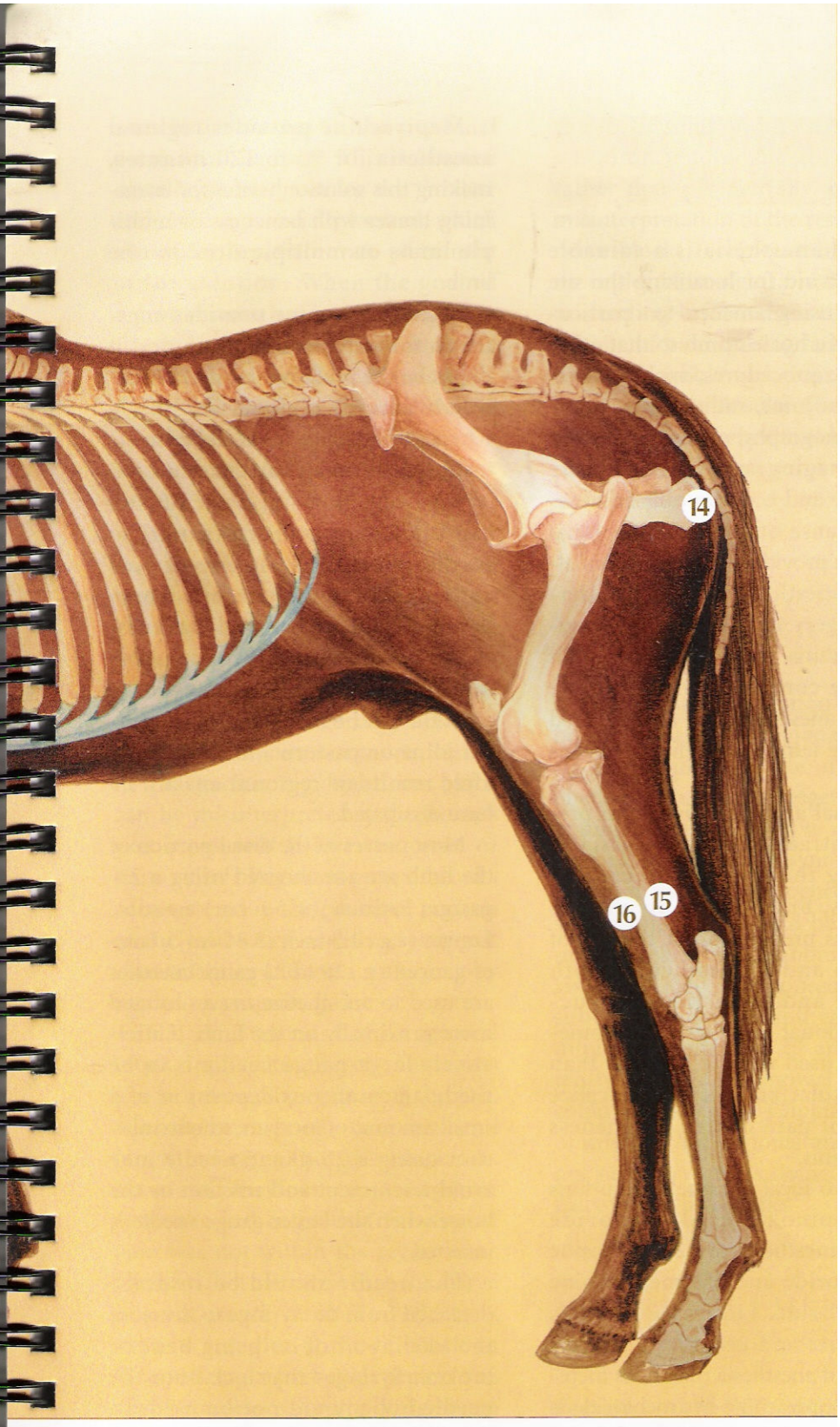
The mandibular condyle is identified as a smooth protrusion approximately midway between the lateral canthus of the eye and the base of the ear (the thumb is situated over the condyle in this photograph). The zygomatic process of the temporal bone is palpated several centimeters above the mandibular condyle (the index finger rests on the process), and a line is imagined between these structures. The site of centesis is midway between these structures and 0.25 to 0.5 inch behind the imagined line.



Key

1 Maxillary
2 Mandibular
3 Infraorbital
4 Mental
5 Median
6 Cutaneous Antebrachial
7 Ulnar
8 Lateral Palmar
9 High Palmar
10 Low Palmar
11 Abaxial Sesamoid
12 Pastern Semi-Ring
13 Palmar Digital
14 Pudendal
15 Tibial
16 Peroneal

PART 2: REGIONAL



NERVE BLOCKS

INTRODUCTION AND USES

Regional anesthesia is a valuable diagnostic aid for localizing the site of pain causing lameness to a particular area of a horse's limb so that other diagnostic procedures, such as anesthesia of a joint, radiography, computed tomography, or magnetic resonance imaging, can be used more effectively and economically to identify the cause of lameness. Regional anesthesia provides supplemental analgesia to anesthetized horses undergoing surgery and allows some surgical procedures to be performed with the horse conscious and standing. Regional anesthesia can also be used to provide temporary relief of chronic pain.

Regional anesthesia is not as precise as intraarticular anesthesia in localizing the site of pain causing lameness, but because its use requires less preparation at the site of injection and it anesthetizes both articular and nonarticular structures, regional anesthesia can sometimes be used more efficiently than intraarticular anesthesia to localize the site of pain during a lameness examination.

The two local anesthetic solutions most commonly used to provide regional anesthesia are 2% lidocaine hydrochloride and 2% mepivacaine hydrochloride. Lidocaine irritates tissue more and provides a shorter duration of anesthesia than does mepivacaine. Bupivacaine hydrochloride is the local anesthetic solution of choice when regional anesthesia is performed for relief of pain because it provides anesthesia that is longer in duration than that provided by either lidocaine or mepivacaine. Bupivacaine provides 4 to 6 hours of pain relief.

Mepivacaine provides regional anesthesia for 90 to 120 minutes, making this solution useful for examining horses with lameness of multiple limbs or multiple sites on one limb.

Because lidocaine provides anesthesia for only 30 to 45 minutes, it might be the preferred local anesthetic solution for regional anesthesia when joint analgesia is likely to be used later during the examination of a horse with a single site of pain causing lameness. For example, to further localize the source of pain causing lameness after a horse becomes sound when regional anesthesia has desensitized the pastern and foot regions, local anesthetic solution can be instilled into the coffin joint or pastern joint, but only after results of regional anesthesia have dissipated.

Most nerves of the distal portion of the limb are anesthetized using a 25-gauge, ⅝-inch (1.59-cm) needle. Longer (e.g., 1.5 inch [3.81 cm]), larger-gauge (e.g., 20 to 22 gauge) needles are used to anesthetize nerves located more proximally on the limb. If a relatively large-gauge needle is to be used, subcutaneous deposition of a small amount of local anesthetic solution using a 25-gauge needle may avoid resentment and reaction by the horse when the larger-gauge needle is inserted.

The needle should be inserted detached from the syringe to decrease the likelihood of its being bent or broken. Syringes that lock onto the needle hub should not be used, so that if the horse moves the limb suddenly, the syringe can be detached quickly to prevent the needle from being removed, bent, or broken.

The volume of local analgesic solution used to anesthetize nerves located in the distal portion of the limb is usually less than that used to

anesthetize nerves in the proximal portion of the limb. This is because distally located nerves are smaller and more superficially located, which allows for more accurate placement of the solution. When the goal of regional anesthesia is to identify a site of pain causing lameness, the smallest volume of local anesthetic solution likely to be effective should be administered to avoid inadvertently anesthetizing the adjacent nerves.

Pain is usually relieved within 5 minutes after administering a local anesthetic solution near a nerve in the distal portion of the limb, but when anesthetizing the large nerves of the proximal portion of the limb, pain may be relieved only after an elapse of 20 minutes or more. Results of a diagnostic regional nerve block can be misinterpreted if the horse's gait is assessed before the onset of pain relief. Regional nerve blocks administered in the proximal portion of the limb occasionally create gait abnormalities and even stumbling by hindering proprioception.

The effectiveness of a regional block applied to alleviate lameness can be assessed by evaluating the gait. A positive response to a regional block indicates that the block was accurately performed. A negative response indicates that the site of pain was not within the region supplied by that nerve or that the nerve was not anesthetized. The effectiveness of a regional nerve block in desensitizing a particular region can also be assessed by applying sharp pressure to the skin over that region using a ballpoint pen or key. The effectiveness of a nerve block can be misinterpreted if only the skin has been desensitized or if the skin has not been desensitized but structures deep to it have been desensitized.

Inadvertently administering a local anesthetic solution into a blood vessel, joint, tendon sheath, or bursa, rather than perineurally, may cause misinterpretation of the results of the nerve block. Techniques of diagnostic regional analgesia may provide misleading information concerning the site of pain causing lameness because of possible variations in neurologic anatomy. Results of diagnostic regional anesthesia should be interpreted with at least some degree of skepticism.

PREPARATION OF THE SITE

A local anesthetic solution can often be administered for regional anesthesia after wiping the site of injection liberally with cotton pledgets or gauze sponges soaked in 70% isopropyl alcohol. If an adjacent synovial structure is at risk of being penetrated, the site of injection should be prepared more carefully by scrubbing with an antiseptic soap. The consequences of subcutaneous infection are usually minor, but infection of an inadvertently penetrated synovial structure could be disastrous. Clipping the site of injection for regional anesthesia is not necessary unless doing so aids in palpation of landmarks.

MANAGEMENT OF THE HORSE

Portions of the limb of most horses can be anesthetized using minimal restraint, but application of a lip twitch or lip chain may be necessary to control a fractious horse. Not all horses respond in the same way to different methods of restraint, but application of a lip twitch provides adequate restraint for most horses.

The twitch is most effective when applied immediately before needle placement. Restraining the horse in stocks to perform regional anesthesia of the lower portion of the limb may increase the risk of injury to the clinician and the horse. The preference of the clinician and the site of injection determine whether the local anesthetic solution is injected with the limb held or bearing weight. When a nerve block on a forelimb is to be performed with the horse standing on the limb, lifting the contralateral forelimb may enhance the safety of the procedure for the clinician, but the clinician should be aware that some horses might collapse the supporting forelimb in reaction to insertion of a needle, resulting in serious injury to the carpus of that limb.

If application of a lip twitch or lip chain does not provide sufficient restraint, acetylpromazine (0.044 mg/kg IV) or xylazine (0.4 mg/kg IV) can be administered to some horses without significantly interfering with gait assessment.[1–3] The degree to which tranquilization or sedation may interfere with assessment of gait may depend on the severity of lameness and the skill of the clinician performing the lameness examination. Because of the uncertainty of the effect of sedatives on gait, these drugs are best avoided if possible. If the clinician is concerned that the effects of sedation may confuse the lameness evaluation, the horse can be examined after the effects of sedation dissipate, provided that anesthesia imparted by the local anesthetic solution persists longer than the effects of the sedative. Waiting until the sedative effects dissipate may, however, confound the results of regional anesthesia because the local anesthetic solution may diffuse, desensitizing structures not intended to be desensitized. If a horse must receive a sedative, such as xylazine, before a local anesthetic solution can be administered, the effects of sedation on gait can be diminished by administering an antagonist to the sedative.[2]

GENERAL TECHNIQUE

To accurately perform regional anesthesia, a good understanding of the relevant anatomy is necessary, and when performing some of the less frequently used blocks (e.g., on the proximal portion of the limb), a fresh review of the anatomy and anesthetic technique may be prudent. The clinician must not only be able to accurately perform the regional anesthetic technique, but he or she must also be aware of the structures that are consistently desensitized by a particular nerve block.

Some clinicians recommend walking the horse for 5 to 10 minutes after administering perineural anesthesia before assessing the results. Walking allows the horse to become habituated to desensitization of a portion of a limb and promotes dispersion of the local anesthetic solution. Dispersion of the local agent, however, may decrease the specificity of the block.

FORELIMB NERVE BLOCKS

When desensitizing a forefoot, we prefer to hold the limb while facing the horse, but some clinicians prefer to perform these procedures facing the same direction as the horse. When facing the same direction as the horse, the horse's foot can be held between the clinician's knees to free both hands for the procedure. In this position, however, the clinician is at risk of injury if the

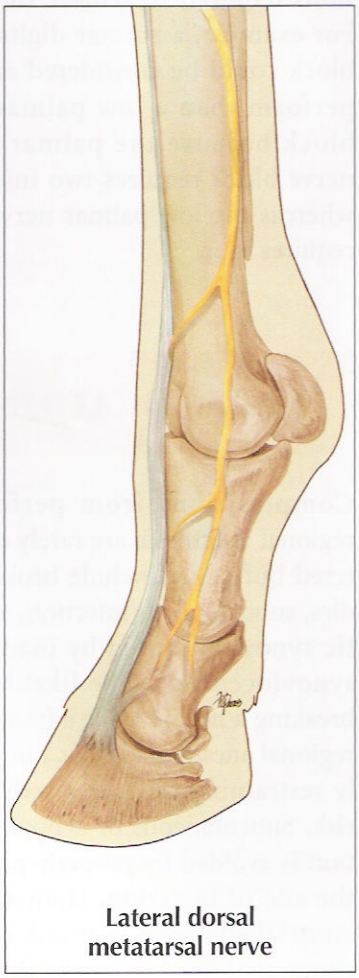
horse swings its limb caudally. When facing the horse, the clinician must perform the block using a single hand because one hand must hold the limb.

For nerve blocks of the lower portion of the limb, a 25-gauge, ⅝-inch (1.59-mm) needle is commonly used. The needle is inserted subcutaneously directly over the digital nerve and directed distally. The needle should not be directed proximally because proximal diffusion of local anesthetic solution may desensitize more structures than intended. Depositing the local anesthetic solution in different tissue planes and as the needle is withdrawn increases the likelihood of rapid contact of the solution with the nerve but may also increase the likelihood of anesthetizing structures not intended to be desensitized.

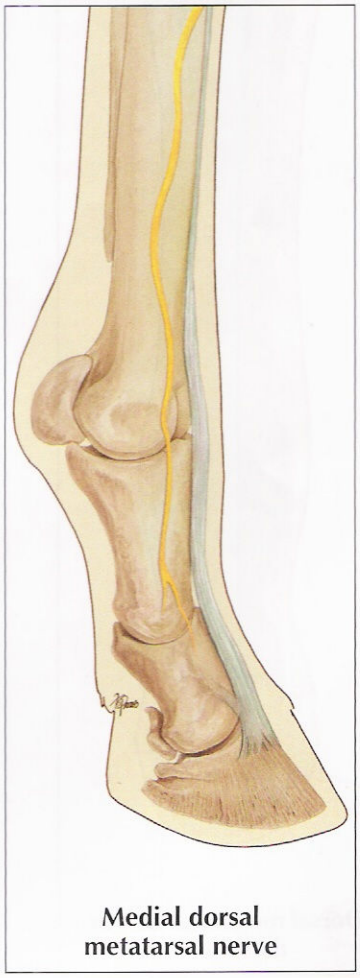
HINDLIMB NERVE BLOCKS

Techniques for anesthesia of the distal portion of the hindlimb are similar to those for the forelimb. The clinician should be aware, however, that in the hindlimb, the dorsal aspect of the coronary band, the dorsal laminae of the foot, and the dorsal aspect of the pastern and fetlock joints are at least partially innervated by the lateral and medial dorsal metatarsal nerves, which are branches of the deep peroneal (fibular) nerve.[4]

The medial dorsal metatarsal nerve courses along the medial side of the long digital extensor tendon and can be anesthetized by injecting 2 to 3 mL of local anesthetic solution subcuta-

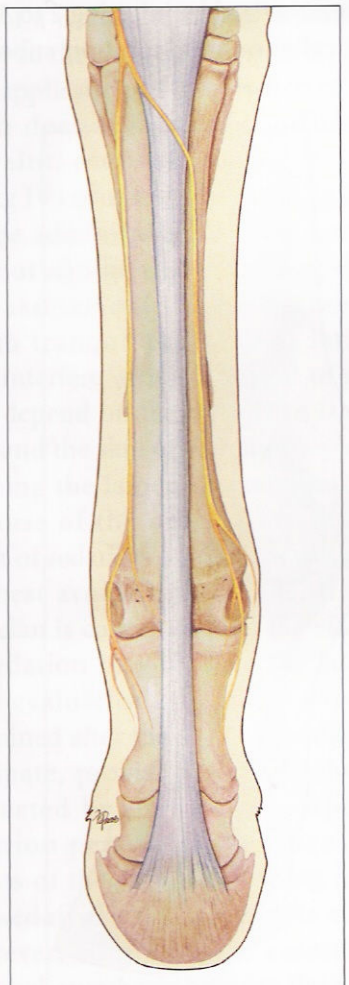


Lateral dorsal metatarsal nerve



Medial dorsal metatarsal nerve

neously on the medial side of the long digital extensor tendon at the level of the distal end of the medial splint bone. The lateral dorsal metatarsal nerve courses distally in the metatarsal region close to the lateral splint bone and deviates dorsally in the region of the fetlock. This nerve can be anesthetized, along with the lateral plantar metatarsal nerve, by injecting 2 to 3 mL of local anesthetic solution subcutaneously slightly dorsally to the distal end of the lateral splint bone. Most lameness of the lower portion of the limb, however, can be evaluated accurately without anesthetizing the dorsal metatarsal nerves.[5]



Dorsal metatarsal nerves, dorsal view

INJECTION STRATEGIES

Specific, step-by-step details of different techniques for administering regional anesthesia are discussed and illustrated in the pages that follow. For each regional block, we have given an approximate needle size. The amount of local anesthetic solution instilled perineurally is arbitrary and depends on whether the block is intended for diagnostic purposes or to achieve surgical anesthesia or temporary relief of chronic pain. We have stated a volume of fluid that is useful for diagnostic purposes. We have omitted assigning a degree of difficulty because the degree of difficulty in performing a nerve block is directly proportional to the number of injections required to achieve the block. For example, a palmar digital nerve block could be considered easier to perform than a low palmar nerve block because the palmar digital nerve block requires two injections, whereas the low palmar nerve block requires four.

COMPLICATIONS

Complications from performing regional anesthesia are rarely encountered but could include broken needles, subcutaneous infection, and septic synovitis caused by inadvertent synoviocentesis. The likelihood of breaking a needle while administering regional anesthesia is low, but properly restraining the horse reduces the risk. Subcutaneous or synovial infection is avoided by properly preparing the site of injection. If an adjacent synovial structure is at risk of being penetrated by the needle, the site of

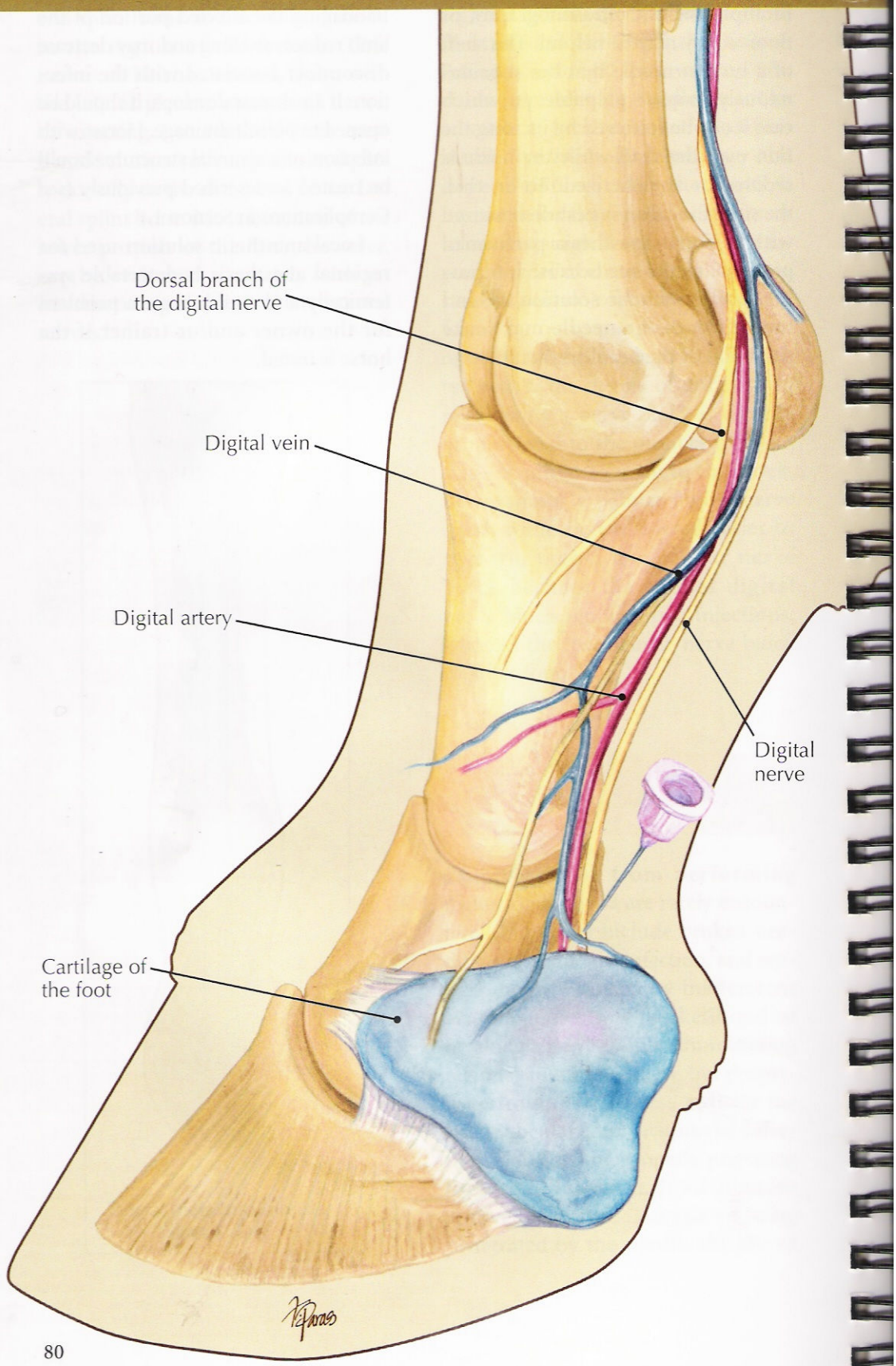
injection should be prepared more meticulously than if synovial structures are remote from the site.

To identify the exact location of the shaft of a broken needle, radiography (with radiographs obtained at multiple angles), ultrasonography, or fluoroscopy may be helpful. The shaft of a broken needle that lies subcutaneously may be palpable, in which case it can be retrieved by incising the skin over the shaft while the horse is sedated or anesthetized. To do this, the site of incision is best desensitized with regional anesthesia performed proximal to the site because infiltrating local anesthetic solution around the region of the needle may make palpation of the needle difficult.

Subcutaneous infection can be resolved with systemic administration of an antimicrobial drug that is likely to be effective on the infective bacteria. Subcutaneous infection is most likely to be caused by staphylococcal organisms. Bandaging the affected portion of the limb reduces swelling and may decrease discomfort associated with the infection. If an abscess develops, it should be opened to permit drainage. Horses with infection of a synovial structure should be treated as described previously (see Complications in Section 1.)

Local anesthetic solution used for regional anesthesia is detectable systemically and could create a problem for the owner and/or trainer if the horse is tested.

Palmar Digital Nerve



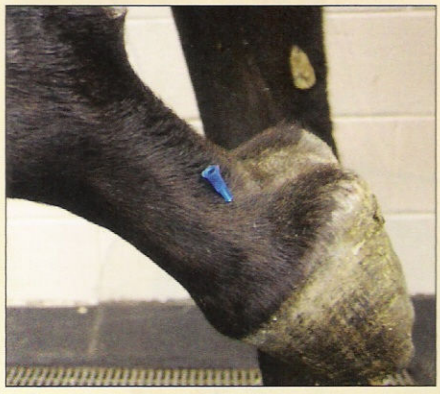
Needle: ⅝ inch (1.59 cm), 25 gauge
Volume: 1.5 mL at each site

With the limb held, the **palmar digital nerve** block is performed by inserting the needle directly over the palmar aspect of the palpable neurovascular bundle about 1 cm above the cartilage of the foot. Insertion of a needle at this site causes local anesthetic solution to be deposited at or slightly below the level of the caudal border of the pastern (proximal interphalangeal) joint because the height of the cartilage of the foot in relation to the level of the caudal border of the pastern joint is probably similar for most horses.[6]

Insert the 25-gauge, ⅝-inch needle in a distal direction, and deposit local anesthetic solution near the junction of the nerve and the cartilage of the foot. By injecting local anesthetic solution as the needle is withdrawn, the solution is deposited in different tissue planes and is less likely to be administered intravascularly in either the digital artery or vein located adjacent to the nerve. Injecting as the needle is withdrawn, however, causes more proximal deposition of local anesthetic solution, which increases the likelihood of anesthetizing branches of the digital nerve that supply the pastern joint.

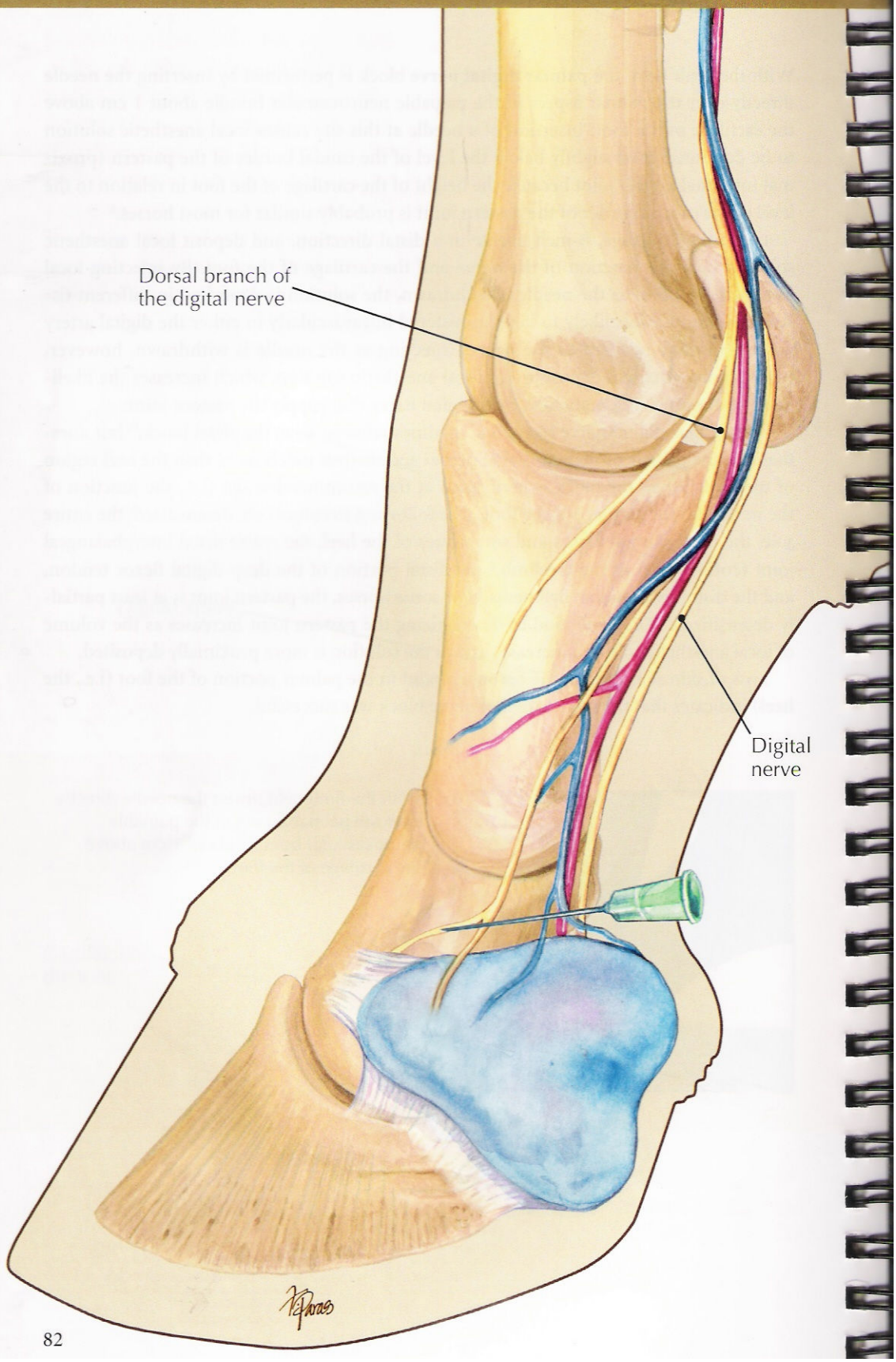
The palmar digital nerve block is sometimes referred to as the "heel block," but anesthesia of the palmar or plantar digital nerves anesthetizes much more than the heel region of the foot. When the block is performed at the recommended site (i.e., the junction of the nerve and the cartilage of the foot), the following structures are desensitized: the entire sole, the navicular apparatus and soft tissues of the heel, the entire distal interphalangeal joint (coffin joint) of the forelimb,[7] the distal portion of the deep digital flexor tendon, and the distal sesamoidian ligaments.[8] For some horses, the pastern joint is at least partially desensitized.[6] The likelihood of desensitizing the pastern joint increases as the volume of local anesthetic solution increases and as the solution is more proximally deposited.

Loss of skin sensation at the coronary band in the palmar portion of the foot (i.e., the heel) indicates that the palmar digital nerve block was successful.



With the limb held, insert the needle directly over the palmar aspect of the palpable neurovascular bundle, about 1 cm above the cartilage of the foot.

Pastern Semi-Ring



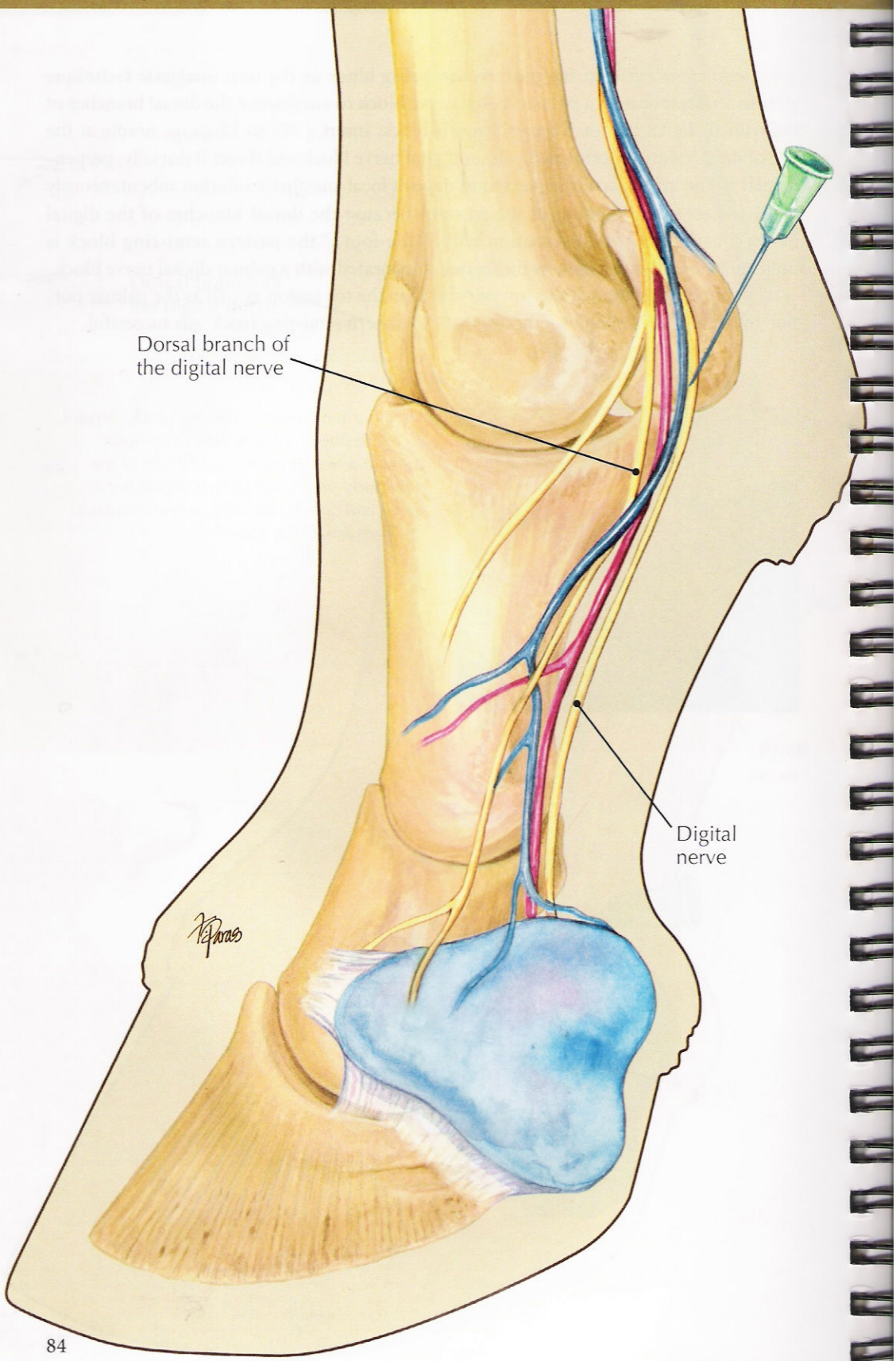
Needle: 1 or 1.5 inch (2.54 or 3.81 cm), 20 to 22 gauge
Volume: 2 to 3 mL at each site after the palmar digital nerve block has been performed

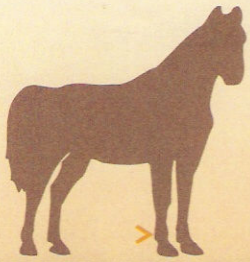
Some clinicians perform the **pastern semi-ring** block as the next analgesic technique after lack of response to a palmar digital nerve block to anesthetize the dorsal branches of the palmar digital nerves. To perform this block, insert a 20- to 22-gauge needle at the site of the previously performed palmar digital nerve block and direct it dorsally, perpendicular to the long axis of the pastern to deposit local anesthetic solution subcutaneously along the sides and dorsum of the pastern. Because the dorsal branches of the digital nerve contribute little to sensation within the foot,[7,9] the pastern semi-ring block is unlikely to ameliorate lameness that is not ameliorated with a palmar digital nerve block.

Loss of skin sensation at the coronary band in the toe region as well as the palmar portion of the foot or heel bulbs indicates that the pastern semi-ring block was successful.

To perform a pastern semi-ring block, deposit local anesthetic solution subcutaneously through a needle inserted at the site of the previously performed palmar digital nerve block and direct it dorsally, perpendicular to the long axis of the pastern.

Abaxial Sesamoid





Needle: ⅝ inch (1.59 cm), 25 gauge
Volume: ≤2 mL at each site

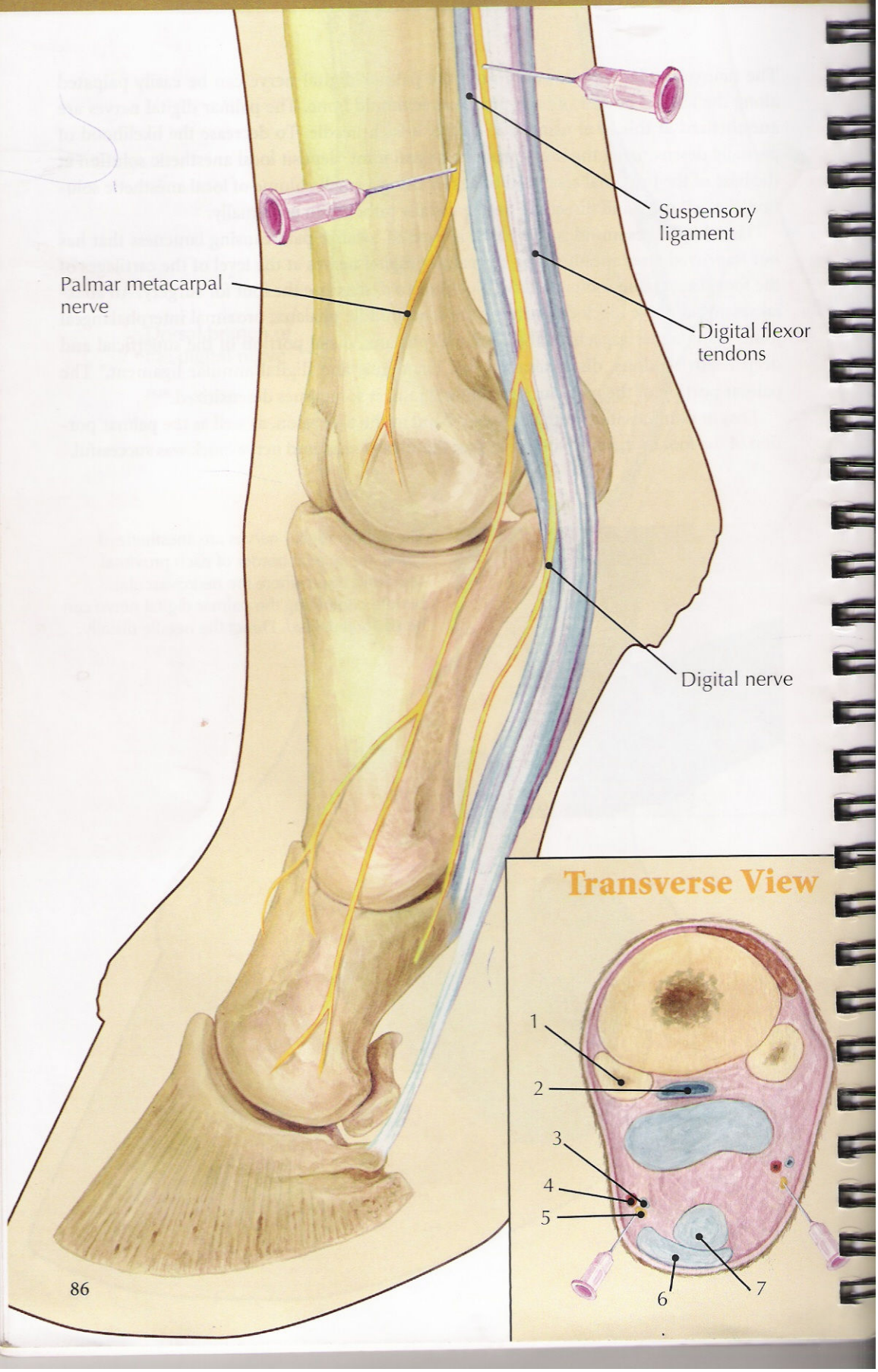
The neurovascular bundle containing the palmar digital nerve can be easily palpated along the abaxial border of each proximal sesamoid bone. The palmar digital nerves are anesthetized at this level using a 25-gauge, ⅝-inch needle. To decrease the likelihood of partially desensitizing the metacarpophalangeal joint, deposit local anesthetic solution at the base of the proximal sesamoid bones by using a small volume of local anesthetic solution (i.e., ≤2 mL), and direct the needle distally rather than proximally.

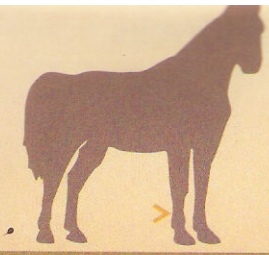
The **abaxial sesamoid nerve** block is used to localize pain causing lameness that has not improved after anesthetizing the palmar digital nerves at the level of the cartilages of the foot (i.e., a palmar digital nerve block) or to desensitize the foot for surgery. An abaxial sesamoid nerve block desensitizes the foot, middle phalanx, proximal interphalangeal joint, distopalmar aspects of the proximal phalanx, distal portion of the superficial and deep flexor tendons, distal sesamoidian ligaments, and digital annular ligament.[8] The palmar portion of the metacarpophalangeal joint is sometimes desensitized.[10,11]

Loss of skin sensation at the coronary band in the toe region, as well as the palmar portion of the foot or the heels, indicates that the abaxial sesamoid nerve block was successful.

The palmar digital nerves are anesthetized along the abaxial border of each proximal sesamoid bone where the neurovascular bundle containing the palmar digital nerve can be easily palpated. Direct the needle distally.

Low Palmar


Suspensory ligament
Palmar metacarpal nerve
Digital flexor tendons
Digital nerve
Transverse View
1
2
3
4
5
6
7



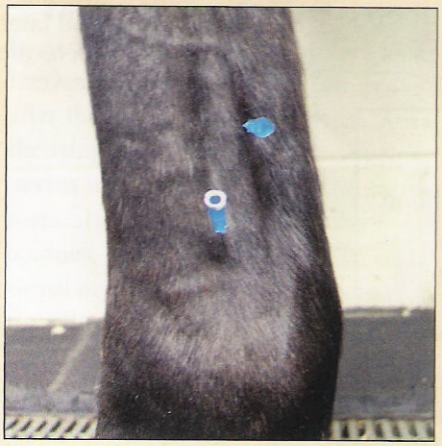
Needle: ⅝ inch (1.59 cm), 25 gauge
Volume: 1 to 2 mL at each site

To perform a **low palmar nerve** block (low four-point block), the medial and lateral palmar nerves and the medial and lateral palmar metacarpal nerves are anesthetized at the level of the distal end of the second and fourth metacarpal bones. Because the palmar pouches of the fetlock joint can be entered inadvertently when anesthetizing the palmar nerves at this level, some clinicians prefer to anesthetize the palmar nerves more proximally but below the anastomotic branch that connects the palmar nerves. These nerves are usually anesthetized with the horse bearing weight on the limb. The lateral and medial palmar nerves lie between the suspensory ligament and the deep digital flexor tendon. To anesthetize them, deposit local anesthetic solution, usually about 2 mL subcutaneously, adjacent to the dorsal surface of the deep digital flexor tendon using a 25-gauge, ⅝-inch needle.

The lateral and medial palmar metacarpal nerves lie between the palmar surface of the third metacarpal bone and the axial surface of either the second or fourth metacarpal bone. To anesthetize them, use a 25-gauge, ⅝-inch needle to deposit local anesthetic solution, usually 1 to 2 mL, next to the periosteum beneath the distal end of each small metacarpal bone where the nerve emerges.

The low palmar nerve block is used to localize pain that is causing lameness that has not improved after anesthetizing the palmar digital nerves at the level of the base of the proximal sesamoid bones or to desensitize the foot or pastern region for surgery. By anesthetizing these four nerves, the fetlock and structures distal to it are desensitized. The superficial and deep digital flexor tendons below this region are desensitized as well as the distal aspect of the branches of the suspensory apparatus.[10]

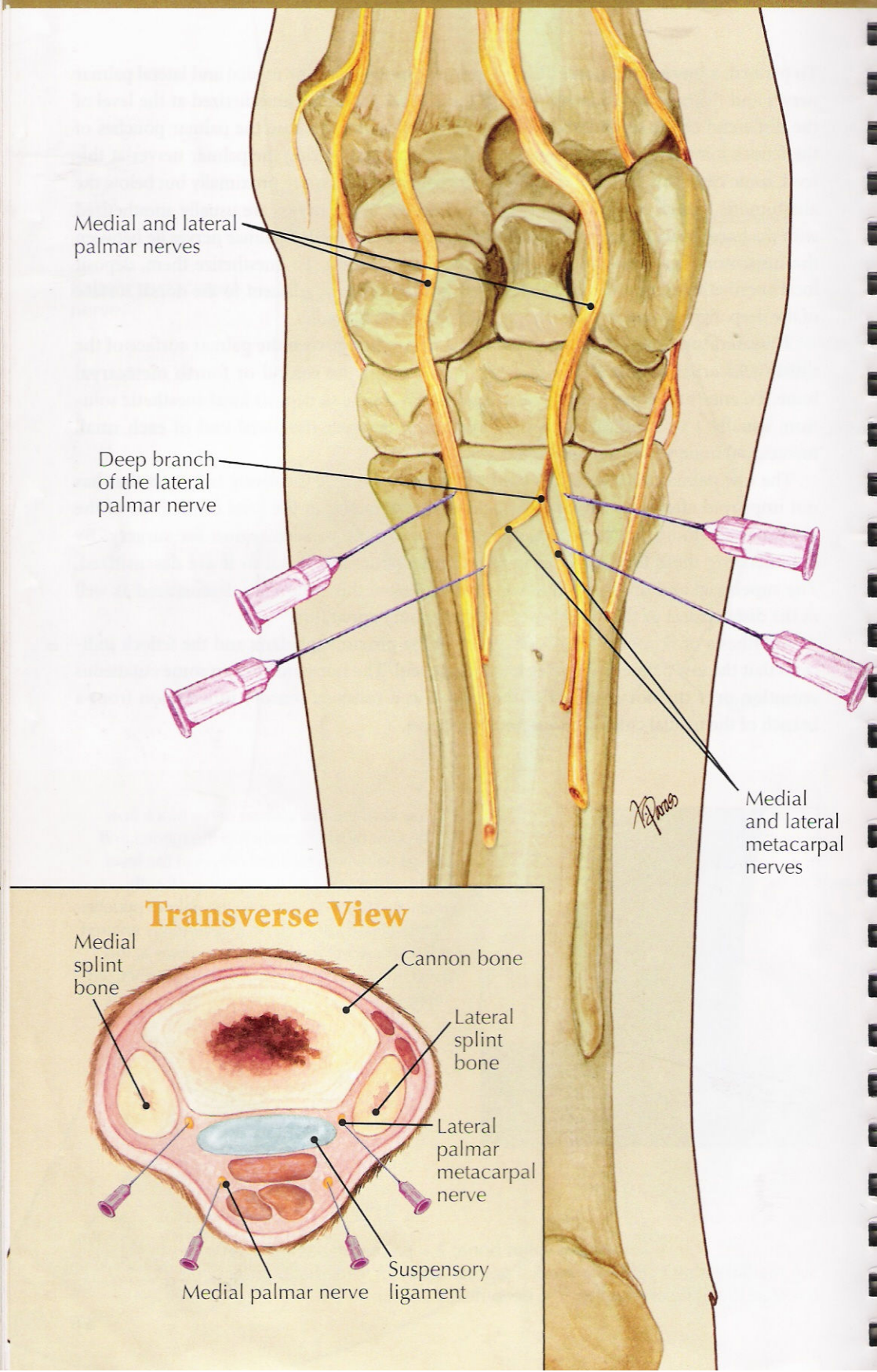
Anesthesia of skin over the dorsal aspect of the proximal phalanx and the fetlock indicates that the low palmar nerve block was successful. The horse may retain some cutaneous sensation over the dorsal aspect of the fetlock as a result of sensory innervation from a branch of the medial cutaneous antebrachial nerve.



To perform the low palmar nerve block (low four-point block), anesthetize the medial and lateral palmar metacarpal nerves at the level of the distal end of the second and fourth metacarpal bones. Because the palmar pouches of the fetlock joint can be inadvertently entered when anesthetizing the palmar nerves at this level, these nerves are sometimes anesthetized more proximally.

Key to inset at left: 1 = medial splint bone; 2 = palmar metacarpal vein; 3 = medial palmar vein; 4 = medial palmar artery; 5 = medial palmar nerve; 6 = superficial flexor tendon; 7 = deep flexor tendon

High Palmar



Transverse View

Needles: ⅝ inch (1.59 cm), 25 gauge and
1.5 inch (3.81 cm), 20 to 22 gauge
Volume: 3 to 5 mL at each site

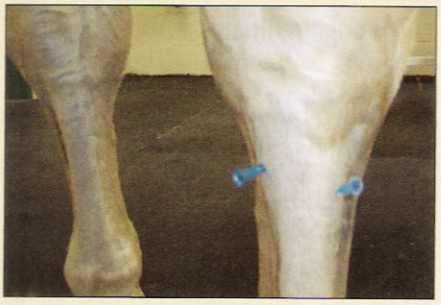
With the **high palmar nerve** block (high four-point block), the medial and lateral palmar nerves and the medial and lateral palmar metacarpal nerves are anesthetized slightly below the level of the carpometacarpal joint. To anesthetize each palmar nerve in this location, deposit 3 to 5 mL of local anesthetic solution through a 25-gauge, ⅝-inch needle inserted through heavy fascia to where the palmar nerve lies adjacent to the dorsal surface of the deep digital flexor tendon. The palmar nerves are usually anesthetized in this location with the horse bearing weight on the limb.

The lateral and medial palmar metacarpal nerves are anesthetized slightly below the carpometacarpal joint where the nerves lie between the palmar surface of the third metacarpal bone and the axial surface of the second or fourth metacarpal bones. Deposit local anesthetic solution, usually about 3 to 5 mL, at each site using a 20- to 22-gauge, 1.5-inch needle. The palmar metacarpal nerves are usually anesthetized in this location with the limb held.

The high palmar nerve block is sometimes the next block used to localize lameness that has not improved after the low palmar nerve block. Anesthetizing the lateral and medial palmar nerves alone slightly below the carpometacarpal joint desensitizes the flexor tendons. Anesthetizing the palmar metacarpal nerves alone at this level desensitizes the second and fourth metacarpal bones and their interosseous ligaments and the proximal portion of the suspensory ligament. The high palmar nerve block desensitizes the inferior check ligament.

Anesthesia of skin over the palmar aspect of the metacarpus indicates that the high palmar nerve block was successful.

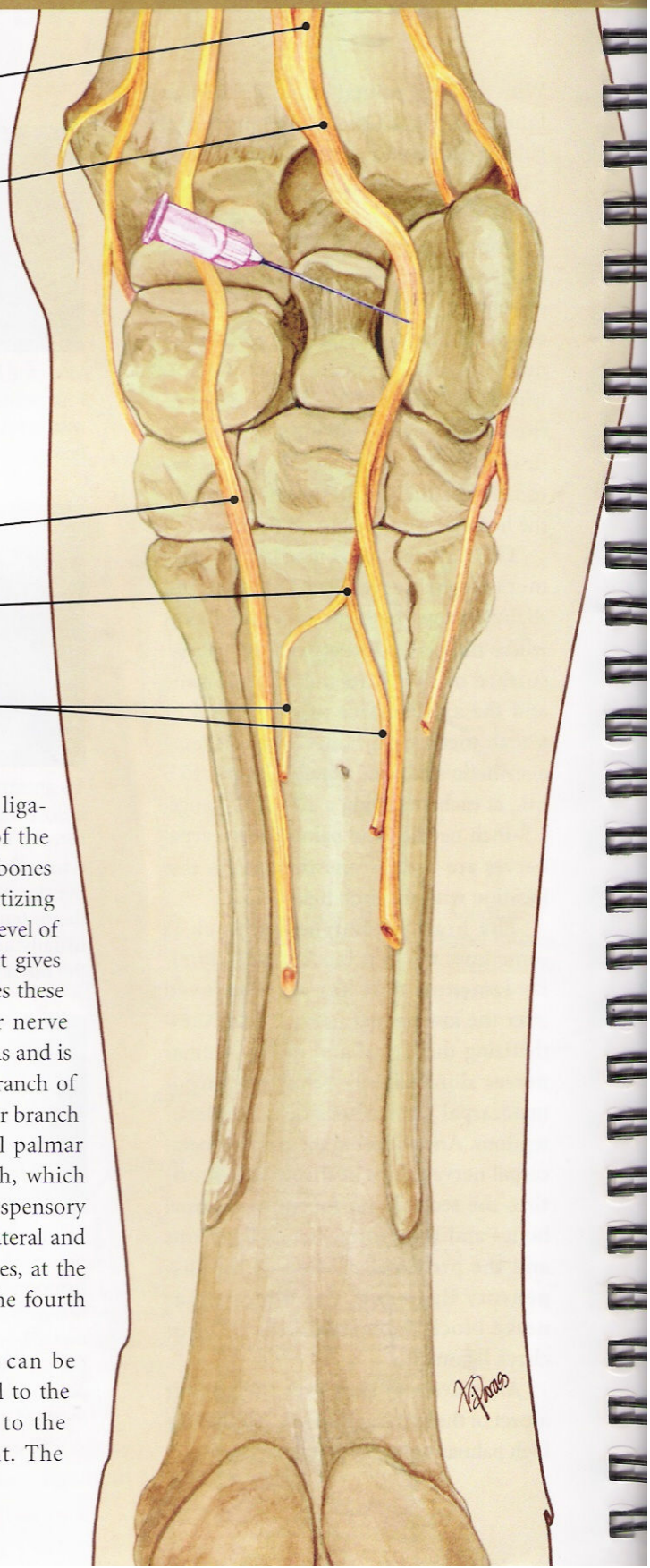
With the high palmar nerve block (high four-point block), the palmar and palmar metacarpal nerves are anesthetized slightly below the level of carpometacarpal joint.



To anesthetize each palmar nerve slightly below the level of carpometacarpal joint, insert a needle through heavy fascia to where the palmar nerve lies adjacent to the dorsal surface of the deep digital flexor tendon. The palmar nerves are usually anesthetized in this location with the horse bearing weight on the limb.

The lateral and medial palmar metacarpal nerves are anesthetized slightly below the carpometacarpal joint where the nerves lie between the palmar surface of the third metacarpal bone and the axial surface of the second or fourth metacarpal bone. The palmar metacarpal nerves are usually anesthetized in this location with the limb held.

Lateral Palmar



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 accessoriometacarpal ligament. The

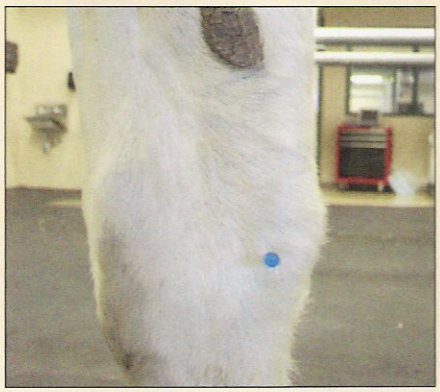
Needle: 1 inch (2.54 cm), 20 to 22 gauge or
⅝ inch (1.59 cm), 25 gauge
Volume: 5 mL or 1.5 to 2 mL

site of injection is located on the palmar border of this ligament midway between the ligament's insertion on the distal aspect of the accessory carpal bone and on the proximal aspect of the fourth metacarpal bone. The nerve is anesthetized, usually with the horse bearing weight on the limb, with 5 mL of local anesthetic solution administered through a 20- to 22-gauge, 1-inch needle, which must penetrate the thick flexor carpal retinaculum.

This injection technique results in a high incidence of penetration of the carpal canal; therefore, anesthesia of the lateral palmar nerve using this technique may lead to erroneous conclusions if the amount of local anesthetic solution deposited within the carpal canal is enough to ameliorate pain associated with disease of the structures contained within this synovial cavity. Although the site of injection is close to the distal aspect of the carpus, inadvertent infiltration of local anesthetic solution into the carpometacarpal and intercarpal joints using this technique is unlikely.[12]

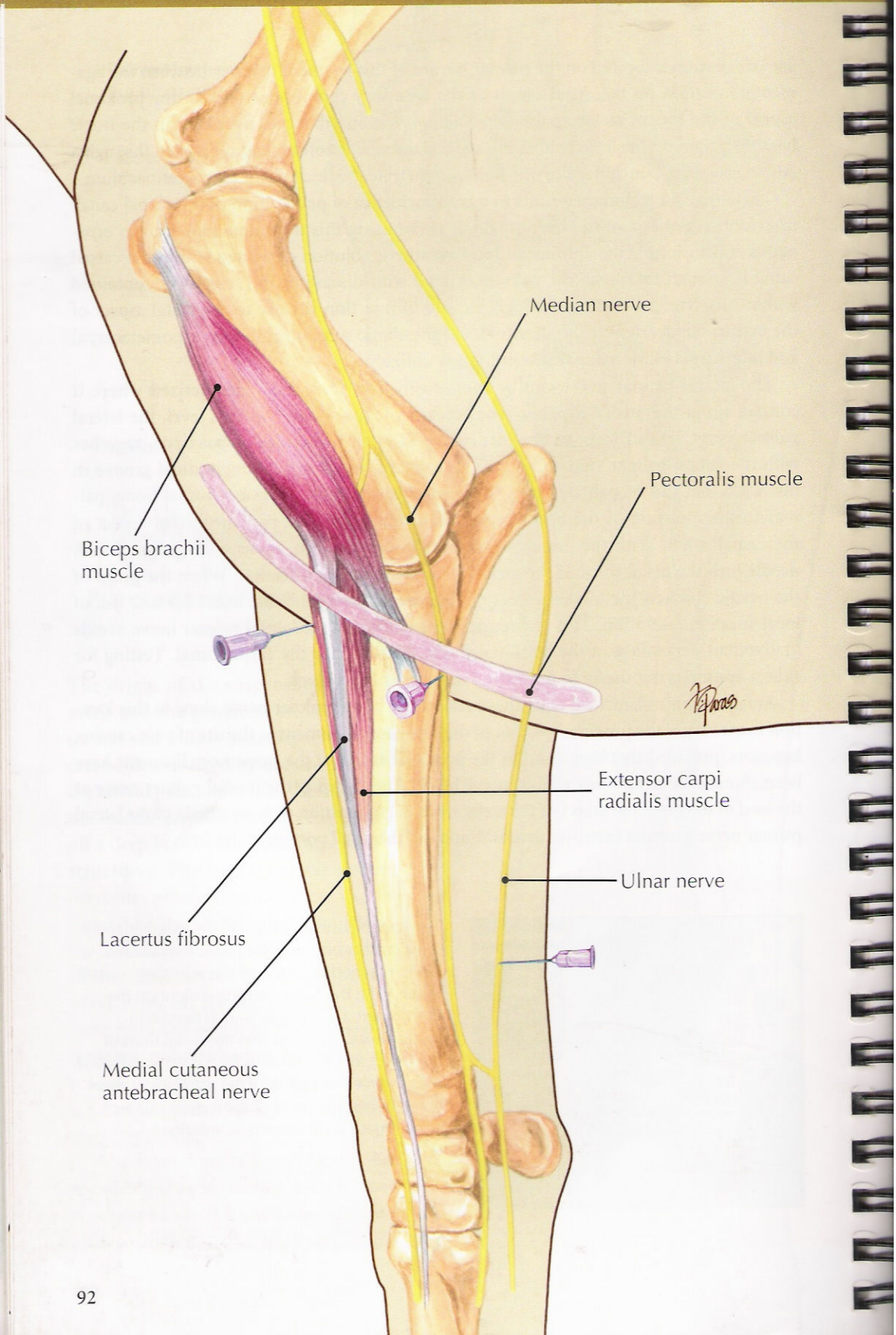
The lateral palmar nerve can be most easily and accurately anesthetized where it courses along the medial aspect of the accessory carpal bone.[13] At this level, the lateral palmar nerve lies adjacent to the medial aspect of the accessory carpal bone, together with the lateral palmar vein and artery. The site of injection is a longitudinal groove in the fascia that can be palpated over the medial aspect of the accessory carpal bone, palmar to the insertion of the flexor retinaculum that forms the palmaromedial aspect of the carpal canal. With the horse bearing weight on the limb, insert a 25-gauge, ⅝-inch needle into the distal third of the groove in a mediolateral direction. When the point of the needle contacts the medial aspect of the accessory carpal bone, inject 1.5 to 2 mL of local anesthetic solution. This technique of anesthetizing the lateral palmar nerve avoids inadvertent deposition of the local anesthetic solution into the carpal canal. Testing for skin sensation is not useful in evaluating the effect of this block.

Amelioration of lameness after anesthesia of the lateral palmer nerve alone at this location incriminates the proximal portion of the suspensory ligament as the site of pain causing lameness, provided that sites distal to the proximal aspect of the suspensory ligament have been eliminated using a low palmar nerve block. Anesthetizing the medial palmer nerve at the level of the proximal aspect of the metacarpus in conjunction with anesthesia of the lateral palmar nerve provides extensive desensitization of the distal portion of the limb.



The lateral palmar nerve can be anesthetized most easily and accurately where it courses along the medial aspect of the accessory carpal bone. With the horse bearing weight on the limb, insert a 25-gauge, ⅝-inch needle in a mediolateral direction into the distal third of the longitudinal groove, which can be palpated over the medial aspect of the accessory carpal bone. When the point of the needle contacts bone, inject local anesthetic solution.

Median, Ulnar, and Medial Cutaneous Antebrachial



Needles: Median nerve—2 to 2.5 inch (5.08 to 6.35 cm), 20 gauge
Ulnar nerve—1 inch (2.54 cm), 20 gauge
Medial cutaneous antebrachial nerve—⅝ inch (1.59 cm), 25 gauge

The carpus and distal aspect of the limb can be desensitized by anesthetizing the median, ulnar, and medial cutaneous antebrachial nerves. Although these nerves are sometimes anesthetized for diagnostic purposes, they are most commonly anesthetized to desensitize the distal portion of the limb for surgery.

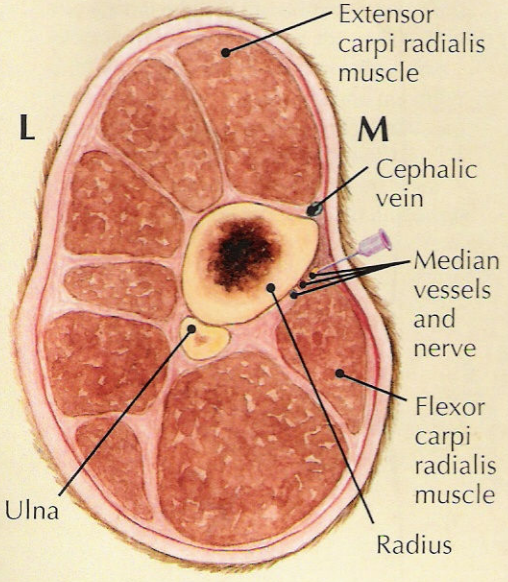
The **median nerve** is anesthetized on the caudomedial aspect of the radius just below the elbow joint, where the ventral edge of the posterior superficial pectoral muscle inserts on the radius. Insert a 20-gauge, 2- to 2.5-inch needle at this site, and direct it proximally and laterally through the fascia close to the caudal surface of the radius to a depth of 1 to 2 inches. Advance the needle close to the radius to avoid the median vein and artery, and deposit about 10 mL of local anesthetic solution. Anesthesia of the median nerve alone partially desensitizes the carpus and distal aspect of the antebrachium and the structures innervated by the medial and lateral palmar nerves.

The **ulnar nerve** is anesthetized about 4 inches proximal to the accessory carpal bone, at which point the nerve lies about 0.25 to 0.5 inch below the surface of the skin under the superficial fascia in the groove between the ulnaris lateralis and the flexor carpi ulnaris muscles. In this region, infuse about 10 mL of local anesthetic solution superficially and deeply through a 20-gauge, 1-inch needle.

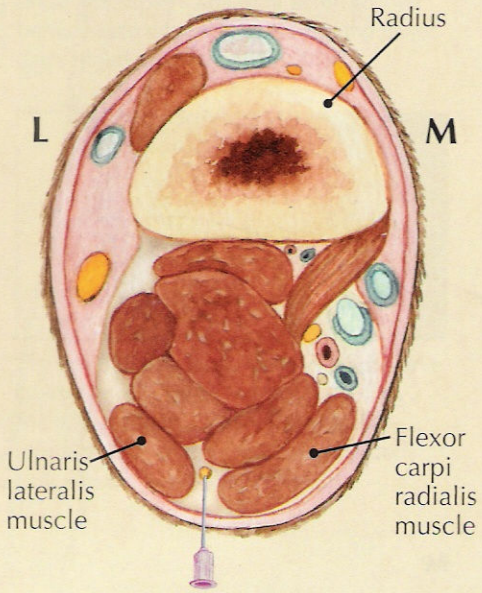
Anesthetizing the ulnar nerve desensitizes the skin of the lateral aspect of the forelimb distal to the injection site down to the fetlock. Lameness caused by lesions of the accessory carpal bone and surrounding structures, the second and fourth metacarpal bones and their interosseous ligaments, and the suspensory ligament is partially ameliorated by anesthetizing the ulnar nerve.

Concurrent anesthesia of both the median and ulnar nerves desensitizes most structures distal to the blocks that might be involved in lameness. Because the medial cutaneous antebrachial nerve innervates only the skin, anesthesia of this nerve is not a necessary part of a lameness examination.[5]

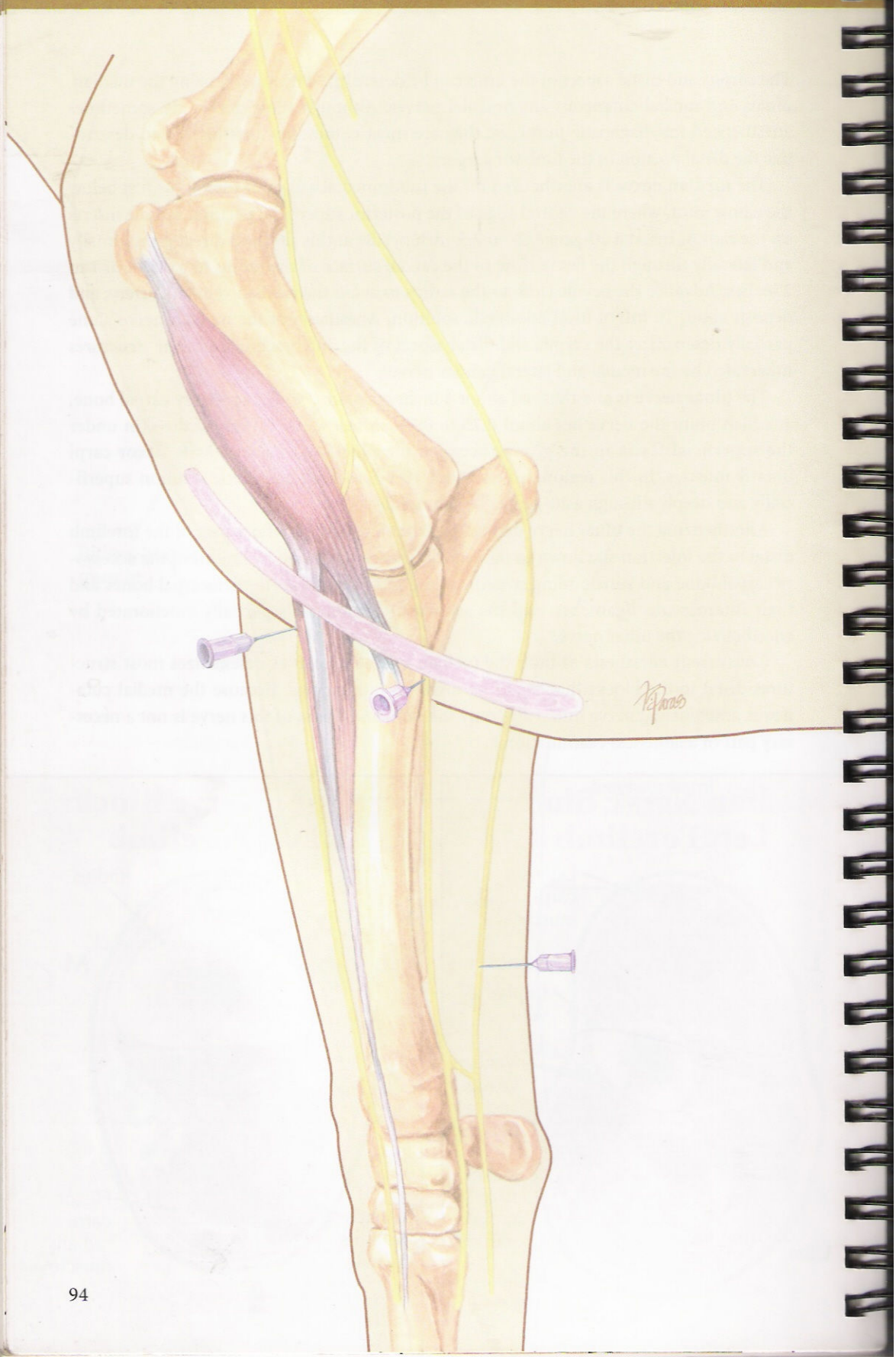
Median Nerve Block: Left Forelimb



Ulnar Nerve Block: Left Forelimb



Median, Ulnar, and Medial Cutaneous Antebrachial (continued)



Volume: Median and ulnar nerves—10 mL each
Medial cutaneous antebrachial nerve and its branches—5 mL at each site

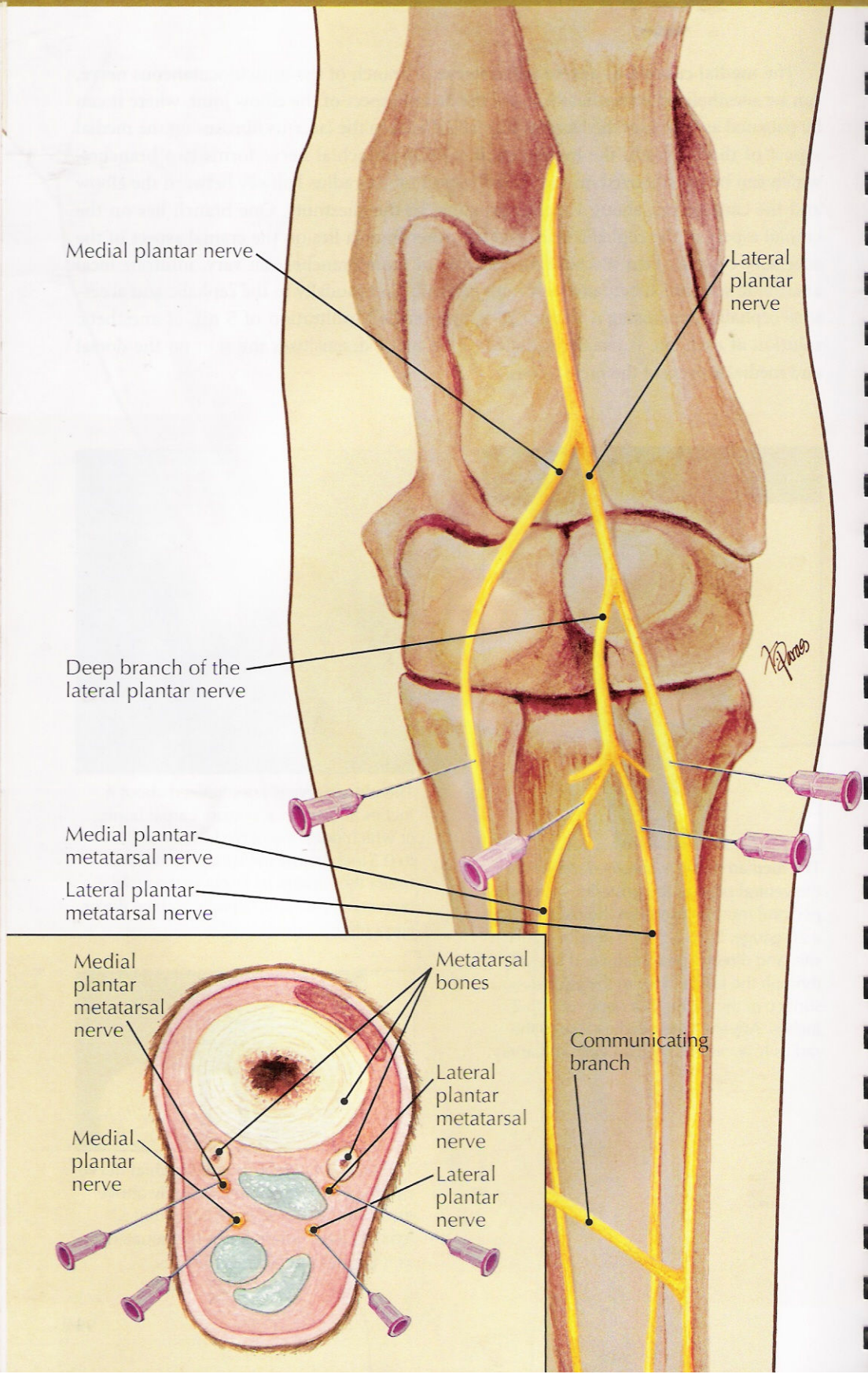
The **medial cutaneous antebrachial nerve**, a branch of the musculocutaneous nerve, can be anesthetized immediately above the dorsal aspect of the elbow joint, where it can be palpated as it crosses the lacertus fibrosus. Distal to the lacertus fibrosus on the medial aspect of the forelimb, the medial cutaneous antebrachial nerve forms two branches, which can be anesthetized on the medial aspect of the radius halfway between the elbow and the carpus (i.e., about 4 inches proximal to the chestnut). One branch lies on the cranial aspect of the cephalic vein, and the other branch lies on the cranial aspect of the accessory cephalic vein. Because the location of these branches can vary, infiltrate local anesthetic solution subcutaneously both cranially and caudally to the cephalic and accessory cephalic veins using a ⅝-inch, 25-gauge needle.[4] Infiltration of 5 mL of anesthetic solution at each site is usually sufficient. This block desensitizes the skin on the dorsal and medial aspects of the metacarpus.

The **median nerve** is anesthetized where the ventral edge of the posterior superficial pectoral muscle inserts on the radius. Insert a 20-gauge, 2- to 2.5-inch needle at this site, and direct it proximally and laterally through the fascia close to the caudal surface of the radius to a depth of 1 to 2 inches. Advance the needle close to the radius to avoid the median vein and artery.

The **ulnar nerve** is anesthetized about 4 inches above the accessory carpal bone, at which point the nerve lies about 0.25 to 0.5 inch below the surface of the skin under the superficial fascia in the groove between the ulnaris lateralis and the flexor carpi ulnaris muscles.

The **medial cutaneous antebrachial nerve** can be anesthetized immediately above the dorsal aspect of the elbow joint (*circled area*) where it can be palpated as it crosses the lacertus fibrosus.

High Plantar

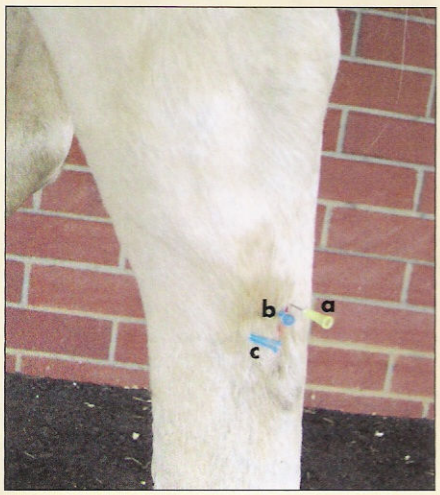


Needle: Plantar metatarsal nerve—
1.5 inch (3.81 cm), 20 to 22 gauge
Plantar nerve—⅝ inch (1.59 cm), 25 gauge
Volume: 3 to 5 mL at each site

With the **high plantar nerve** block (high six-point block), anesthesia of the medial and lateral plantar nerves, the medial and lateral plantar metatarsal nerves, and the dorsal metatarsal nerves just distal to the tarsometatarsal joint provides complete analgesia to structures in the metatarsal region and below. To anesthetize the plantar metatarsal nerves in this region, insert a 20- to 22-gauge, 1.5-inch needle about 1 cm distal to the tarsometatarsal joint and axial to the second or fourth metatarsal bone until its point contacts the third metacarpal bone. Deposit 3 to 5 mL of local anesthetic solution at this location. The plantar metatarsal nerves are usually anesthetized in this location with the horse bearing weight on the limb. Anesthetizing both plantar metatarsal nerves alone at this level desensitizes the second and fourth metatarsal bones and their interosseous ligaments as well as the proximal portion of the suspensory ligament. Although not likely, local anesthetic solution could be inadvertently placed in the tarsometatarsal joint with this block. Inadvertent administration of local anesthetic solution into the tarsal sheath, however, is likely when blocking the plantar metatarsal nerves.[14]

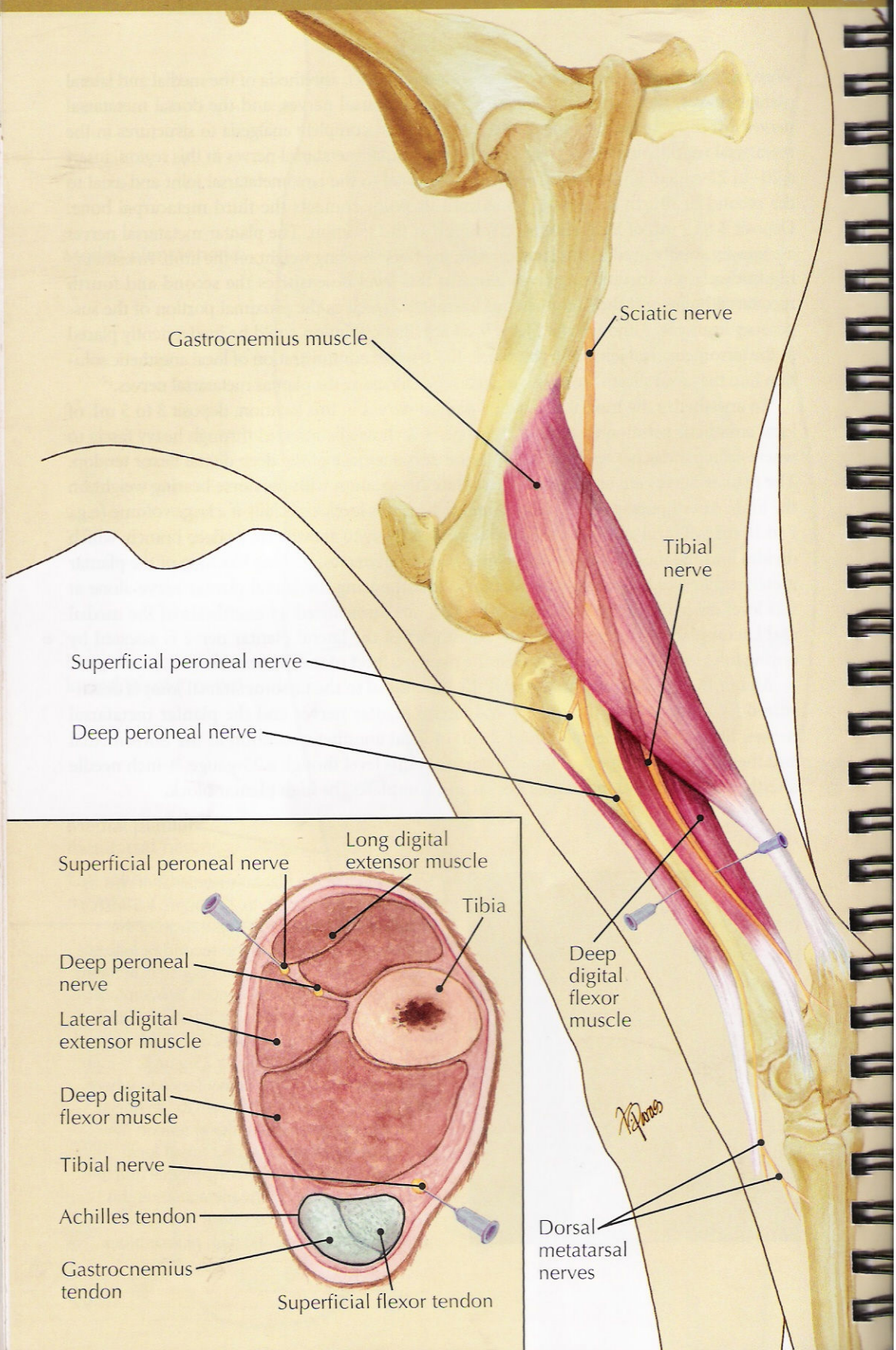
To anesthetize the medial and lateral plantar nerves in this location, deposit 3 to 5 mL of local anesthetic solution through a 25-gauge, ⅝-inch needle inserted through heavy fascia to where each plantar nerve lies adjacent to the dorsal surface of the deep digital flexor tendon. The plantar nerves are usually anesthetized in this location with the horse bearing weight on the limb. Anesthetizing the lateral plantar nerve at this level, especially if a large volume (e.g., 7 to 10 mL) of local anesthetic solution is used, is likely to anesthetize its deep branch, which divides into the medial and lateral plantar metatarsal nerves, making blocking of the plantar metatarsal nerves individually unnecessary. Anesthesizing the lateral plantar nerve alone at this level desensitizes the same structures that are desensitized by anesthesia of the medial and lateral plantar metatarsal nerves. Anesthesia of the lateral plantar nerve is assessed by testing for a lack of skin sensation over the plantar aspect of the metatarsus.

All but the proximodorsal aspect of the limb distal to the tarsometatarsal joint is desensitized by anesthetizing the medial and lateral plantar nerves and the plantar metatarsal nerves. Subcutaneous deposition of 2 mL of local anesthetic solution at the dorsomedial and the dorsolateral aspect of the metatarsus at this level though a 25-gauge, ⅝-inch needle anesthetizes the dorsal metatarsal nerves and completes the high plantar block.



To anesthetize the plantar metatarsal nerves in this region, insert a 20- to 22-gauge, 1.5-inch needle about 1 cm distal to the head of the splint bones and axial to the second or fourth metatarsal bone until its point contacts the third metacarpal bone *(a)* and deposit 3 to 5 mL of local anesthetic solution. For the medial and lateral plantar nerves, deposit 3 to 5 mL of local anesthetic solution through a 25-gauge, ⅝-inch needle inserted through heavy fascia to where each plantar nerve lies adjacent to the dorsal surface of the deep digital flexor tendon *(b)*. Subcutaneous deposition of 2 mL of local anesthetic solution at the dorsomedial and the dorsolateral aspects of the metatarsus at this level *(c)* anesthetizes the dorsal metatarsal nerves and completes the high plantar block.

Tibial and Peroneal (Fibular)

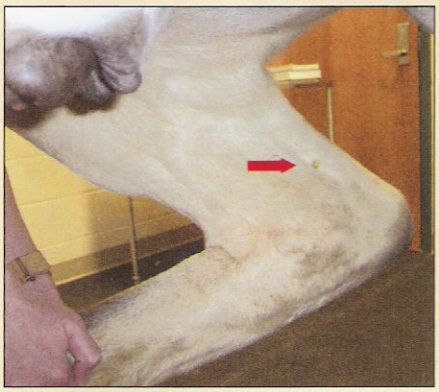


Needle: Tibial nerve—1.5 inch (3.81 cm), 20 to 22 gauge
Peroneal nerves—1.5 to 2 inch (3.81 to 5.08 cm), 20 to 22 gauge
Volume: Tibial nerve—15 to 20 mL
Peroneal nerves—Total of 20 mL

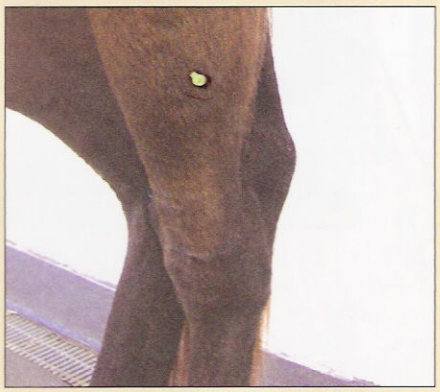
Anesthetizing the **tibial and deep and superficial peroneal nerves** above the point of the hock desensitizes the entire distal portion of the limb. The tibial nerve is anesthetized approximately 4 inches above the point of the hock on the medial aspect of the limb, where it can be palpated on the caudal surface of the deep digital flexor muscle, cranial to the Achilles tendon. The nerve can be palpated at this level only while the limb is flexed. To anesthetize this nerve, deposit 15 to 20 mL of local anesthetic solution at this site in at least several planes in the fascia that overlies the deep digital flexor muscle through a 20- to 22-gauge, 1.5-inch needle. Amelioration of lameness after the tibial nerve has been anesthetized incriminates the suspensory ligament as a site of pain, provided that more distal structures of the limb have been eliminated as a source of pain using a low plantar nerve block.

To completely desensitize the hock and the limb distal to the hock, the deep and superficial peroneal (fibular) nerves must also be anesthetized. The site at which the peroneal nerves are usually anesthetized is on the lateral aspect of the limb about 4 inches above the point of the hock in the groove formed by the lateral and long digital extensor muscles. To anesthetize the deep peroneal nerve, insert a 20- to 22-gauge, 1.5- to 2-inch needle into the groove, and direct it slightly caudally until it contacts the caudal edge of the tibia. After depositing 10 mL of local anesthetic solution at this site to anesthetize the deep peroneal nerve, deposit another 10 mL superficially in three or four planes to anesthetize the superficial peroneal nerve as the needle is withdrawn. The horse may drag the toe of the desensitized limb when the tibial and superficial and deep peroneal nerves are anesthetized.

Loss of skin sensation over the plantar aspect of the pastern and the heels indicates that the blocks were performed correctly.

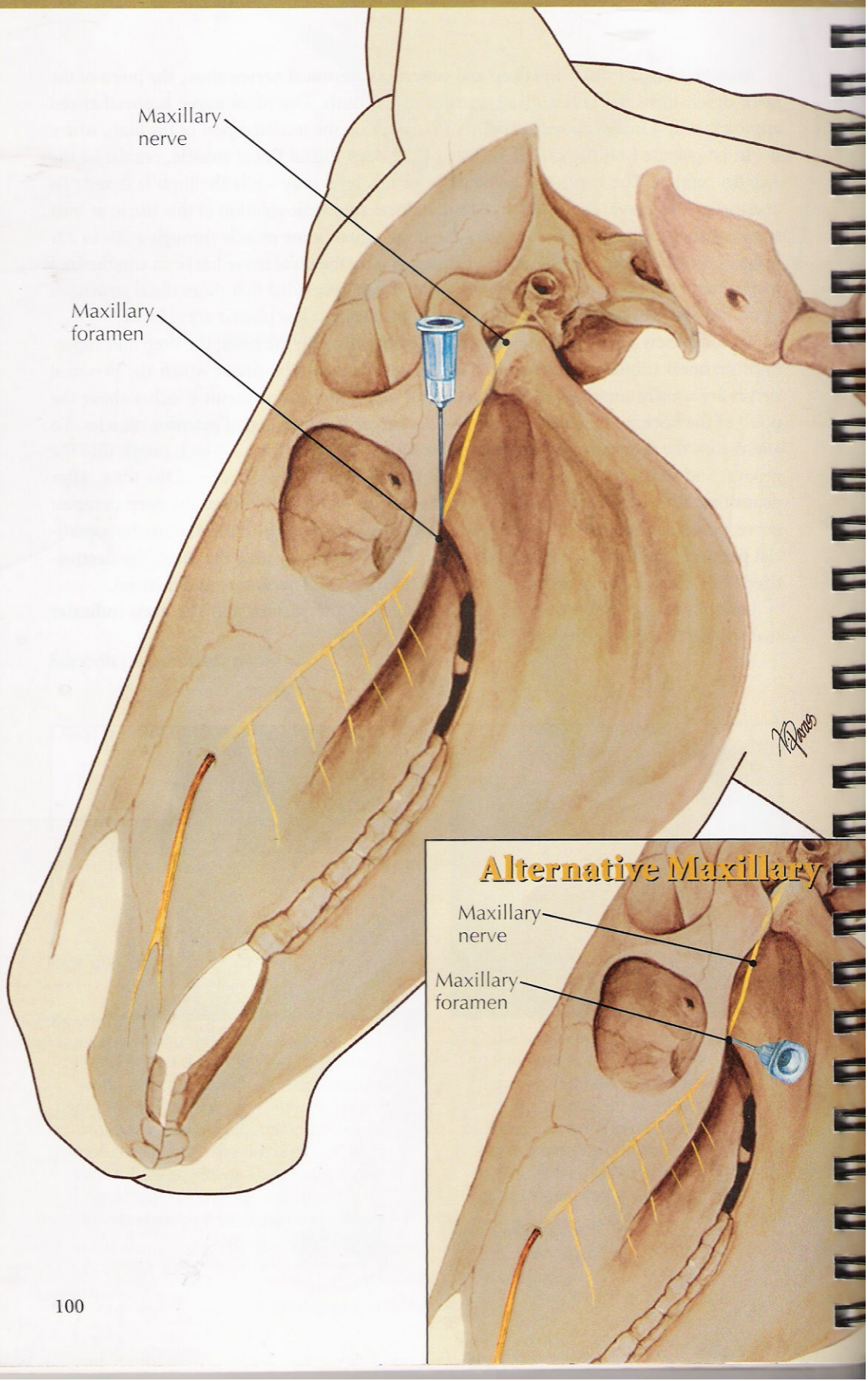


The tibial nerve is anesthetized about 4 inches above the point of the hock on the medial aspect of the limb, where it can be palpated on the caudal surface of the deep digital flexor muscle, cranial to the Achilles tendon. The nerve can be palpated at this level only while the limb is flexed. *Arrow* indicates needle placement.



The site at which the peroneal nerves are usually anesthetized is on the lateral aspect of the limb about 4 inches above the point of the hock in the groove formed by the lateral and long digital extensor muscles. To anesthetize the deep peroneal nerve, insert a 20- to 22-gauge, 1.5- to 2-inch needle into the groove, and direct it slightly caudally until it contacts the caudal edge of the tibia.

Maxillary


Maxillary nerve
Maxillary foramen
Alternative Maxillary
Maxillary nerve
Maxillary foramen

Needle: 3.5 to 5 inch (8.89 to 12.7 cm),
20 to 22 gauge, spinal
Volume: 15 to 20 mL

The paranasal sinuses, nasal cavity, and maxillary and premaxillary teeth and associated alveoli and gingiva can be desensitized by anesthetizing the ipsilateral maxillary nerve. The nerve is anesthetized in the pterygopalatine fossa at the maxillary foramen, where the nerve enters the infraorbital canal to become the infraorbital nerve.

To anesthetize the **maxillary nerve** at the maxillary foramen, insert the point of a 20- to 22-gauge, 3.5- to 5-inch spinal needle just ventral to the ventral border of the zygomatic process. Direct the needle rostrally and ventrally, aiming toward the rostral edge of the contralateral facial crest, until the point of the needle strikes the bone of the pterygopalatine fossa. The horse may jerk its head if the needle contacts the nerve.

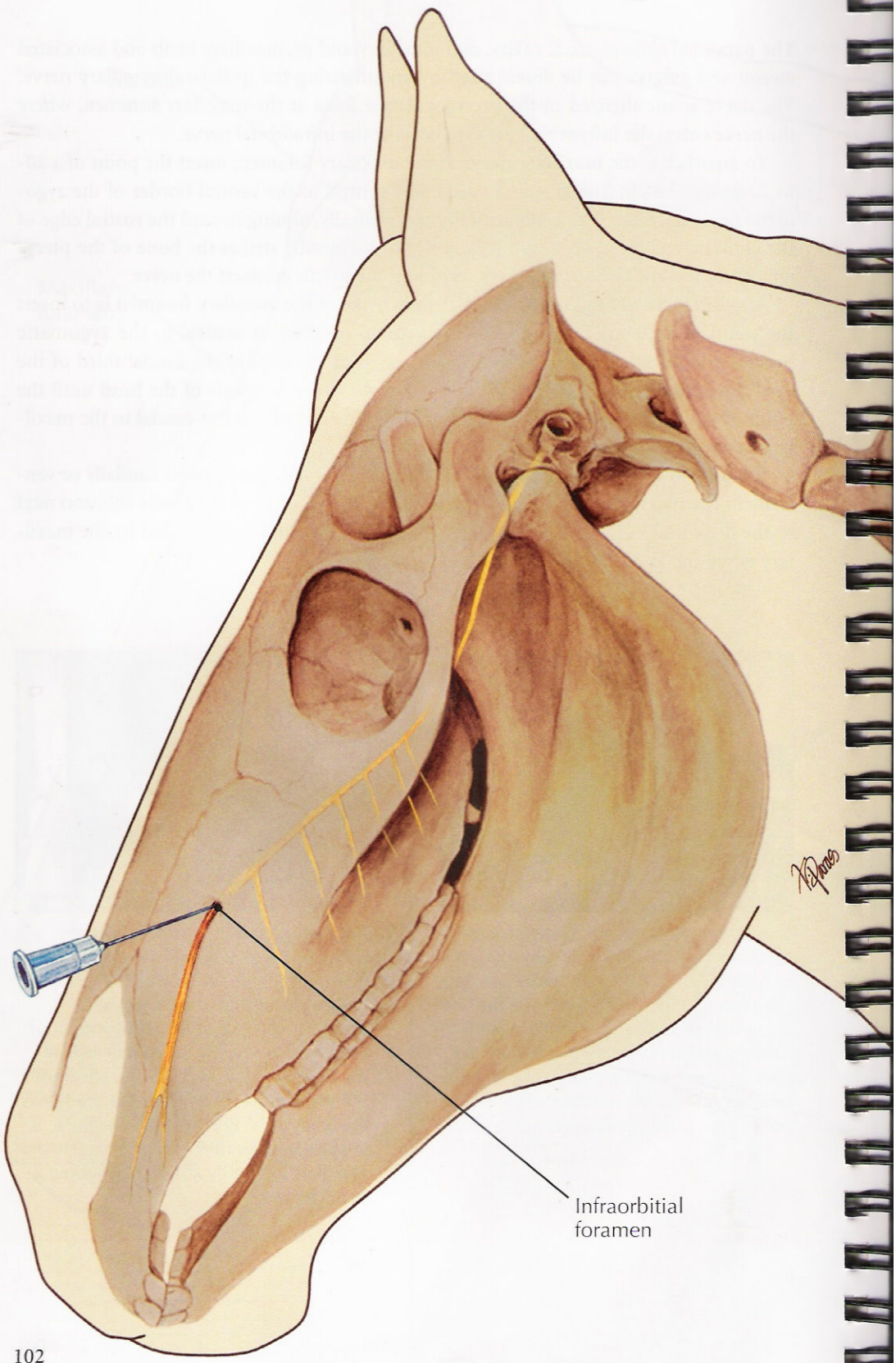
Another method of blocking the maxillary nerve at the maxillary foramen is to insert the point of a 20- to 22-gauge, 3.5-inch spinal needle just ventral to the zygomatic process and dorsal to the transverse facial vessels at the level of the caudal third of the eye.[15] Insert the point of the needle at a 90° angle to the long axis of the head until the point of the needle strikes the bone of the pterygopalatine fossa just caudal to the maxillary tuberosity at a depth of about 2 to 2.5 inches.

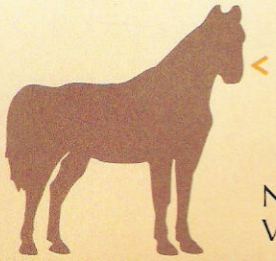
If blood flows from the needle, the needle has been positioned too far caudally or ventrally in the pterygopalatine fossa. Deposit 15 to 20 mL of local anesthetic solution next to the bone and as the needle is withdrawn slightly. Structures innervated by the maxillary nerve are desensitized within 10 to 15 minutes.

To anesthetize the maxillary nerve at the maxillary foramen, insert the point of a 20- to 22-gauge, 3.5- to 5-inch spinal needle just ventral to the ventral border of the zygomatic process and direct the needle rostrally and ventrally, aiming toward the rostral edge of the contralateral facial crest until the point of the needle strikes the bone of the pterygopalatine fossa.

Another method of anesthetizing the maxillary nerve at the maxillary foramen is to insert a 20- to 22- gauge, 3.5-inch spinal needle just ventral to the zygomatic process and dorsal to the transverse facial vessels at the level of the caudal third of the eye.[15] Insert the point of the needle at a 90° angle to the long axis of the head until the point of the needle strikes the bone of the pterygopalatine fossa just caudal to the maxillary tuberosity at a depth of about 2 to 2.5 inches.

Infraorbital



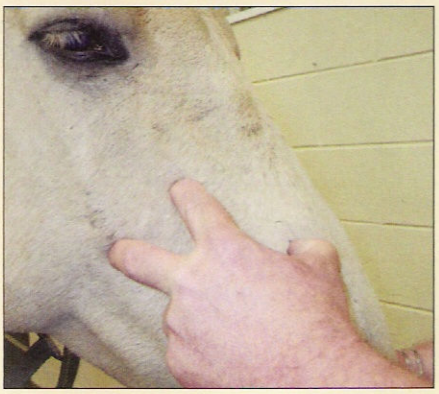


Needle: 1.5 inch (3.81 cm), 20 to 22 gauge
Volume: 5 to 10 mL

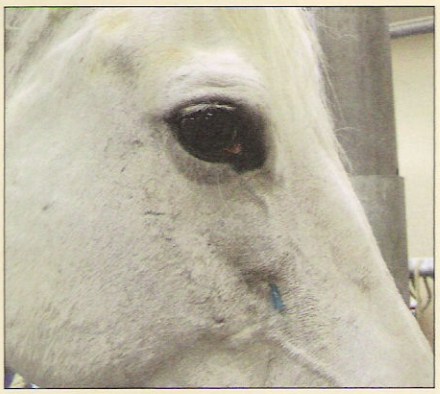
The **infraorbital nerve** can be anesthetized within the infraorbital canal or where the nerve emerges from the infraorbital foramen. When anesthetized at the infraorbital foramen, the desensitized area includes the skin of the lip, nostril, and face up to the level of the foramen on that side of the head. Additional structures that are desensitized by injecting local anesthetic solution within the infraorbital canal include the ipsilateral nasal cavity, premaxillary incisors, canine tooth, premolars, probably the molars, and associated alveoli and gingiva.

To locate the infraorbital foramen, place a thumb in the nasomaxillary notch and the middle finger on the rostral end of the facial crest. Locate the foramen with the index finger halfway between and 0.5 to 1 inch caudal to an imaginary line between these points. The bony ridge of the foramen can be palpated by pushing the ventral edge of the levator nasolabialis muscle dorsally. To anesthetize the infraorbital nerve within the infraorbital canal, insert a 20- to 22-gauge, 1.5-inch needle through the skin about 1 inch rostral to the foramen after elevating the levator nasolabialis muscle. Insert the shaft of the needle about 1 inch into the canal, and deposit 5 to 10 mL of local anesthetic solution.

The infraorbital nerve block is useful for performing surgery of the nose or incisors, and both infraorbital nerves are sometimes anesthetized within the infraorbital canal as part of a diagnostic procedure to determine the cause of head shaking. Because the block is not tolerated well by the horse, adequate restraint and great care should be taken during its administration.

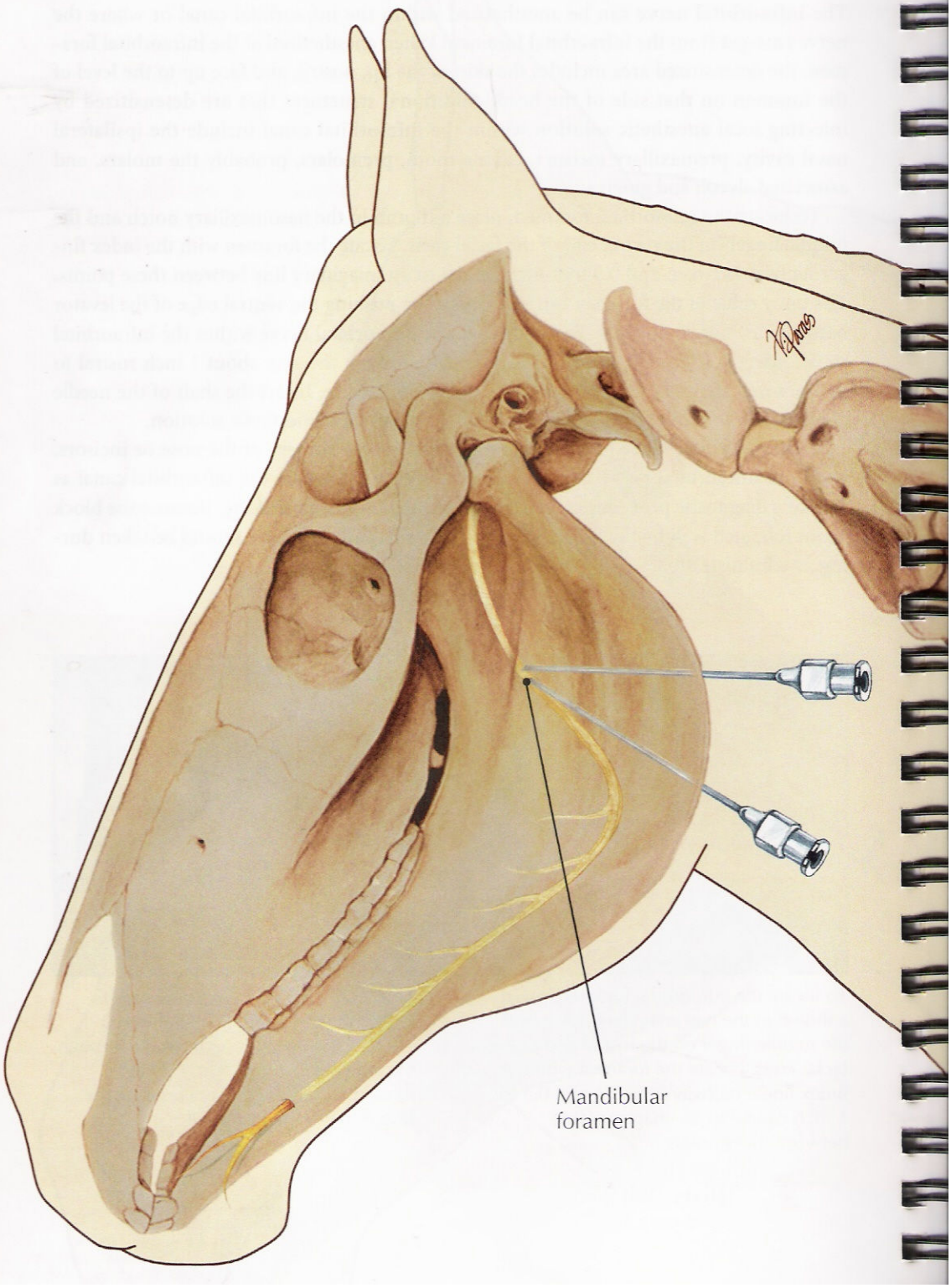


To locate the infraorbital foramen, place a thumb in the nasomaxillary notch and the middle finger on the rostral end of the facial crest. Locate the foramen with the index finger halfway between and 0.5 to 1 inch caudal to an imaginary line between these points.



To anesthetize the infraorbital nerve within the infraorbital canal, insert a 20- to 22-gauge, 1.5-inch needle through the skin about 1 inch rostral to the infraorbital foramen after elevating the levator nasolabialis muscle.

Mandibular

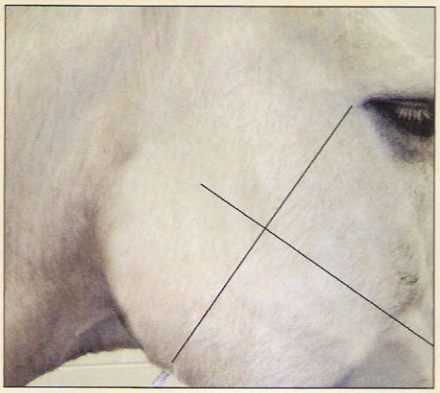


Needle: 3.5 or 6 inch (8.89 or 15.24 cm), 20 to 22 gauge, spinal
Volume: 15 to 20 mL

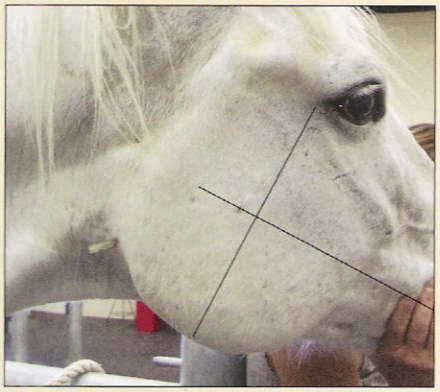
To desensitize one side of the mandible and all of its dental structures, the ipsilateral **mandibular nerve** can be anesthetized at the mandibular foramen where it enters the mandibular canal to become the mandibular alveolar nerve. The mandibular foramen is situated on the medial aspect of the vertical ramus of the mandible, at the junction of an imaginary line that extends along and caudal to the palpable buccal edge of the maxillary dental arcade and a second imaginary line drawn perpendicular to the first line from the lateral canthus of the eye.

To anesthetize the mandibular nerve, insert the point of a 20- to 22-gauge, 6-inch spinal needle at the medial aspect of the ventral border of the horizontal part of the ramus of the mandible, slightly rostral to the angle of the mandible. Advance the point of the needle vertically for 4 to 6 inches along the medial surface of the ramus until it reaches the junction of the previously described imaginary lines. Deposition of 15 to 20 mL of local anesthetic solution at this site desensitizes structures innervated by the mandibular nerve within 15 to 30 minutes.[15]

Another method of advancing the spinal needle to the mandibular foramen is to insert the point of the needle at the angle formed by the vertical and horizontal rami of the mandible. When this site for insertion of the needle is selected, a 3.5-inch spinal needle can be used. Advance the point of the needle about 3.5 inches rostrally and dorsally, as close as possible to the medial surface of the ramus, to the junction of the previously described imaginary lines.[15]

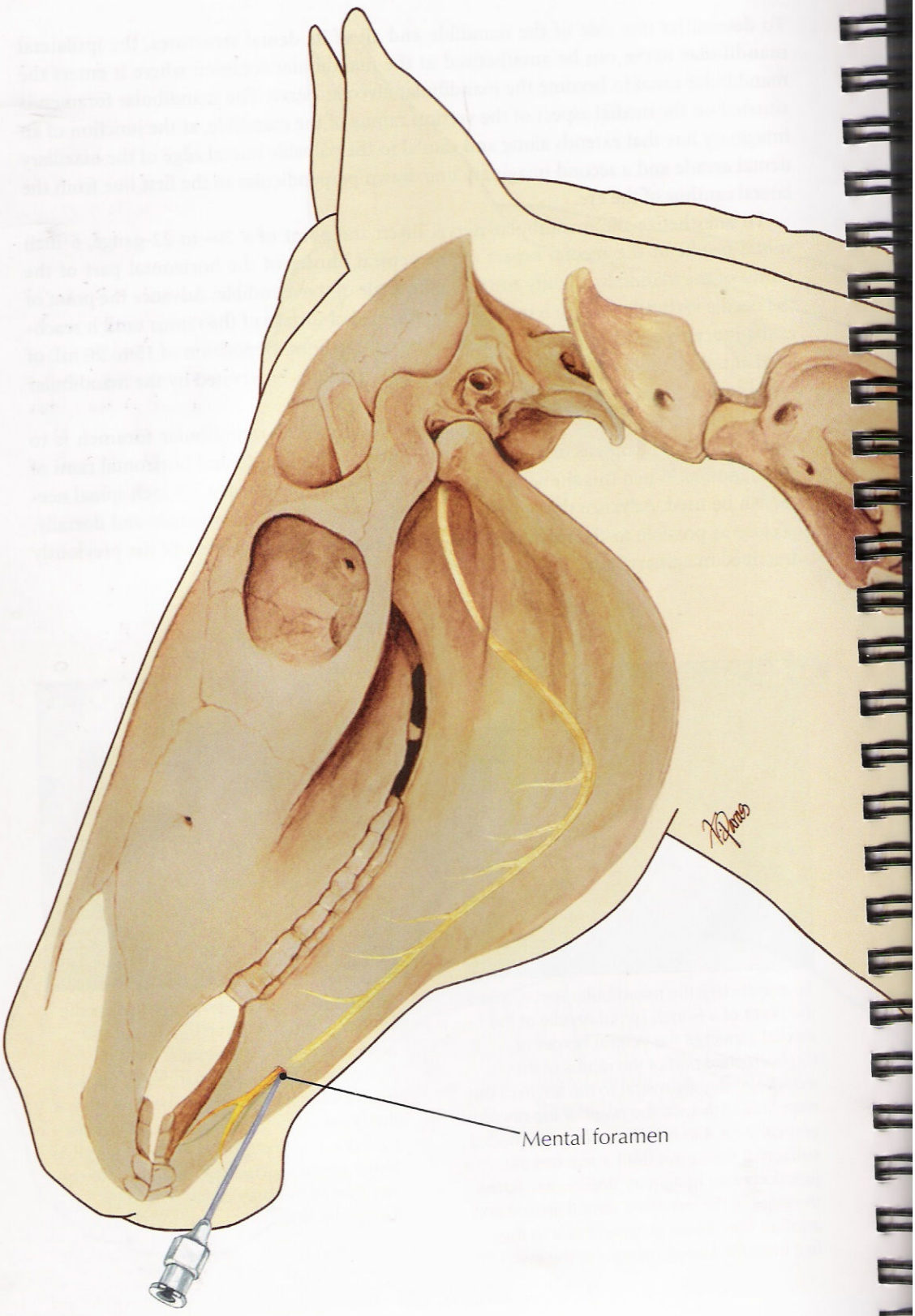


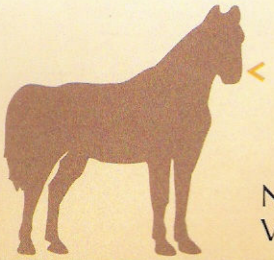
To anesthetize the mandibular nerve, insert the point of a 6-inch spinal needle at the medial aspect of the ventral border of the horizontal part of the ramus of the mandible, slightly rostral to the angle of the mandible. Advance the point of the needle vertically for 4 to 6 inches along the medial surface of the ramus until it reaches the junction of an imaginary line drawn across the edge of the maxillary dental arcade and another line drawn perpendicular to the first from the lateral canthus of the eye.



When the site for insertion of the needle for a mandibular nerve block is at the angle formed by the vertical and horizontal rami of the mandible, a 3.5-inch spinal needle can be used. Advance the point of the needle about 3.5 inches rostrally and dorsally, as close as possible to the medial surface of the ramus, to the junction of the previously described imaginary lines.[15]

Mental

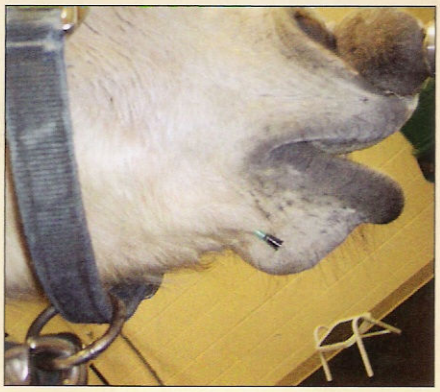




Needle: 1.5 inch (3.81 cm), 20 to 22 gauge
Volume: 5 to 10 mL

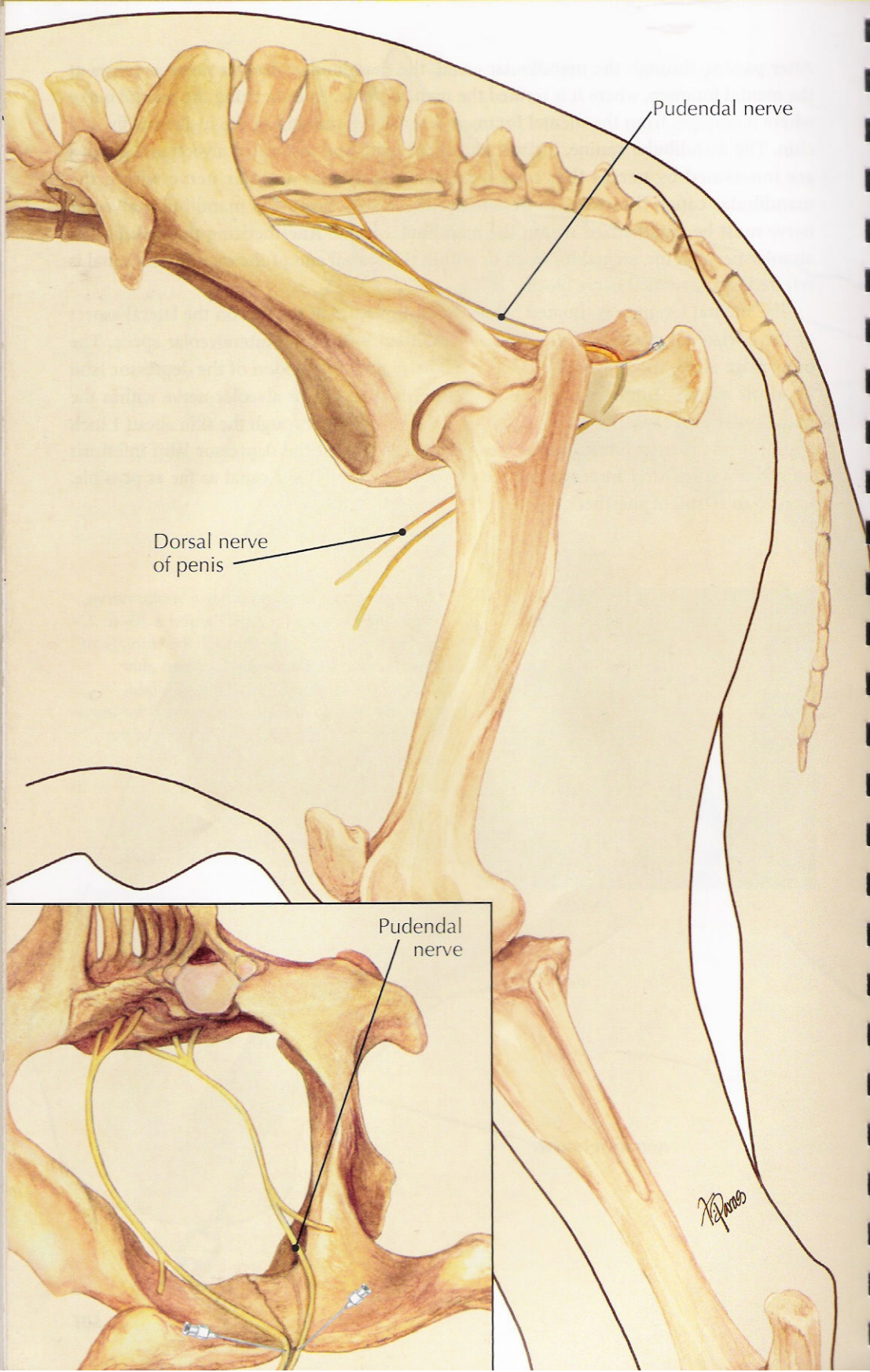
After passing through the mandibular canal, the mandibular alveolar nerve emerges at the mental foramen, where it is termed the **mental nerve**. Anesthetizing the mental nerve where it emerges from the mental foramen desensitizes the skin of the ipsilateral lip and chin. The mandibular canine, incisor, and cheek teeth and associated alveoli and gingiva are innervated by nerves that arise from the mandibular alveolar nerve within the mandibular canal; therefore, to desensitize these structures, the mandibular alveolar nerve must be anesthetized within the mandibular canal. Anesthetizing the mandibular alveolar nerve at the mental foramen or within the rostral end of the mandibular canal is referred to as a mental nerve block.

The mental foramen is situated below the commissure of the lips on the lateral aspect of the horizontal portion of the ramus of the mandible in the interalveolar space. The bony ridge of the foramen can be palpated by elevating the tendon of the depressor labii inferioris muscle with a finger. To anesthetize the mandibular alveolar nerve within the mandibular canal, insert a 20- to 22-gauge, 1.5-inch needle through the skin about 1 inch rostral to the mental foramen after pushing the tendon of the depressor labii inferioris muscle dorsally. After inserting the needle into the mandibular canal as far as possible, inject 5 to 10 mL of anesthetic solution.



To anesthetize the mandibular alveolar nerve within the mandibular canal, insert a 20- to 22-gauge, 1.5-inch needle through the skin about 1 inch rostral to the mental foramen after pushing the tendon of the depressor labii inferioris muscle dorsally. The mental foramen lies ventral to the lateral commissure of the lips.

Pudendal



Needle: 1.5 inch (3.81 cm), 20 to 22 gauge
Volume: 5 mL

The penis and internal lamina of the prepuce can be desensitized and extruded from the preputial cavity by anesthetizing the **pudendal nerves** at the level of the ischial arch.[16] To anesthetize the pudendal nerves where they course around the ischium, insert a 20- to 22-gauge, 1.5-inch needle on both the right and left sides of the anus about 1 inch dorsal to the ischial arch and an equal distance lateral to the anus. Angle the point of the needle ventrally toward the midline until the point of the needle contacts the ischial arch. The penis usually protrudes within 5 minutes after 5 mL of local anesthetic solution is deposited at each site. Using a short-acting local anesthetic solution (e.g., lidocaine) rather than mepivacaine avoids prolonged penile and preputial protrusion. Mepivacaine should be used if prolonged penile and preputial desensitization are required.

To anesthetize the pudendal nerves where they course around the ischium, insert a 20- to 22-gauge, 1.5-inch needle on both the right and left sides of the anus about 1 inch dorsal to the ischial arch and an equal distance lateral to the anus. Angle the point of the needle ventrally toward the midline until the point of the needle contacts the ischial arch.