# New Landmarks for the Anterior Approach to the Sciatic Nerve Block: Imaging and Clinical Study

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In this study, we assessed the reliability of the inguinal crease and femoral artery as anatomic landmarks for the anterior approach to the sciatic nerve and determined the optimal position of the leg during this approach. An imaging study was conducted before the clinical study. The sciatic nerve was located twice in 20 patients undergoing ankle or foot surgery, once with the leg in the neutral position and once with the leg in the externally rotated position. The patient was lying supine. A 22-gauge, 150-mm insulated b-beveled needle connected to a nerve stimulator was inserted 2.5 cm distal to the inguinal crease and 2.5 cm medial to the femoral artery and was directed posteriorly and laterally with a 10°–15° angle relative to the vertical plane. The sciatic nerve was located in all patients at a depth of 10.6 ± 1.8 cm when the leg was in the neutral position and 10.4 ± 1.5 cm when the leg was in the externally rotated position (not significant). In the neutral position and in the externally rotated position, the time needed to identify anatomic landmarks was 28 ± 15 s and 26 ± 14 s, respectively (not significant), and the time needed to locate the sciatic nerve was 79 ± 53 s and 46 ± 25 s ($P < 0.006$), respectively. We conclude that the inguinal crease and femoral artery are reliable and effective anatomic landmarks for the anterior approach to the sciatic nerve and that the optimal position of the leg is the externally rotated position.

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Blockade of the sciatic nerve may be used to provide anesthesia to the foot and the lower extremity to the knee. The sciatic nerve can be approached at the pelvic level posteriorly, anteriorly, or laterally. The anterior approach to the sciatic nerve is performed with the patient remaining in the supine position and can therefore be advantageous in situations where patient mobilization is limited. The anterior approach to the sciatic nerve was first described by Beck (1) in 1963. Landmarks for the technique included identification of the greater trochanter, which can be difficult in obese patients or painful in trauma patients. Chelly and Delaunay (2) described a new anterior approach using easy-to-identify landmarks. Nevertheless, both techniques require drawing lines between bony landmarks and perpendicular dissectors.

The inguinal crease and femoral artery can be easily identified, even in obese patients. This study was designed to prospectively evaluate the efficacy of a new anterior approach to the sciatic nerve by using the inguinal crease and femoral artery as landmarks. We also tried to determine whether the best position of the leg for the anterior approach technique was the neutral or the externally rotated position. The study was conducted in two parts. The clinical study was conducted after an imaging study designed to determine the optimal puncture site and needle direction.

## Methods

The two parts of the study were conducted after IRB approval and informed consent had been obtained. The imaging study included an ultrasonography study, a radiological study, a computed tomography scan, and a magnetic resonance imaging study.

In the ultrasonography study, the safe medial distance from the center of the femoral artery to the medial edge of the femoral vein to avoid transfixion of the femoral vein was studied prospectively by using ultrasonographic images in 37 adult patients who were 72 ± 9 yr old, weighed 69 ± 15 kg, and were 162 ± 9 cm tall (values are mean ± SD). The ultrasonography study was performed by use of a Siemens Elegra system (Erlangen, Germany) with a 13-MHz transducer. The leg of the patient was in the neutral position at the time of Doppler examination.

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The Doppler probe was placed 2.5 cm distal to the inguinal crease. The distance between the middle of the femoral artery and the medial edge of the femoral vein was measured in each case. Color Doppler imaging was associated with real-time ultrasonography in all cases.

The radiological study of the hip was performed in 30 adult patients, who were 59 ± 15 yr old, weighed 68 ± 15 kg, and were 167 ± 8 cm tall (values are mean ± SD). The patients were lying supine and were scheduled to undergo lower-limb arteriography. A metallic landmark was put on the inguinal crease. A graduated slide rule was put on the patient's hip. The aim of the radiological study was to assess the distance between the inguinal crease and the lesser trochanter. The distance was assessed from a point located on the inguinal crease 2.5 cm medial to the femoral artery.

The second part of the study was a prospective, randomized clinical study. Twenty ASA physical status I and II patients scheduled to undergo ankle or foot surgery were enrolled. Exclusion criteria included neurologic or neuromuscular disease and skin infection at the site of needle insertion. All the blocks were performed by the first author. Patients were positioned supine. Standard monitoring was used. All patients were sedated with IV propofol (0.5 mg/kg) before performance of the sciatic nerve block. Oxygen was delivered via face mask. In every patient, the sciatic nerve was located twice by using a nerve stimulator (Digistim; Organon-Technica, Durham, NC). The leg of the patient was put either in the neutral position or in the externally rotated position. The leg was placed in the externally rotated position with a passive rotational effort. The degree of rotation was not noted. Computer-generated randomization determined the order of position of the leg for location of the sciatic nerve (Microsoft Excel; Microsoft, Redmond, WA).

The inguinal crease was identified. The femoral artery was palpated at the level of the inguinal crease and drawn on the skin. According to the results of the imaging study, a line was drawn parallel to the femoral artery 2.5 cm medially. The puncture site was located on this line, 2.5 cm distally to the inguinal crease (Fig. 1). The time needed to identify the anatomic landmarks was recorded.

After standard skin preparation and after subcutaneous anesthesia at the puncture site with lidocaine 1% 1 mL, the leg of the patient was put in the first position determined by the randomization list. A 22-gauge, 150-mm insulated b-bevel needle (Stimuplex; B-Braun, Boulogne-Billancourt, France) connected to the nerve stimulator was inserted and directed posteriorly and laterally with a 10°–15° angle relative to the vertical plane (Fig. 2). At a depth of 5 cm, the nerve stimulator was set to deliver a current of 5.0 mA.

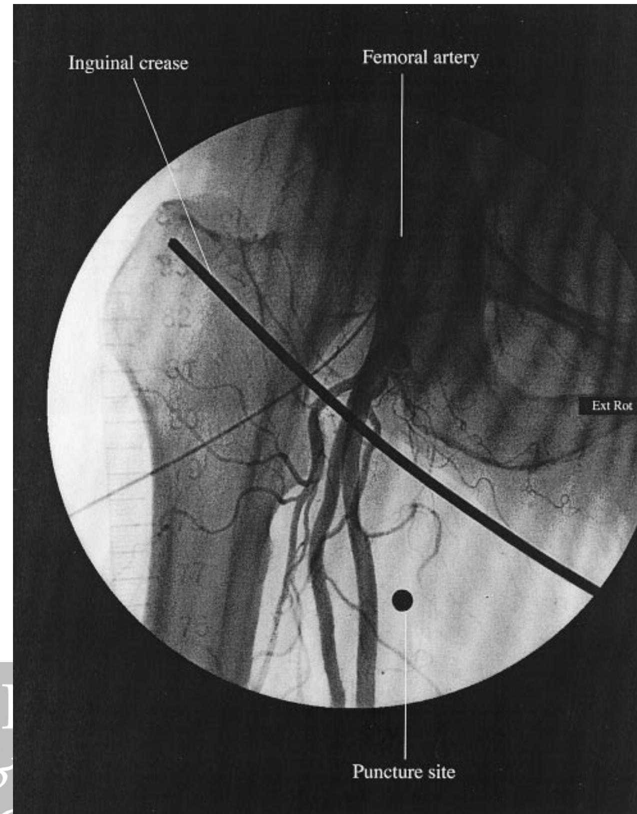


**Figure 1.** Radiograph of the hip. Metallic landmarks are placed on the inguinal crease and at the level of the puncture site, 2.5 cm medial to the femoral artery and 2.5 cm distal to the inguinal crease.

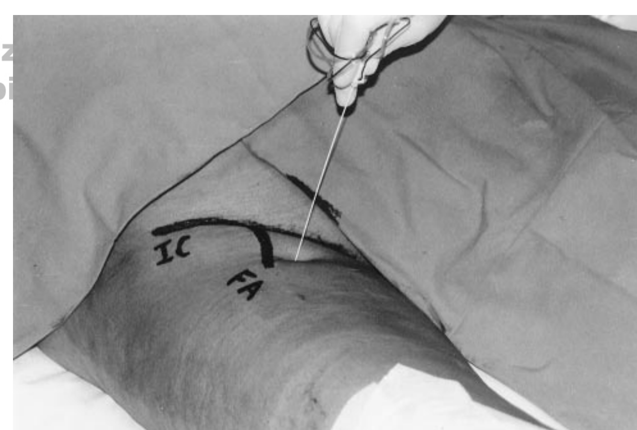


**Figure 2.** Performing the anterior approach to the sciatic nerve. The needle is inserted posteriorly and laterally with a 10°–15° angle relative to the vertical plane, 2.5 cm medial to the femoral artery and 2.5 cm distal to the inguinal crease. FA = femoral artery; IC = inguinal crease.

Within a depth of 10–15 cm, the sciatic nerve was identified (Fig. 3) via stimulation and muscular responses of one of its two components: plantar flexion or inversion of the foot for the tibial nerve (TN) and dorsiflexion or eversion of the foot for the common

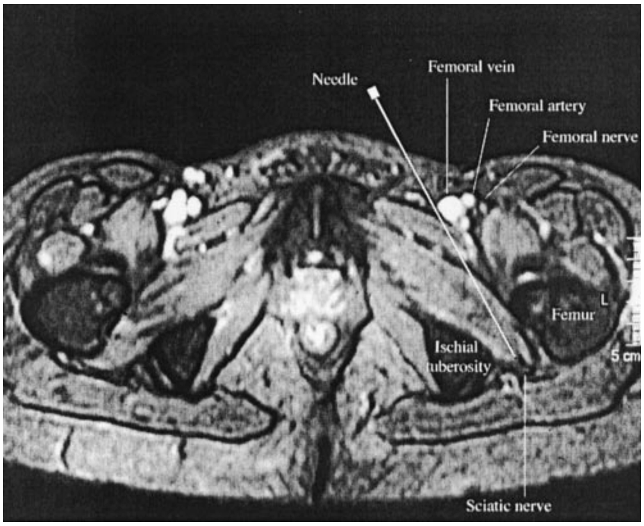


**Figure 3.** Transverse T2-weighted magnetic resonance image of the thigh 2.5 cm distal to the inguinal crease, showing the 150-mm needle introduced anteriorly to the sciatic nerve block with use of the femoral artery and the inguinal crease as landmarks.

peroneal nerve (CPN) (3). The current was then decreased until the muscular response of either the TN or the CPN was elicited at 0.5- to 0.7-mA impulses delivered at a frequency of 1 Hz (2). At that time, the stimulator was switched off, and the needle was retracted to the level of the skin. The leg was put in the second position, and the same procedure was repeated. After localization of the sciatic nerve during the second procedure, the local anesthetic solution was injected over a 2-min period. All patients received mepivacaine 1.5% 30 mL (Astra, Rueil-Malmaison, France).



After negative blood aspiration and after a 1-mL test dose to exclude intraneural injection, the local anesthetic was injected by increments of 5 mL (2). To allow tourniquet placement at the level of the calf, the saphenous nerve was blocked by injecting 5 mL of the same anesthetic solution in a subcutaneous ring from the medial aspect of the tibia to the border of the patellar tendon (4). If no muscular response was obtained at a depth of 15 cm or if the needle ended on the lesser trochanter, the needle was retracted to the level of the skin and reintroduced slightly more medially. The incidence of vascular puncture, the first component of the sciatic nerve stimulated, the distance from the skin to the sciatic nerve, the number of attempts, and the time to perform the block were recorded during each procedure.

Motor and sensory blockade were assessed every 5 min up to 45 min after performance of the block and every hour after surgery by using a three-point scale rating (2, no block; 1, paresis or hypoesthesia; 0, paralysis or anesthesia). Motor blockade was assessed by asking the patient to perform dorsiflexion (CPN) or plantar flexion (TN) of the foot. Sensory blockade was assessed for TN (plantar aspect of the foot) and CPN (dorsal aspect of the foot) by pinprick with a 20-gauge blunted needle (5). Recovery time was determined by recovery of sensory and motor function in the territories of the CPN and the TN. Patients were observed after surgery during the first 72 h for assessment of sensory or motor deficit.

Data are expressed as mean ± SD or mean (range) and were analyzed with $\chi^2$ and paired Student's *t*-tests, as appropriate. $P < 0.05$ was considered significant. Times to onset and completeness of the sensory and motor blockades were analyzed with the Mann-Whitney ranked sum test. All analyses were performed with the statistical package StatView (StatView for Windows and Macintosh Version 5.0; Abacus Concepts, Inc., Berkeley, CA).

## Results

In the ultrasonography study, the distance between the center of the femoral artery and the medial edge of the femoral vein was 1.5 ± 0.2 cm (0.9–2 cm) in all 37 patients. Therefore, 2.5 cm medial to the center of the femoral artery was a safe distance to avoid transfixion of the femoral vein at the inguinal crease level.

In the radiological study, the distance between the inguinal crease and the lesser trochanter was 1.8 ± 0.4 cm (1–2.3 cm) in all 30 patients. Therefore, 2.5 cm distal to the inguinal crease was a safe distance to avoid encountering bone (Fig. 1).

For the clinical study, 18 patients were women and 2 were men. Their ages ranged from 18 to 88 yr (mean, 58 yr), their weight ranged from 37 to 86 kg (mean, 70 kg), and their height ranged from 152 to 175 cm (mean, 163 cm). The time needed to identify anatomic landmarks was 28 ± 15 s when the leg was in the neutral position and 26 ± 14 s when the leg was in the externally rotated position (not significant). The time needed to locate the sciatic nerve was 79 ± 53 s when the leg was in the neutral position and 46 ± 25 s when the leg was in the externally rotated position ($P < 0.006$). Location of the sciatic nerve was successful in all patients, independent of the leg position. When the leg was in the neutral position, the first attempt at location of the sciatic nerve was successful in 7 (35%) of 20 patients. The first attempt at location of the sciatic nerve was successful in 9 (45%) of 20 patients when the leg was in the externally rotated position. The number of attempts at location of the sciatic nerve was 3 (1–7) when the leg was in the neutral position and 2 (1–5) when the leg was in the externally rotated position (not significant). The distance from the skin to the sciatic nerve was 10.6 ± 1.8 cm when the leg was in the neutral position and 10.4 ± 1.5 cm when the leg was in the externally rotated position (not significant). The TN was first stimulated in 11 (55%) of 20 patients when the leg was in the neutral position and 17 (85%) of 20 patients when the leg was in the externally rotated position.

The sensory block lasted 4.1 h (2.6–5.5 h), whereas the motor block lasted 3.6 h (1.6–5.1 h). A complete sensory block was obtained 13 min (5–17 min) after the injection, whereas a complete motor block was obtained after 27 min (12–45 min). Surgical anesthesia was successful in all cases.

No blood aspiration or paresthesia occurred during performance of the block. During the block, 2.5 cm medial to the femoral artery always cleared the femoral vein irrespective of the patient's size. No sensory or motor deficits were observed after surgery during the first 72 h of assessment.

## Discussion

The anterior approach was first described by Beck (1) in 1963. A line was drawn from the anterosuperior iliac spine to the pubic tuberosity. The greater trochanter was identified, and a line parallel to this anterosuperior iliac spine/pubic tuberosity line was drawn medially. A perpendicular dissector was drawn from the middle of the anterosuperior iliac spine/pubic tuberosity line. The site of introduction of the needle was at the intersection of this perpendicular dissector, with the line parallel to the anterosuperior iliac spine/pubic tuberosity line. This approach may be difficult because the greater trochanter is not always easily identified, e.g., in obese patients.



Chelly and Delaunay (2) described a new anterior approach that did not require identification of the greater trochanter. A line was drawn between the inferior border of the anterosuperior iliac spine and the superior angle of the pubic symphysis tubercle. From this anterosuperior iliac spine/pubic symphysis line, a perpendicular dissector line was drawn in the middle and extended 8 cm caudad to define the site of introduction of the needle (2). Identification of the sciatic nerve was successful in the 22 patients of the study.

Nevertheless, both techniques require drawing lines between bony landmarks and perpendicular dissectors. Subsequently, even a small error in bony landmark identification may lead to important variations in defining the site of needle insertion.

Our technique is based on the use of the inguinal crease and femoral artery—both easily identified, even in obese patients. A detailed knowledge of the anatomic area where the nerve is going to be blocked is extremely valuable to clinicians. Anatomic studies on cadavers are certainly useful; however, cadaveric dissection is complicated by distortion of the normal anatomy. Imaging studies are, therefore, of great interest. Our imaging study showed that the sciatic nerve could be reached by a needle introduced anteriorly, 2.5 cm medial to the femoral artery and 2.5 cm distal to the inguinal crease. Respective positioning of the femoral artery and vein related to leg placement was not studied in the ultrasonographic study. Therefore, whether the safe distance from the femoral artery for performing the block is dependent on leg placement is unknown. Although distances determined from radiological examination did not consider interpatient variability, these findings were confirmed by clinical experience.

The operator was not blinded. Therefore, he possibly performed the second approach on the basis of the experience of the first one. A more valid comparison might have been obtained by a randomization of two groups of patients. Further study would be valuable to assess this hypothesis. Use of 5 mA for stimulation might induce patient discomfort. Patient satisfaction and experience of pain during needle insertion were not assessed, although sedation was used during needle insertion. Even if no guidelines are available, it might be valuable not to increase the intensity of the current more than 3.0 mA. Patient discomfort is a potential disadvantage of the anterior approach, because the needle has to traverse a longer distance into the muscle layers with this approach. This longer distance might explain potential multiple attempts before success.

Vloka et al. (6) demonstrated that external rotation of the leg facilitates an anterior approach to the sciatic nerve when the puncture site is 2 cm inferior to the lesser trochanter. They demonstrated that progressive medial reinsertion of the needle with slight lateral angulation is usually required to reach the sciatic nerve in the classical anterior approach, but multiple attempts and medial reinsertion of the block needle increase the risk of puncturing the femoral nerve, femoral artery, or both (6). The results of the imaging study showed that the puncture site was below that described by Chelly and Delaunay (2) and inferior to the lesser trochanter (Fig. 1) and that it is unlikely that the femoral nerve, the femoral artery, or the femoral vein would be punctured when this approach is used. External rotation of the leg induces external rotation of the medial ridge of the triangle-like profile of the femoral shaft and swings the ridge anterolaterally. Thus, it opens the plane required for the block needle to pass medially to the femur (6).

The use of a nerve stimulator for the anterior approach allowed Chelly and Delaunay (2) to identify the sciatic nerve in every patient. In the study of Davies and McGlade (7), identification of the sciatic nerve with the posterior approach was positive in <50% of the patients with use of paresthesia but was successful in 92% with use of a nerve stimulator. Therefore, we decided to perform the blocks with a nerve stimulator.

The time of onset and duration of the block were similar to those reported by Chelly and Delaunay (2) when mepivacaine 1.5% was used, as was the distance from the skin. Although no vessel puncture occurred in the study, a much larger sample of patients would be necessary to assess the risk of puncturing the gluteal artery when using this approach (Fig. 3).

We conclude that the inguinal crease and the femoral artery are reliable and effective anatomic landmarks for the anterior approach to the sciatic nerve and that the optimal position of the leg is the external rotation position. This anterior technique is an interesting alternative to the traditional approaches, especially in obese patients and those with limited mobility.

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