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, and they never get to be 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, combined with the high success of neuraxial anesthesia, has contributed to make lower extremity peripheral nerve blocks less popular than the techniques of the upper extremity.

The introduction of low molecular weight heparin, with its increased risk for epidural hematoma in association with neuraxial blocks, has produced a renewed interest in lower extremity 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 iliopsoas muscle. As it passes under the inguinal ligament, the nerve is superficial to the iliopsoas muscle. Approximately 3-4 cm below the inguinal ligament, the saphenous 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 femoral artery passes under the inguinal ligament medial to it, followed by the femoral vein medial to the artery (VAN from medial
to lateral). The nerve is covered by the iliac fascia, which separates it from the main vessels, and more superficially by the deep fascia of the thigh (fascia lata).

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 the pelvis is located on the medial side of the psoas muscle. It runs along the lateral pelvis until it reaches the obturator foramen, through which it enters the thigh. In the thigh the nerve divides into anterior and posterior branches. The anterior division runs caudally, in front of the obturator externus and the adductor brevis and behind the pectineus and adductor longus. 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 pierces the obturator externus and passes downwards, behind the adductor brevis and in front of the adductor magnus. 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 sensory branch of the obturator nerve has contributed to the confusion about how much can be obtained from a single block performed at the femoral level (“3-in-1” block).

**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. These two components can be easily identified as two separate nerves in about 11% of the cases. However, even in those cases the two components are surrounded by a common sheath. Therefore, this should not be confused with a true “early” division of the nerve. The real separation of the two components of the nerve, takes place always in the popliteal fossa.

The nerve comes out of the pelvis through the greater sciatic foramen, entering the gluteal region anterior to the piriformis muscle and cephalad to the ischial tuberosity. After reaching the lateral aspect of this bony prominence, the nerve turns vertically downwards to run between the ischium medially and the greater trochanter laterally, as shown in figure 1.

For most of its trajectory in the buttocks, the sciatic nerve runs parallel to the midline, at a distance of about 10 cm in adult patients. With 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 enormously the approach to the sciatic nerve in our practice (see references 5 and 10).

![Fig 1. The sciatic nerve (1) travel parallel to the midline (5). Piriformis muscle (2), ischium (3) and greater trochanter (4) are also](image)

The nerve enters the thigh deep to the biceps femoris muscle. In the thigh, the position of the nerve 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 hamstring 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.

**Subgluteal fold**

The fold that defines the buttocks inferiorly is a fold of the skin. It 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 (see figure 2). 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. Anesthesia of the posterior cutaneous nerve of the thigh is not reliable at this level, because this nerve usually is already superficial (above the fascia) at the subgluteal fold.
**Genitofemoral nerve**

It derives from the ventral rami of spinal nerves L1-L2. It provides some of the innervation of the genital area, part of the medial upper thigh and the skin over the femoral vessels.

**Posterior cutaneous nerve of the thigh**

Also known as posterior femoral cutaneous nerve. It is not a branch of the sciatic nerve, although it has a close relationship with it in the gluteal area, before it becomes a superficial 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 (posterior in anatomic position) to the sciatic nerve. Somewhere caudal to the ischium, the nerve pierces the deep fascia (fascia lata) and becomes a superficial structure. It innervates the lower part of the buttocks as well as the posterior thigh, frequently reaching down as far 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, 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. At a variable point caudal to the knee joint, it pierces the deep fascia to become superficial. Below 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, before terminating around the base of the first metatarsal.

Male and female pelvis issue

The pelvis of the female is adapted to accommodate child bearing and as a result the female inner pelvis is wider than males. 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 (Cunningham’s Anatomy). The thicker bones in the male pelvis compensate for a “roomier” female pelvis (Hollinshead’s Anatomy). According to some anthropologists (3) the human bony pelvis is “surprisingly” similar in males and females at all ages. The 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 bony pelvis. The bony pelvis determines the position of the sciatic nerve in the buttocks.

Clinical pearls

- The nerves of the lower extremity are distant from each other, making it impossible to block the entire extremity from a single injection point.
- The position of the sciatic nerve in the buttocks with respect to the midline is 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 inferior border of the gluteus maximus muscle goes diagonally from medial superior to lateral inferior to insert in the iliotibial tract.
- The gluteus maximus is the only gluteal muscle to cover the sciatic nerve superficially, caudal to the piriformis muscle. Gluteus medius and minimus are located cephalad and lateral to the sciatic nerve.
- The inguinal crease does not correspond deep 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

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**

This can be a superficial block (above the fascia lata) if the block is performed at 2 or more cm distal to the inguinal ligament. More proximally the nerve is deep. This is important because this fascia 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 1 cm caudal to the ASIS. The needle is advanced perpendicular to the skin and directed deep to the fascia where the local anesthetic is injected in a fanwise fashion. A nerve stimulator with pulse duration of 0.3 to 1 ms (300 to 1000 μsec) can be used to elicit a paresthesia in the lateral thigh.

**Local anesthetic and volume**

A volume of 5 to 10 mL of 1% mepivacaine is frequently used. A long acting agent, as ropivacaine, can be used if necessary.

**Complications**

Very rare. Some patients can complain of dysesthesia in the area from minor injury to the nerve. It usually goes away without sequelae.

**FEMORAL NERVE BLOCK**

**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. It is also the point of injection for a “3-in-1” block.

**Point of contact with the nerve**
The nerve is usually approached just below the inguinal crease. However, if possible, the nerve can be approached above the crease, closer to the inguinal ligament. At this level the nerve is more compacted, prior to branching off.

**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. Ultrasound provides usually an excellent image of the nerve and neighboring vascular structures facilitating any technique to block it.

**Patient position and landmarks**

The patient lies supine. If necessary, the back of the bed can be 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 recognized and the trajectory of the artery is marked. 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.

**Nerve stimulator technique**

A 2”, insulated needle usually suffices. The nerve stimulator is set at 1.0 mA, a frequency of 1 Hz and pulse duration of 0.1 msec (100 µsec). The needle is directed 45-degree cephalad and parallel to the femoral artery 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 to about 0.5 mA or less and, if the response is still visible, 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. My own anatomic dissections fail to make the case for this, because the point at which the block is attempted is usually cephalad to the origin of the branch to the sartorius.

**Ultrasound technique**

The femoral nerve is relatively superficial in most of patients. As usual, use a high frequency probe (>12 MHz) to define structures expected to be at less than 3 cm of depth. For deeper structures use less than 10 MHz of frequency which provides deeper penetration and less resolution.

A linear probe at 13-15 MHz can usually provide a good image of the femoral nerve and vessels. The probe is placed parallel to the inguinal crease. The needle can be advanced out of plane with the image of nerve in cross section. The needle can also be advanced in plane with the probe from lateral to medial. The femoral vein is the most medial structure of the neurovascular bundle and is easily collapsible by the probe. The artery is just lateral to the vein.
The nerve is lateral to the artery. There is usually a gap of about 1 cm in between.

**Local anesthetic and volume**

A slow injection of 20 mL of 1% or 1.5% mepivacaine is usually used for this block. Using larger volumes, in an attempt to produce a “3-in-1” block by cephalad spread of local anesthetic, is not supported by the available evidence.

**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**

**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 approaches the nerve after it exits the obturator foramen, below the inguinal ligament.

**Main characteristics**

This is a deep block that requires good anatomical knowledge.

**Patient position and landmarks**

The patient lies supine. The easiest way to do it is to use the femoral artery pulse at the inguinal ligament as the main landmark. The point of needle entrance is found about 4 cm medial to the artery and 2 cm below the inguinal crease.

**Technique**

A 4”, insulated needle connected to a nerve stimulator is advanced perpendicular to the frontal plane. A local twitch from the pectineus and or adductor longus is usually obtained. This is just a direct muscle twitch. Deep to this level, the tip of the needle should reach the nerve eliciting thigh adduction. The current is lowered to 0.5 mA, and if a twitch is still visible, a slow injection is started. If the needle makes contact with the pubis ramus, it is walked off caudally.

**Local anesthetic and volume**
Usually 10-15 mL of 1% to 1.5% mepivacaine or a longer acting agent is used.

**Complications**

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

**LUMBAR PLEXUS BLOCK** (alternatively called “psoas compartment block”)

**Indications**

Its goal is to produce anesthesia of the lateral femoral, femoral and obturator nerves, so it can be used along with sciatic nerve to provide anesthesia of the entire lower extremity. It is also used to provide postoperative analgesia after hip and knee surgery.

**Point of contact with the nerve(s)**

The plexus is accessed deeply in the lumbar area in the space limited by the quadratus lumborum posteriorly (more superficial) and the psoas muscle anteriorly (deeper).

**Main characteristics**

It is the posterior approach of a “3-in-1” block. It is a deep block, in which the needle goes through several layers, including subcutaneous tissue, the mass of paraspinal muscles, and the quadratus lumborum muscle before ending just superficial to the psoas muscle, in the retroperitoneal space.

Because of the depth at which the nerves are located, the operator has little control over the exact location of the needle tip, increasing the potential risk for complications. It is essential that the operator be familiar with the anatomy. The epidural, subdural and intrathecal spaces are very close to the trajectory of the needle and so is the kidney and the iliac vessels. Cases of penetration of the peritoneal cavity with injury of the contents have been reported.

This block should not be performed in obese patients.

**Patient position and landmarks**

The patient is placed in the lateral position with both hips and knees flexed like for neuraxial block. A line joining both iliac crests is drawn (L4-L5 interspace). The posterior superior iliac spine is identified, and a parasagittal line is drawn at this level (perpendicular to the bicrestal line). The point of intersection between the two lines becomes the needle insertion point. Alternatively the point of entrance can be found at 4-5 cm from the midline at the bicrestal line.

**Nerve stimulator technique**
A 4”, insulated needle connected to a nerve stimulator is used. The needle is advanced parallel to the midline, perpendicular to the skin. If the transverse process of L4 is contacted, the needle is “walked off” caudally. A muscle twitch of the femoral nerve or obturator indicates good placement. It is frequent to accept higher currents (around 1 mA) to inject. Thorough aspiration for blood or CSF is performed combined with a slow injection, alternated with frequent aspirations.

**Ultrasound technique**

This is a deep block. Some people use a curved 4-5 MHz probe to delineate the psoas and the anatomy of the lumbar plexus, but it is challenging. We do not perform it routinely.

**Local anesthetic and volume**

A volume of 30-40 mL of 1% mepivacaine or 0.5% ropivacaine can be used. For analgesia the concentration is lowered.

**Complications**

This is the regional anesthesia technique associated with the highest amount of complications. Retroperitoneal hematomas, subdural and intrathecal injection, total spinal, as well as kidney and bowel punctures have been reported.

**Clinical pearls**

- This is a deep block with important potential complications. It is not a block for the novice.
- The anesthesiologist must carefully balance the potential benefits against the risks of complications.

**SCIATIC NERVE BLOCK**

**Classic approach (Labat as modified by Winnie)**

**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 emerging 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 an accurate approach if the operator is able to accurately determine the actual position of the PSIS and GT, disregarding ANY soft tissue (i.e., muscle, bursa, subcutaneous tissue).

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. Marking the GT on the lateral buttock for example, would artificially add length to the PSIS-GT line (soft tissue), making its midpoint artificially 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, which combined with the original Labat’s are known collectively now as the “classic” technique. In order to deal with the several modifications in the length of Labat’s 3-cm perpendicular line, they proposed an additional transverse line extending from the sacral hiatus (SH) to the tip of the greater trochanter, to be added to the PSIS-GT line. This way, the length of Labat’s perpendicular line would be determined by the distance between the two transverse lines, without any need to measure it. Quoting the authors, “with this technique the distance along the perpendicular line will vary with the height of the patient”. This apparent solution has some problems of its own. Because, as discussed earlier, 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). As a result, a taller patient (longer line) would end up with a sciatic nerve located closer to the midline than a shorter 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**

We usually like to use 1.5% mepivacaine plus 1:400,000 epinephrine in a volume of 30-35 mL to provide 3-4 hrs of anesthesia. Ropivacaine 0.5-0.75% 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. 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 usually resolve within 1-2 weeks.

**SCIATIC NERVE BLOCK**

**Franco’s approach**

**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 “surprisingly” similar in males and females at any given age. Variation in hip width reflects a
hormone-dependent, gender-related different pattern of fat deposition. In fact most of the differences in the human bony pelvis are limited to the inner pelvis. 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. The sciatic nerve is about 10 cm from the midline (intergluteal sulcus) in all adults. What remains highly variable is the depth at which the nerve is located and the distance from the nerve to the lateral side of the patient. However, the distance midline-nerve is dictated by the distance midline-ischium. As the bony pelvis stops growing, this distance becomes fixed and unaffected by soft tissue.

Position of the patient and landmarks
This block can be performed in lateral decubitus or prone. 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.

![Fig 3. The patient lies on lateral decubitus. The point of needle entrance is easily found at 10 cm from the midline at about midgluteal level.](image)

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 midpoint of the intergluteal sulcus, from top to bottom, is identified. From this point, the needle insertion point is marked at 10 cm lateral to it (see figure 3). 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.

Nerve stimulator technique
A skin wheal of local anesthetic is raised at 10 cm from the midline in the midgluteal area. A small amount of subcutaneous infiltration, in the line of insertion of the blocking needle, can also be given. A 4”, insulated needle is usually sufficient, although in some cases a 6” needle is necessary. 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 msec (100 µsec).

The needle is advanced slowly and parallel to the midline, until it reaches the gluteus maximus muscle. Usually this is evidenced by a local muscular twitch of the buttock. 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 into 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.

**Ultrasound technique**

The nerve is identified in cross section as usual. Because of the sciatic nerve depth, usually a curved 5-7 MHz probe is needed. The needle can be advanced cephalad out of plane. Injecting small amounts of local anesthetic helps to localize the tip of the needle.

**Local anesthetic and volume**

We commonly use 30-35 mL of 1.5% mepivacaine, usually with 1:400,000 epinephrine for a 3-4 hr duration of anesthesia. Ropivacaine can be used if needed.

**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.

**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 tranverse plane in the buttocks, as shown in figure 1. Di Benedetto’s perpendicular line going caudal and lateral, needs to have the trochanter located significantly higher than the ischium.
2. The subgluteal fold is about 8 cm caudal to the midpoint between ischium and greater trochanter and not 4 cm. On the other hand, being the subgluteal fold so evident, would it suffice to extend the line until it intercepted the subgluteal fold?
3. At the subgluteal fold the three components of the hamstring muscles are practically fused together in one single tendon, without any evident groove in between. More distally in the thigh a groove can be found between biceps and semitendinosus, but it is too subtle to be easily
palpable through several layers of tissue (skin, subcutaneous tissue and thick fascia lata).

4. A groove is visible in most people between the biceps and the iliotibial tract. This groove has nothing to do with the trajectory of the sciatic nerve.

5. The sciatic nerve runs under the biceps femoris and not in a groove between biceps and semitendinosus.

**Technique**

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

**Local anesthetic and volume**

The same as indicated for classic approach

**Complications**

Common to other approaches to the sciatic nerve.

**SCIATIC NERVE BLOCK, SUBGLUTEAL**

**Franco’s approach**

The subgluteal approach can be easily performed at 10 cm from the midline at the subgluteal fold, with the patient lying in lateral decubitus, as shown in fig 4.
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 more likely. Depending on depth, the nerve could 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 or in lateral position. The nerve is visualized in cross section and the needle is advanced either out of plane 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; 31: 215-20). The reason is that the posterior femoral nerve is usually already a superficial nerve (above the fascia) at the level of the subgluteal fold.
2. As shown in fig 7-2, 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.
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 the 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 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 fuses with the fat that fills the popliteal fossa. The fat of the popliteal fossa would “soak” away the local anesthetic, “stealing” it from the nerve surroundings.

**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. 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. The needle insertion point is marked 7-9 cm above the crease. A good orientation is to insert the needle at a distance from the crease that is 1 cm longer than the intertendinous distance.

**Nerve stimulator technique**

A 2”, 22-gauge, insulated needle usually suffices. The nerve stimulator is set at 1-1.5 mA, frequency of 1 Hz and pulse duration of 0.1 msec (100 µsec). 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. 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.

**Ultrasound technique**
Patient is prone. A linear high frequency probe can be used, but a lower frequency probe is usually needed. The probe is placed across the fossa to obtain a cross section of vessels and nerves. It is easier to start scanning at the popliteal crease, where the two nerve components are more superficial. The probe is then moved cephalad from the popliteal crease to identify the point at which both components come together. An alternative method is to find the common peroneal division just medial to the biceps tendon at the crease and follow it proximally toward the main sciatic trunk.

**Local anesthetic and volume**

I believe that a block of the sciatic nerve in the popliteal fossa requires a higher volume than more proximal approaches. As a general rule I give about 10 mL more of anesthetic solution than what I would give the same patient in more proximal locations. This comes to about 35-45 mL of 1.5% mepivacaine or a longer acting agent if needed. When using ultrasound there is no need to use higher volumes, if a good distribution of local anesthetic surrounding the nerve is observed.

**Complications**

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

**POPLITEAL BLOCK, LATERAL APPROACH**

**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 technique. The needle approaches the sciatic nerve from the lateral side, before its two components diverge from each other. The needle is advanced between the biceps (posteriorly) and vastus lateralis (anterioiy) 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.

**Nerve stimulator 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.

**Ultrasound technique**

The patient is placed prone with a slight rotation to the opposite side. The probe is placed across in the popliteal fossa facing anterior. A cross section of the sciatic nerve is obtained. The needle is advanced from the lateral side, in plane with the probe.

**Local anesthetic and volume**

The same than for posterior approach.

**Complications**

The same than for posterior approach.
References