Plantar Flexion Seems More Reliable than Dorsiflexion with Labat’s Sciatic Nerve Block: A Prospective, Randomized Comparison

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Labat’s classic approach to the sciatic nerve has not been able to show which motor response of the foot provides a more frequent rate of complete sensory and motor block. In this prospective, randomized, double-blind study, we compared plantar flexion with dorsiflexion with regard to onset time and efficacy of sciatic nerve block using the classic posterior approach. A total of 80 patients undergoing hallux valgus repair were randomly allocated to receive sciatic nerve block after evoked plantar flexion ($n = 40$) or dorsiflexion ($n = 40$). Twenty milliliters of 0.75% ropivacaine was injected after the motor response was elicited at $<0.5$ mA. Success rate was defined as complete sensory and motor block in all sciatic nerve distributions associated with a pain-free surgery. Time required for onset of sensory and motor block of the foot was recorded. Success was more frequent after elicited plantar flexion (87.5%) than dorsiflexion (55%; $P < 0.05$). Onset of complete sensory and motor block of the foot was faster after elicited plantar flexion ($10 \pm 11$ min and $10 \pm 12$ min, respectively) compared with dorsiflexion ($20 \pm 11$ min and $24 \pm 12$ min; $P < 0.05$). We conclude that plantar flexion of the foot predicts a shorter onset time and a more frequent success rate than dorsiflexion with Labat’s classic posterior sciatic nerve block.

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The sciatic nerve block may be used alone or in combination with other peripheral nerve blocks for orthopedic procedures on the lower limb. Several approaches have been described (1–6), yet the most frequently used one is Labat’s classical posterior approach in the lateral decubitus position.

Various factors markedly affect the success rate in peripheral nerve block, such as the concentration and volume of the injected anesthetic solution (7), the use of additives (8), and a double-injection technique (9,10). Several recent articles have focused on an additional factor: the type of evoked motor response after nerve stimulation (11–13). With the posterior popliteal approach to sciatic nerve block, patients exhibiting inversion or dorsiflexion of the foot had significantly faster onset times and were more successfully blocked than patients with plantar flexion (11). A more recent investigation showed that plantar flexion predicted a better success rate and faster onset time than dorsiflexion during lateral popliteal sciatic nerve block (13). No information is available regarding the relationship of the evoked motor response and the latency and success rate of sciatic nerve block associated with Labat’s classic posterior approach.

The purpose of the present prospective, randomized, double-blind study was to compare plantar flexion with dorsiflexion of the foot in their relationship to onset time and efficacy using Labat’s classic posterior approach to the sciatic nerve.

Methods

The study protocol was approved by the Hospital Ethical Committee of the University of Santiago de Compostela, and written informed consent was obtained from all participants. Eighty ASA physical status I or II patients, aged 18–80 yr and scheduled for elective hallux valgus repair under sciatic nerve block, were included. Exclusion criteria were patient refusal,
pregnancy, neurologic or neuromuscular disease, anticoagulation, and skin infection at the site of needle insertion.

Before the nerve block, IV access was established, and continuous electrocardiogram, noninvasive arterial blood pressure, and pulse oximetry were monitored during block insertion and throughout the surgical procedure. All patients received 1–2 mg of midazolam IV as premedication. The sequence of elicited motor response was randomized using sealed envelopes opened just before performing the block.

Patients were positioned in the lateral decubitus position with the leg to be blocked uppermost and rolled forward with the knee flexed at a 90-degree angle (Sim’s 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. This point represented the site of needle insertion. After local skin infiltration, an 8-cm, 22-gauge short-beveled stimulating needle (Pajunk, Medizintechnologie, Geisingen, Germany) attached to a nerve stimulator (Pajunk) was inserted with a 90-degree angle to the skin and advanced until either plantar flexion or dorsiflexion of the foot was obtained. The needle was then directed either medially or laterally to elicit the desired motor response. Initially, the stimulating current was set between 1.5 to 2 mA, and the frequency of stimulation was set at 2 Hz. The intensity of the stimulating current was gradually decreased as the needle approached the targeted nerve. The position of the needle was adjusted to maintain an adequate muscular response with a stimulating current <0.5 mA; then, 20 mL of 0.75% ropivacaine was injected slowly after careful intermittent aspirations. Patients received an additional femoral nerve block with 10 mL of 1.5% mepivacaine because all surgeries were performed with an arterial tourniquet below the knee.

Arterial blood pressure, heart rate, pulse oximetry, and progress of both sensory and motor block on the operated limb were evaluated every 5 min after local anesthetic injection for a total of 45 min by an independent blinded observer. Time required for onset of motor and sensory block were recorded. Sensory block assessments were performed in the distributions of the common peroneal and tibial nerves, i.e., the superficial and deep peroneal nerves, the sural, lateral plantar, medial plantar, and calcaneus plantar nerves (six peripheral nerves total). Forty patients in each group (plantar and dorsiflexion) thus received 6 peripheral nerve assessments equivalent to a total of 240 assessments per group. The extent of sensory block of each nerve was classified as follows: 0 = normal sensation in the respective nerve distribution (no block), 1 = blunted sensation (analgesia), and 2 = absence of sensation (anesthesia). Sensory block was considered complete when each sensory testing using the pin-prick test with a 22-gauge hypodermic needle in the sciatic nerve distributions had a score of 2. When the sensory block score was <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 in 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. Patients who did not have complete anesthesia at the surgical site by the end of a 45-min period were given a supplemental lateral popliteal sciatic nerve block (14) before the beginning of surgery. The degree of pain during surgery was assessed with a 4-point verbal rating scale score (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 μg of supplemental IV fentanyl was given. If this did not provide adequate conditions, general anesthesia was induced.

A power analysis estimated that 38 patients per group would be required to detect a 30% difference in the success rate after elicited plantar flexion when compared after elicited dorsiflexion, with a two-tailed α error of 5% and a statistical power of 80%.

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 two-sampled Student’s t-test or the Mann-Whitney U-test, depending on data distribution. Discrete variables were compared between groups using a χ² or Fisher’s exact test when numbers were small. A P value <0.05 was considered statistically significant. Continuous variables are presented as mean ± SD, and qualitative data are displayed as numbers (percentage).

**Results**

Eighty patients were enrolled in the study (40 in each group). There were no significant differences between groups in terms of demographic data (age, weight, and height), ASA physical status, surgical times, or type of surgical procedure (Table 1). No severe untoward event was reported in any patient.

Success was more frequent after elicited plantar flexion than after dorsiflexion (87.5% versus 55%, respectively; P < 0.05). The total amount of peripheral nerves blocked in the distribution of the common
peroneal and tibial nerves after elicited plantar flexion was larger (232 of 240 peripheral nerve distributions) than after dorsiflexion (166 of 240 peripheral nerve distributions; \( P < 0.05 \)). The number of successful blocks in the distributions of the tibial nerve was more after plantar flexion than after dorsiflexion (Fig. 1; \( P < 0.05 \)). No differences were observed between plantar and dorsiflexion in the distribution of the peroneal nerve. Supplemental lateral popliteal sciatic nerve blocks were required for 5 patients after elicited plantar flexion (12.5%) and 18 patients after dorsiflexion (45%; \( P < 0.05 \)). A general anesthetic was required for 2 patients after dorsiflexion and none after plantar flexion (\( P = ns \)).

The onset of complete sensory and motor block was faster after elicited plantar flexion than after dorsiflexion (Table 2; \( P < 0.05 \)). Patients exhibiting plantar flexion had similar onset time in all nerve distributions. In contrast, patients after dorsiflexion had a shorter onset time of anesthesia in the cutaneous distribution of the sural, deep, and superficial peroneal nerves than in the cutaneous distribution of the lateral, medial, and calcaneal plantar nerves (Table 2; \( P < 0.05 \)).

### Discussion

The present randomized, double-blind investigation demonstrated a faster onset time and overall more frequent success of complete sensory and motor block with inclusion of more terminal branches of the sciatic nerve after elicited plantar flexion than after dorsiflexion of the foot after Labat’s classic sciatic nerve block.

Various factors markedly affect the onset time of peripheral nerve blocks. These include the concentration and volume of the injected anesthetic solution (7), the use of additives (8), a double-injection technique (9,10), the type of approach to the sciatic nerve (15), or the intensity of the current at which peripheral nerve stimulation is achieved (16,17). Because all of these factors remained the same in the two groups of the present study, the type of evoked motor response may explain the results obtained.

The sciatic nerve is composed of two separate nerve trunks, the tibial and common peroneal nerves, which are surrounded by a common fascial sheath (18,19). When electrically stimulated, the two trunks may be identified by their peripheral motor responses. A dorsiflexion of the foot identifies the common peroneal nerve; plantar flexion indicates a tibial nerve response. Inversion of the foot results from stimulation of both the tibial and common peroneal nerves. As previously demonstrated with the posterior popliteal approach to the sciatic nerve, patients exhibiting inversion or dorsiflexion of the foot had significantly faster onset times and more frequent success of complete block than those with plantar flexion as the evoked motor response (11). In contrast, in the present study using the Labat’s classic posterior approach, plantar flexion resulted in more frequent success and shorter onset time of sensory and motor block than dorsiflexion. The difference in results between the present and Benzon et al.’s (11) study may be explained by a different approach to the sciatic nerve used and the research group’s different method of assessment of sensory block that was based on cutaneous sensory testing and no subsequent surgery. At the popliteal level, the two nerve trunks are already separated to a comparatively high degree; fat and layers of connective tissue make it difficult for the local anesthetic to cover the distance when a single injection is used. To improve success rates, a larger volumes of local anesthetic may be administered (20), or the local anesthetic may be injected between the tibial and common peroneal nerves, as suggested by Benzon et al. (11). When a more proximal approach is used, as was the case in the present study, the two sciatic nerve components were in close proximity and wrapped by a fascial sheath. The size of the sciatic nerve at this level and the thickness of its epineurium may explain the inability of local anesthetics to completely penetrate the nerve after an injection with the needle tip on either side of the nerve or when a small volume of local anesthetic is used (20).

To obtain better success with a single injection at this level, either a large volume of local anesthetic is injected or the larger of the two sciatic nerve components, the tibial nerve, is stimulated. This may explain why a targeted evoked motor response is important at the gluteal level when only 20 mL of local anesthetic is used. With plantar flexion, the needle tip is located near the tibial nerve, which is larger than the common peroneal nerve. Local anesthetic will then reach the larger tibial nerve first, followed by block of the common peroneal nerve with a comparably smaller volume. In contrast, with dorsiflexion as the initial motor response, the needle tip is located near the common peroneal nerve; local anesthetic may not sufficiently penetrate the tibial nerve. This phenomenon is depicted in Figure 1 and may explain the earlier onset of sensory block and more frequent success of sensory and motor blocks in the peroneal nerve distributions.
compared with the tibial nerve distributions after eliciting a dorsiflexion. Similarly, with the lateral approach to the sciatic nerve 10 cm above the popliteal fossa, plantar flexion resulted in more frequent success and shorter onset time of sensory and motor block than dorsiflexion (13).

The present study demonstrated that plantar flexion of the foot after tibial nerve stimulation resulted in a shorter onset time and more frequent success of sciatic nerve block when compared with dorsiflexion with Labat’s classic approach. This was achieved with only 20 mL of ropivacaine 0.75%.

**References**


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