# A COMPREHENSIVE REVIEW OF LOWER EXTREMITY PERIPHERAL NERVE BLOCKS

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Unlike the upper extremity, the entire lower extremity cannot be anesthetized using a single injection. Because of the nerves anatomical locations, injections are generally deeper than those required for upper extremity blocks (see key phrase 1). In the past decade, there has been an increased interest in performing lower extremity PNB's because of the potential complications associated with centroneuraxial blockade, i.e. increased risk of epidural hematoma with new anti-thromboembolic prophylaxis regimens, and transient neurologic symptoms associated with spinal anesthesia. Additionally, evidence that improved rehabilitation outcome may be associated with continuous lower extremity PNB's has stimulated even more interest (see key phrase 2). This review focuses on techniques and applications of lower extremity nerve blocks, as well as potential complications and ways to avoid them. When a nerve stimulator is used in block descriptions, a frequency of 2 Hz, and a pulse width of 100 microseconds is assumed. *The Journal of NYSORA 2009; 12: 11-22*

## LOWER EXTREMITY NERVE BLOCK TECHNIQUES

### LUMBAR PLEXUS (PSOAS COMPARTMENT) BLOCK

The lumbar plexus block (LPB) is a deep block that is approached posteriorly. It can be performed either as a single injection or as a continuous technique with catheter placement for prolonged analgesia. The lumbar plexus consists of six nerves on each side (iliohypogastric, ilioinguinal, genitofemoral, lateral femoral cutaneous, femoral, obturator), the first of which emerges between the first and second lumbar vertebrae, and the last of which exits between the last lumbar vertebra and the base of the sacrum. A LPB can provide anesthesia and/or analgesia to the entire distribution of the lumbar plexus, including the anterolateral and medial thigh, the knee, and the saphenous nerve below the knee. When combined with a sciatic nerve block, anesthesia of almost the entire lower extremity can be achieved (see key phrase 3).[1,2] The LPB is used for analgesia following total hip arthroplasty (THA)[3], total knee arthroplasty (TKA)[2] and in the treatment of chronic hip pain.[4]

At the L4-L5 level, the following anatomic structures are encountered from posterior to anterior: posterior lumbar fascia, paraspinous muscles, anterior lumbar fascia, quadratus lumborum, and the psoas muscle. The psoas muscle is located inside a fascial sheath called the psoas compartment. The common iliac artery and vein lie anterior to the psoas muscle. The most consistent approach to block the entire lumbar plexus with a single injection is via the posterior approach, since the lumbar plexus travels through the body of the psoas muscle. The LPB provides consistent anesthesia in the distributions of the femoral, lateral femoral cutaneous, and obturator nerves.

*a. Positioning*

The patient should be placed in the lateral decubitus position, operative side up, with a slight forward tilt. The foot on the side to be blocked should be positioned over the dependent leg so that twitches of the patella or contractions of the quadriceps muscle can be easily seen.

### b. Sedation

Because this is a deep block traversing several muscle layers, sedation prior to the block is essential for patient comfort during needle penetration. A combination of midazolam and fentanyl or alfentanil titrated to provide patient comfort provides adequate sedation and pain relief during the performance of this block.

### c. Surface Landmarks

There are only two surface anatomic landmarks that are important in determining the insertion point for the needle: the iliac crest, and the midline spinous processes, Figure 1.[5] The top of the iliac crest correlates with the body of the L4 vertebral body or the L4-L5 interspace in most patients. A line drawn 4 cm lateral to the intersection of the iliac crest and the midline spinous processes marks the needle insertion site.



**Figure 1.** Lumbar plexus block Landmarks: 1. Midline, 2. Illiac crest, 3. Needle insertion site ("x") is labeled 3-4 cm lateral to the midline.

### d. Technique

A nerve stimulator is set at an initial current of 1.5 mA. The needle is advanced at an angle perpendicular to all skin planes, Figure 2. As the needle is advanced, local twitches of the paravertebral muscles are first obtained. As the needle is further advanced, the transverse process may be encountered. Contact with the transverse process

is not routinely sought, however when present, it provides a consistent landmark to avoid excessive needle penetration during LPB.[6] The distance from the skin to the lumbar plexus ranges from 6.1-10.1 cm in men and 5.7 – 9.3cm in women.[7] This distance correlates with gender and body mass index (BMI). Once the transverse process is contacted, the needle is "walked off" either superiorly or inferiorly approximately 2 cm deeper. The distance from the transverse process to the lumbar plexus is typically less than 2 cm, independent of BMI or gender. Contraction of the quadriceps muscle is obtained (usually at a depth of 6 to 8 cm). The nerve stimulator current is reduced to produce stimulation of the quadriceps muscle between 0.5 to 1.0 mA.
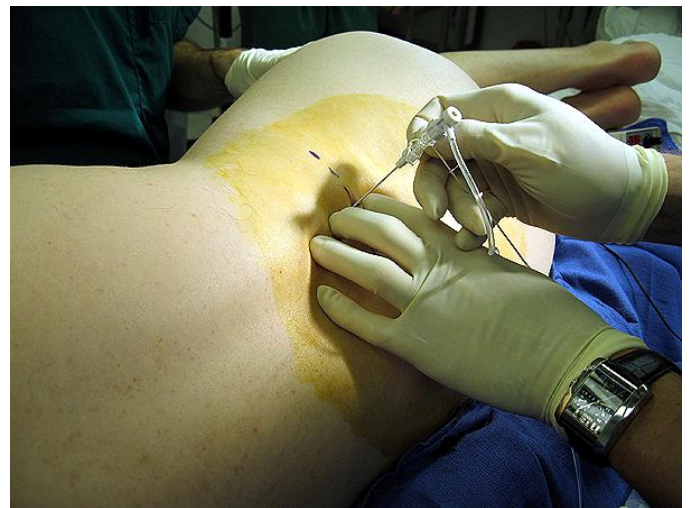


**Figure 2.** Needle is inserted perpendicular to the skin plane until it either twitches of the quadriceps muscle are elicited or the transverse process is contacted. If the transverse process is contacted first, the needle is redirected cephalad or caudad and advanced another 2-3 cm to localize the lumbar plexus.

The depth of needle insertion to localize the lumbar plexus is emphasized because too deep needle placement can result in complications such as renal hematoma, pneumocele, total spinal anesthesia, and unintended intraabdominal or intervertebral disk placement of a peripheral nerve catheter.[8-10] Epidural spread of local anesthetic is relatively common, occurring in 9-16% of adult patients.[11] In children, one study reported a greater than 90% incidence of epidural spread when using the original landmarks of Chayen compared to no epidural spread when using the landmarks as modified by Winnie.[12] The epidural spread is attributed to diffusion of the local anesthetic into the epidural space with too medial needle placement and when large volumes of local anesthetic

(greater than 20 ml) are used. In most cases of epidural spread, lumbar plexus blockade significantly outlasts the contralateral epidural block. Vigilance must be maintained during the management of this block due to the risk of systemic toxicity and total spinal anesthesia.[10,11]

## CONTINUOUS LUMBAR PLEXUS (PSOAS COMPARTMENT) BLOCK

Continuous LPB techniques are used for analgesia following a variety of operations including THA, TKA, open reduction and internal fixation (ORIF) of acetabular fractures, ORIF of femur fractures and anterior cruciate ligament (ACL) reconstruction.[13,14] Interest in this block developed as practitioners sought alternatives to central neuraxial techniques that could provide consistent analgesia following hip, femur and knee surgery. One advantage of LPB is the decreased likelihood of catheter dislodgement because of the large muscle mass traversed when performing the block. The catheter is typically placed at a depth of 8-10 cm past the needle tip. Continuous infusion of local anesthetic should be started after an initial bolus is given through the catheter. Care must be taken to watch for local anesthetic toxicity, intravenous injection, and the sympathetic blockade that may accompany an LPB. Overthreading of the catheter, or directing the needle bevel towards the vertebral column (medially) should be avoided because it could potentially increase the chance of epidural spread and total spinal.

## FEMORAL NERVE BLOCK

The femoral nerve block is a basic nerve block technique that is relatively easy to master, carrying a low risk of complications and having significant clinical applications for surgical anesthesia and postoperative analgesia.[5] Indications for single injection femoral nerve block (FNB) include anesthesia for knee arthroscopy in combination with intraarticular local anesthesia; anesthesia and analgesia for femoral shaft fractures, ACL reconstruction, and total knee reconstruction in multimodal regimens.[15-20]

The femoral nerve is the largest branch of the lumbar plexus. It arises from the second, third, and fourth lumbar nerves, descends through the fibers of the psoas muscle, eventually emerging underneath the inguinal ligament into the thigh where it divides into anterior and posterior divisions. At the femoral crease, the nerve is covered by the fascia iliaca and separated from the

**Figure 3.** Femoral nerve block landmarks: 1. Femoral crease, 2. Femoral artery, 3. Needle insertion site just lateral to the femoral artery.

femoral artery and vein by a portion of the psoas muscle and the ligamentum iliopectineus. This physical separation of the nerve from the vascular fascia prevents spread of local anesthetic when performing a "blind paravascular" technique to anesthetize the nerve. In a study comparing four needle insertion sites, insertion of the needle just lateral to the femoral pulse at the level of the femoral crease yielded the highest frequency of needle-femoral nerve contacts.[21] Lateral circumflex femoral artery (LFCA), a small branch of the femoral artery, and other large blood vessels are often present in this area. Careful aspiration to rule out intravascular needle placement is of paramount importance during peripheral nerve block injection.

*a. Positioning*

The patient is positioned supine with both legs extended. In obese patients, placing a pillow underneath the hips may facilitate palpation of the femoral artery and block performance.

*b. Sedation*

The femoral nerve is fairly superficial. Large doses of sedatives/narcotics are not usually necessary. Nonetheless, sedation should be guided by patient comfort.

*c. Landmarks/Technique*

The only anatomic landmarks necessary for the femoral nerve block are the femoral crease and the femoral artery pulse, Figure 3. The needle insertion site is immediately lateral to the femoral artery, the needle is introduced in the sagittal, slightly cephalad plane. Stimulation of the femoral nerve is indicated by patellar movement as the quadriceps muscle contracts.

Commonly, the anterior division of the femoral nerve (which innervates the sartorius muscle) will be identified first.[21] Stimulation of this branch leads to contraction of the sartorius muscle on the medial aspect of the thigh and should not be accepted, as the articular and muscular branches arise from the posterior division of the femoral nerve. When the sartorius muscle twitch occurs, the needle is simply redirected laterally (without withdrawal) and advanced several millimeters deeper until twitches of the patella are seen.

*d. Ultrasound Guided Technique*

Because of its relatively superficial location when compared to the lumbar plexus, the femoral nerve is usually easily visualized using ultrasound (10- to 15- MHz), and thus ultrasound guided femoral nerve block is easy to perform. Ultrasound guided femoral nerve block has been shown to improve onset time, quality of block, and decrease the incidence of vascular puncture when compared to a nerve stimulator technique.[22] Furthermore, it has also been shown that successful femoral nerve block using ultrasound can be performed with less local anesthetic compared to a nerve stimulator technique. When placing the probe in the transverse axial plain, the femoral nerve is identified just lateral to the femoral artery (Figures 4 and 5). The needle is inserted lateral to the ultrasound probe, with the needle in the plane of the ultrasound beam, facilitating needle tip visualization.

### CONTINUOUS FEMORAL NERVE BLOCK

Continuous FNB has been shown to improve surgical outcome following major knee and vascular surgery of the lower extremity compared to intravenous narcotic therapy or continuous intraarticular infusions of analgesics.[23,24] Two prospective randomized studies compared three different modes of analgesia following TKA. Improvement in perioperative rehabilitation scores and a decreased duration of stay in a rehabilitation center was seen with continuous FNB and epidural analgesia compared to intravenous narcotic therapy (see key phrase

4). Continuous FNB was shown to have equivalent analgesia with fewer side effects than epidural analgesia.[23,25] However, not all investigators have been able to demonstrate these improvements in outcome with continuous FNB after TKA.[26] The accuracy of catheter placement may play a role in these conflicting findings. In one study, the accuracy of final catheter placement correlated well with the quality of analgesia as measured by VAS scores following proximal lower limb surgery.[27]
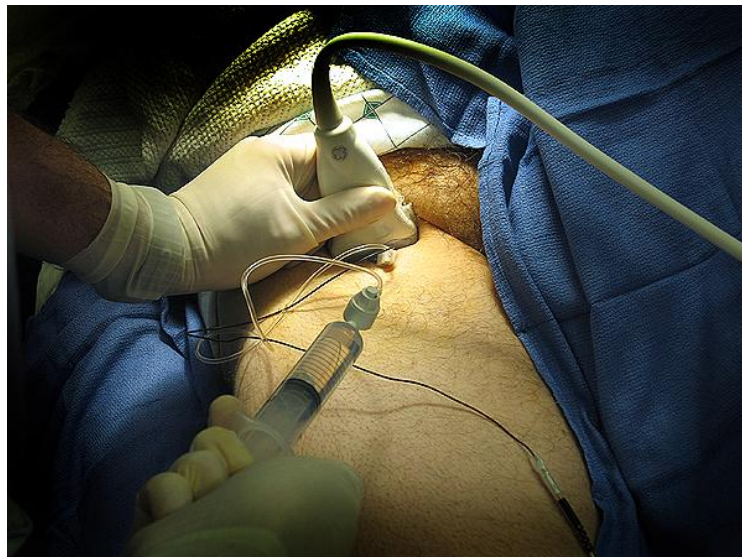


**Figure 4.** Femoral nerve block – ultrasound assisted. Shown are the proper position of the ultrasound probe, needle insertion and injection of the local anesthetic.

The continuous femoral nerve block technique is similar to the single injection procedure. Because of the larger size of the stimulating needle (i.e. 17 or 18 gauge), additional sedation may be necessary for selected patients. A sterile preparation and adherence to strict sterile precautions are important as the catheter will be left in place for extended periods of time.

*Technique with stimulating catheter:*

After sterile preparation and draping, and local anesthetic infiltration, the stimulating needle is advanced at a 45º to 60º angle. After a quadriceps muscle twitch is obtained at a 0.5 mA current, the stylette is removed from the needle and the stimulating catheter is then advanced through the needle, Figure 6. The nerve stimulator is connected to the catheter, with the goal being to elicit the quadriceps muscle response at 0.5 mA to 1.0 mA current (for postoperative analgesia). The internal wire is removed from the catheter followed by careful removal of the

stimulating needle. The catheter is then secured with a sterile clear dressing. Final catheter position can be confirmed again with the nerve stimulator, and local anesthetic can then be injected through the catheter.
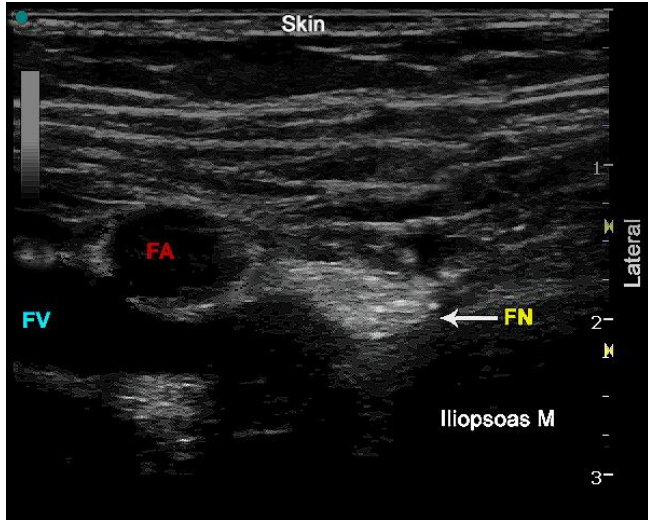


**Figure 5.** Ultrasonographic anatomy of the femoral triangle at the level of the femoral crease. Note that the nerve (FN) is lateral to the femoral arteryt (FA), and femoral vein (FV).



**Figure 6.** Femoral nerve block – insertion of the catheter.

### SCIATIC NERVE BLOCKS

The sciatic nerve is formed from the L4 through S3 nerve roots. It is the largest nerve in the body, measuring nearly 2 cm in width. The sciatic nerve innervates the posterior thigh and almost the entire leg below the knee with the exception of the medial aspect that is innervated by the saphenous nerve. When combined with a lumbar plexus block, anesthesia of almost the entire leg is obtained. Depending on the surgical procedure, the sciatic

nerve can be blocked at the level of the gluteus maximus[28,29], subgluteal level[30-32], the politeal fossa[33-35], or at the ankle as terminal branches[36]. Table 1 lists general guidelines for nerve block at various levels along the course of the sciatic nerve (see key phrase 5).

### 1. Sciatic block: Posterior (trans-gluteal) approach

Gaston Labat first described the approach to the SNB (sciatic nerve block), now referred to as the Classic Approach of Labat, at the beginning of the 20th century. This approach is based on the bony relationship of the posterior superior iliac spine (PSIS) and the greater trochanter with the patient positioned in a modified Sims position. Winnie was the first to modify the original description by adding another landmark, the sacral hiatus, to more precisely account for varying body habitus.[29] Raj later described a supine, subgluteal approach to the sciatic nerve in the flexed hip position initiating the block at the midpoint between the greater trochanter of the femur and the ischial tuberosity. The positioning of the patient was thought to be advantageous compared to the classic approach by Labat "thinning the gluteus maximus muscles, making the sciatic nerve more superficial."[37] However, identifying these bony landmarks in very obese patients maybe challenging. Maintaining the position requires additional personnel to assist the patient. In our practice, a lateral transgluteal approach is most commonly used, because of ease of performance and a high success rate when properly performed.

#### a. Positioning

The patient is placed in the lateral decubitus position tilted slightly forward, with the hip flexed. The foot on the side to be blocked should be positioned over the dependent leg so that twitches of the foot or toes can be easily observed.

| Table 1: Nerve Block Guidelines of the Sciatic Nerve | |
| --- | --- |
| Ankle block | Surgery on the distal third of the foot |
| Popliteal block | Surgery on the lower leg below the knee (without thigh tourniquet) |
| Gluteal sciatic block | Surgery on the knee, calf, Achilles tendon, ankle and foot with or without thigh tourniquet |

*b. Sedation*

This is a deep block requiring the stimulating needle to traverse a thick layer of muscle, therefore, it can be uncomfortable to patients. A combination of midazolam and a short-acting narcotic is usually sufficient for patient comfort. Typically, 2 – 4 mg of midazolam with 500-1000mcg of alfentanil allows the procedure to be performed with excellent patient tolerance.

*c. Landmarks*

Landmarks for the posterior approach to a sciatic block are easily identified in most patients. They include: (1) the greater trochanter, (2) posterior superior iliac spine (PSIS), and the needle insertion point 4 cm distal to the midpoint between landmarks 1 and 2 (Figure 7). A line between the greater trochanter and the PSIS is drawn and divided in half. From that point, another line extending perpendicularly 4 cm caudad is drawn. The end of this line is marked as the needle insertion site.
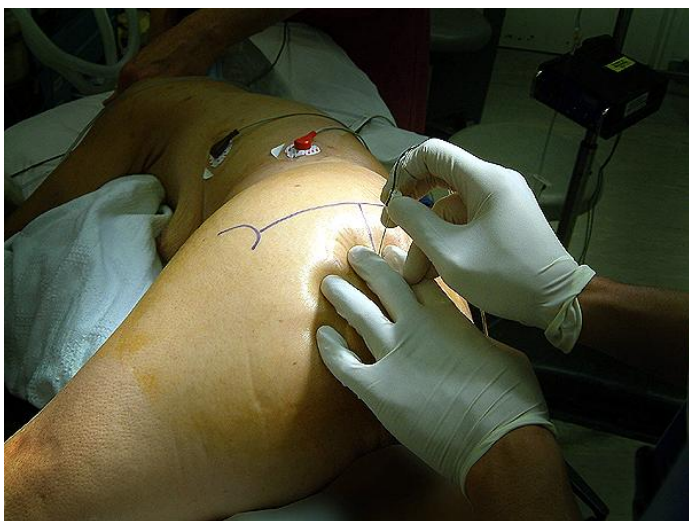


**Figure 7.** Sciatic nerve block. The landmarks include the greater trochanter (GT) and posterior superior iliac spine (PSIS). The line connecting the two is divided in half and a perpendicular line passing through the midpoint between the greater trochanter and is extended 4 cm caudad. The needle is inserted in a perpendicular fashion.

*d. Technique*

After positioning and sedation, local anesthetic is infiltrated subcutaneously at the determined needle insertion site. The fingers of the palpating hand should be firmly pressed on the gluteus muscles to decrease the skin-nerve distance, Figure 7. The palpating hand should not be moved during the entire procedure as even small

movements of the palpating hand can change the position of the needle insertion site due to the highly movable skin and soft tissues in the gluteal region. The nerve stimulator is initially set to deliver 1.5 mA current to allow detection of the twitches of the gluteal muscles and stimulation of the sciatic nerve. As the needle is advanced, twitches of the gluteal muscles are usually observed first indicating the shallow position of the stimulating needle. As the needle is advanced, the gluteal twitches disappear, and brisk response of the sciatic nerve is observed (hamstring, calf, foot, or toe twitches). The stimulating current is gradually reduced until twitches are still seen or felt at 0.2 to 0.5 mA, typically at a depth of 5 to 8 cm. At this level, twitches of the hamstring are acceptable because the separation of the neuronal branches to the hamstring muscle occur below this level.

## 2. Sciatic Block: Anterior Approach

The anterior approach to the sciatic nerve has the appeal of supine positioning and one skin prep when combined with a femoral nerve block. However, its clinical utility has been limited by its complexity, patient discomfort, and lower success rate. The sciatic nerve is blocked more distally leading to sparing/incomplete block of the hamstring muscles. A higher level of skill is required to achieve reliable anesthesia. In separate studies, several authors have described the importance of internal rotation of the leg if the path to the sciatic nerve is obstructed by the lesser trochanter.[38,39] This technique is not best suitable to catheter insertion because of the deep location and perpendicular angle of insertion required to reach the sciatic nerve. It is not recommended for patients on anticoagulation because of the deep nature of the block.

*a. Positioning*

The patient should be placed in the supine position with both legs fully extended. A slight internal rotation of the leg may be necessary for successful nerve localization.

*b. Sedation*

Heavier sedation is often required when compared to more superficial blocks as this is a deep block. A combination of midazolam and a short acting narcotic such as alfentanil can be used effectively.

*c. Landmarks*

There are three landmarks to identify for this block: the femoral crease, the femoral artery pulse, and the

needle insertion site. The needle insertion site is marked 4



**Figure 8.** Sciatic block, anterior approach. The Landmarks include femoral crease (1) and femoral artery (2). The needle is inserted perpendicularly 4-5 cm caudad to the intersection of the femoral artery and femoral crease.

to 5 cm distally on a line passing perpendicularly from the femoral crease where the pulse of the femoral artery is located, Figure 8.

*d. Technique*

After sterile skin preparation and draping, local anesthetic is infiltrated subcutaneously at the determined needle insertion site. The fingers of the palpating hand should be placed firmly against the quadriceps muscle to decrease the skin-nerve distance. The needle is introduced at a perpendicular angle to the skin plane. The nerve stimulator should be initially set to deliver 1.5 mA current. Stimulation typically occurs at a depth of 10-12 cm. The goal is visible or palpable twitches of the calf muscles, foot, or toes at 0.2 to 0.5 mA. Hamstring muscle twitches are not a reliable sign of sciatic nerve localization as branches to the hamstring muscles may leave the main truck of the sciatic nerve more proximally. Bone contact is frequently encountered during needle advancement (usually the lesser trochanter). When this occurs, the needle should be withdrawn 2 to 3 cm, the leg internally rotated (to swing the lesser trochanter downward and out of the path of the needle), and the needle advanced.

## 3. Sciatic Nerve: Block at the Level of the Popliteal Fossa

The popliteal block is a block of the sciatic nerve at the level of the popliteal fossa. It is typically used for foot and ankle surgery, i.e. corrective foot surgery, foot debridement, and Achilles tendon repair.[40] In addition, this technique offers advantages over spinal anesthesia in patients having short saphenous vein stripping, and has been successfully utilized in the pediatric population.[40,41] As opposed to an ankle block, popliteal sciatic block anesthetizes the musculature of the lower leg allowing tolerance for application of a calf tourniquet, and provides an immobile foot for surgery.

The sciatic nerve is a nerve bundle consisting of two separate nerve trunks, the tibial and the common peroneal nerves. As the sciatic nerve descends toward the knee, the two components eventually diverge near the popliteal fossa, giving rise to the tibial and the common peroneal nerves. This division of the sciatic nerve usually occurs between 50 and 70mm proximal to the popliteal fossa crease.[21,34,35] The components of the sciatic nerve may be blocked at the level of the popliteal fossa via a posterior or lateral approach. Access to the sciatic nerve may also occur with the patient in the lithotomy position.[42] Continuous techniques have been described using both the posterior and the lateral approaches.[43,44]

### *Posterior (Intertendinous) Approach: Position, sedation and technique

The posterior approach to the popliteal fossa is accomplished with the patient in the prone position. The three landmarks are the popliteal fossa crease, tendons of the semitendinosus and semimembranosus muscles (medially), and tendon of the biceps femoris muscle (laterally).[45] The needle insertion point is marked at 7 cm above the popliteal fossa crease at the midpoint between the two tendons, Figure 9. Mild sedation is recommended for patient comfort. Twitches of the foot or toes at 0.2 to 0.5 mA is the goal prior to local anesthetic injection. Relying on the tendons of the biceps femoris and semitendinosus as landmarks makes this approach easy to use even in obese patients.[45]
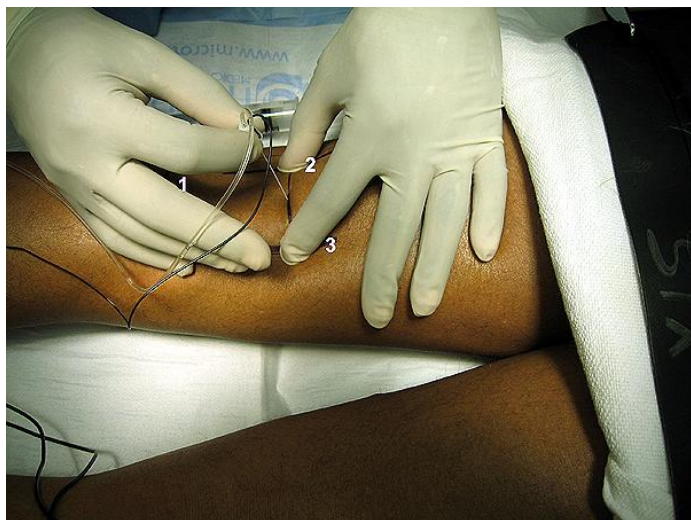
**Figure 9.** Popliteal block. The needle is inserted 7-8 cm above the popliteal fossa crease (1) at the midpoint between biceps femoris (2) and semitendinosus muscles (3).



**Figure 10.** Lateral popliteal block. The needle is inserted 8 cm above the popliteal fossa crease (1) between vastus lateralis (2) and biceps femoris (3) muscles (or tractus iliotibialis) and advanced 30-45º posterior.

## *Popliteal block – Lateral approach

The patient is placed supine with the foot elevated on a footrest so that even the slightest movement of the foot or toes can be easily observed (making certain that the Achilles tendon protrudes beyond the footrest). The foot should form a 90º angle to the horizontal plane of the table. The landmarks for the block are as follows: vastus lateralis muscle, biceps femoris muscle, and the popliteal fossa crease. The needle insertion site is marked in the groove between the vastus lateralis and biceps femoris muscles 8 cm above the popliteal fossa crease, Figure 10. The needle is inserted in a horizontal plane and perpendicular to the long axis of the leg between the vastus lateralis and biceps femoris muscles, and advanced to contact the femur. After femur contact, the needle is then withdrawn to skin level, redirected 30º posteriorly to the angle at which the femur was contacted, and advanced toward the nerve. The depth of the sciatic nerve is typically 1 to 2 cm beyond the skin-femur distance. If a twitch is not obtained at a distance of 2 cm past the skin-femur distance, the angle of insertion is most likely incorrect. Because further needle penetration can lead to politeal artery puncture, needle advancement should be stopped and the needle should be reinserted at a steeper angle. The goal of nerve stimulation is to obtain visible or palpable twitches of the foot or toes at a current of 0.2 to 0.5 mA. Appropriate sedation is usually required for patient comfort due to the depth of the block and the tissues traversed.

## * Ultrasound Guided Technique

Because of its deep location, ultrasound guided sciatic nerve block using the trans-gluteal approach is difficult. However, blockade at the subgluteal, and at the politeal level, are more amenable to ultrasound guidance. In a case series of 10 patients, using a 4- to 7-MHz ultrasound probe, the sciatic nerve anatomy, and spatial relationships between the tibial and peroneal nerves were easily identified.[46] There have even been case reports of successful politeal nerve block in patients where nerve stimulation alone was unsuccessful at localizing the nerve.[47]

The landmarks for this technique are identical to the landmarks used when performing the intertendinous approach with a nerve stimulator technique. After cleansing the area and applying conducting gel, the ultrasound probe is positioned perpendicular to the long axis of the leg so that an axial view of the sciatic nerve and popliteal artery is obtained. It is important to establish prior to needle insertion which side of the ultrasound display is medial and which side is lateral. The nerve is always lateral to the popliteal artery (Figure 11). The needle insertion site can either be in parallel with the long or short axis of the ultrasound probe. The benefit of using the long axis is that the entire needle length can be seen approaching the nerve. The advantage of the short axis is the smaller amount of tissue that needs to be traversed with needle placement. Visual displacement of the tissues as the needle is advanced provides adequate information

of needle position without actually visualizing the needle tip when approaching this block from the ultrasound probe's short axis. Because a nerve stimulator is used, final needle position is confirmed by muscle twitch. It is sometimes possible to visualize the tibial nerve (TN) and common peroneal nerve (CPN) components of the sciatic nerve separately on ultrasound, and these branches can be blocked individually. Once twitch of the toes (plantar flexion-TN or dorsiflexion-CPN) is seen at 0.2 to 0.5 mA, local anesthetic is injected in a similar fashion to the intertendinous approach without ultrasound guidance.
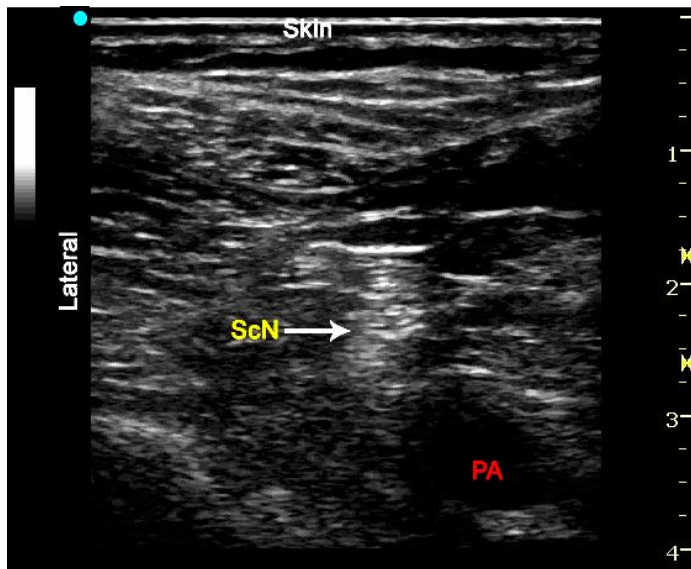


**Figure 11.** Ultrasound image of sciatic nerve proximal to popliteal fossa– The sciatic nerve (ScN) is always lateral to the popliteal artery (PA).

## CONTINUOUS SCIATIC NERVE BLOCKS

Continuous peripheral nerve blocks can theoretically be achieved at any level along the course of the sciatic nerve. Continuous sciatic nerve block is used for analgesia following major foot and ankle reconstruction, ankle fracture fixation, and below the knee amputation.[48,49] Several studies have shown a continuous infusion of local anesthetic via a popliteal catheter was superior to intravenous analgesia in reducing pain scores, opioid consumption, and sleep disturbances (see key phrase 4).[43,44,50] Placing continuous sciatic catheters are advanced regional anesthesia techniques. Expertise in single-injection techniques is recommended to ensure both efficacy and patient comfort and safety. Positioning and landmarks are the same for each of the blocks. Slight angulation of the stimulating or Tuohy needle is necessary to facilitate threading the catheter. Either a stimulating or non-stimulating catheter can be inserted for the continuous technique.[51,52] The catheter should be secured with a clear dressing and cloth tape at a minimum.

## ANKLE BLOCK

An ankle block is essentially a block of the four distal branches of the sciatic nerve (deep and superficial peroneal, tibial, and sural), and one cutaneous branch of the femoral nerve (saphenous). An ankle block is a basic peripheral nerve block, easy to perform, basically devoid of systemic complications, and very effective for a wide variety of procedures on the foot and toes (see key phrase 6).[53,54] There is considerable variation in the branching and distribution of the sensory nerves of the foot. For this reason, blockade of all five nerves has been advocated to provide adequate anesthesia.[55] The landmarks and injection sites for this block are as follows:

*Posterior Tibial Nerve*
This nerve is anesthetized by injecting local anesthetic just behind the medial malleolus followed by the same fan technique as described for the deep peroneal nerve (Figure 12).



**Figure 12.** Posterior Tibial Nerve block: This nerve is anesthetized by injecting local anesthetic just behind the medial malleolus followed by the same fan technique as described for the deep peroneal nerve.

*Deep Peroneal Nerve.* Landmarks

Immediately lateral to the tendon of the extensor hallucis longus muscle, Figure 13. The needle is advanced through the skin until bone is contacted. Then the needle is withdrawn back 1 to 2 mm, and 2 to 3 ml of local anesthetic is injected. A "fan" technique is then utilized redirecting the needle 30◦ medially and laterally with additional injections of 2-3 ml of local anesthetic in both directions.

*Blocks of the Superficial Peroneal, Sural and Saphenous Nerves*

These three nerves are superficial cutaneous extensions of the sciatic and femoral nerves. A block of all three nerves is accomplished using a simple circumferential injection of local anesthetic subcutaneously at the level of the medial and lateral malleolus (Figure 14).



**Figure 13.** *Deep Peroneal Nerve:* The injection point is immediately lateral to the DP artery; lateral to the tendon of the extensor hallucis longus muscle.



**Figure 14.** *Blocks of the Superficial Peroneal, Sural and Saphenous Nerves.* These three nerves are superficial cutaneous extensions of the sciatic and femoral nerves. A block of all three nerves is accomplished using a simple circumferential injection of local anesthetic subcutaneously at the level of the malleoli.

## SUMMARY

Evidence of improved rehabilitation outcome with continuous lower extremity PNB's has lead to an increased interest in their application. Research and focus on functional regional anesthesia anatomy have significantly contributed to the ease and success rate of lower extremity nerve blocks. More widespread acceptance of nerve blocks in clinical practice will depend on our ability to complete the transformation of this subspecialty field of anesthesiology into a more objective, standardized and reproducible practice with more clearly defined indications both to improve their clinical utility and to reduce the risk of complications.

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