A Simple Approach to the Sciatic Nerve That Does Not Require Geometric Calculations or Multiple Landmarks

Anupama Wadhwa, MD,* Heather Tlucek, DO,* and Daniel Sessler, MD†

BACKGROUND: Blockade of the sciatic nerve is necessary for complete analgesia of the lower extremity using peripheral nerve blocks. We identified the sciatic nerve in relation to the ischial tuberosity in fresh cadaver dissections as well as in patients to compare sciatic nerve blockade using the conventional approach versus our experimental approach. Specifically, we tested the hypothesis that in patients in the prone position, our novel approach (changing the point of needle insertion to 3 cm lateral from the ischial tuberosity) requires fewer needle passes and less time.

METHODS: The location of the sciatic nerve in relation to the ischial tuberosity was identified in 20 cadavers; this information was used to devise an alternative approach to the sciatic nerve. In a randomized, controlled, crossover patient study, we compared a prone subgluteal approach (conventional approach, n = 19) with an experimental approach with the insertion point 3 cm lateral to the midpoint of ischial tuberosity with patients in prone position (n = 20). We recorded the number of passes and the time taken to obtain an initial sciatic nerve twitch at a current of 1.5 mA and a twitch at <0.5 mA.

RESULTS: The sciatic nerve averaged 2.8 ± 0.4 cm from the midpoint of ischial tuberosity in cadavers in prone position. When needles were inserted from surface landmarks, those inserted through the experimental insertion point consistently transected the sciatic nerve. In contrast, needles inserted through the conventional approach were 2.27 ± 0.47 cm lateral to the sciatic nerve. Clinically, our experimental approach required fewer passes to obtain a sciatic nerve twitch than the conventional approach. We were unable to obtain a twitch in 55% of patients with the conventional approach and converted them to the experimental approach. In patients originally assigned to the experimental approach and those switched to the experimental approach after failure with the conventional approach, we obtained the first sciatic nerve twitch in 1 pass in 45% of the patients and in 3 passes in 85%.

CONCLUSIONS: We describe a landmark that is more effective for identifying the location of the sciatic nerve than that used for the prone subgluteal approach. (Anesth Analg 2010;110:958–63)

L eg and foot analgesia requires that the sciatic nerve be blocked. The first approaches to the sciatic nerve required multiple calculations and the needle had to pass through the bulky gluteus maximus.1,2 Other proposed approaches include the parasacral approach of Mansour,3 the anterior approach of Chelly and Delaunay,4 the infragluteal-parabiceps approach of Sukhani et al.,5 and the subgluteal approach of Di Benedetto et al.6

The subgluteal approach is currently popular. In patients lying semiprone (Sims position), the midpoint of a line joining the ischial tuberosity and greater trochanter identifies the anchor point for a 4-cm perpendicular line going caudad, the end of which is the insertion point for the needle. The subgluteal approach has the advantages of reducing the amount of muscle tissue traversed by the needle and that there are no major adjacent vascular structures. In our experience, however, this approach does not consistently predict the location of the sciatic nerve.

Upon reviewing previous dissections (Fig. 1A), we noticed that the sciatic nerve appeared closer to the ischial tuberosity than the greater trochanter. Thus, we conducted a 2-part study. Initially, we dissected the sciatic nerve in fresh cadavers to determine the relationship among the sciatic nerve, external landmarks, the ischial tuberosity, and the greater trochanter. Based on these results, we developed a novel and simple approach for patients in prone position, which we compared with the subgluteal approach. Specifically, we tested the hypothesis that in patients in the prone position, fewer attempts are required to obtain an adequate motor response to electrical stimulation of the sciatic nerve when using a fixed distance (3 cm) lateral from the midpoint of the ischial tuberosity as the insertion point than when the prone subgluteal method is used (midpoint of ischial tuberosity and greater trochanter projected 4 cm caudad).

CADAVER STUDY

Methods

Twelve fresh cadavers of varying body habitus were positioned prone. All dissections were performed by one of the

From the *Department of Anesthesiology and Perioperative Medicine, University of Louisville, Louisville, Kentucky; and †Department of Outcomes Research, The Cleveland Clinic, Cleveland, Ohio.

Accepted for publication November 2, 2009.

Supported by the Joseph Drown Foundation (Los Angeles, CA).

Anupama Wadhwa is a member of the Outcomes Research Consortium.


Address correspondence and reprint requests to Anupama Wadhwa, MD, Department of Anesthesiology and Perioperative Medicine, University Hospital, 530 S. Jackson St., Louisville, KY 40202. Address e-mail to anwadh01@louisville.edu.

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DOI: 10.1213/ANE.0b013e3181c95b4e

958 www.anesthesia-analgesia.org

March 2010 • Volume 110 • Number 3
authors (HT). Of the 12 cadavers, the sciatic nerve had previously been dissected on one side in 4 of them. Therefore, we were only able to dissect one nerve in those 4. We dissected 20 nerves in total.

Before dissection, the investigator palpated the sides of the ischial tuberosity with her index and middle fingers and then rolled her index finger over it to identify the most prominent part of the ischial tuberosity where a Kay wire was pinned. The greater trochanter was also identified. A line was drawn joining these 2 bony landmarks. The midpoint of this line was identified and another line starting at this point was extended 4 cm caudal. This was the point for needle insertion using the conventional subgluteal approach. We also identified a point 3 cm lateral from the Kay wire on this line and extended this for 4 cm caudally. This point was used as the experimental point of insertion.

Once we confirmed our hypothesis in the first few cadavers, we performed further investigation with insulated needles. In a subset of 6 cadavers in prone position, insulated needles were inserted via the skin at the 2 insertion points (prone subgluteal and experimental). The distances between the 2 points and from the tip of each needle to the sciatic nerve were determined.

The gluteal areas were then dissected from the gluteal cleft to the lateral margins of the greater trochanter. The gluteus maximus muscle was reflected laterally, and the ischial tuberosity and greater trochanter were identified. The sciatic nerve was identified (Fig. 1B). We measured the distance from the midpoint of ischial tuberosity to the midpoint of sciatic nerve, lateral border of ischial tuberosity to midpoint of sciatic nerve, and midpoint of ischial tuberosity to medial border of greater trochanter. We used the medial border of the greater trochanter instead of the midpoint because we also wanted to determine whether the sciatic nerve was lateral to the midpoint of these 2 structures.

**Results**

The mean height of the cadavers was 65 ± 3 cm. The average distance of the midpoint of the sciatic nerve to the midpoint of the ischial tuberosity was 2.8 ± 0.4 cm (Table 1). The distance between points described by the conventional subgluteal approach and the experimental approach was 2.3 ± 0.5 cm. The distance from the midpoint of ischial tuberosity to medial aspect of greater trochanter was 7.2 cm; thus, the midpoint of these 2 points identified a point lateral to that identified with the conventional approach. A needle inserted through the experimental insertion point consistently transected the sciatic nerve. In contrast, needles inserted through the prone subgluteal approach were 2.27 ± 0.47 cm lateral to the sciatic nerve.

**CLINICAL STUDY**

**Methods**

With approval of the Human Studies Committee of the University of Louisville and patient written informed consent, we recruited 40 patients between 18 and 80 years of age. All were ASA physical status I-IV, who were scheduled for lower limb surgery and agreed to receive peripheral nerve blocks as part of their anesthetic management. Patients with a history of severe peripheral neuropathy or nerve injury were excluded.

Twenty patients per group provided a 90% power to detect differences of 2 needle passes between groups in the median number of attempts using a Mann-Whitney rank sum test and assuming a standard deviation of about 1.9 for the number of attempts for each group. Forty consecutive patients were randomized into 2 study groups of 20 patients per group: conventional or experimental.
approach (described below). Computer-generated randomizations were provided to the investigators in sequentially numbered, sealed opaque envelopes.

Nerve blocks were performed in the holding area before patients were taken into the operating room (OR). They were sedated with midazolam 1 to 5 mg, titrated to keep the patient calm. Fentanyl was given if patients reported any preexisting pain or if they reported pain with muscle twitching. Oxygen was supplemented with a nasal cannula at 2 to 4 L/min. A nurse measured heart rate, noninvasive arterial blood pressure, and \( \text{Sao}_2 \) every 5 minutes during the placement of block and then every 2 minutes after the local anesthetic was injected throughout the procedure.

The attending anesthesiologist (AW) marked the landmarks for both the conventional and experimental approach to the sciatic nerve with the patient in prone position before the randomization envelope was opened. This differs from the original Di Benedetto approach in that the patients were in semiprone position in the original study. The landmarks were as follows:

- Conventional approach: A sciatic nerve block was attempted with an insertion point based on the landmarks described by Di Benedetto et al.\(^6\) The midpoint of the ischial tuberosity and greater trochanter were identified, and a line was drawn joining these 2 bony landmarks. Another line was drawn perpendicular from the midpoint of that line and extended caudally for 4 cm; this defined the initial needle insertion point for this group.

- Experimental approach: The midpoint of the ischial tuberosity was identified by external palpation of both sides of the ischial tuberosity between the middle and index fingers. Another point was identified 3 cm lateral to this point on the line drawn previously. A second line was extended perpendicular caudally to 4 cm, which defined the initial needle insertion point for this group.

The first author (AW) performed all the sciatic nerve blocks. A 6- or 10-cm needle, depending on patient size, was inserted at a 45° angle to the skin with a cephalad and anterior orientation within the parasagittal plane at the designated insertion point. The stimulation frequency was set at 2 Hz at a current of 1.5 mA. An investigator who was blinded to needle insertion site observed the foot for tibial or common peroneal motor responses. If no motor response was observed, the needle was withdrawn and reinserted slightly medially or slightly laterally. Needle angulation was progressively increased first medially and then laterally with each pass for a maximum of 6 to 8 passes. When a sciatic motor response at 1.5 mA was obtained, the needle was adjusted as necessary to obtain a brisk plantar flexion or an inversion or dorsiflexion of the foot until the current was reduced to <0.5 mA. The type of response was not recorded. Once sciatic nerve motor responses were visible, \( \text{Sao}_2 \) was observed continuously throughout the block procedure. If \( \text{Sao}_2 \) dropped to <90%, 100% oxygen was supplied.

A complete block was defined as one associated with a total score of 5 combining the sensory and motor blockade in the distributions of both the tibial and peroneal branches of the sciatic nerve. The sensory block was tested with ice in the distribution of the posterior cutaneous nerve of the thigh and the superficial peroneal and the tibial nerves. A 3-point scale was used: 1 = normal sensation (very cold), 2 = analgesia (ice felt, but not cold), and 3 = anesthesia (ice not felt at all). The motor block was assessed on a 3-point scale: 0 = normal strength (no discernible weakness), 1 = paresis (diminished movement), and 2 = paralysis (no movement at all). This scale was used previously for a similar study.\(^5\) A blinded investigator (KW) assessed plantar flexion (representing tibial nerve component) and dorsiflexion of the foot at the ankle (representing peroneal nerve component) and scored it. The block was assessed every 2 minutes for 10 minutes and then at 15 and 30 minutes. Patients were taken to the OR once the block was established. If the patients were taken to the OR before the 30-minute assessment was done, those assessments were done in the OR.

If required for the surgical procedures, residents in the department at the University of Louisville performed femoral nerve block in the inguinal area or saphenous nerve blocks at the level of tibial tuberosity or above the medial malleolus in addition to the sciatic nerve block.

Additional sedation was provided as necessary in the OR with midazolam (1–2 mg, up to 5 mg), fentanyl (up to 100 \( \mu \)g), and propofol infused at a rate not exceeding 100 \( \mu \)g \( \cdot \) kg\(^{-1} \) \( \cdot \) min\(^{-1} \). Patients who did not have complete anesthesia at the surgical site at the end of a 30-minute period from the injection of local anesthetic in either the sciatic or femoral block were given general anesthesia.

Patient characteristics such as age, weight, sex, and ASA physical status were recorded. A timer was started after the investigator performing the block had inserted the needle through the skin only. The blinded investigator recorded the time from insertion of needle until the first sciatic nerve response and the time required to obtain a sciatic nerve response at 0.5 mA. The number of passes required to achieve a motor response was noted, as was the need to switch to the alternative needle insertion site by the unblinded investigator. In addition, we recorded the depth of the needle at which the injection was made, current intensity at needle positioning, duration of surgery, and tourniquet time when one was used.

**Statistical Analysis**

Our primary outcome was the number of passes required to obtain an adequate sciatic nerve response, including the attempts using the method to which the patient was randomized and the attempts at using the alternate method, if the patient crossed over. The randomized groups were compared on the number of passes using the Mann-Whitney rank sum test where patients who did not achieve the desired block after the maximal number of attempts, or who dropped out for whatever reason before reaching the block, were considered to be censored at the last failed attempt.

Secondary outcomes included the number of times an alternate approach was required and the time required to...
achieve surgical block. Groups were compared on secondary outcomes using Mann-Whitney rank sum tests or t tests, as appropriate. \( P < 0.05 \) was considered statistically significant for each hypothesis.

**Results**

The data sheets for one patient in the conventional approach group were lost; consequently, the results from only 19 of 20 patients were included in the statistical analysis for this group. All 20 patients randomized to the experimental group completed the study; accordingly, data from all 20 participants were included in the analysis. The physical characteristics and surgical procedures of the patients were similar in the 2 groups (Table 2).

Sciatic nerve twitches were never obtained in 11 of 19 patients (55\%) within 6 to 8 passes in the conventional group. As a result, these patients were converted to the experimental approach. For one of these patients, a sciatic nerve twitch was not obtained even with the experimental approach. For one of these patients, a sciatic nerve twitch was not obtained even with the experimental approach. For one of these patients, a sciatic nerve twitch was not obtained even with the experimental approach. For one of these patients, a sciatic nerve twitch was not obtained even with the experimental approach. Therefore, these patients were converted to the experimental approach. For one of these patients, a sciatic nerve twitch was not obtained even with the experimental approach. In contrast, none of the patients in the experimental group was converted to the conventional approach. In contrast, none of the patients in the experimental group was converted to the conventional approach. In contrast, none of the patients in the experimental group was converted to the conventional approach. In contrast, none of the patients in the experimental group was converted to the conventional approach. In contrast, none of the patients in the experimental group was converted to the conventional approach.

because a sciatic nerve twitch was obtained in fewer than 6 passes in all 20 patients (Table 3).

The median number of passes attempted to obtain the first sciatic nerve twitch was greater in the conventional group compared with the experimental approach (Table 3). The sciatic nerve was reached at a shorter distance with the experimental approach than with the conventional approach (74 ± 11 vs 83 ± 12 mm, \( P = 0.043 \)). Among the conventional-approach patients in whom a twitch was obtained, the needle had to be angled medially in each case.

The median time taken to obtain the first sciatic nerve twitch at a 1.5-mA current was greater in the conventional group compared with the experimental group (\( P < 0.001 \), Mann-Whitney rank sum test) (Table 3). For those patients in the conventional group who had to be converted to the experimental approach, the time to first sciatic nerve twitch at 1.5 mA includes the time spent on both approaches. Time-to-twitch at a 1.5-mA current is shown for the 2 approaches as both scatter and box plots (Fig. 2).

The median time taken to obtain sciatic nerve twitches at \( \leq 0.5 \) mA was also greater for the conventional group compared with the experimental group Mann-Whitney rank sum test) (Table 3). For patients in the conventional group who had to be converted to the experimental approach, the time to first sciatic nerve twitch at \( \leq 0.5 \) mA includes the time spent on both approaches. Time-to-twitch at \( \leq 0.5 \) mA current is shown for the 2 approaches as both scatter and box plots (Fig. 3). The median overall time spent

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**Table 2. Patient Characteristics**

<table>
<thead>
<tr>
<th></th>
<th>Conventional (n = 19)</th>
<th>Experimental (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>44 ± 11</td>
<td>41 ± 11</td>
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<tr>
<td>Sex (male/female)</td>
<td>11/8</td>
<td>10/10</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>170 ± 10</td>
<td>173 ± 10</td>
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<tr>
<td>Weight (kg)</td>
<td>80 ± 26</td>
<td>92 ± 30</td>
</tr>
<tr>
<td>ASA physical status</td>
<td>3/11/4</td>
<td>3/11/6</td>
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<tr>
<td>(I/II/III)*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time of surgery (min)</td>
<td>61 ± 40</td>
<td>79 ± 50</td>
</tr>
<tr>
<td>Type of surgery (number of patients)</td>
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<td></td>
</tr>
<tr>
<td>Foot/heel debridement</td>
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<td>2</td>
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<td>Total knee replacement</td>
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<td>4</td>
</tr>
<tr>
<td>Amputation</td>
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<td>2</td>
</tr>
<tr>
<td>Knee arthroscopy</td>
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<td>3</td>
</tr>
<tr>
<td>Open reduction,</td>
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<td>6</td>
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<tr>
<td>internal fixation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tendon repair</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Incision and drainage</td>
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<td>0</td>
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<tr>
<td>Toe repair</td>
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<td>1</td>
</tr>
<tr>
<td>Hardware removal</td>
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<td>0</td>
</tr>
<tr>
<td>Muscle flap</td>
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<td>0</td>
</tr>
<tr>
<td>Tissue excision</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Data presented as number of patients or mean ± sd. There were no significant differences between groups.

* Missing data.

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**Table 3. Major Outcomes**

<table>
<thead>
<tr>
<th></th>
<th>Conventional (n = 19)</th>
<th>Experimental (n = 20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Successful placement (Y/N)</td>
<td>8/11</td>
<td>20/0</td>
</tr>
<tr>
<td>Number of passes</td>
<td>5 (5, 6)</td>
<td>2 (1, 3)</td>
</tr>
<tr>
<td>Number of passes (1/2/3/≤4)</td>
<td>0/1/1/17</td>
<td>9/5/3/3</td>
</tr>
<tr>
<td>Time to first sciatic nerve twitch at 1.5 mA (s)</td>
<td>114 (53, 140)</td>
<td>23 (10, 46)</td>
</tr>
<tr>
<td>Time to first sciatic nerve twitch at ≤0.5 mA (s)</td>
<td>139 (122, 176)</td>
<td>61 (34, 96)</td>
</tr>
<tr>
<td>Threshold stimulating current accepted before local anesthetic injection</td>
<td>0.31 ± 0.15</td>
<td>0.39 ± 0.07</td>
</tr>
</tbody>
</table>

Data presented as number of patients or mean (1st quartile, 3rd quartile).

* Includes data from patients in which a twitch was obtained with the conventional approach (n = 9).

† Mann-Whitney rank-sum test.

‡ Unpaired, t-test.
Simplified Approach to the Sciatic Nerve

In our clinical study, the onset of block was almost 7 minutes quicker in patients receiving blocks by the experimental approach, even though the lowest intensity to stimulate the sciatic nerve achieved on the nerve stimulator was similar in both groups. This may have occurred because the motor response is achieved near the center of the nerve in the experimental approach but on the nerve’s lateral border in the conventional approach. The onset of block with the experimental approach using 0.5% ropivacaine was comparable with the onset of block in previous studies using 0.75% ropivacaine with the conventional approach in lateral position.11 We assume this is either because of the closer proximity to the center of the nerve or the larger volume we used (40 vs 30 mL).

One of the limitations of our study is that the patients were placed in prone position even though the Di Benedetto approach was described with the patients in the semiprone position.11–13 We used the prone position because our dissections were all performed in this position; it is difficult to place cadavers in Sims position. It is possible that the sciatic nerve is more medial (approximately 3 cm from the ischial tuberosity) in the prone position and more lateral in the semiprone position with the thigh flexed, which explains our low success rate with the prone subgluteal approach. Also, 3 of the 6 times, the needle was targeted laterally. Thus, the medial angulation was attempted a maximum of 4 times, which also explains the higher failure rate in our study compared with that in routine clinical practice. Another limitation was that we did not collect data for incidence of temporary or permanent nerve injuries. A final limitation is that one anesthesiologist did all the nerve blocks.

The median time to obtain the first sciatic nerve twitch at a 1.5-mA current was 21 seconds with the experimental approach. In patients with a successful sciatic nerve twitch with conventional approach, the needle was angulated medially after the first pass. In contrast, we achieved the twitch in the first attempt in 11 patients, slightly medial in 6 patients, and slightly lateral in 3 patients with the experimental approach. Thus, even from a surface landmark that is 45 mm medial to the conventional landmark, the successful twitch was obtained slightly medial in almost one-third of the patients; we believe this confirms the superiority of this landmark to predict the location of the sciatic nerve.

In summary, we describe a simple landmark-based technique for sciatic nerve block at the subgluteal level that requires only one landmark. Needle insertion 3 cm lateral to the midpoint of ischial tuberosity is a more accurate landmark than the midpoint of greater trochanter and ischial tuberosity when patients are in prone position.

**DISCUSSION**

Improved landmarks that more accurately predict the position of the targeted nerve or plexus potentially will decrease the number of needle insertions and the time to perform peripheral nerve blocks as well as improve patient comfort. Identification of accurate correlations of nerves with bony or soft tissue landmarks helps to identify structures more easily; however, bony landmarks may have the advantage of better visualization with ultrasound than soft tissue landmarks.7,8

From our observations and those by previous investigators,9,10 it was apparent that using the midpoint of ischial tuberosity and greater trochanter, as done with the subgluteal approach, identifies an insertion point far more lateral than the actual location of the sciatic nerve. According to our fresh tissue dissections, the nerve lies slightly medial even to the midpoint of the line joining the inner border of the greater trochanter and midpoint of the ischial tuberosity.

**ACKNOWLEDGMENTS**

The authors thank Kim Williams, RN, Laura Clark, MD, and Alparslan Turan, MD, from the Department of Anesthesiology & Perioperative Medicine, University of Louisville, for their contributions. The authors also thank Gilbert Haugh, MS, for analyzing the data and Nancy Alsip, PhD, for editing the manuscript.
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