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# *Sciatic Nerve Block* via *Posterior Labat Approach Is More Efficient Than Lateral Popliteal Approach Using a Double-injection Technique*

## *A Prospective, Randomized Comparison*

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***Background:*** **For peripheral nerve blockade, the double-injection technique proved to be superior to a single injection in previous investigations. The current study was designed to compare onset time and efficacy of two different double-injection approaches for sciatic nerve block with 0.75% ropivacaine.**

***Methods:*** **A total of 50 patients undergoing foot surgery were randomly assigned to receive sciatic nerve blockade by means of the classic (Labat) posterior approach (n = 25) or a lateral popliteal approach (n = 25). All blocks were performed with the use of a nerve stimulator, and both major components of the sciatic nerve (tibial and common peroneal nerves) received separately 10 ml ropivacaine, 0.75%. Success rate was defined as a complete sensory and motor block associated with pain-free surgery.**

***Results:*** **A greater success rate was observed in the classic group (96%) as compared with the popliteal group (68%; $P < 0.05$). A general anesthetic became necessary in six patients (24%) with the lateral popliteal approach and none with the classic approach ($P < 0.05$). The onset of complete sensory and motor blockade was significantly faster in the classic group (12 ± 6 min) as compared with the popliteal group (26 ± 10 min; $P < 0.05$).**

***Conclusion:*** **A double injection with a relatively low volume of 0.75% ropivacaine generated a higher success rate and a shorter onset time of sensory and motor blockade after the classic Labat approach than after a lateral popliteal approach.**

THE sciatic nerve block may be used alone or in combination with other peripheral nerve blocks for orthopedic procedures involving the lower limb. Several approaches, both proximal and more distal ones, have been described.[1–5]

Various factors markedly affect the efficacy outcomes of peripheral nerve blocks, including the concentration and volume of the injected anesthetic solution,[6] the use of additives,[7] the type of evoked motor response obtained,[8,9] the intensity of the current at which peripheral nerve stimulation is achieved,[10,11] or a double-injection technique.[12,13]

Hitherto, many comparisons of sciatic nerve blockade focus on comparisons of single- *versus* double-injection techniques. Using the lateral approach to the sciatic nerve at the popliteal fossa, Paqueron *et al.*[12] demonstrated a higher success rate after double injection than after a single-injection technique. Bailey *et al.*[13] found similar results using the classic Labat approach, demonstrating an increased success rate and a faster onset time when separate stimulation of the two sciatic nerve components were administered. Most recently, the effects of three different approaches (classic, subgluteal, and lateral popliteal) on the onset time and efficacy of sciatic nerve block with a single injection technique were compared.[14] However, no information is currently available comparing the effects of two different approaches to the sciatic nerve with a double-injection technique. The current investigation was designed to compare the effects of the classic Labat approach and the lateral popliteal approach on the onset time and efficacy of sciatic nerve blockade when both of its components, the tibial and the common peroneal nerves, were identified separately and anesthetized with a comparatively small amount of local anesthetic.

## Materials and Methods

The study protocol was approved by the Hospital's Ethical Committee of the University of Santiago de Compostela (Santiago de Compostela, Spain), and written informed consent was obtained from all participants. Fifty patients with American Society of Anesthesiologists physical status I or II who were aged 18–70 yr and scheduled to undergo elective hallux valgus repair under sciatic nerve blockade were included. Exclusion criteria consisted of patient refusal, pregnancy, neurologic or neuromuscular disease, anticoagulation, or skin infection at the site of needle insertion.

Before the nerve block, intravenous access was established, and continuous electrocardiogram, noninvasive blood pressure, and pulse oximetry were monitored during block insertion and throughout the surgical procedure. All patients received 1–2 mg midazolam intrave-

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nously as premedication. Patients were randomized with use of sealed envelopes, which were opened just before performing the block, to receive one of the two approaches to the sciatic nerve: the classic approach described by Labat (n = 25) or a lateral popliteal approach (n = 25). Because all surgeries required a tourniquet below the knee, patients received an additional femoral nerve block with 10 ml mepivacaine, 1.5%.

All peripheral nerve blocks were performed by two anesthesiologists with substantial expertise in both regional anesthesia techniques using a nerve stimulator (Pajunk, Medizintechnologie, Geisingen, Germany) and an 8-cm, 22-gauge, short-beveled stimulating needle (Pajunk, Medizintechnologie). The stimulation frequency was set at 2 Hz, and the duration of the stimulating pulse was set at 0.1 ms. Initially, the stimulating current was set to deliver 2.0 mA, and it was progressively decreased to less than 0.5 mA while maintaining the appropriate motor response. A plantar flexion of the foot identified the tibial nerve, and a dorsiflexion of the foot was required to identify the common peroneal nerve. The tibial nerve was located first to maintain consistency among groups in terms of onset times and block efficacy.[8,9] If a peroneal response occurred first, the needle was withdrawn and redirected 2–3 mm more medially in the posterior classic approach or more posteriorly in the lateral popliteal approach.

Patients in the classic group were placed in the lateral decubitus position, with the leg to be blocked uppermost and rolled forward, with the knee flexed at a 90° angle (Sim position). A line was drawn from the posterior superior iliac spine to the midpoint of the greater trochanter, and a second perpendicular line was drawn from the midpoint and extended caudally for 4 cm.[1] This point represented the site of needle insertion. After skin infiltration, the stimulating needle was inserted at a 90° angle to the skin and advanced until both components of the sciatic nerve were identified. When the tibial nerve was identified with a stimulating intensity less than 0.5 mA, 10 ml of the 0.75% ropivacaine was slowly injected. The intensity of the stimulating current was then turned up to 2.0 mA, and the needle was withdrawn and redirected 3–4 mm laterally to identify the common peroneal nerve with a stimulating current less than 0.5 mA. Then, 10 ml of the same local anesthetic solution was slowly administered.

Patients receiving a lateral popliteal sciatic nerve block were positioned supine, with their legs extended at the knee joint. The long axis of the foot was positioned at a 90° angle to the table. The site of needle insertion was 7 cm cephalad to the most prominent point of the lateral femoral epicondyle in the groove between the biceps femoris and the vastus lateralis muscles.[15–18] After local skin infiltration, the needle was advanced 20°–30° posterior to the horizontal plane, with a slight caudal direction, until both components of the sciatic nerve were identified. After identification of the tibial nerve, the needle was withdrawn and redirected laterally following the same axis to identify the common peroneal nerve. For both components, 10 ml ropivacaine, 0.75%, was injected slowly when the intensity of nerve stimulation was less than 0.5 mA.

Sensory and motor blockade on the operated limb were evaluated every 5 min after injection of the local anesthetic, for a total of 45 min. Data collection was performed by an independent observer, who was not involved in block placement. Times required for onset of motor and sensory block were recorded. The extent of sensory blockade of each nerve (deep peroneal, superficial peroneal, posterior tibial, and sural nerves) was classified as follows: 0 = normal sensation within the nerve distribution (no block), 1 = blunted sensation within the nerve distribution (hypoalgesia), and 2 = absence of sensation within the nerve distribution (anesthesia). Sensory block was considered complete when each sensory testing (pinprick test) in the sciatic nerve distributions reached a score of 2. If the score of sensory blockade was less than 2 in any of the nerve distributions at the end of the 45-min assessment period, the sciatic block was considered incomplete. Motor block was assessed for voluntary motor responses by asking the patient to plantar-flex or dorsiflex the foot. It was classified as follows: 0 = normal movement, 1 = decreased movement, and 2 = no movement. Motor block was considered complete when motor response for both plantar flexion and dorsiflexion had a score of 2; otherwise, it was considered incomplete. The success rate was defined as a complete sensory and motor block associated with a pain-free surgery. The degree of pain during surgery was assessed on a four-point verbal rating scale (0 = no pain, 1 = mild or moderate pain, 2 = severe pain, and 3 = unbearable pain). If a verbal rating scale of more than 1 was reported by the patient, 50 $\mu$g supplemental fentanyl was given intravenously. If this did not provide adequate conditions, general anesthesia was induced.

The acceptance of the anesthetic technique was evaluated 24 h after surgery using a two-point score: 1 = satisfactory (if necessary, I would have the same anesthetic again) and 2 = unsatisfactory (different anesthetic).

### *Statistical Analysis*

To calculate the required number of patients to be included in the study, we considered previous findings on sciatic nerve block with the double-injection technique.[12,19] We intended to detect a 10-min difference in the time to achieve adequate surgical anesthesia between the two double-injection techniques, accepting a two-tailed $\alpha$ error of 5% and a $\beta$ error of 10%. Based on these figures, the required study size ranged from 20 to 25 patients/group.

**Table 1. Demographic Data and Surgical Procedures of the Two Groups of Patients**

| | Classic Group (n = 25) | Popliteal Group (n = 25) |
|---|---|---|
| Age, yr | 58 ± 13 | 55 ± 12 |
| Weight, kg | 68 ± 7 | 68 ± 6 |
| Height, cm | 162 ± 6 | 164 ± 7 |
| Sex, M/F | 6/19 | 7/18 |
| ASA physical status, I/II | 22/3 | 20/5 |
| Surgical times, min | 48 ± 15 | 44 ± 14 |
| Surgical procedures: hallus valgus | 25 | 25 |

Data are presented as mean ± SD, except for sex, surgical procedures, and American Society of Anesthesiologists (ASA) physical status (number of patients).

There were no statistically significant differences between the two groups.

Statistical analysis was performed by using the Statistical Package for the Social Sciences (SPSS for Windows, version 10.0; SPSS Inc., Chicago, IL). Data distribution was first evaluated using the Kolmogorov-Smirnov test. Continuous variables were compared between groups using either the two-sampled Student *t* test or the Mann–Whitney U test, according to the data distribution. Discrete variables were compared between groups using a chi-square or Fisher exact test when numbers were small. A *P* value of less than 0.05 was considered statistically significant. Continuous variables are presented as mean ± SD, and qualitative data are presented as numbers (percentage).

## Results

There were no significant differences between groups in terms of demographic data (age, weight, and height), American Society of Anesthesiologists physical status, surgical times, or type of surgical procedure (table 1). No severe untoward event was reported in any patient.

The onset times for sensory and motor block are listed in table 2. The onset of complete sensory and motor blockade was markedly faster in the classic group as compared with the popliteal group (table 2). Figure 1 displays a survival analysis of the total time required for the patients of the two groups to be considered ready for surgery.

A higher success rate was observed in the classic group as compared with the popliteal group (table 2; $P < 0.05$). A general anesthetic became necessary in six patients with the lateral popliteal approach and none with the classic approach ($P < 0.05$). Eight patients with the lateral popliteal approach and one patient with the classic approach required supplemental fentanyl during surgery (table 2; $P < 0.05$).

Overall patient satisfaction with the anesthetic procedure is displayed in table 2. No differences were found between groups.

## Discussion

Previously, the double-injection technique for sciatic nerve blockade had been compared to a single injection for the lateral popliteal approach[12] and the posterior classic approach.[13,19] No information is yet available comparing the effects of a proximal approach (Labat) *versus* a distal approach (lateral popliteal) on onset time and efficacy of sciatic nerve blockade using exclusively double injection and the same volume of local anesthetic solution. The current prospective, randomized, double-blind investigation demonstrated that after the classic Labat approach, a faster complete anesthesia and a higher success rate were achieved than after the lateral popliteal approach.

**Table 2. Anesthetic Data**

| | Classic Group (n = 25) | Popliteal Group (n = 25) |
|---|---|---|
| Intensity of stimulation, mA | 0.46 ± 0.05 | 0.47 ± 0.05 |
| Success rate | 24 (96%) | 17 (68%)* |
| Intraoperative fentanyl supplementation | 1 (4%) | 8 (32%)* |
| General anesthesia | 0 | 6 (24%)* |
| Onset time of sensory block, min | | |
| Superficial peroneal nerve distribution | 8 ± 6 | 20 ± 9* |
| Deep peroneal nerve distribution | 9 ± 6 | 19 ± 9* |
| Posterior tibial nerve distribution | 8 ± 6 | 20 ± 10* |
| Sural nerve distribution | 7 ± 4 | 15 ± 7* |
| Onset time of complete sensory block, min | 9 ± 6 | 20 ± 10* |
| Onset time of motor block, min | | |
| Peroneal nerve distribution (dorsiflexion) | 12 ± 6 | 24 ± 10* |
| Tibial nerve distribution (plantar flexion) | 12 ± 6 | 26 ± 10* |
| Onset time of complete motor block, min | 12 ± 6 | 26 ± 10* |
| Satisfaction with anesthetic technique | | |
| Satisfactory | 23 (92%) | 24 (96%) |
| Unsatisfactory | 2 (8%) | 1 (4%) |

Data are presented as mean ± SD, except for success rate, intraoperative fentanyl administered, and satisfaction with anesthetic technique (number of patients and percentages).

* $P < 0.05$, lateral popliteal group *vs.* classic group.

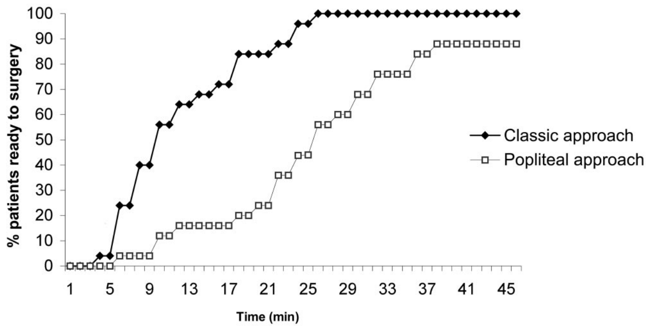


**Fig. 1. Survival analysis of the total time required from the completion of sciatic double injection until patients were judged ready for surgery with sciatic nerve block placed by using either a popliteal approach (n = 25) or a classic approach (n = 25). The log-rank curves representing the two groups studied are significantly different (*P* < 0.05).**

Various factors affect the efficacy and onset time of peripheral nerve blocks. These include the use of additives[7]; the type of evoked motor response[8,9]; the intensity of the current at which peripheral nerve stimulation is achieved[10,11]; the type, concentration, and volume of the injected anesthetic solution[6]; and the use of a double-injection technique stimulating several components of a peripheral nerve separately.[12,13] This latter technique proved to be superior to a single injection in previous investigations, whichever approach was used (classic posterior, subgluteal, or popliteal approach).[12,13,19,20] The effects of a subgluteal approach to the sciatic nerve using a double- *versus* a single-injection technique have been evaluated recently.[20] Using 30 ml ropivacaine, 0.75%, it could be shown that onset time of sensory and motor block was significantly faster after injection of 15 ml to each component of the sciatic nerve than after a single injection of 30 ml. In the current study, using a double-injection technique for both approaches, marked differences were found in onset time and success rate between the proximal and distal approaches to the sciatic nerve. An explanation for this phenomenon could be that there are minor but important aspects in anatomical differences at the two injection sites interfering with the diffusion of local anesthetics. Floch *et al.*[21] demonstrated that there is a division of two distinct sheaths surrounding the common peroneal and tibial nerves that occurs at highly variable distances from the upper border of the greater trochanter. Computed tomography scans of the thigh showed in more detail that two separate trunks existed in 27% of subjects at 20 cm, in 72% at 25 cm, and in 90% at 30 cm distal to the greater trochanter. The cross-sectional areas of the perineural space measured at 20, 25, and 30 cm were 1.8, 3.9, and 5.6 $cm^2$, respectively. The space between these trunks was filled with adipose tissue and blood vessels.[21] Therefore, it seems that the more distally from the Labat injection site a local anesthetic is administered for sciatic nerve blockade, the more tissue barriers it has to overcome to eventually reach a targeted second nerve component. In general, this drawback can be compensated for by increasing the volume[6,20] or the potency/lipophilicity[12,13,22] of a local anesthetic or its mixtures. Eight sciatic nerve blocks (32%) were considered incomplete at the popliteal level in the current study. Presumably, because of the previously outlined anatomy, 10 ml ropivacaine, 0.75%, was not sufficient to block each component of the sciatic nerve in these eight patients. In contrast, at the gluteal level, the two trunks of the sciatic nerve are very close together, separated by a negligible amount of adipose tissue. A smaller amount of local anesthetic then still ensured a high success rate and a short onset time of nerve blockade.

Recently, the effects of three different approaches (classic Labat, subgluteal, and lateral popliteal) on the onset time and quality of sciatic nerve block after single injection of 30 ml ropivacaine, 0.75%, were evaluated.[14] A clinically relevant improvement in onset time was achieved when using more proximal approaches to the sciatic nerve. However, no differences in the efficacy of nerve block were found. In contrast, in the current study, differences in both onset time and success rate could be demonstrated between proximal and distal approaches to the sciatic nerve with 20 ml ropivacaine, 0.75%. An explanation for this result may be related to the amount of local anesthetic administered: 30 ml compared with 20 ml, especially when the two sciatic nerve components are more distant from one another at the popliteal fossa.

In conclusion, the results of the current randomized, double-blind study demonstrate that a markedly higher success rate and a shorter onset time could be achieved when blocking the sciatic nerve at a more proximal level. The anatomical configuration at this level seems to favor the administration of smaller amounts of local anesthetic for sciatic nerve blockade, thereby decreasing the chance of toxic plasma concentrations.

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