CHAPTER 7: LOWER EXTREMITY BLOCKS

LOWER EXTREMITY BLOCKS

The innervation of the lower extremity comes from the lumbar and sacral plexuses. The different nerve elements of the lower extremity run more distant from each other than those of the upper extremity, never being confined to a small surface area like the trunks of the brachial plexus do. Therefore, no single peripheral block technique is able to provide anesthesia of the whole lower extremity. This anatomical fact, combined with the high success of neuraxial anesthesia, has traditionally affected the popularity of lower extremity peripheral nerve blocks.

The introduction of low molecular weight heparin in the United States in the early 1990s with its increased risk for epidural hematoma in association with neuraxial blocks produced a renewed interest in lower extremity nerve blocks. The use of ultrasound in regional anesthesia has also contributed to the increased popularity of all sort of peripheral nerve blocks.

Anatomy

Lateral femoral cutaneous nerve

It is an exclusively sensory nerve originating from the ventral rami of spinal nerves L2-L3. It appears in the pelvis, lateral to the psoas muscle, caudal to the ilioinguinal nerve. It runs anteriorly under the iliac fascia, parallel to the iliac crest. It emerges from the pelvis, under the inguinal ligament, between the anterior superior and anterior inferior iliac spines, as shown in figure 7-1 and 7-2. It provides sensory innervation to the lateral thigh.

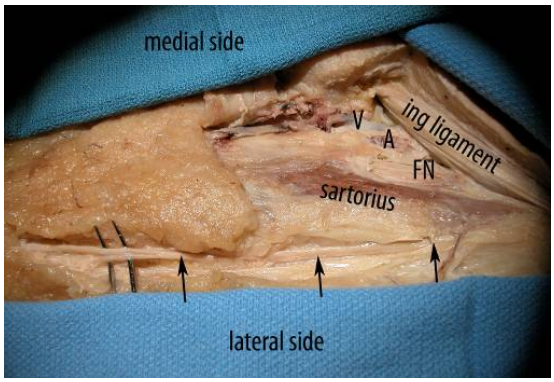


Fig 7-1. Lateral femoral cutaneous nerve (LFCN). The LFCN shown with arrows perforates the fascia lata below the inguinal ligament to become a superficial nerve. Cadaver dissection by Dr Franco. Image is copyrighted.

Femoral nerve

It is a motor and sensory nerve derived from the posterior divisions of the ventral rami of spinal nerves L2-L3-L4. In the pelvis it is also located lateral to the psoas muscle, in the cleavage between psoas and iliacus muscles. As it passes under the inguinal ligament the nerve is superficial to the combined iliopsoas muscle. Under the inguinal ligament the femoral nerve has the femoral artery medial to it, followed by the femoral vein medial to the artery (VAN from medial to lateral), as shown in figure 7-2.

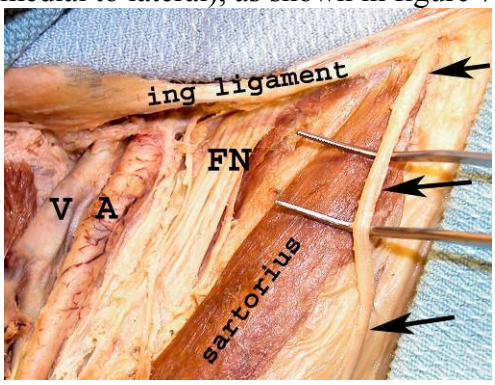


Fig 7-2. Femoral nerve. The femoral nerve (FN) passes under the inguinal ligament lateral to the femoral artery (A). LFCN is shown with arrows . Cadaver dissection by Dr Franco. Image is copyrighted.

Approximately 3-4 cm below the inguinal ligament, the femoral nerve divides into anterior and posterior divisions. The anterior division has two sensory branches that supply the anteromedial thigh, and two muscular branches that supply the sartorius and pectineus muscles. The posterior division has one sensory branch, the saphenous nerve, and muscular branches to the quadriceps. The nerve is covered by the iliac fascia, which separates it from the main vessels, and more superficially by the fascia lata, the deep fascia of the thigh.

The muscular branch to the rectus femoris also supplies the hip joint while the muscular branches to the three vasti muscles also supply the knee joint.

Obturator nerve

It is usually a mixed nerve (motor and sensory) derived from the anterior divisions of the ventral rami of spinal nerves L2-L3-L4. It emerges on the medial side of the psoas muscle just above the pelvic brim running down between this muscle and the lumbar vertebral column. As it enters the pelvis it turns laterally to run along its lateral wall until it reaches the obturator

foramen, through which it enters the thigh. In the thigh the nerve divides into anterior and posterior branches, as shown in figure 7-3.

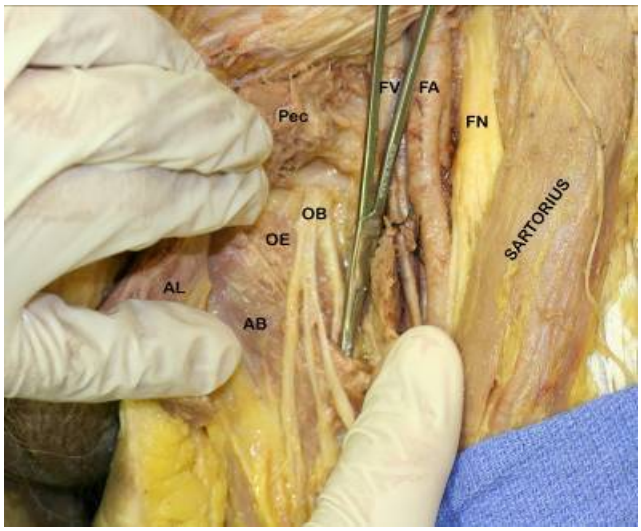


Fig 7-3. Obturator nerve. The obturator nerve (OB) comes out of the obturator foramen where its two branches eventually straddle the adductor brevis muscle (AB). Also shown are femoral nerve (FN), femoral artery (FA), femoral vein (FV), pectineus (Pec), obturator externus (OE) and adductor longus (AL) Cadaver dissection by Dr Franco. Image is copyrighted.

The anterior division runs caudally, first located between the pectineus muscle in front and the obturator externus behind. A few cm distally the nerve runs between the adductor longus anteriorly and the adductor brevis posteriorly. It gives innervation to the gracilis, adductor brevis and adductor longus, and sometimes to the pectineus. It gives also articular branches to the hip joint. On occasions it supplies the skin of the medial side of the thigh.

The posterior division after a short trajectory it usually pierces the obturator externus to then run caudally between the adductor brevis in front of the adductor magnus behind. It supplies the obturator externus, the adductor magnus and the knee joint. The anterior sensory branch can be frequently missing and in that case the medial thigh is also supplied by the femoral nerve.

The highly variable distribution of the cutaneous branch of the obturator nerve has contributed to the confusion about how much anesthesia can be obtained from a single block performed at the femoral level ("3-in-1" block). Most of the studies have used pinprick of the medial, anterior and lateral thigh to test for anesthesia of obturator, femoral and lateral femoral cutaneous nerves respectively. This resting does not take into account the fact that many variations exist in the innervation patters of the thigh including the absence of a cutaneous branch of obturator nerve. Nevertheless many authors believe that a block at the femoral level could also produce anesthesia of the lateral femoral cutaneous nerve by lateral diffusion of the local anesthetic under the fascia iliaca ("2-in-1 block"). Spread of local anesthetic to the obturator nerve either, medially under the vessels or proximally toward the pelvis is more unlikely.

Sciatic nerve

It is the largest nerve in the body. It originates from the ventral rami of spinal nerves L4-L5, S1-S3. Part of the anterior ramus of L4 joins the anterior ramus of L5 to originate the lumbosacral trunk, which together with the first three sacral roots form the sciatic nerve. The nerve has two components, the tibial nerve (on its medial side), which is derived from the anterior divisions of the ventral rami of L4-L5, S1-S3 and the common peroneal nerve (on its lateral side), which is derived from the posterior divisions of the ventral rami of L4-L5, S1-S2.

The nerve comes out of the pelvis through the greater sciatic foramen, entering the gluteal region anterior (deep as seen from the gluteal region) to the p iriformis muscle and cep halad to the ischial tuberosity. After reaching th e lateral as pect of this bony promin ence, the nerve turn s vertically downwards to run between the ischium medially and the greater trochanter laterally, as shown in figure 7-4.

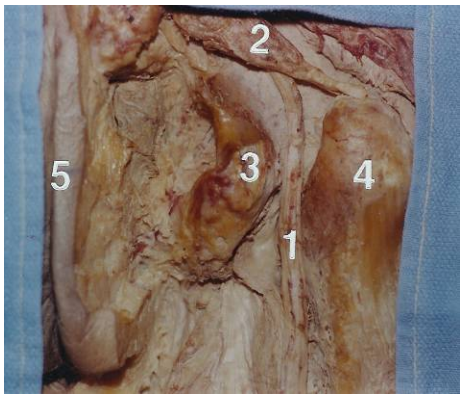


Fig 7-4. The sciatic nerve (1) enters the gluteal region covered superficially by the piriformis muscle (2). It th en travels parallel to the midline (5), between the ischium (3) and greater trochanter (4). Cadaver dissection by Dr Franco. Image is copyrighted.

For most of its trajectory in the buttocks, the sciatic nerve runs parallel to the m idline, at a distance of about 10 cm in adult patients. W ith the hips in adduction this distance is maintained throughout adult life, not being influenced by gender or body weight. This previously unknown fact has simplified enorm ously the approach to th e sciatic nerv e in our practice (for m ore information see references 3 through 9).

The tibial and comm on peroneal com ponents can be easily identified as two separate nerves during their entire trajectory in about 11% of the cases. However, even in those cases the two components are surrounded by a common sheath of connective tissue as shown in figure 7-5.

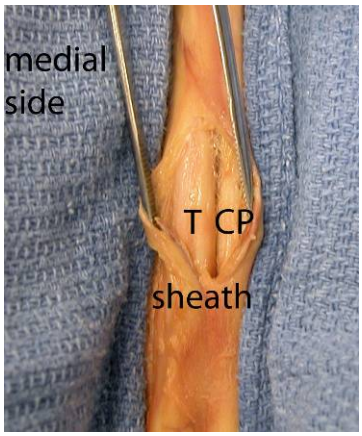


Fig 7-5. The sciatic nerve components, tibial (T) and common peroneal (CP) ca n be separated from their origin but they share a c ommon sheath. Cadaver dissection by Dr Franc o. Image is copyrighted.

Therefore, it is im portant not to confuse th is with a true separation of the com ponents, which invariably takes place always in the popliteal fossa, as shown in figure 7-6.

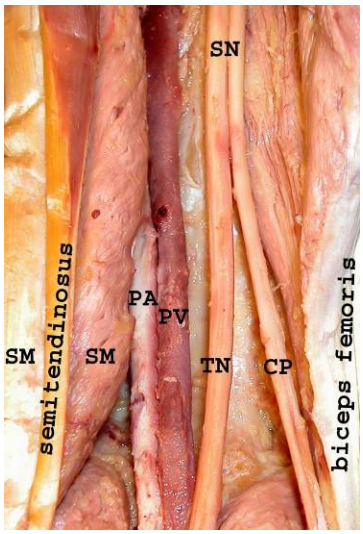


Fig 7-6. The sciatic nerve division after soft tissue removal. The sciatic nerve (SN) divides into its two components, tibial (TN) and common peroneal (CP), in the popliteal fossa. Also shown are the popliteal vein (PV), popliteal artery (PA) and muscles including semimembranosus (SM). Cadaver dissection by Dr Franco. Image is copyrighted.

The nerve enters the thigh deep to the biceps femoris muscle (and not lateral to it as usually mentioned in our literature), as shown in figure 7-7.

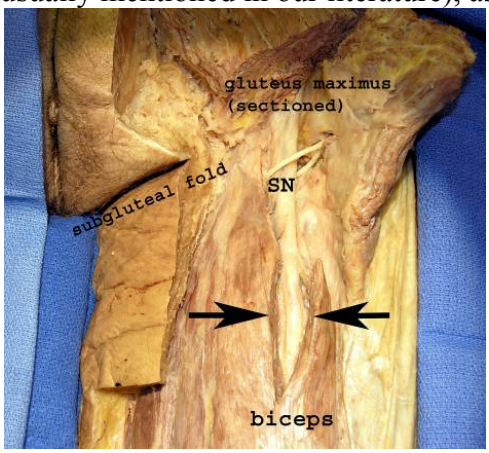


Fig 7-7. The sciatic nerve (SN) enters the thigh under the cover of gluteus maximus (sectioned) and biceps, which is shown split between two arrows. Cadaver dissection by Dr Franco. Image is copyrighted.

As opposed to what happen in the gluteal region, the position of the sciatic nerve in the thigh with respect to the midline is influenced both by the degree of hip abduction as well as by the amount of fat accumulating in the inner thigh.

The nerve runs in the posterior thigh under the cover of the ham string muscles, until it reaches the popliteal fossa. Upon entering the popliteal fossa, the two nerve components, peroneal and tibial, finally diverge from each other, having never mixed their fibers. The posterior tibial nerve continues to run in the direction of the main trunk, at the center of the fossa. The common peroneal component turns laterally to run just medial to the biceps tendon, as shown in figure 7-6.

Subgluteal fold

The fold that defines the buttocks inferiorly is a fold of the skin and does not correspond with the lower border of the gluteus maximus muscle, as frequently thought. In fact the inferior border of this muscle crosses the subgluteal fold diagonally as it runs laterally to insert in the iliotibial tract, as shown in figure 7-8. Therefore, during a subgluteal approach to the sciatic

nerve, the needle crosses the same planes (fat and gluteus maximus) than in more proximal approaches, although the fat layer can be thinner.

Fig 7-8. The inferior border of the gluteus maximus and subgluteal fold are two different things. They cross each other diagonally. Cadaver dissection by Dr Franco. Image is copyrighted.

Genitofemoral nerve

It derives from the ventral rami of spinal nerves L1-L2. Its genital branch provides some of the innervation of the genital area, while its femoral component provides sensory innervation of the medial upper thigh and the skin over the femoral vessels.

Posterior cutaneous nerve of the thigh

It is also known as posterior femoral cutaneous nerve. It originates from the ventral rami of spinal nerves S1-S3. It exits the pelvis through the greater sciatic foramen, first medial and then superficial to the sciatic nerve. Somewhere caudal to the ischium, the nerve pierces the deep fascia (fascia lata) and becomes a superficial structure. It is not a branch of the sciatic nerve, although it has a close relationship with it in the gluteal area, as shown in figures 7-9 and 7-10, before it becomes a superficial nerve as shown in figure 7-11.

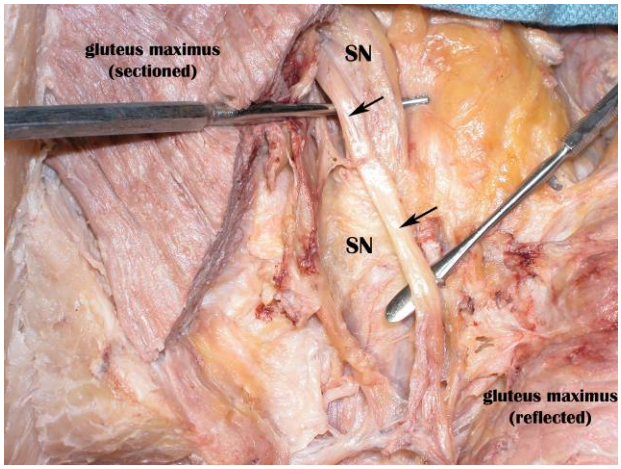


Fig 7-9. The posterior femoral cutaneous nerve shown with arrows is in close contact to the sciatic nerve (SN) in the gluteal area. The sheath of the nerve is partially intact. Cadaver dissection by Dr Franco. Image is copyrighted.

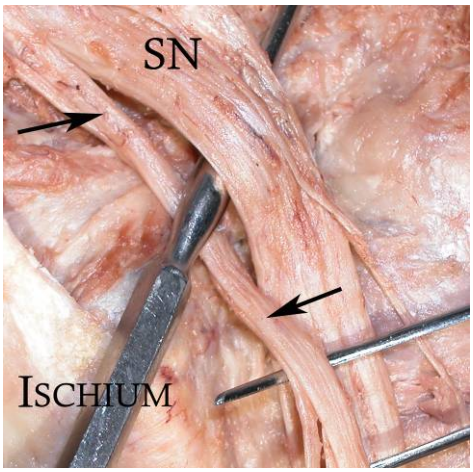


Fig 7-10. The posterior femoral cutaneous nerve shown with arrows and sciatic nerve (SN) after removal of connective tissue. Cadaver dissection by Dr Franco. Image is copyrighted.

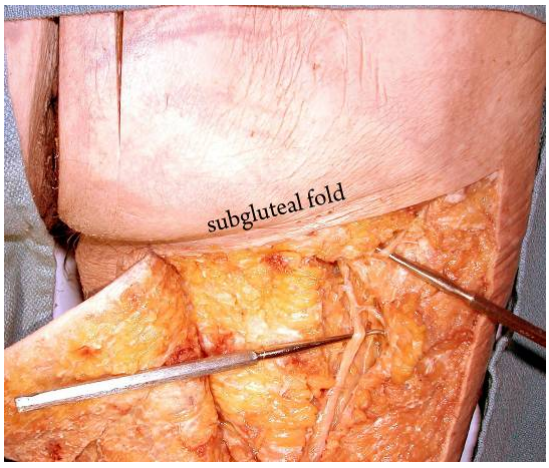


Fig 7-11. The posterior femoral cutaneous nerve becomes a superficial nerve around the subgluteal fold and is no longer in contact with the sciatic nerve. Cadaver dissection by Dr Franco. Image is copyrighted.

It innervates the lower part of the buttocks as well as the posterior thigh, frequently reaching down as far down as the proximal posterior aspect of the leg. A block of the sciatic nerve performed in the gluteal area will predictably produce anesthesia of this cutaneous nerve as well. A block performed at the subgluteal level on the other hand, will not reliably block it.

Saphenous nerve

It is a sensory nerve that originates from the posterior division of the femoral nerve (L3-L4) in the inguinal region. It is the largest cutaneous branch of the femoral nerve. It runs down the femoral canal along with the femoral vessels, under the cover of the sartorius muscle. It emerges on the medial side of the knee between the tendons of sartorius and gracilis, as shown in figure 7-12

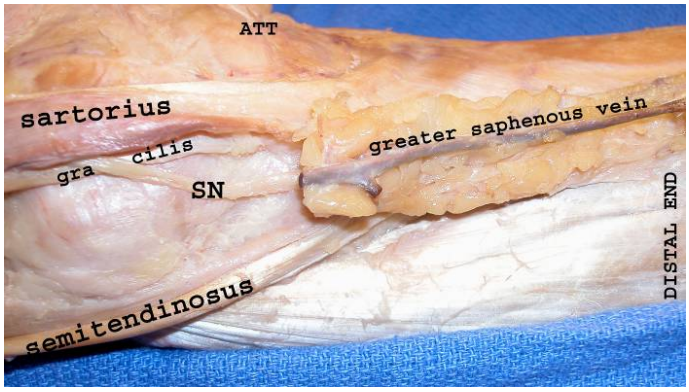


Fig 7-12. The saphenous nerve (SN) emerges on the medial side of the knee between sartorious and gracilis to run along the greater saphenous vein on the medial side of the leg. ATT: anterior tibial tuberosity. Cadaver dissection by Dr Franco. Image is copyrighted.

At a variable distance caudal to the knee, it pierces the deep fascia to become superficial. Distal to the knee it gives off the subpatellar branch, which supplies the medial side of the knee (chance for injury during knee arthroscopy). Once it becomes superficial, it runs alongside the greater saphenous vein in the leg, passing in front of the medial malleolus in the ankle, before terminating around the base of the first metatarsal on the medial side of the foot.

Male and female pelvis issue

The female pelvis is adapted to accommodate child bearing and as a result the pelvic cavity or inner pelvis is wider in the female than in the male. However, the total width of the bony pelvis, that is the diameter between both iliac crests (bicrestal diameter), is similar in both sexes, measuring an average of 280 mm in males and 275 mm in females (see Cunningham's Anatomy reference). The thicker bones in the male pelvis compensate for a "roomier" female pelvis (see Hollinshead's Anatomy reference). According to some anthropologists (Hall et al reference) the human bony pelvis is "surprisingly" similar in males and females at all ages. The perceived difference in pelvis size corresponds to hormone-dependent, different patterns of fat deposition in both sexes. In other words the difference in pelvic size among the sexes is mostly due to soft tissue and not due to differences in the total width of the bony pelvis. It is the latter what determines the position of the sciatic nerve in the buttocks as I will discuss further when I describe the gluteal approaches to the sciatic nerve.

Clinical pearls

- The nerves of the lower extremity are more distant from each other than in the upper extremity so it is not possible to block the entire lower extremity from a single injection point.
- The position of the sciatic nerve in the buttocks with respect to the midline is dictated by the bony pelvis and as such it not affected by gender or obesity. Its relationship to bone structures and to the midline remains unchanged throughout adulthood.
- The inferior border of the gluteus maximus muscle does not correspond with the subgluteal fold (Snell's Clinical Anatomy for Medical Students, 3rd edition, page 554). In fact both cross each other diagonally. The subgluteal fold is a fold of the skin anchored to the deep fascia.
- The gluteus maximus is the only gluteal muscle to cover the sciatic nerve superficially, caudal to the pirifformis muscle. Gluteus medius and minimus are located cephalad and lateral to the sciatic nerve.
- The inguinal crease does not correspond with the inguinal ligament. Both structures are parallel to each other. The inguinal crease runs about 1 inch (2.5 cm) caudal and parallel to the inguinal ligament.

LATERAL FEMORAL CUTANEOUS NERVE BLOCK
ANATOMICAL TECHNIQUE

Indications

This block can be performed alone to provide anesthesia of the lateral thigh (e.g., donor area for a skin graft). It can also be performed along with femoral, obturator and sciatic blocks to provide anesthesia of the thigh for surgical procedures above the knee and for thigh tourniquet. It is also one of the nerves targeted in a "3-in-1" block, a block of the femoral nerve performed with a higher volume of local anesthetic, that aims to block also the lateral femoral and obturator nerves (not supported by the evidence).

Point of contact with the nerve

The nerve is approached as it emerges from under the inguinal ligament, medial and inferior to the anterior superior iliac spine (ASIS).

Main characteristics

AS mentioned this nerve has a constant relationship to the ASIS although for several cm its trajectory is deep to the fascia lata until it perforates it to become a superficial nerve running on the lateral thigh. This is important to remember because the fascia lata is thick enough to slow the transfer of local anesthetic to the target nerve.

Patient position and landmarks

The patient lies supine. The ASIS is identified by palpation.

Technique

The needle entrance point is identified about 1 cm medial and about 2 cm caudal to the ASIS. The needle is advanced perpendicular to the skin until it pierces the fascia lata where a small volume of local anesthetic is injected. A nerve stimulator with pulse duration of 0.3 to 1 msec (300 to 1000 microsec) can be used to identify the nerve by eliciting a sensory paresthesia on the lateral thigh.

Local anesthetic and volume

A volume of around 5 mL of 1% mepivacaine is frequently used. A long acting agent, like ropivacaine or bupivacaine, can be used if longer anesthesia or analgesia is needed.

Complications

Very rare. On occasions some patients may complain of dysesthesia on the lateral thigh that usually goes away in a few days without sequelae.

LATERAL FEMORAL CUTANEOUS NERVE BLOCK
ULTRASOUND TECHNIQUE

The use of ultrasound facilitates this block. As I mentioned before, the lateral femoral cutaneous nerve passes under the inguinal ligament medial to the ASIS and deep to the fascia lata, as shown in figure 7-13.

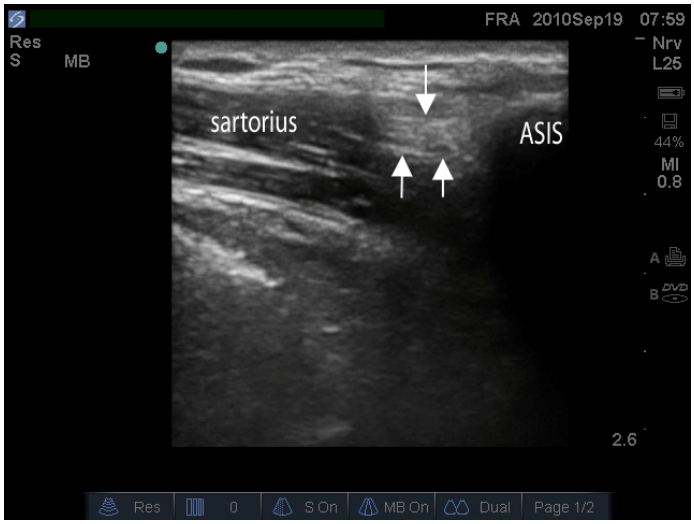


Fig 7-13. Lateral femoral cutaneous nerve and ASIS. As the nerve, shown with arrows, enters the thigh medial to the anterior superior iliac spine (ASIS) and deep to the fascia lata. (Author's archive).

A few cm distal to the inguinal ligament the nerve, still under the fascia lata, can be observed causing a small indentation on the anterolateral surface of the sartorius, as shown in figure 7-14.

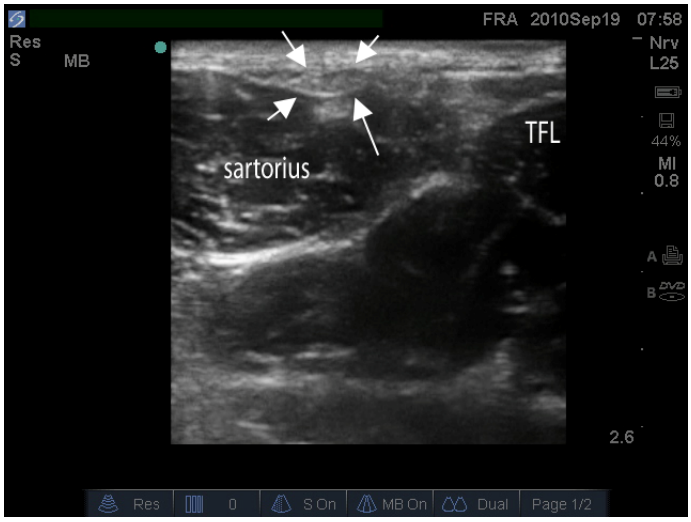


Fig 7-14. Lateral femoral cutaneous nerve and sartorius. As the nerve, shown surrounded by arrows travels a few cm away from the ASIS it can be seen causing a small indentation on the anterolateral surface of sartorius. Tensor fascia lata (TFL) can also be seen laterally. (Author's archive).

This nerve is usually superficially located and either an in plane or an out of plane technique can be used deposing a small volume of local anesthetic around it.

FEMORAL NERVE BLOCK
NERVE STIMULATOR TECHNIQUE

Indications

An isolated femoral nerve block can be performed to provide anesthesia for surgery on the anterior thigh, patella and some knee procedures. It is more commonly performed along with sciatic to provide anesthesia of the entire lower extremity.

Point of contact with the nerve

The nerve is usually approached just below the inguinal crease. However, if possible, the nerve can be approached immediately above the crease (1 cm), where it is more compacted, before its branches start to diverge.

Main characteristics

This is a simple block performed lateral to the pulse of the femoral artery, deep to the fascia lata (deep fascia of the thigh) and deep to the fascia iliaca (the fascia that covers the iliopsoas muscle). The femoral artery pulse usually provides an easy and reliable landmark to the nerve.

Patient position and landmarks

The patient lies supine. If necessary, the back of the bed can be slightly elevated for patient's comfort. If done in combination with a sciatic nerve block, we prefer to do the sciatic block first because this is a block that needs more time to settle than the femoral. The femoral pulse at the inguinal crease is found by palpation. The point of entrance is marked on the skin, proximal or distal to the inguinal crease, about 2 cm lateral to the pulse of the femoral artery, as shown in figure 7-15.

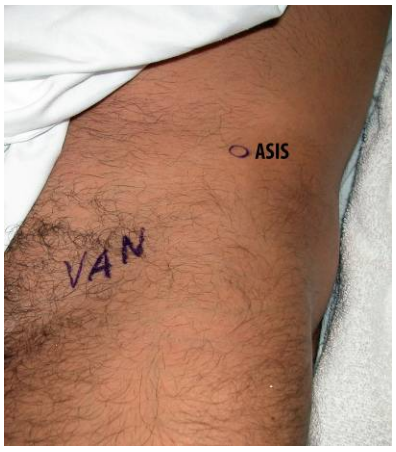


Fig 7-15. Patient position and landmarks. The patient is supine or semi seated. The location of the femoral artery (A) is found by palpation. The femoral nerve (N) is lateral to the artery, while the femoral vein (V) is medial to it. Also shown is the anterior superior iliac spine (ASIS). (On a model with permission).

Type of needle

A 5 cm, 22G, insulated needle usually suffices.

Nerve stimulator settings

The nerve stimulator is set to deliver a 1.0 mA current, at a frequency of 1 Hz and pulse duration of 0.1 msec (100 microsec).

Needle insertion

The needle is inserted 1-2 cm lateral to the pulsation of the femoral artery with a 30-45-degree cephalad orientation, as shown in figure 7-16 a and b.

Fig 7-16 a. Needle insertion, frontal view. The needle is inserted lateral to the artery, about 1 cm above the inguinal crease and in a 30-45 degree cephalad orientation. (On a model with permission).

Fig 7-16 b. Needle insertion, lateral view. The needle is inserted lateral to the artery, about 1 cm above the inguinal crease and in a 30-45 degree cephalad orientation. (On a model with permission).

The needle is advanced parallel to the midline in the direction of the inguinal ligament. A twitch of the quadriceps muscle with movement of the patella is a good response. The current is lowered and with a muscle twitch still visible at 0.5 mA a slow injection is started. A response from the sartorius is usually considered not a good response, because it could be the result of stimulation of the nerve to the sartorius, a branch of the anterior division of the femoral nerve. If the block is performed 1 cm above the inguinal crease where the nerve has not branched off yet, a twitch from the sartorius is equally acceptable.

Local anesthetic and volume

The femoral nerve is a collection of branches flat in the frontal plane that offers a large area of absorption. Usually we use at this location 10-15 mL of local anesthetic solution. For anesthesia we usually use 1.5 % mepivacaine plus 1 :400,000 epinephrine for 3 -4 hours of surgical anesthesia. For longer anesthesia 0.5% ropivacaine or bupivacaine can be used alone or in combination with mepivacaine. For analgesia we usually use 10-15 mL of 0.2% ropivacaine. We always use epinephrine 1:400,000 as an intravascular marker.

Side effects and complications

Blocks at the femoral level are usually well tolerated and complications are rare.

FEMORAL NERVE BLOCK
ULTRASOUND TECHNIQUE

Indications

The same indications than for nerve stimulator techniques.

Patient position

The patient is either supine or semi seated for more comfort.

Type of needle

Usually a 22G, 5cm insulated needle is used.

Type of transducer

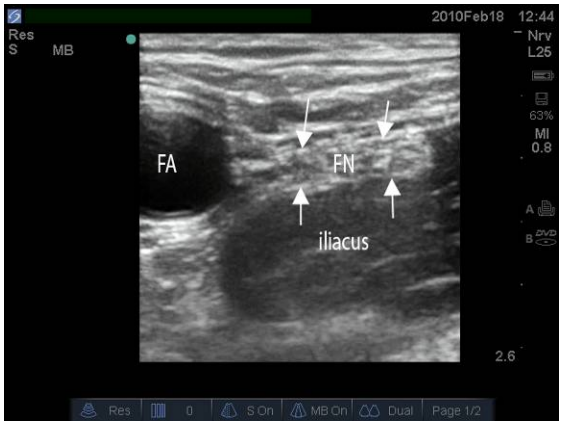
The femoral nerve is f airly superficial in most of patients, so a high frequency (8-15 MHz) linear probe is usually adequate.

Scanning

The probe is placed across the upper thigh over the femoral vessels, as shown in figure 7-17.

Fig 7-17. Scanning. The probe is placed across the neurovascula r bundle, right above the crease to obtain a short axis view of the femoral nerve and vessels. (On a model with permission).

The image obtained at this level is shown in figure 7-18.



If possible we like to p lace the probe parallel and immediately (1 cm) above the crease. At this location, abov e the crease and below th e inguinal ligament, the m ultiple branches that form the femoral nerve are clo sely together forming a more compact structure. The femoral vein is the most medial structure of the neurovasc ular bundle and is easily collapsible by the probe. The artery is situa ted lateral to the vein and th e femoral nerve is loc ated lateral to the arte ry. There can be a gap of about 1 cm in between the artery and the nerve.

Needle insertion

The needle can be advanced in plane, from lateral to medial, as shown in figure 7-19, or out of plane caudal to proximal, as shown in figure 7-20.

Fig 7-20. Needle insertion, out of plane. The needle is inserted from caudal to proximal on a cephalad direction towards the femoral nerve. (On a model with permission).

Local anesthetic and volume

The multiple branches that constitute this nerve provide an ample area of absorption for the local anesthetic. Usually we use 10-15 mL of local anesthetic solution. For anesthesia we use 1.5% mepivacaine plus 1:400,000 epinephrine, alone or in combination with 0.5% ropivacaine or bupivacaine. For analgesia 0.2% ropivacaine is our drug of choice.

Side effects and complications

Very rare. Hematomas from puncture of the femoral artery are possible, but avoidable with meticulous technique, use of small gauge needles and thorough compression of the arterial puncture when it occurs. The use of ultrasound almost eliminates this problem.

OBTURATOR NERVE BLOCK
NERVE STIMULATOR TECHNIQUE

Indications

It is rarely performed alone. It is more often combined with femoral, lateral femoral and/or sciatic blocks.

Point of contact with the nerve

The needle is inserted, if possible, immediately (1 cm) above the inguinal crease to approach the nerve just distal to the obturator foramen.

Main characteristics

Although the obturator nerve exits the obturator foramen usually already divided into anterior and posterior branches, they both run for a short distance physically contiguous in the plane between the pectineus anteriorly and the obturator externus posteriorly. After running together for 1-2 cm they separate when they reach the lateral border of the adductor brevis muscle, with the anterior branch passing anteriorly to this muscle and the posterior branch posterior to it. It is a common practice to perform separate injections of both branches. However we believe that if the injection is attempted 1 cm above the crease both main branches of the obturator nerve can be blocked by a single injection deep to the pectineus muscle.

Patient position and landmarks

The patient lies supine with the head of the bed slightly elevated. The thigh is slightly abducted and externally rotated. Many methods have been devised to locate the obturator nerve. Our own method is to use as the main landmark the pulsation of the femoral artery. To locate the right obturator nerve the operator uses the right hand and for the left obturator the left hand. The middle finger is used on both sides to palpate the pulse of the femoral artery. This way the index finger on either side always points to the femoral nerve, the ring fingers locates the femoral vein while the little finger points to the obturator nerve, as shown in figure 7-21.

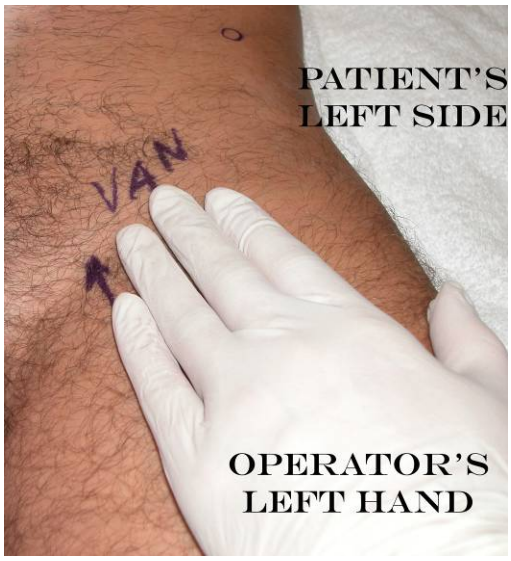


Fig 7-21. Finding the obturator nerve. Our own method to locate the obturator nerve uses the femoral artery pulse, which is palpated using the middle finger of the same side to be blocked (right hand to palpate right side, left hand to left side). This way the little finger will always roughly indicate the position of the obturator nerve (pointed with an arrow). (On a model with permission).

Type of needle

Depending on the patient, a 5cm or 10cm insulated needle is used.

Nerve stimulator setting

The nerve stimulator is set to deliver a 1.0 mA current, at a frequency of 1 Hz and pulse duration of 0.1 msec (100 microsec).

Needle insertion

The needle is inserted almost perpendicular to the frontal plane with a slight cephalad angulation, as shown in figure 7-22.

Fig 7-22. Needle insertion. The needle is inserted immediately above the inguinal crease, almost perpendicular to the frontal plane, with a slight cephalad orientation. (On a model with permission).

As the needle traverses the muscular plane, a localized twitch from the pectineus and or adductor longus is usually elicited by direct muscle stimulation. As the needle reaches the deep face of the muscle and the proximity of the obturator nerve a more global twitch of the thigh in adduction is obtained. At this point the current is lowered progressively to around 0.5 mA, and if

a twitch is still visible, a slow injection is st arted. If the needle m akes contact with the pubis ramus, it is walked off caudally.

Local anesthetic and volume

A volume of 10-15 mL of local anesthetic is usually used. Mepivacaine 1.5% can be used with 1:400,000 epinephrine for 3-4 hr of anesthes ia. For longer anesthesia 0.5% ropivacaine or bupivacaine can be used. For analgesia 0.2% ropivacaine is commonly used.

Complications

Hematoma is the most frequent complication of this technique. Adductor m uscles spasm can occur.

OBTURATOR NERVE BLOCK
ULTRASOUND TECHNIQUE

Indications

The same indications mentioned for nerve stimulator techniques.

Patient position

The patient lies supine with the head of the bed slightly elevated. The thigh is slightly abducted and externally rotated.

Type of needle

Depending on the patient, a 5cm or 10cm insulated needle is used.

Type of transducer

If at all possible a high frequency (8-15 MHz) linear probe is used.

Scanning

Before performing the scanning it is useful, if possible, to locate the adductor longus, the most superficial of the three adductor muscles, as shown in figure 7-23.

Fig 7-23. Identifying the adductor longus muscle. With the thigh in slight abduction and slight external rotation the adductor longus (AL) can usually be easily palpated. (On a model with permission).

This way the determination of the location of the obturator nerve is framed between two easily identifiable structures, the femoral vessels on the lateral side and the medial border of the adductor longus on the medial side. The probe is placed parallel and slightly above the inguinal crease over the femoral vessels and then traced medially until it rests over the pectineus muscle, as shown in figure 7-24.

Fig 7-24. Scanning the obturator nerve. The probe is placed across the femoral vessels, as done for femoral block, and then slowly displaced medially until it rests over the pectineus muscle, just cephalad to the inguinal crease. (On a model with permission).

With the probe over the pectineus muscle the obturator nerve can be seen as a mostly hyperechogenic ovoid image under the pectineus muscle, as shown in figure 7-25.

Fig 7-25. Obturator nerve, proximal view. With the probe close to the inguinal crease the obturator nerve with its two main components can be seen under the pectineus muscle shown with an arrow. Also shown is the femoral vein (FV). Author's collection.

If the scanning instead is performed a few centimeters more distally then the two branches of the obturator can be seen, as shown in figure 7-26.

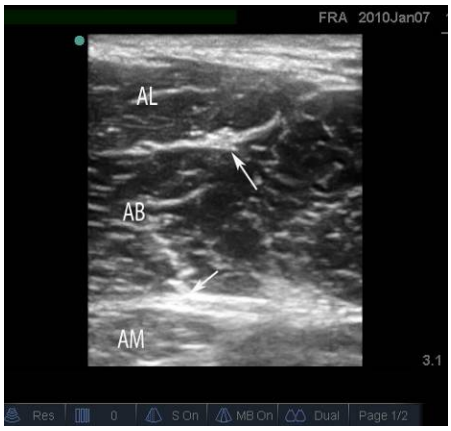


Fig 7-26. Obturator nerve, distal view. With the probe close to the inguinal crease the obturator nerve with its two main components can be seen under the pectineus muscle shown with an arrow. Also shown is the femoral vein (FV). Author's collection.

Needle insertion

My preferred method for this particular block is to use and out of plane technique from distal to proximal, as shown in figure 7-27.

Fig 7-27. Needle insertion. The needle is introduced out of plane, from distal to proximal. On a model with permission).

Local anesthetic and volume

A volume of 10-15 mL of local anesthetic is usually used. Mepivacaine 1.5% can be used with 1:400,000 epinephrine for 3-4 hr of anesthesia. For longer anesthesia 0.5% ropivacaine or bupivacaine can be used. For analgesia 0.2% ropivacaine is commonly used.

Complications

Hematoma is the most frequent complication of this technique. Adductor muscles spasm can occur.

LUMBAR PLEXUS BLOCK (also called "psoas compartment block")
NERVE STIMULATOR TECHNIQUE

Indications

Its goal is to produce anesthesia of the three terminal branches of the lumbar plexus , the lateral femoral, femoral and obturator nerves. Along with a m idgluteal (i.e., proxim al) sciatic nerve block it provides anesthesia of the entir e lower extrem ity. It is also used to provid e postoperative analgesia after hip and knee surgery.

Point of contact with the nerve(s)

The plexus is through the posterior lum bar area in the space lim ited by the quadratus lumborum posteriorly and the psoas muscle anteriorly.

Main characteristics

It is the posterior version of what a "3-i n-1" block in the fe moral area intend s to accomplish. It is a deep block, in which the needle goes through several layers, includ ing subcutaneous tissue, the mass of paraspinal muscles, and the quadratus lumborum muscle before ending just posterior to the psoas muscle, in the retroperitoneal space.

Because of the depth at which the nerves are located and the long needles used, the operator using a "blind" technique m ay lose cont rol over the exac t location of the needle tip, increasing the potential risk for complications. T he most frequent complication is to produce an epidural block (injection too m edial), but also cases of total spinal anesthesia have been described. Because of the relatively large volumes of local anesthetics used systemic toxicity can also develop. Cases of penetration of the peritoneal cavity with injury of its contents, as well as large retroperitoneal hematomas and death have been reported with this block. It is essential that the operator be familiar with the anatomy of this region before attempting this block. This block should be performed only by experienced people.

The lumbar plexus block perhaps should not be performed in obese patients.

Patient position and landmarks

The patient is plac ed in the latera l position with both hips and knees flexed like for a neuraxial block. A line is drawn at the leve l of the iliac cre st (L4-L5 interspace) starting at the midline (spinous processes) and extending to the le vel of the posterior supe rior iliac spine. The line is then divided into thirds, as shown in figure 7-28.

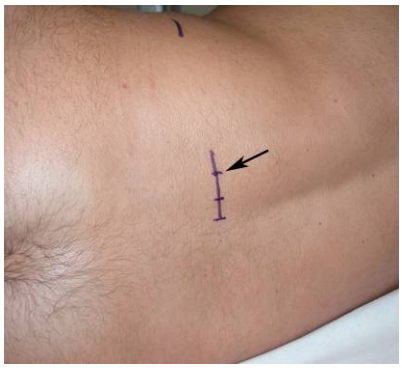


Fig 7-28. Landmarks. A line at the level of the iliac crests is drawn from the midline to the PSIS and divided into thirds. The junction of the lateral and middle thirds is the point of needle insertion shown with an arrow. On a model with permission).

Type of needle

At least a 10cm, 21-G, insulated needle is necessary for this block.

Nerve stimulator settings

The nerve stimulator is set to deliver a current of 1.5 mA, at a pulse frequency of 1 Hz and pulse duration of 0.1 msec (100 microsec).

Needle insertion

The needle is inserted parallel to the midline at the junction between the lateral third and middle third of the line joining the midline with the level of the posterior superior iliac spine, as shown in figure 7-29.

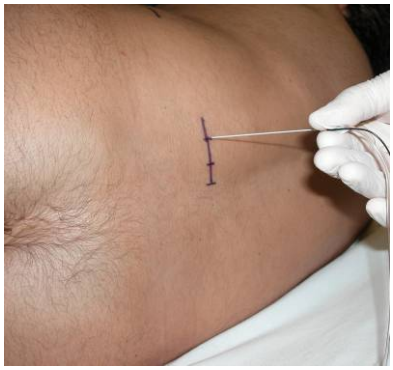


Fig 7-29. Needle insertion. The needle is inserted at the junction between the lateral and middle thirds of the line drawn from the midline to the PSIS, and directed parallel to the midline. On a model with permission).

This insertion is more medial than the original technique. It is based on a study by Capdevila et al in 2002 in which they showed that a needle inserted at the level of the PSIS falls lateral to the plexus making it necessary to reposition it medially and potentially increasing the risk for epidural or spinal injection.

As the needle is inserted through the mass of the paraspinal muscles a local contraction is usually observed. The transverse process of L4 or the nerves of the lumbar plexus should be contacted within 3 cm from the disappearance of the local back muscles twitch. If not, the needle is withdrawn superficially and redirected caudally or cephalad. If the transverse process (usually L4) is contacted the needle should be walked off caudally until a quad twitch is obtained, not deeper than 2 cm from the transverse process. If no response is obtained within 2 cm the needle can be redirected cephalad from the transverse process and again advanced for up to 2 cm.

When a muscle twitch from the quad is obtained the current in the nerve stimulator is decreased to around 0.5-0.8 mA and with a visible response a gentle aspiration is performed for blood or CSF before injecting a "test dose" amount of 3-5 mL of local anesthetic with epinephrine 1:200,000. If no intravascular or subarachnoid injection is detected the rest of the local anesthetic volume is slowly injected in small increments with frequent gentle aspirations.

The preferred response in this block is quad response. An obturator response could mean that the needle is too medial and should be redirected slightly lateral.

Local anesthetic and volume

For anesthesia of 3-4 hours 1.5% mepivacaine with epinephrine 1:400,000 can be used. For longer anesthesia the preferred drug is 0.5% ropivacaine or 0.5% bupivacaine plus 1:400,000 epinephrine. For analgesia 0.2% ropivacaine or 0.25% bupivacaine are adequate.

Complications

I already mentioned that this block should be performed only by experienced people. Epidural spread is the most common problem with a reported incidence of 1-16%, but that in some cases can be as high as 88%. Subarachnoid injection is a dangerous complication not always avoided by a test dose. Large retroperitoneal hematomas are possible and therefore this block should adhere to the same anticoagulation guidelines than neuraxial techniques. Kidney and other organs injuries as well as death have been also reported.

LUMBAR PLEXUS BLOCK
ULTRASOUND TECHNIQUE

This ultrasound technique is based on th e ability to reco gnize and understand the anatomy of the posterior abdom inal wall and asso ciated structures including the lumbar spine. Because of the depth of these structures a curved, low frequency probe is used in adults.

The anatomy-ultrasound correlation

The three term inal branches of the lum bar plexus, the la teral femoral, femoral and obturator nerves originate from the anterior rami of L2-L4 spinal nerves. It is m y experience from the anatomy lab that the th ree branches of the plexus are located in between the psoas and the quadratus lumborum at or around the transverse plane of the iliac crest, which corresponds to the plane where this block is commonly attem pted. The presence of the lum bar plexus branches in this intermuscular gap is shown in figure 7-30.

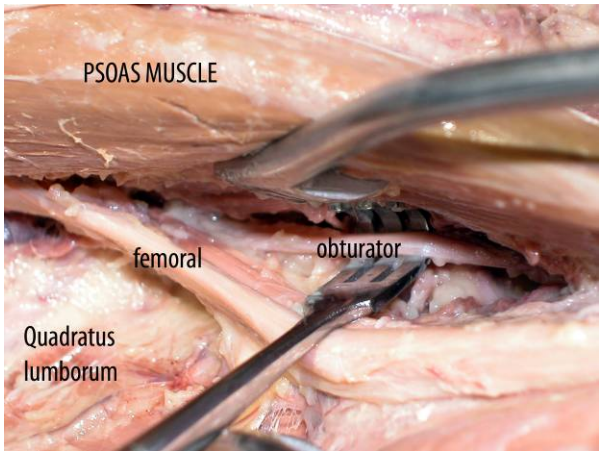


Fig 7-30. The branches of lumbar plexus are located in between psoas anteriorly and quadratus (transverse process) posteriorly at the transverse plane of the iliac crest. Cadaver dissection by Dr Franco. Image is copyrighted.

Based on this information the operator needs only to identif y the psoas muscle anteriorly and the tran sverse process of lower lum bar vertebras posteriorly (where the quadratus inserts) and deposit the local anesthetic in between the two without the need to penetrate the substance of the psoas muscle.

Figure 7-31 shows a schematic representation of the posterior abdominal wall and lumbar plexus branches.

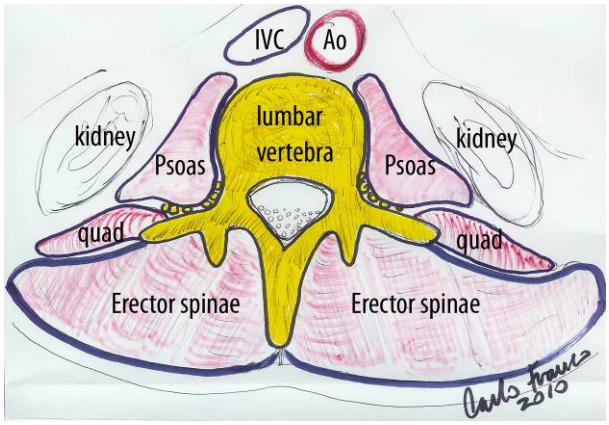


Fig 7-31. The posterior abdominal wall and the branches of the lumbar plexus. To access t he branches of the lum bar plexus the needle crosses the erector spinae muscles which are s urrounded by the thoracolumbar fascia and ends in between the quadratus lumborum (transverse process) and psoas muscles. Original drawing by Dr Fra nco. Image is copyrighted.

In order to visualize the quadratus lumborum and psoas muscle with ultrasound the operator needs to take advantage of the small spaces or "acoustic windows" located between the bone structures of the lumbar spine.

Figures 7-32; 7-33 and 7-34 represent a sequence of images obtained with the probe in the transverse position, across the lower lumbar spine.

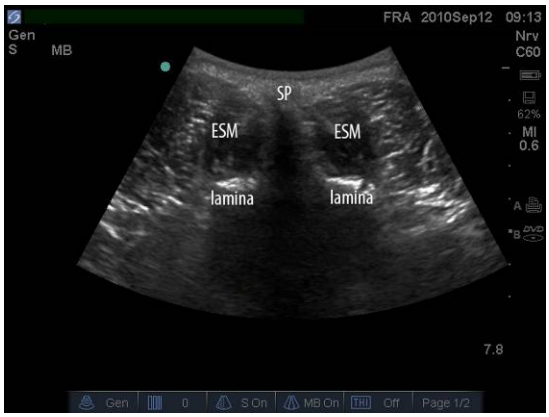


Fig 7-32. Transverse view midline. With the probe centered across the lumbar spine a spinous process (SP) is visualized casting a posterior shadow as well as the corresponding laminas, both bone structures cast acoustic shadows. On both sides the erector spinae muscles (ESM) are also observed. Author's collection.

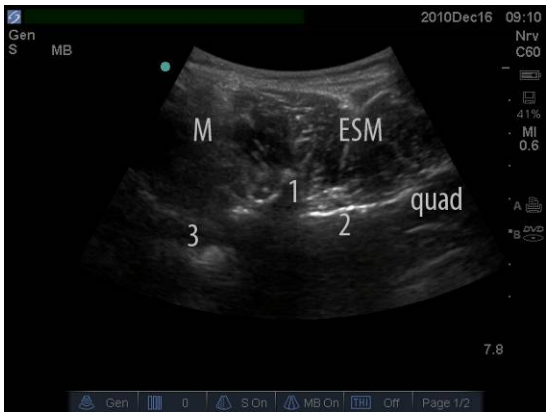


Fig 7-33. Transverse view paramedian, over a transverse process. The probe has been moved laterally from previous position and placed over the erector spinae muscle (ESM). Also shown are midline (M), facet joint (1), transverse process (2), spinal canal (3) and quadratus lumborum (quad). The acoustic shadow under the transverse process prevents the visualization of psoas muscle. Author's collection.

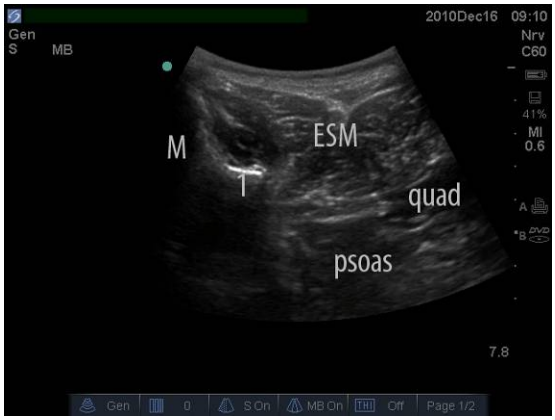


Fig 7-34. Transverse view paramedian, in between two transverse proceses. From the previous position the probe has been moved off a transversus process to visualize psoas. Also shown are midline (M), transverse process (1), quadratus lumborum (quad). The needle is advanced to the plane between quadratus and psoas. Author's collection.

Another way to visualize the point of injection between the psoas and quadratus lumborum would be to use the longitudinal paramedian approach with the probe placed

vertically across the transverse processes of lower lumbar vertebrae. The image obtained in shown in figure 7-35.

Fig 7-35. Longitudinal, paramedian view over transverse processes. The top of the image corresponds to the skin, the left side is cephalad and right side caudal. Two transverse processes (T) are observed casting posterior acoustic shadows and through the acoustic window in between the two we can observe the quadratus lumborum (qu) and psoas muscles. Beyond psoas we can see part of retroperitoneum. Author's collection.

The operator can either use the ultrasound as an assisting tool to locate a certain interspace level and/or transverse process and to measure depth or choose to perform the technique under direct ultrasound guidance. In that case the probe is encased in a sterile sheath. An out of plane technique makes the needle trajectory shorter. With a transverse view the needle can be inserted from distal to proximal below the probe and with the longitudinal paramedian position the needle is inserted from lateral to medial. A nerve stimulator can be used in conjunction to confirm location.

SCIATIC NERVE BLOCK
Classic approach (Labat as modified by Winnie)
NERVE STIMULATOR TECHNIQUE

Indications

As an isolated block, it provides anesthesia of the back of the thigh (through anesthesia of the posterior cutaneous nerve of the thigh, a branch of the sacral plexus) and most of the lower extremity below the knee, with the exception of the medial side of the leg (saphenous nerve). If used along with femoral, lateral femoral and obturator nerve blocks (lumbar plexus block), it completes the anesthesia of the entire lower extremity.

Point of contact with the nerve

The nerve is contacted in the gluteal area at the point where it is entering the gluteal area caudal to the piriformis muscle. The needle on occasions could traverse through the piriformis.

Main characteristics

Labat's approach is a highly anatomical approach that requires the identification of the posterior superior iliac spine (PSIS) and the greater trochanter (GT). A dissection of the gluteal area shows that this is a reliable approach if the operator is able to accurately determine the position of the PSIS and GT, disregarding ANY soft tissue (i.e., muscle, bursa, subcutaneous tissue and fat).

Position of the patient and landmarks

The patient is positioned in lateral decubitus, with the side to block up. The dependent leg is extended. The non-dependent leg is flexed at the hip and at the knee, while the buttock is rotated anteriorly (Sim's position).

The PSIS is marked and so is the superior aspect of the GT. The midpoint of this PSIS-GT transverse line is determined. From this midpoint a perpendicular line measuring 3 cm, is directed caudally and medially. This is the point of needle insertion. It is important that the marks placed on the skin truly represent the **posterior projection** of the bony prominences on the skin. Marking the position of the GT on the lateral buttock for example, would artificially add length to the PSIS-GT line (because of soft tissue), making its midpoint artificially more lateral and away from the sciatic nerve. The 3-cm length of the perpendicular line has also been a source of problems. Several authors have modified the length of this line, from 2-5 cm, blaming it for the difficulty with the technique.

In 1974 Winnie and collaborators published in Anesthesiology Review a modification to the Labat's technique. This modification is part of what it is usually known as the "classic" technique. In order to deal with the controversy about the appropriate length of Labat's original 3-cm perpendicular line, they proposed to draw an additional transverse line extending from the sacral hiatus (SH) to the tip of the greater trochanter to provide a distal point of intersection for the perpendicular line. In this manner, the length of Labat's perpendicular line would be determined by the distance between the two transverse lines, and would be "self adjustable" to every particular patient. Quoting the authors, "with this technique the distance along the perpendicular line will vary with the height of the patient". This apparent solution is widely

accepted but it might have some problems of its own. Because, as discussed in the anatomy section, the transverse diameter of the pelvis is fairly constant in all adults, any prolongation of the perpendicular line would bring it closer to the midline (its direction is caudal and medial). This will mean that a tall patient with a long sacrum will have a sciatic nerve located closer to the midline (long perpendicular line) than a short patient. This obviously could not be the case. The fact is that the perpendicular line of Labat was not created to be flexible in length.

The combined "classic" approach (Labat-Winnie), despite its shortcomings, is the most commonly used posterior approach to the sciatic nerve in the gluteal area.

Technique

Usually the block can be completed with a 4", insulated needle, but sometimes a longer needle needs to be used. The needle is advanced, perpendicular to all planes until a twitch from the sciatic nerve is found. If a twitch is still visible at 0.5 mA a slow injection is started with frequent aspirations. If the nerve is not contacted, the technique does not have a clear strategy for reposition of the needle. In fact the nerve could be at any point around a 360-degree radius.

Local anesthetic and volume

For anesthesia 1.5% mepivacaine plus 1:400,000 epinephrine in a volume of 30-35 mL can provide 3-4 hrs of anesthesia. Ropivacaine 0.5-0.75% with epinephrine or 0.5% bupivacaine with epinephrine can be used if longer duration is needed.

Complications

The literature mentions that the absorption from this site is minimal. However, it is important to remember that the branches of the inferior gluteal vessels at this level are large and multiple, therefore hematomas could develop. The patient lying supine immediately post block could theoretically help to decrease the chance for a hematoma to develop.

It is important to inject slowly, alternated with frequent and gentle aspirations. Dysesthesias in the territories of the sciatic or posterior femoral cutaneous nerves are reported more frequently after this block than any other. These problems usually resolve within 1-2 weeks.

SCIATIC NERVE BLOCK
Franco's 10-cm approach
NERVE STIMULATOR TECHNIQUE

Indications

The same indications than for a classic technique.

Point of contact with the nerve

This is a mid-gluteal technique that approaches the sciatic nerve distal to the piriformis in the proximity of the ischium (about the same level than the classic technique). However, because caudal to the piriformis the sciatic nerve runs almost parallel to the midline, this technique can be performed at any point between mid-gluteal to subgluteal levels. It can also be used for continuous catheter techniques.

Main characteristics

This is a simple technique that relies on one simple anatomical landmark, the intergluteal sulcus (midline), making the palpation of any buried landmarks totally unnecessary. It is based on simple, although not universally known facts:

1. The trajectory of the sciatic nerve in the gluteal region is for the most part parallel to the midline.
2. The width of the adult pelvis is similar in all adults and according to some anthropologists "surprisingly" similar in males and females at any given age. Variations in hip width are mainly the result of hormone-dependent, different patterns of fat deposition in both sexes and are not due to significant differences in the width of the bony pelvis. Although male and female pelvises are indeed different, most of those differences are limited to the diameters of the minor or inner pelvis without affecting the total pelvis diameter. Thicker bones in the males compensate for the wider inner pelvis of females to make the average bicrestal diameter (total width) 280 mm in males and 275 mm in females.
3. As determined by our own study (Anesthesiology, 2003), the sciatic nerve is located about 10 cm from the midline (intergluteal sulcus) in all adults. What remains highly variable is the amount of adipose tissue that can accumulate in the buttocks affecting the depth of the nerve and its distance to the lateral side of the patient. The distance midline-nerve is, on the other hand, unaffected by fat accumulation as it is dictated by the distance between the ischium and the midline (fixed after puberty).

Position of the patient and landmarks

This block can be performed in the lateral decubitus or in the prone position. We prefer to do it almost 100% of the times in the lateral position, because it is more comfortable for the patient and faster to prepare for. The patient is placed in the lateral position with both hips and knees slightly flexed. In a true lateral decubitus, a tangential line to the buttocks, should form a 90-degree angle with the table. Having the patient placed at straight angles with the table, makes his/her midline parallel to the table.

The midgluteal sulcus is identified and the point of needle insertion is marked at 10 cm from it at about midgluteal region, as shown in figure 7-36.

Fig 7-36. Patient position and point of needle insertion. The patient lies on lateral decubitus. The point of needle entrance is easily found at 10 cm from the midline at about midgluteal level. (On a patient with permission).

This is a linear measurement that, on purpose, disregards any particular curvature or contour in the patient's buttocks. The insertion point, always located at 10 cm from the midline, can be moved distally at will, as far caudal as the subgluteal fold. This could be necessary for example, if the buttock is large and the needle is not long enough.

Type of needle

A 4", insulated needle is usually sufficient, although in some cases a 6" needle is necessary.

Nerve stimulator settings

For this technique we set the nerve stimulator current at 1.5 mA (1.8 mA in diabetic patients), with a frequency of 1 Hz and pulse duration of 0.1 ms (100 microsec).

Needle insertion

The needle is advanced parallel to the midline, as shown in figure 7-37.

Fig 7-37. Needle insertion. The needle is inserted parallel to the midline. (On a patient with permission).

When the needle reaches the gluteus maximus muscle a local muscular twitch of the buttock is observed. This twitch is very reassuring, telling the operator that the needle-stimulator unit is functional and most importantly, providing information on sciatic nerve depth. If 8 cm or more, of a 10 cm needle, have been used to reach the gluteus maximus, it is unlikely that the needle will be long enough to reach the sciatic nerve.

The needle is advanced through the gluteus muscle, with a visible local twitch that does not disappear until the needle reaches beyond the deep surface of this muscle. The ensuing "silence" is evidence that the needle is passing through the connective tissue that separates the gluteus maximus from the nerve. It should be soon followed by a twitch resulting from

stimulation of the sciatic nerve. The nerve is rarely more than 2 cm deeper to the gluteus maximus.

I believe that any of the possible responses from the sciatic nerve (i.e. eversion, dorsiflexion, inversion and plantar flexion) are adequate, provided that the injection is made with a visible response at 0.5 mA or less. There are few reports in the literature that argue in favor of inversion and against eversion. This is not our experience.

If no response from the sciatic nerve is obtained deeper to the gluteus maximus, then a reposition of the needle is necessary. Here is very important to take in to account the "vector" effect, the impact of the angle of reinsertion in the final position of the needle. According to my own calculations, at a theoretical depth of 9 cm, a 10-degree correction angle, moves the needle tip 1.6 cm, while a 20-degree correction moves it 3.4 cm. Because the nerve is around 1.5 cm wide, it would be very easy to "overshoot" the correction.

Some useful tips when trying to "pinpoint" the sciatic nerve

When an adequate twitch is found, the nerve stimulator current is lowered until a twitch is still visible at 0.5 mA or less. This is done while maintaining visual contact with the twitch. If the twitch becomes too weak, before reaching 0.5 mA, the current is not lowered any further and instead the operator slowly moves the needle closer to the nerve.

It is not infrequent to see the response fade as the needle is inserted deeper. This can be the result of a needle approaching the nerve tangentially, along one of the sides of the nerve. We usually try to perform a small correction in order to get a "bull's eye" alignment with the nerve. Deciding whether to correct lateral or medial depends on what type of response is being elicited. Eversion and dorsiflexion are responses from the common peroneal nerve (lateral side), while inversion and plantar flexion are responses from the tibial nerve (medial side). A small correction is then made accordingly. A more controlled correction can be accomplished by only partially removing the needle a couple of cm. The unburied portion of the needle is then bent and directed in the desired direction. The buried portion of the needle keeps the needle from overcorrecting. Bringing the needle out completely, and then reinserting it, carries a chance of overshooting the correction.

Complications

Same as classic approach.

Pearls

- The 10 cm measurement is a linear measurement that disregards, on purpose, the patient's buttock contour. This linear measurement tries to reflect only the distance between the midline and the outer lip of the ischium, without soft tissue interference.
- Placing the patient in true lateral position, makes the patient's midline parallel to the table. If this position is not possible, the operator needs to ascertain the degree of inclination of the midline with respect to the table, so the needle still may be advanced parallel to the patient's midline.
- When the nerve is not found at first attempt, it could only be located either lateral or medial to the needle. Because of gravity, it is more frequent to underestimate the midline-nerve distance (sagging midline). Therefore, the first correction should be lateral.
- When reposition is necessary, keep in mind the "vector" effect. At a theoretical distance of 9 cm a 10-degree correction will move the needle app 1.6 cm. A 20-degree correction

will move it 3.4 cm. This big "jump" could easily overshoot the correction. A small 10-degree correction usually is all it takes to localize the nerve.

MIDGLUTEAL SCIATIC BLOCK
ULTRASOUND TECHNIQUE

Indications

The same than for nerve stimulation techniques.

Patient position

For a midgluteal approach the patient can be placed prone, lateral or in Sim's position.

Type of needle

A 10 or 15cm, 21-G, insulated needle is used.

Type of transducer

Because of the depth at which the sciatic nerv e is located in the gluteal a rea, most of the times a curved, low frequency (5-7 MHz) probe is needed.

Scanning

The nerve is identified in cross section (short axis) by placing the tr ansducer across the midgluteal area at which point the sciatic nerve ca n be identified between the greater trochanter and ischial tuberosity, as shown in figure 7-38.

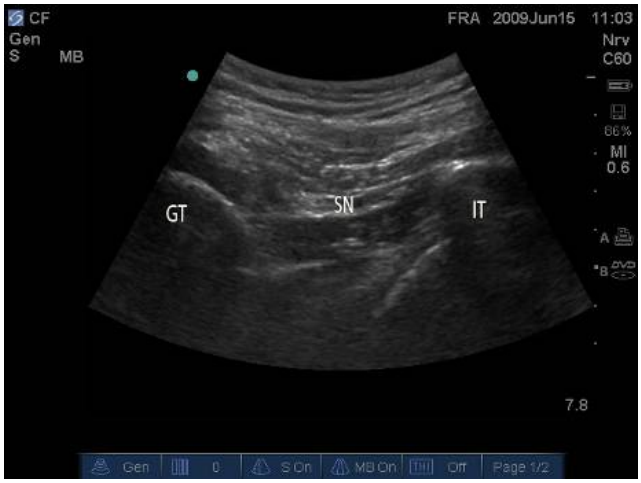


Fig 7-38. Sciatic nerve scanning. With the probe in the m idgluteal region the sciatic nerve (SN) is observed between the greater trochanter (GT) and isch ial tuberosity (IT). Author's collection.

Needle insertion

The easiest approach is to in troduce the needle out of plane from distal to proxim al as observed in figure 7-39.

Fig 7-39. Needle insertion. The needle is inserted out of plane from distal to proximal. On a model with permission).

Figure 7-40 shows an ultrasound image of an out of plane technique after injection.

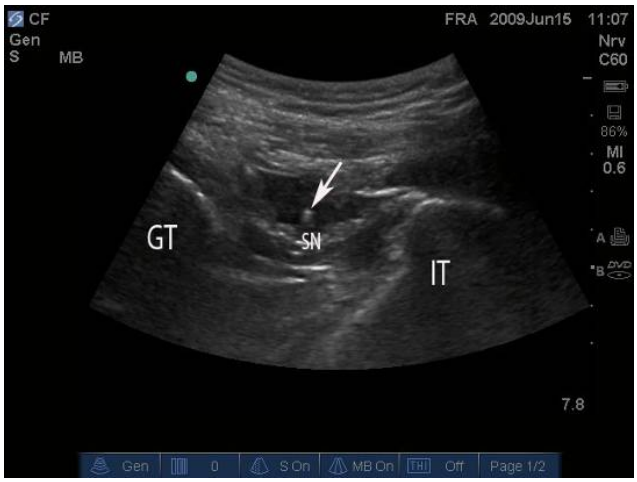


Fig 7-40. Sciatic nerve injection. Out of plane technique. The sciatic n erve (SN) is shown in between greater trochanter (GT) and ischial tuberosity (IT). The tip of the needle is sh own above the nerve pointed with an arrow and the injected local anesthetic appears as a dark hypoechoic shadow surrounding the nerve. Author's collection.

Local anesthetic and volume

For anesthesia 1.5% m epivacaine plus 1:40 0,000 epinephrine prov ides 3-4 hr of anesthesia. For longer duration 0.5-0.75% rop ivacaine or 0.5% bupiv acaine can be used. We always add epinephrine as intravascular marker. For analgesia 0.2% ropivacaine is appropriate.

Complications

The same as other nerve stimulation techniques at this location.

SCIATIC NERVE BLOCK, SUBGLUTEAL
Di Benedetto's approach

Indications

This is a block more suitable for surgery below the knee, because it does not reliably block the posterior femoral cutaneous nerve (back of the thigh). It can also be used for continuous catheter techniques.

Point of contact with the nerve

The nerve is approached in the vicinity of the subgluteal fold.

Main characteristics

There are several techniques performed at or around the subgluteal fold. Some authors mention Raj's "supine approach" to sciatic nerve (Anesthesia & Analgesia 1975) as being the first. In fact, this is a sciatic block performed between the ischium and greater trochanter (mid-gluteal, not subgluteal level), just a few cm caudal to Labat's classic approach. In this technique the extremity is elevated and flexed at the hip and knee, stretching the buttock tissues. This supposedly brings the sciatic nerve closer to the skin. It is interesting to note that, even though this technique is universally known as "Raj's supine approach", a completely similar technique was published a year earlier (1974) by Winnie and colleagues in Anesthesiology Review. Raj's technique was correctly devised "for below-the-knee operations". This fact is frequently forgotten and we will revisit it later.

A popular infra or subgluteal technique is the technique introduced by Di Benedetto and colleagues in 2001.

Patient position and landmarks

This block is performed in the Sim's position, as the classic technique. The greater trochanter and the ischium are identified and a line is drawn in between the two. The midpoint of this line is determined. A second line is drawn from this midpoint, perpendicularly and caudally for 4 cm. This is the needle insertion point. According to the authors, the operator should be able to palpate at this point a "skin depression", which would represent "the groove between the biceps femoris and semitendinosus muscles". This groove supposedly represents the trajectory of the sciatic nerve. This is just one more instance in which anesthesiologists display their love affair with grooves. In fact cadaver dissections show:

1. Ischium and greater trochanter are located at about the same transverse plane in the buttocks, as shown in figure 7-1. Di Benedetto's lines show a greater trochanter located significantly higher than the ischium.
2. Being the subgluteal fold so evident, it would seem appropriate to just extend the perpendicular line until it intercepts the subgluteal fold without need to measure.
3. The sciatic nerve runs under the biceps femoris and not in a groove between biceps and semitendinosus.

Technique

The authors advice inserting the needle perpendicular to the skin until a twitch from the sciatic nerve is obtained.

Local anesthetic and volume

The same than for classic approach

Complications

Common to other approaches to the sciatic nerve.

SCIATIC NERVE BLOCK, SUBGLUTEAL
Franco's 10-cm approach

The subgluteal approach can be easily perf ormed at 10 cm from the m idline at the subgluteal fold, with the patient lying in lateral decubitus, as shown in fig 7-41.

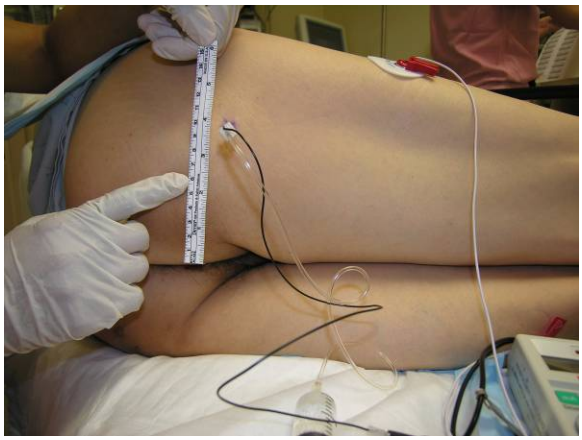


Fig 7-41. Needle insertion point. It is easily found at 10 cm from the midline as done for the midgluteal approach. (On a patient with permission).

The 10-cm measurement is made lateral to the midline at the level of the subgluteal fold, in a way similar to the one described for the mid-gluteal approach. The needle is advanced parallel to the midline, through the gluteus maximus muscle and into the sciatic nerve. The current is lowered to around 0.5 mA and a slow injection is started. If the nerve is missed at first pass it could only be located medial or lateral to the needle. The needle is reinserted, with a small 10-degree correction in its orientation, first lateral (toward the trochanter) and then medial (to the midline) if necessary.

Ultrasound technique

Although the same tissue layers cover the sciatic nerve at the midgluteal and subgluteal levels, the fat layer is usually thinner. This makes the ultrasound visualization of the sciatic nerve at this level usually easier than in the midgluteal area. Depending on depth, the nerve can be visualized with a linear high frequency probe, but frequently a lower frequency probe is needed. Curved low frequency probes are needed for bigger patients. The patient is placed prone, lateral position or Sim's position. The nerve is visualized in cross section (short axis) and the needle is advanced either out of plane (usually) or in line with the probe.

A few facts on subgluteal approach

1. This approach consistently misses the posterior femoral cutaneous nerve, so anesthesia of the back of the thigh is only obtained in about 30% of the cases (our own data, Reg Anesth Pain Med, 2006). The reason is that th e posterior femoral nerve is usually already a superficial nerve (above the fascia) at the level of the subgluteal fold.

2. The inferior border of gluteus maximus and subgluteal fold are not the same thing. Therefore, during a subgluteal approach the needle needs to pass through the same layers of tissue than at more proximal approaches.
3. The sciatic nerve is relatively more superficial at the subgluteal fold because the amount of fat decreases from mid-gluteal to subgluteal level, although the type of layers (fat and muscle) remains the same.
4. The popliteal fossa is the only level in the trajectory of the sciatic nerve in which the nerve is not covered superficially by muscle. Approaching the sciatic nerve, without passing through muscle is the only true advantage of a popliteal approach.
5. In terms of anesthesia distribution, the subgluteal approach is more comparable to the popliteal block than to other more proximal approaches.

SCIATIC NERVE BLOCK, POPLITEAL
Franco's approach
NERVE STIMULATOR TECHNIQUE

Indications

It is especially suitable for foot surgery. Along with femoral nerve block (saphenous) it provides complete anesthesia below the knee.

Point of contact with the nerve

The needle approaches the sciatic nerve high in the popliteal fossa, before its main components diverge from each other.

Main characteristics

This is the only place in the trajectory of the sciatic nerve where the nerve is not covered superficially by muscle, perhaps its only true advantage over other more proximal approaches to the sciatic nerve. Characteristically, a sciatic block done at this level has a slower onset and lower success rate than more proximal approaches. The fact that the two components of the nerve diverge from each other could account for some of the partial blocks. However, slower onset and lower success rates are sometimes observed in cases where there is reasonable evidence to believe that the main trunk has been contacted. One of the possible reasons is that the nerve sheath at this level fuses with the fat that fills the popliteal fossa soaking the local anesthetic away from the nerve.

Patient position and landmarks

This block is most usually performed in the prone position. The patient's patella is palpated with two hands, to verify the neutral position of the knee on the bed (the natural resting position of the knee is with a small degree of lateral rotation). The patient is then asked to flex the knee slightly to make the biceps (lateral) and semitendinosus (medial) tendons visible at the popliteal crease. A mark is placed on both tendons at the crease, as shown in figure 7-42.

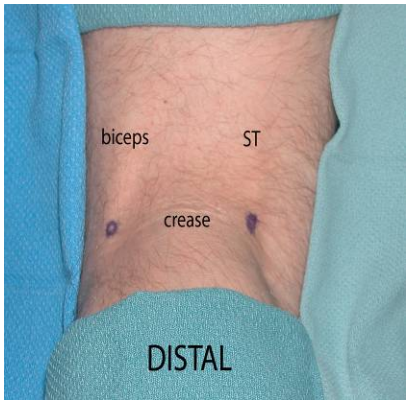


Fig 7-42. Landmarks. The biceps tendon and semitendinosus tendon (ST) are marked at the crease. (On a model with permission).

The distance between these two points in adults is usually 6-7 cm in females and 7-8 cm in males. The midpoint between the two tendons is located and marked, as shown in figure 7-43.

Fig 7-43. Inter tendinous distance. The midpoint between biceps and semitendinosus tendons is determined at the crease . (On a model with permission).

The needle insertion point is then found 7-9 cm above the crease, as shown in figure 7-44.

Fig 7-44. Point of needle insertion. The point of insertion shown with an arrow, is found 7-9 cm above the midpoint of the tendons at the crease. (On a model with permission).

Type of needle

A 5cm, 22-G, insulated needle is usually adequate.

Nerve stimulator settings

The nerve stimulator is set to deliver a current of 1.0 mA (higher in diabetics) with a pulse frequency of 1 Hz and pulse duration of 0.1 msec (100 microsec).

Needle insertion

The needle is introduced with a 30-45 degree cephalad orientation, as shown in figure 7-45.

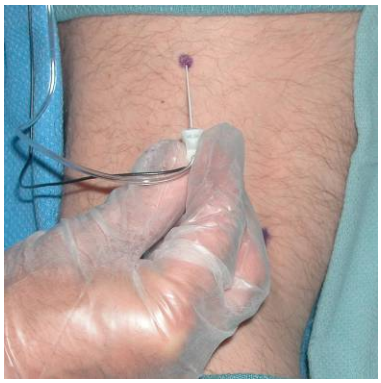


Fig 7-45. Needle insertion. The needle is inserted with a cephalad orientation. (On a model with permission).

The needle is directed approximately 45-degrees cephalad, so the contact with the nerve happens at 1-2 cm higher from the crease than the actual entrance point, increasing the chances that the sciatic nerve is contacted prior to its division. The distance at which the needle is inserted varies according to the patient's height. A good ballpark estimation is to insert the needle at a distance from the crease that is 1 cm longer than the inter tendinous distance.

Once a response from the sciatic nerve is elicited, and still present at 0.5 mA or less, a slow injection is started with frequent aspirations.

Local anesthetic and volume

I believe that a block of the sciatic nerve in the popliteal fossa using nerve stimulation requires a higher volume than more proximal approaches. As a general rule I give about 10 mL more of local anesthetic solution than what I would give to the same patient at more proximal locations. This comes to about 35-45 mL of 1.5% mepivacaine with 1:400,000 epinephrine for 3-4 hr of anesthesia. If longer anesthesia is desired I would use a combination of 1.5% mepivacaine with epinephrine followed by 0.5% ropivacaine or bupivacaine plus epinephrine.

Complications

Small hematoma can develop. Residual dysesthesias lasting up to two weeks can be seen.

POPLITEAL BLOCK, LATERAL APPROACH
WITH NERVE STIMULATOR

Indications

It is especially suitable for any surgery below the knee including ankle and foot, in patients who cannot be placed in any other position than supine

Point of contact with the nerve

Similar to the posterior approach. The needle approaches the sciatic nerve from the lateral side, before this nerve's main components diverge from each other. The needle is advanced between the biceps (posteriorly) and vastus lateralis (anteriorly) into the popliteal fossa.

Main characteristics

Blocking the sciatic nerve with this approach is a little bit more challenging than the posterior approach. Biceps and vastus lateralis fibers are in close physical contact so the needle usually stimulates some muscle fibers before reaching the sciatic nerve.

Patient position and landmarks

The patient lies supine in the semi sitting position. A pillow is placed under the leg, so the hip and knee are slightly flexed. The patient can be asked to shift his/her weight to the opposite side, so a small degree of lateral rotation is obtained. The popliteal crease is identified and marked toward the lateral side of the knee. The cleavage between the biceps and vastus lateralis is identified. A mark is placed in this groove 10 cm proximal to the popliteal crease. This is the point of needle insertion.

Technique

The midpoint of the patella is found and a line is drawn from it proximally into the thigh. This line represents roughly the projection of the sciatic nerve and therefore it can be used to estimate the depth of the sciatic nerve, as measured from the lateral side. With the thigh in slight lateral rotation the needle is advanced with a 30-degree posterior orientation. A local twitch of biceps and/or vastus lateralis muscles can be found before entering the popliteal fossa. If the needle overshoots the projection of the nerve without eliciting a twitch, it is withdrawn to the skin and a small 10-degree posterior correction is applied before reinsertion. With a visible twitch at 0.5 mA or less, a slow injection is started with frequent aspirations.

Local anesthetic and volume

The same than for posterior approach.

Complications

The same than for posterior approach.

POPLITEAL BLOCK
ULTRASOUND TECHNIQUE

Indications

The same indications than nerve stimulation techniques.

Patient position

There are basically two main positions in which this block can be performed, supine and prone. The views obtained are similar, but in general the supine technique can be more challenging, especially in larger patients. The supine technique involves an in plane lateral approach, while the prone technique provides the opportunity for out of plane approaches also. Whether the technique is done supine or prone, having the patient flex the knee improves the visualization of the sciatic nerve and its components.

Type of needle

If an out of plane technique is performed usually a 22-G, 5cm, insulated needle suffices. If an in plane lateral approach is attempted usually a longer 10cm , 21-G, insulated needle is needed.

Type of transducer

In most cases a linear, high frequency (8-15 MHz) is used. In larger patients it is sometimes necessary to use a curved, low frequency (3-7 MHz) probe.

Scanning

The nerve is scanned in short axis. The scanning can be started at any level in the popliteal fossa but it is helpful to start at the crease where the popliteal vessels, vein and artery, have an intimate relationship with the tibial component of the sciatic nerve. Figures 7-46 A-D show a sequence of images as the probe is moved from distal to proximal.

Fig 7-46, A. Popliteal scanning. Image obtained at the popliteal crease shows popliteal vein (PV), popliteal artery (PA) and tibial nerve (arrow). Author's collection.

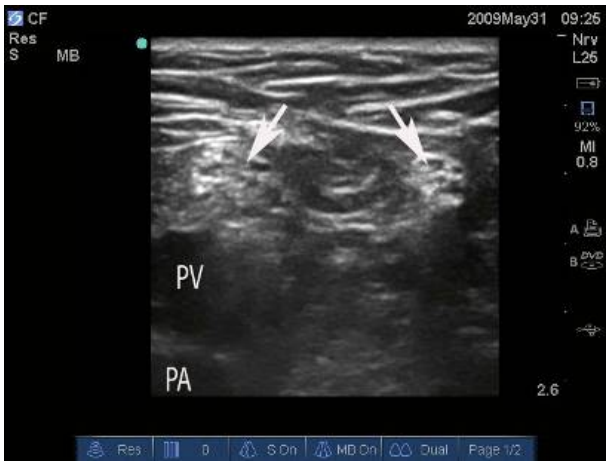


Fig 7-46, B. Popliteal scanning. Image obtained slightly more proximal than the previous one, shows popliteal vein (PV), popliteal artery (PA) and both the tibial and common peroneal nerves (arrows). Author's collection.

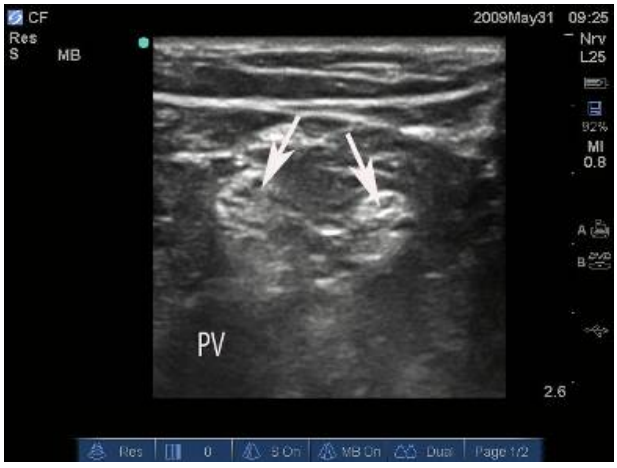


Fig 7-46, C. Popliteal scanning. The probe has been moved more proximally, away from the popliteal crease. Tibial and common peroneal components, shown with arrows, are close to each other. Author's collection.

Needle insertion

The needle can be inserted out of p lane, usually from distal to proximal or in plane from lateral to medial, as shown in figure 7-47.

Fig 7-47. Needle insertion, supine technique. The needle is inserted in plane, from the lateral side in the groove between vastus lateralis and b iceps. (On a m odel with permission).

A needle inserted in pla ne from the lateral side is easily seen in the screen as sho wn in figure 7-48.

Fig 7-48. Popliteal block, in plane technique. The needle (shown with 2 arrows) is seen approaching the sciatic nerve (SN) from the lateral side. The injected local anest hetic is seen as a h ypoechoic (dark) lagoon surrounding the nerve. Author's collection.

Local anesthetic and volume

For surgery 30 m L of 1.5% m epivacaine plus epinephrine 1:400,000 can provide 3-4 hr of anesthesia. For longer cases 30 mL of 0.5% ropivacaine or bupivacaine plus epinephrine can be used. For analgesia 0.2% ropivacaine is adequate.

References

1. Snell RS: Clinical anatomy for medical students, 3rd edition. Boston, MA: Little, Brown and Company; 1986
2. Labat G: Regional anesthesia: Its technique and clinical application. Philadelphia, PA: W.B. Saunders, 1922
3. Shipman P, Walker A, Bichell D: Human skeleton. Cambridge, MA: Harvard University Press; 1985
4. Hall J, Froster-Iskenius U, Allanton J: Handbook of normal physical measurements. Oxford: Oxford University Press; 1989
5. Cunningham's Textbook of Anatomy, 5th edition. Edited by Robinson A. New York, William Wood and Company, 1928, pp 258
6. Hollinshead's Textbook of Anatomy, 5th edition. Edited by Rosse C, Gaddum-Rosse P. Philadelphia, Lippincott-Raven, 1997, pp 641–80
7. Winnie A, Ramamurthy S, Durrani Z, et al. Plexus blocks for lower extremity surgery. Anesthesiology Review 1974; 1: 11-16
8. Franco, CD. Posterior approach to the sciatic nerve in adults: Is Euclidean geometry still necessary? Anesthesiology 2003; 98: 723-728
9. Franco CD, Choksi N, Rahman A, Voronov G, Almachnouk M. A Subgluteal Approach to the Sciatic Nerve in Adults at 10 cm from the Midline. Reg Anesth Pain Med 2006; 31: 215-20
10. Di Benedetto P, Bertini L, Casati A, et al. A new approach to the sciatic nerve block: A prospective, randomized comparison with the classic posterior approach. Anesth Analg 2001; 93: 1040-1044
11. Rogers J, Ramamurthy S: Lower extremity blocks, Regional anesthesia and analgesia. Edited by Brown DL. Philadelphia, PA: W.B. Saunders Company, 1996
12. Mulroy M: Regional Anesthesia, An illustrated procedural guide, 3rd edition. Philadelphia, PA: Lippincott Williams & Wilkins; 2002
13. Enneking FK, Chan V, Greger J, et al. Lower-extremity peripheral nerve blockade: Essentials of our current understanding. Reg Anesth Pain Med 2005; 30: 4-35
14. Vloka JD, Hadzic A, Drobnik L, Ernest A, Reiss W, Thys DM. Anatomical landmarks for femoral nerve block: A comparison of four needle insertion sites. Anesth Analg 1999; 89: 1467-1470
15. Capdevila X, Macaire P, Dadure C, Choquet O, Biboulet P, Ryckwaert Y, D'Athis F. Continuous psoas compartment block for postoperative analgesia after total hip arthroplasty: New landmarks, technical guidelines, and clinical evaluation. Anesth Analg 2002; 94: 1606-1613
16. Orebaugh SL. The femoral nerve and its relationship to the lateral circumflex femoral artery. Anesth Analg 2006; 102: 1859-1862