

Ultrasound Guidance In Regional Anesthesia: Techniques for Lower-Extremity Nerve Blocks



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We believe that vision is the best of the primary human senses. Ultrasound allows the anesthesiologist to evaluate complex and varied neural anatomy *prior to* needle insertion. In addition to providing real-time guidance of the needle toward a nerve or plexus, ultrasound allows the anesthesiologist to witness (and alter) the spread of local anesthetic after the initiation of an injection. Ultimately, it is this visual confirmation of the perineural spread of a local anesthetic that generates a rapid and successful block.

Equipment Specification

1. Ultrasound system
2. Ultrasound transducer, 5- to 12- MHz linear array with variable resolution settings
3. Stimulating needles
4. Ultrasound gel (sterile and nonsterile)
5. Sterile transducer cover
6. Nerve block kit containing sterile drape, skin wheal needles, extension tubing, and syringes of choice

OPTIONAL EQUIPMENT

- A. Needle-guide systems
- B. Transducer-stabilizing device

In-Plane Versus Out-of-Plane Technique

Structures of interest (blood vessels, tendons, and nerves) can be imaged on either the short axis (cross-section) or the long axis. A short-axis view becomes a long-axis view when the probe is turned 90 degrees in either direction. Figure 1 demonstrates these principles.

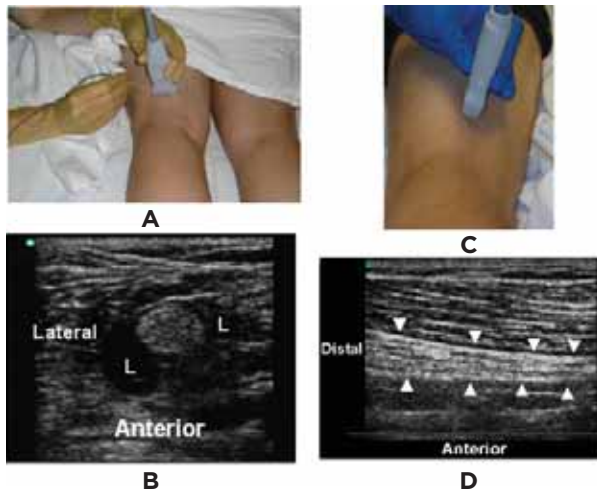


Figure 1. The differences between imaging a structure on the short axis and imaging on the long axis.

For this demonstration, the patient is in the prone position.

A. Transducer position to image the sciatic nerve on the short axis in the popliteal fossa. **B.** The corresponding short-axis ultrasound image of the sciatic nerve. Note the characteristic circular appearance of the nerve. On the short axis, the anesthesiologist has simultaneous anterior-posterior and lateral-medial perspectives of the nerve. **C.** If the probe position for the short-axis view is turned 90 degrees (clockwise or counterclockwise), the long-axis view of the same structure will be generated. **D.** The long-axis ultrasound image of the popliteal sciatic nerve. Note the characteristic tubular appearance. When imaging a nerve on the long axis, the operator loses the lateral-medial perspective. This can be disadvantageous when one is trying to identify needle location and the circumferential spread of local anesthetic around the nerve.

L, local anesthetic

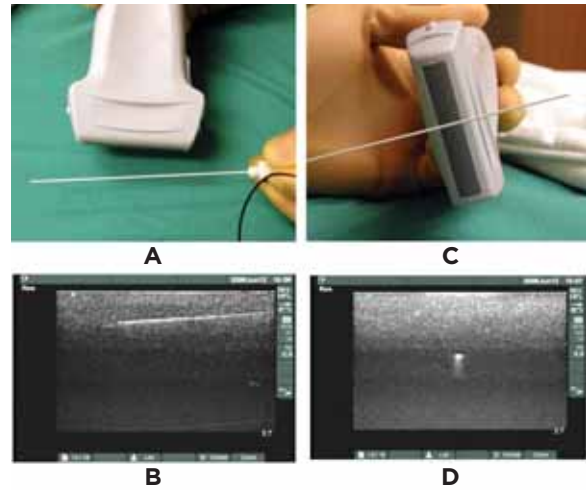


Figure 2. The needle in relation to the probe.

A. The needle is in-plane (long axis) with the ultrasound beam. **B.** The corresponding ultrasound image of the needle in-plane with the ultrasound beam. **C.** The out-of-plane technique with the needle imaged on the short axis. This is also referred to as a cross-sectional view. **D.** The corresponding ultrasound image of the needle out-of-plane with the ultrasound beam and imaged on the short axis.

There are 2 methods of needle insertion with respect to the ultrasound beam. State-of-the-art clinical imaging is currently 2-dimensional; the inserted needle can be visualized in either the long axis or the short axis (Figure 2).

When the needle is inserted in the long-axis view, the entire needle can be visualized. This is known as the *in-plane technique*. This technique affords visualization of the entire needle and the tip, allowing the operator to make very precise real-time adjustments (Figures 2A and 2B).

When the needle is inserted in the short axis, a cross-sectional view of the needle will be obtained (Figures 2C and 2D). This is known as the *out-of-plane technique*. The out-of-plane technique results in the needle being imaged on cross-section. An 18- to 22-gauge needle imaged on cross-section appears as a small dot, which can be difficult to see in real time. In addition, the needle will cross the ultrasound beam only once. Therefore, when the needle is visualized, it may be well above or below the target nerve, depending on the angle of insertion.

For single-injection nerve blocks, we prefer the in-plane technique. The out-of-plane technique is preferred for continuous catheter placement. When the out-of-plane technique is used, it is helpful to inject small amounts of saline, local anesthesia, or 5% dextrose (D5) to help define the location of the needle tip as it advances. The major learning obstacle for the in-plane technique is the ability to keep the needle in the path of the ultrasound beam.

1. Use a high-frequency ultrasound system (≥ 12 MHz) for superficial blocks with a depth of 3 cm or less. This allows the best resolution of the neural structures and surrounding tissue. Deeper blocks will require a lower-frequency transducer that provides better penetration of the ultrasound beam into the tissue.
2. The needle is visualized before being advanced when the in-plane technique is used. The ultrasound beam is very thin, which means that subtle movements can bring the needle in and out of visualization.
3. Subtle pressure or angulation of the transducer (probe) can dramatically improve or worsen the image.

- Practice your needle skills on a turkey breast with an olive placed in it. Interventional radiologists like to use this as a model of a cyst in a human breast.
- Ask the experts at your institution for clinical pearls and insights. We have learned many tricks of the trade by speaking with radiologists and ultrasonographers. Specifically, the operator should be familiar with depth, color flow indicators, gain, focus, frequency settings, and image storing.
- Keep a database of your cases; you will quickly realize the improvement in efficiency and efficacy of your regional anesthesia service.
- Many ultrasound systems provide optional needle-guide devices for their transducers. These secure the needle to the transducer and allow the operator to follow a predetermined course to the target of interest. Although these devices may appear attractive, we have found that they often limit the anesthesiologist's options. That is, once the needle is secured into the needle-guide device, one cannot change angles and approaches to the nerve to generate the circumferential spread of local anesthetic around the nerve.
- The transducer is held in the operator's nondominant hand and the needle in the dominant hand. The ability to use both hands to drive the needle provides an advantage because it is easier to establish an ergonomically stable situation regardless of block type and patient position.
- Place the ultrasound machine on the opposite side of the patient and have the operator stand on the same side as the extremity to be blocked.
- The ultrasound image display is set so that the top of the screen should be the side closest to the transducer. Screen left should be the right side of the patient. Screen right should be the left side of the patient. This practice allows us to clearly communicate and teach the techniques to residents and students alike. To help the operator establish landmarks, there is an orientation cue on the screen that corresponds to a physical marker on the side of the transducer.
- Terminology: *hyperechoic*, whiter or brighter; *hypoechoic*, gray or darker; *anechoic*, black.

Femoral Nerve Block: Single Injection

Patient Position: Supine
Probe Location: Infra-inguinal
Frequency: High to intermediate, depending on body habitus
In-Plane/Out-of-Plane: Either
Nerve Image: Triangular and hyperechoic, lateral to femoral artery
Needle Size: 50 to 100 mm
Local Volume: 20 to 30 mL

- Place the transducer in the infra-inguinal region. Transducer specifications: variable high to intermediate resolution, 13- to 15-MHz linear array with a footprint of 25 to 38 mm. Use the higher-frequency

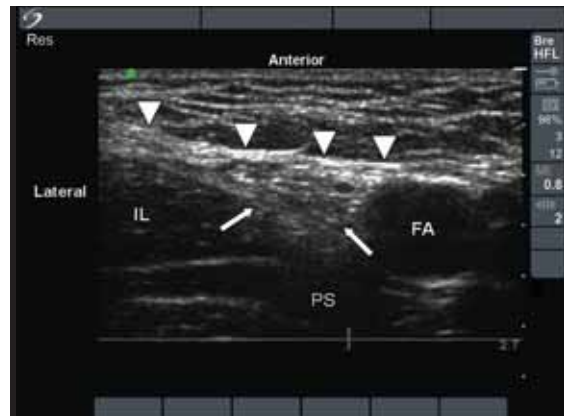


Figure 3. The short-axis view of the infra-inguinal structures.

The arrows indicate the femoral nerve, which appears as a hyperechoic triangular structure. The triangles indicate the fascia iliaca.

FA, femoral artery; **IL**, iliacus muscle; **PS**, psoas muscle



Figure 4. Needle insertion with the in-plane technique.

Note that the needle is inserted in a lateral to medial direction.

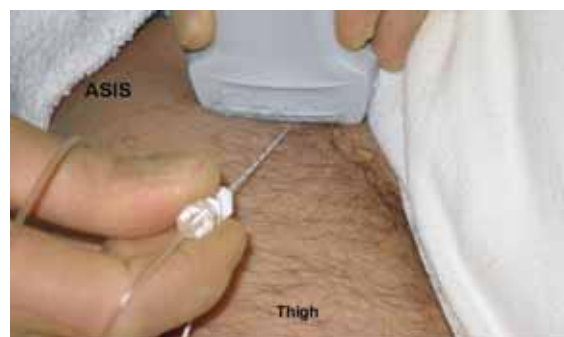
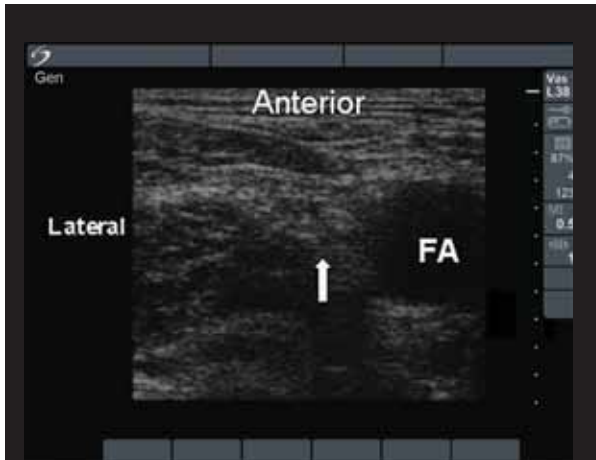


Figure 5. Needle insertion with the out-of-plane technique.

ASIS, anterior superior iliac spine



A



B

Figure 6. Anesthetizing the femoral nerve.

A. Femoral nerve before the injection of local anesthetic. **B.** Femoral nerve after the injection with surrounding “doughnut sign” of local anesthetic. The arrow indicates the femoral nerve. **FA,** femoral artery

- settings for pediatric patients and patients with little adipose tissue.
2. Image the femoral artery (anechoic, pulsatile circle) on the short axis.
3. Use color Doppler if required to help identify the femoral artery.
4. Image the femoral nerve just lateral to the femoral artery.
5. Key structures to identify along with the nerve include the iliacus muscle, psoas muscle, and fascia iliaca. The fascia iliaca, the key landmark, appears as a horizontal hyperechoic tissue plane found just anterior to the vessels and nerve (Figure 3).
6. An infra-inguinal short-axis view of the femoral nerve usually appears as a hyperechoic (bright) triangular structure with internal hypoechoic small circles.
7. Our preference is to insert the needle in-plane with the ultrasound beam in a lateral to medial direction (Figure 4).
8. An alternative approach would be to insert the needle in the middle of the transducer such that the needle is imaged on the short axis as it approaches the nerve (Figure 5).
9. Inject the local anesthetic.

CLINICAL PEARLS

- The primary objective of real-time ultrasound imaging for this block is to ensure that the needle and the spread of local anesthetic are located below the fascia iliaca and lateral to the femoral artery. Needle adjustments should be made (usually to advance) if local anesthetic is seen spreading superficial to this layer.
- While nerve stimulation (“twitch”) is an excellent physiologic test of needle proximity to the femoral nerve, our experience suggests that if the needle and spread of the local anesthetic are located below the fascia iliaca and lateral to the femoral artery, successful blocks result regardless of twitch status. Given that there is a known false-negative rate for all diagnostic devices (including nerve stimulation), demanding a specific motor response pattern despite correct needle location may result in an unnecessary increase in the number of needle passes.
- Rapid and profound blocks occur when the local anesthetic spreads circumferentially around the femoral nerve. This has been described as the “doughnut sign” (Figures 6A and 6B).
- Using this approach, we have reduced our volumes of injection by 30% to 50% in comparison with those of traditional approaches.
- When an out-of-plane technique is used, injecting a small amount of local anesthetic, saline, or D5 as the needle is advanced will help identify the needle tip. This is because fluid appears anechoic, serving as a contrast-like agent.
- Look for associated femoral artery pathology. An atherosclerotic plaque in the femoral artery

appears as a hyperechoic structure lying within the normally hypoechoic lumen. Often, there is a dark drop-out shadow posterior to the lumen because the calcium-filled plaque prevents ultrasound from penetrating the lumen. This coincidental finding does not change the block.

Femoral Nerve Block: Continuous Catheter Technique

Patient Position: Supine

Probe Location: Infra-inguinal

Frequency: High to intermediate, depending on body habitus

In-Plane/Out-of-Plane: Out-of-plane

Nerve Image: Triangular and hyperechoic, lateral to femoral artery

Needle Size: 50 to 100 mm

Local Volume: 10-mL bolus dose

Steps 1 through 6 are the same as for the single-injection femoral nerve block.

7. Insert the needle in the middle of the transducer (out-of-plane technique) and slightly angled toward the midline. The needle should be hooked up to extension tubing with the bolus dose ready to inject (Figure 5). The needle should be advanced and visualized crossing the ultrasound beam below the fascia iliaca and over the femoral nerve.
8. A bolus injection of 10 mL of either saline or local anesthetic is utilized to confirm that the needle tip is correctly located above the femoral nerve and below the fascia iliaca. This is the critical end point. The needle is in the correct location when the hypoechoic local anesthetic forces the fascia iliaca anteriorly toward the transducer and the femoral nerve posteriorly away from the transducer (Figure 6). Many practitioners may also choose to use nerve stimulation.
9. The transducer is then put aside if it is not being held in a stabilizing device (see *Clinical Pearls*).
10. The catheter is inserted and advanced 10 to 20 cm (Figure 7). The ultrasound image will demonstrate the catheter entering under the fascia. However, because the femoral nerve and catheter are being imaged on the short axis, you will not see the catheter traveling proximally.
11. If you choose to utilize a stimulating catheter, you may want to bolus with a dextrose solution to maintain the ability to use the nerve stimulator.

CLINICAL PEARLS

- Catheters advanced following confirmed correct needle location under the fascia iliaca (via the bolus injection) will be in one of 3 locations: 1) at the level of the lumbar plexus; 2) under the fascia iliaca over the psoas muscle; or 3) under the fascia iliaca over the iliacus muscle.¹ All locations should work to generate a femoral block. The likelihood of a continuous 3-in-1 blockade is highest with location 1.



Figure 7. Threading the femoral nerve catheter.

Note that the extension tubing has been disconnected following bolus injection.

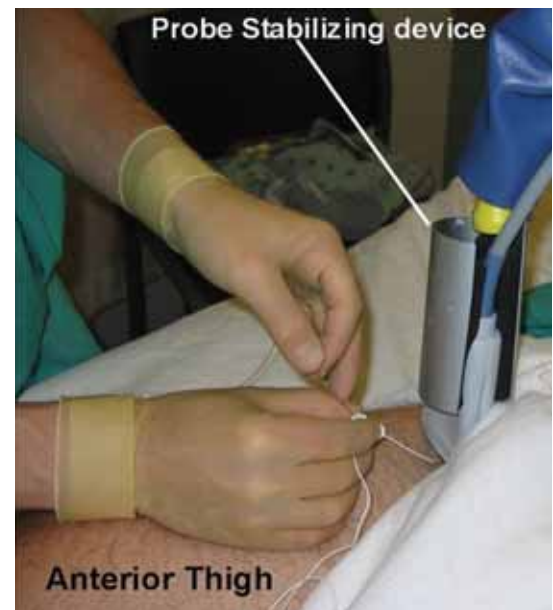


Figure 8. Insertion of the femoral catheter is facilitated by the use of a probe-stabilization device.



Figure 9. Probe positioning for subgluteal sciatic block.

The probe is placed at the subgluteal crease.

GMM, gluteus maximus muscle

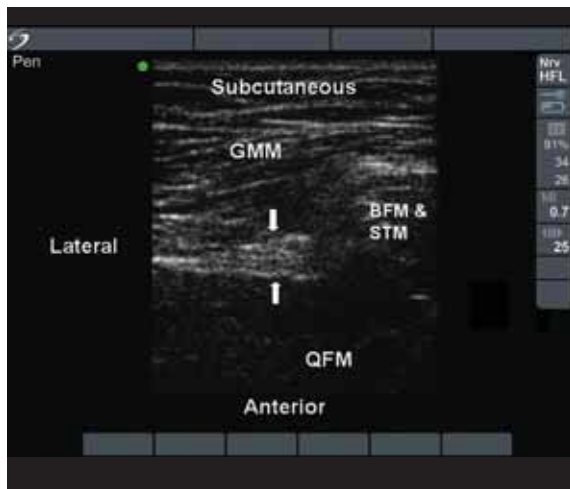


Figure 10. Ultrasound image for subgluteal sciatic block.

Arrows indicate the sciatic nerve.

BFM, biceps femoris muscle; **GMM**, gluteus maximus muscle; **QFM**, quadriceps femoris muscle; **STM**, semitendinosus muscle

- Because there are many steps in this technique (holding the transducer, inserting the needle, bolus injection, disconnecting extension tubing, stabilizing the needle, and threading the catheter), it can be challenging for one person to perform the procedure alone. It is for this reason that we prefer to use a transducer-stabilizing device. This is essentially a mechanical arm that fixes the transducer on the patient and allows the operator to dedicate both hands to the placement of the catheter (Figure 8).

Subgluteal Sciatic Block

Patient Position: Prone

Probe Location: Subgluteal crease

Frequency: Intermediate to low, depending on body habitus

In-Plane/Out-of-Plane: Either

Nerve Image: Triangular and hyperechoic, lateral to the biceps femoris muscle (BFM)-semitendinosus muscle (STM)

Needle Size: 50 to 100 mm

Local Volume: 20 to 30 mL

1. Ideally, the patient should be in the prone position. This block is performed at or just below the gluteal crease, just inferior to the ischial tuberosity.
2. Start by palpating the skin crease made by the gluteus maximus muscle. This large, ropelike muscle complex should be easily palpated. The complex comprises the BFM and the STM. These muscles originate from the ischial tuberosity.
3. Place the transducer in the subgluteal crease over the BFM-STM complex. Transducer specifications: lower-frequency 5- to 10-MHz linear array (Figure 9).
4. On the short axis, the BFM-STM muscle complex should appear as a hypoechoic structure with internal fascial components that appear hyperechoic. Lying just lateral to this muscle complex will be the sciatic nerve. The sciatic nerve appears as an oval or triangular hyperechoic structure (Figure 10).
5. Use either the in-plane technique (Figure 11) or the out-of-plane technique (Figure 12) to insert the block needle.
6. Nerve stimulation may be used, as in a traditional approach.
7. Local anesthetic is injected to spread circumferentially around the sciatic nerve.

CLINICAL PEARLS

- This is a more challenging block, given the general similarity of the ultrasound appearance of perineural structures and the lack of consistent vascular relationships.
- If the image is difficult to visualize, identify the sciatic nerve in the popliteal fossa and trace it back proximally to the subgluteal region.
- The sciatic nerve in this region is easier to image in obese patients because the adipose tissue serves as a contrast agent for the nerve. That is, adipose



Figure 11. In-plane technique for subgluteal sciatic block.

The needle is brought into plane from a lateral approach.
GMM, gluteus maximus muscle



Figure 12. Out-of-plane technique for subgluteal sciatic block.

GMM, gluteus maximus muscle



Figure 13. Patient positioning for the anterior approach to the sciatic nerve.

The leg is externally rotated at approximately 45 degrees with the hip and knee flexed.

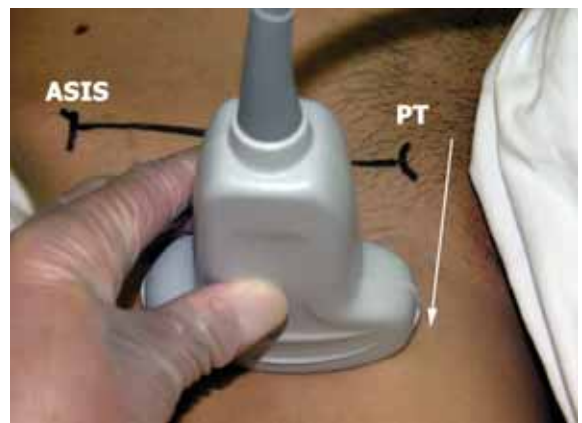


Figure 14. Probe placement for anterior approach to the sciatic nerve.

The probe is positioned approximately 8 cm distal to the inguinal crease. The arrow indicates the direction in which to insert the needle.

ASIS, anterior superior iliac spine; **PT**, pubic tubercle

tissue lining the sciatic nerve generates a nice echo interface in which the white nerve stands out in contrast to the darker fat.

- Transducer pressure on the skin often improves this image.
- We favor this block over the transgluteal approach because the nerve is located more superficially, which results in a better neural image and less discomfort with needle insertion.

Sciatic Nerve Block: Anterior Approach

Patient Position: Supine

Probe Location: Below the inguinal crease

Frequency: Intermediate to low, depending on body habitus

In-Plane/Out-of-Plane: In-plane

Nerve Image: Flat oval or triangular, hyperechoic

Needle Size: 100 to 150 mm

Local Volume: 20- to 30-mL bolus

1. Place the patient in the supine position with leg(s) externally rotated (Figure 13).
2. Place the transducer approximately 8 cm distal to the inguinal crease (Figure 14). Transducer specifications:



Figure 15. Ultrasound image of the anterior approach to the sciatic nerve.

The arrows indicate the sciatic nerve, which appears as a hyperechoic triangular structure.

AMM, adductor magnus muscle; **FA**, femoral artery; **FV**, femoral vein; **LT**, lesser trochanter

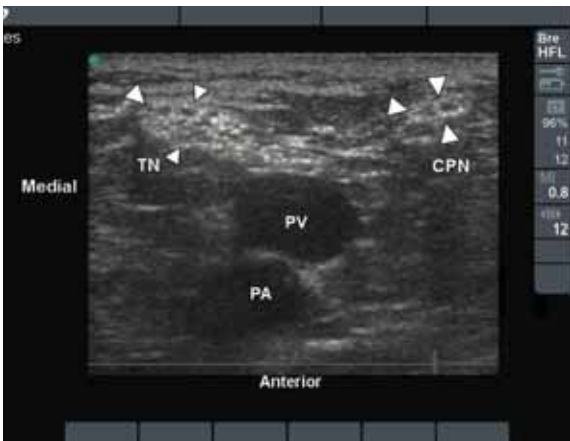


Figure 16. Ultrasound image of the popliteal fossa.

CPN, common peroneal nerve; **PA**, popliteal artery; **PV**, popliteal vein; **TN**, tibial nerve

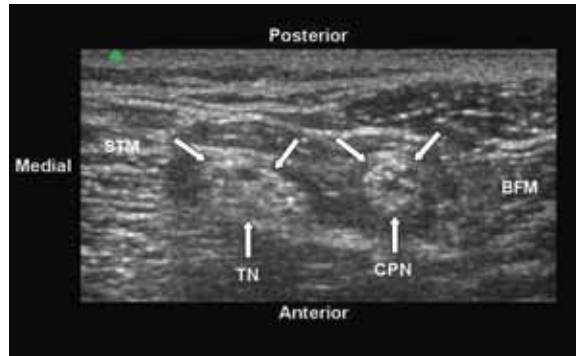


Figure 17. Ultrasound image of the common peroneal nerve and tibial nerve just distal to the division of the sciatic nerve, 5 cm proximal to the popliteal crease.

BFM, biceps femoris muscle; **CPN**, common peroneal nerve; **STM**, semitendinosus muscle; **TN**, tibial nerve

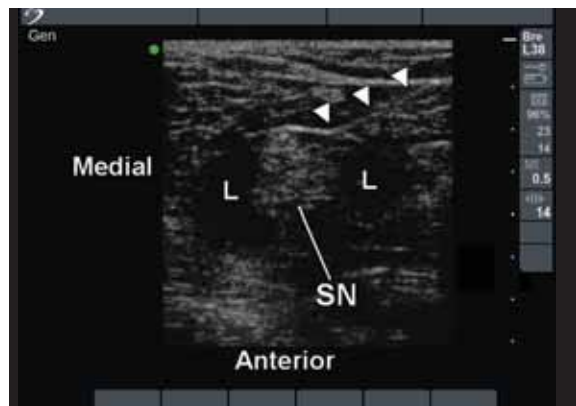


Figure 18. Image of a prone popliteal approach to the sciatic nerve during injection of local anesthetic.

The triangles indicate needle location.

L, local anesthetic; **SN**, sciatic nerve

variable resolution (2-5 MHz) convex or linear array. Image the femoral artery on the short axis.

3. Key landmark structures to help identify the nerve include the lesser trochanter and the adductor magnus muscle (Figure 15).
4. The sciatic nerve appears as a hyperechoic circle or triangle lying between the lesser trochanter and the ischial tuberosity.
5. Insert a 100- to 150-mm needle from the medial aspect of the probe and via the in-plane technique.
6. Inject 20 to 30 mL of local anesthetic so that it surrounds the nerve circumferentially.

CLINICAL PEARLS

- The anterior approach can be associated with significant pain during placement of the block, possibly requiring more generous sedation.
- With this approach, both sciatic and femoral blocks can be placed with the patient in the same position. It has a great advantage when the patient is immobilized or injured.
- External rotation of the leg will help visualize the sciatic nerve.
- This block, coupled with a femoral 3-in-1 block or a lumbar plexus block, will generate adequate tourniquet coverage.

Popliteal Block: Prone Positioning Technique

Patient Position: Prone

Probe Location: Variable distance above the popliteal crease

Frequency: Intermediate to low, depending on body habitus

In-Plane/Out-of-Plane: Either

Nerve Image: Hyperechoic circle with internal hypoechoic dots

Needle Size: 50 to 100 mm

Local Volume: 20 to 30 mL

1. Start by placing the transducer in the popliteal fossa at the level of the popliteal crease.
2. Image the popliteal artery on the short axis at this level by using a linear transducer with a variable intermediate to low frequency (8-12 MHz), depending on body habitus.
3. The tibial nerve will lie just posterior and medial to the popliteal artery. It appears as a hyperechoic oval or circular structure with internal hypoechoic small circles. The common peroneal nerve will appear as a hyperechoic circle or oval just lateral to the popliteal artery (Figure 16).
4. Move the transducer proximally until you see the common peroneal nerve joining the tibial nerve (Figure 17). The common peroneal nerve tends to be smaller than the tibial nerve. As the transducer is moved proximally, the common peroneal nerve will travel from the lateral aspect of the screen toward the middle of the screen.



Figure 19. Prone positioning with the in-plane technique for sciatic nerve block.

Final probe position identifies the site where the tibial and common peroneal nerves converge.

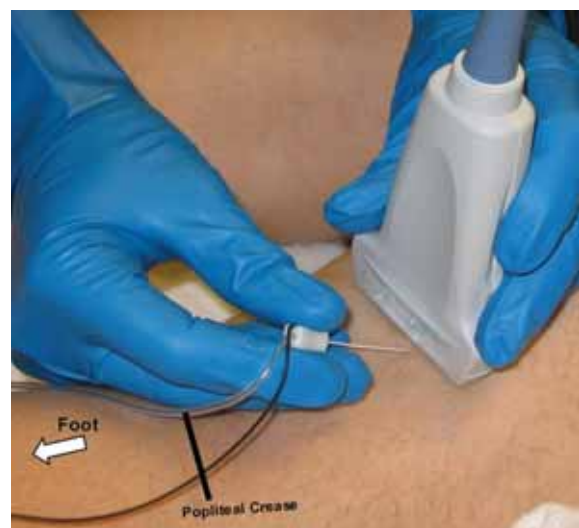


Figure 20. Prone positioning with the out-of-plane technique for sciatic nerve block.



Figure 21. Probe placement for imaging the sciatic nerve on the long axis in the popliteal fossa with the patient in the prone position.

The arrow indicates the direction in which to thread a continuous nerve catheter.

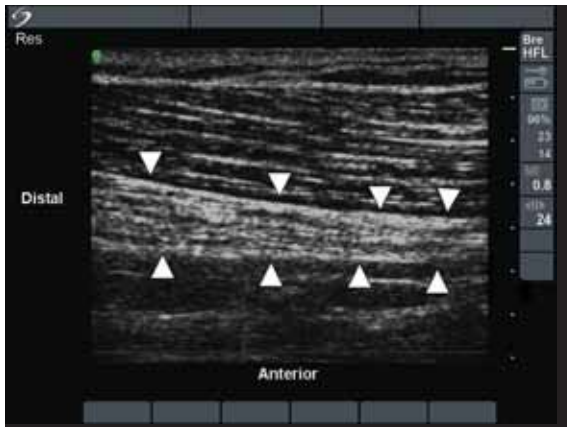


Figure 22. The sciatic nerve imaged on the long axis in the popliteal fossa.

Triangles demarcate the sciatic nerve. Note the internal neural fascicles of the sciatic nerve.

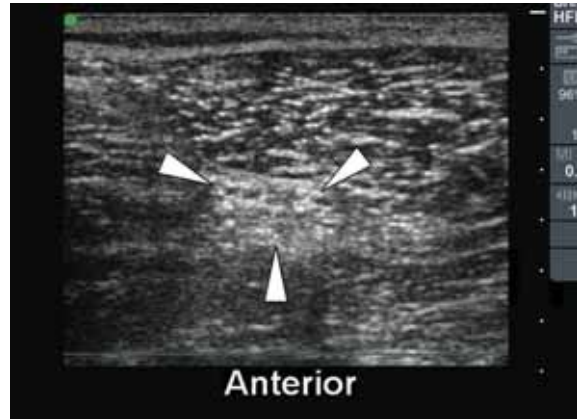


Figure 23. The sciatic nerve in a patient with minimal adipose tissue.

Note the difficulty in distinguishing the nerve from the surrounding tissue. The triangles indicate the location of the sciatic nerve. Note the difference between this image and the image in Figure 22. These images are from the same patient. There is more adipose tissue distally around the tibial and common peroneal nerves.

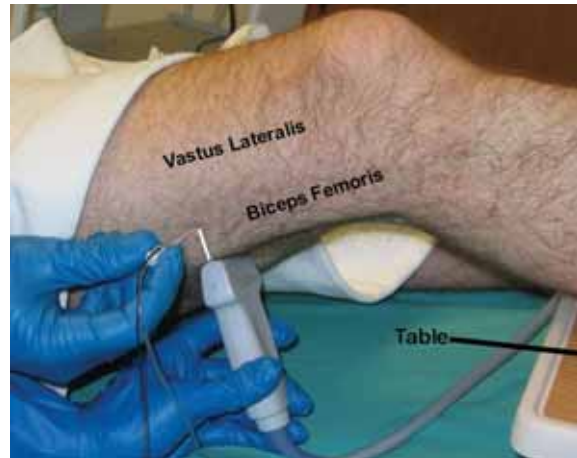


Figure 24. Patient positioning for the supine popliteal approach to the sciatic nerve.

The leg rests on an adjustable-height table. Note that the depth of needle insertion has been obtained from the ultrasound image (the measured distance of the white line) to identify the site for needle insertion. When this site is used, the needle will be inserted completely parallel to the ultrasound beam/probe.

- The target for the nerve block is the site where the common peroneal and tibial nerves join (Figure 18).
- The needle can be inserted with either the in-plane or out-of-plane technique (Figures 19 and 20). Once again, the benefit of the in-plane technique is that the needle can be visualized in its full course. When the in-plane technique is used, the needle is inserted in a lateral-to-medial direction. The end point of the injection should be the circumferential spread of local anesthetic around the sciatic nerve (Figure 18).

Continuous Popliteal Catheter

Patient Position: Prone

Probe Location: Variable distance above popliteal crease

Frequency: Intermediate to low, depending on body habitus

In-Plane/Out-of-Plane: Either

Nerve Image: Short axis, hyperechoic circle; long axis, hyperechoic tube

Needle Size: 50 to 100 mm

Local Volume: 10 mL for the bolus injection

For catheter insertion, steps 1 through 5 are the same as those for the popliteal block.

- The stimulating needle is inserted via the out-of-plane technique. Following an appropriate motor response, 10 mL of local anesthetic is injected through the needle. The catheter is then threaded 3 to 5 cm (Figure 20).
- An alternative approach is to visualize the sciatic nerve on the long axis (Figures 21 and 22) and insert the needle via the in-plane technique in a distal-to-proximal direction. This technique makes it possible to visualize the catheter traveling perineurally and cephalad.

CLINICAL PEARLS

- Adipose tissue in the popliteal fossa makes the nerves easier to visualize. This is because the acoustic impedance of adipose tissue differs from the common peroneal, tibial, and sciatic nerves. Fat appears dark or hypoechoic, whereas the nerves are bright or hyperechoic.
- It is because of this difference between fat and nerve tissue that the nerves are easier to image at the level of the popliteal crease. Therefore, if the sciatic nerve is too difficult to image more proximally, where there is less fat (Figure 23), then simply inject local anesthetic individually around the common peroneal nerve and tibial nerve more distally in the popliteal fossa. They are extremely easy to image at this location.
- The image of the sciatic nerve often can be greatly improved by pushing the transducer harder onto the skin (anteriorly) and tilting the handle of the transducer toward the patient's feet.

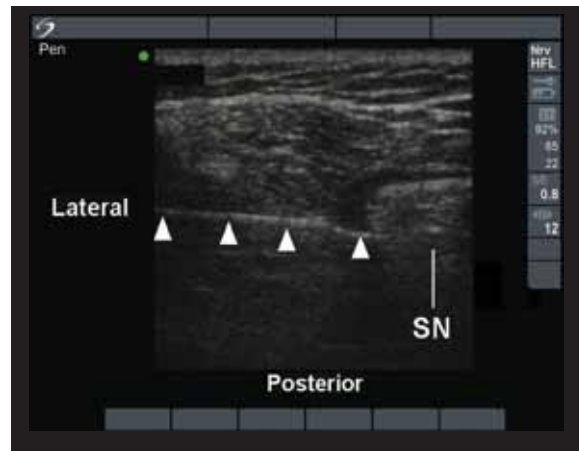


Figure 25. Ultrasound image of the supine popliteal approach to the sciatic nerve.

Note that the needle demarcated by the triangles is highly hyperechoic because it is parallel to the ultrasound probe. Hypoechoic local anesthetic is also visualized around the sciatic nerve.

SN, sciatic nerve

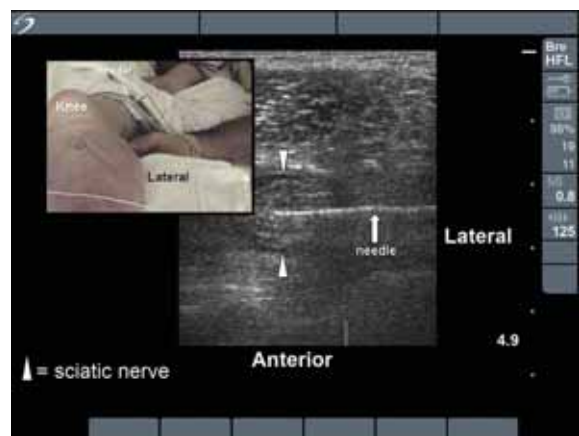


Figure 26. Intraneuronal injection aborted: short-axis view of the sciatic nerve in the popliteal fossa.

The needle is being inserted from a lateral perspective with the patient supine. The needle was found to be intraneuronal. The patient experienced no paresthesia or pain with needle insertion. In addition, the test injection of 0.5 mL demonstrated no resistance. The needle was safely withdrawn from the nerve.



Figure 27. Image of the probe and needle position for saphenous nerve block.



Figure 28. Ultrasound image of the saphenous nerve and vein.

Arrows indicate the location of the saphenous nerve.

SAPH, saphenous nerve; **V**, saphenous vein



Figure 29. Ultrasound image of a saphenous nerve block injection with color flow Doppler for monitoring.

Local anesthetic can be seen spreading around the vein as a hypoechoic region.

Popliteal Block: Supine Positioning Technique

Patient Position: Supine with leg on adjustable table

Probe Location: Behind the leg and above the popliteal crease

Frequency: Intermediate to low, depending on body habitus

In-Plane/Out-of-Plane: In-plane

Nerve Image: Hyperechoic circle with internal hypoechoic dots

Needle Size: 100 mm

Local Volume: 20 to 30 mL

1. The patient's leg is placed on an adjustable table to expose an area behind the knee that will easily accommodate a transducer (Figure 24).
2. The same transducer is used as for the prone position.
3. The transducer is placed behind the knee and the imaging objectives are the same as for the prone approach.
4. Once the sciatic nerve is identified, the software on the ultrasound machine is used to measure the distance from the skin to the nerve. This distance is used to define the site of the needle insertion.
5. A 100-mm needle should be inserted parallel to the ultrasound beam (Figure 25).
6. The goal of the injection should be the circumferential spread of local anesthetic around the sciatic nerve.

CLINICAL PEARLS

- Because the needle is inserted perpendicular to the ultrasound beam, it appears very bright, allowing the operator to direct the needle to the target with the utmost accuracy. An example of the importance of this accuracy is the ability to detect the location of the needle within the nerve (Figure 26).
- Sometimes the distance measured in step 4 makes it necessary for the needle to penetrate the semitendinosus muscle. This can be somewhat uncomfortable for the patient, and more I.V. analgesia may be required.
- If the operator commonly performs the popliteal block with the patient in the prone position, then the ultrasound image will appear “backward” on the screen. That is, hand movement that would normally (in the prone position) drive the needle in a more anterior fashion now will direct the needle more posteriorly. Knowledge of this difference can help the operator anticipate the correct hand movement before the block. In addition, an image orientation control on the ultrasound system changes the image orientation to virtually create a prone position scenario.

Saphenous Nerve Block

Patient Position: Supine

Probe Location: Medial aspect of lower leg and below the knee

Frequency: Highest frequency

In-Plane/Out-of-Plane: In-plane

Nerve Image: Hyperechoic circle lateral to the saphenous vein

Needle Size: 50 mm

Local Volume: 5 mL

1. The saphenous nerve is usually targeted proximal to the midtibial level; however, any site along the leg distal to the knee joint should suffice (Figure 27).
2. A high-frequency, small-footprint linear array transducer is preferred.
3. The block is based on the intimate association of the saphenous nerve with the saphenous vein. The goal is to visualize these structures on the short axis (Figure 28).
4. The nerve does not have to be visualized for a successful block.
5. When visualized, the nerve appears as a hyperechoic circle, usually smaller than the vein. In true anatomic position, the nerve should be just lateral to the saphenous vein. The vein appears as a circular anechoic structure (Figure 28).
6. The needle is inserted with the in-plane technique.
7. An induced paresthesia or a stimulated paresthesia can be sought.
8. Alternatively, local anesthetic can be injected circumferentially around the vein.
9. Only 5 mL is needed.

CLINICAL PEARLS

- Because this block relies on the close relationship of the saphenous nerve and vein, if the patient does not have a saphenous vein (ie, after coronary artery bypass graft surgery), then the ultrasound technique can be difficult and a conventional approach may be more appropriate.
- Placing a venous tourniquet proximal to the site of the block will help identify the saphenous vein by making it increase in size.
- The saphenous nerve is the terminal branch of the femoral nerve and supplies sensation to the medial aspect of the leg and ankle. A saphenous nerve block is often coupled with a popliteal block for foot and ankle surgery.
- Very light transducer pressure should be applied because small degrees of pressure can compress the vein and make it difficult to find.
- We often leave the Doppler color on during the injection. This is because as the injection commences, the vein will collapse and become lost to the sight of the operator. By keeping the color flow on the vein, the spread of local anesthetic around this structure can be monitored continuously (Figure 29).



Figure 30. Probe placement for tibial nerve block at the ankle.

Ankle Block

TIBIAL

Patient Position: Supine

Probe Location: Above the medial malleolus, medial aspect of the leg

Frequency: Highest frequency

In-Plane/Out-of-Plane: In-plane

Nerve Image: Short axis, hyperechoic circle, posterior to the tibial artery

Needle Size: 50 mm

Local Volume: 5 mL

DEEP PERONEAL

Patient Position: Supine

Probe Location: Above the medial malleolus, anterior aspect of the leg

Frequency: Highest frequency

In-Plane/Out-of-Plane: In-plane

Nerve Image: Short axis, hyperechoic circle, lateral to the dorsalis pedis artery (DPA)

Needle Size: 50 mm

Local Volume: 5 mL

1. There are 4 distal branches of the sciatic nerve. Of these, two are easily visible with ultrasound: the tibial nerve and the deep peroneal nerve.
2. For this block, a small-footprint, high-frequency linear array transducer is desirable. We utilize a hockey stick-shaped transducer, scanning at 15 MHz.
3. For the tibial nerve, we place the transducer 1 to 2 cm above the medial malleolus (Figure 30). Image the posterior tibial artery on the short axis. It appears as a hypoechoic circle lying approximately

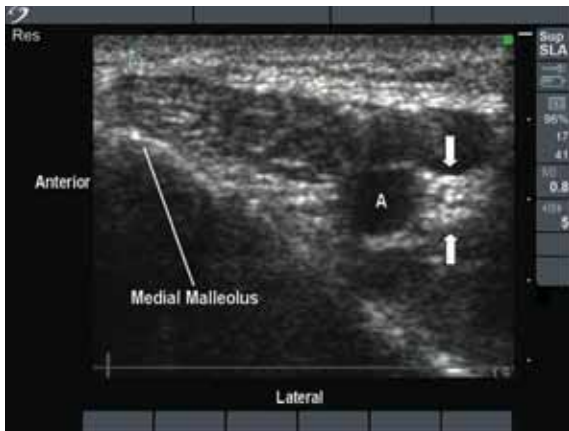


Figure 31. Ultrasound image of the tibial nerve and surrounding structures.

Arrows indicate the position of the tibial nerve.
A, artery

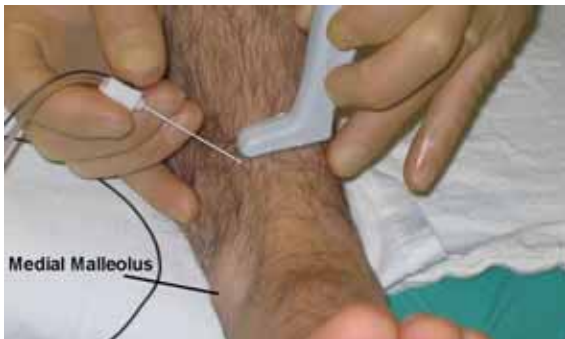


Figure 32. Probe placement for deep peroneal nerve block at the level of the ankle.



Figure 33. Ultrasound image of the deep peroneal nerve and surrounding structures.

Arrows indicate the location of the nerve.
A, artery

- 0.5 cm medial and posterior to the tibia (Figure 31).
4. The tibial nerve appears as a hyperechoic circle lying just posterior to the posterior tibial artery (Figure 31).
5. Insert a 50-mm needle from the posterior aspect of the transducer with the in-plane technique.
6. A 5-mL injection of a plain local anesthetic should generate a sufficient block.
7. For the deep peroneal nerve, the same transducer is placed on the skin 1 to 2 cm above the superior border of the medial malleolus (Figure 32). During imaging on the short axis, the DPA is found as a small hypoechoic and pulsatile structure. Color Doppler may be used to help identify this artery.
8. The nerve appears as a small, hyperechoic circular structure lying just lateral to the artery (Figure 33).
9. Insert a 50-mm needle from either aspect of the transducer with the in-plane technique.

CLINICAL PEARLS

- If the saphenous nerve is critical for the surgery, we perform this block as described above.
- We perform the block of the superficial peroneal and sural nerves via traditional and non-ultrasound techniques.

Reference

1. Capdevila X, Biboulet P, Morau D, et al. Continuous three-in-one block for postoperative pain after lower limb orthopedic surgery: where do the catheters go? *Anesth Analg.* 2002;94:101-106.