ORIGINAL ARTICLE

An Ultrasound-Guided Lateral Approach for Proximal Sciatic Nerve Block

A Randomized Comparison With the Anterior Approach and a Cadaveric Evaluation

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Background and Objectives: The lateral and anterior approaches for proximal sciatic nerve (SN) block can be used in patients lying supine. We assume that the posterior femoral cutaneous nerve (PFCN) is simultaneously blocked more often via the lateral approach than via the anterior approach, given the proximity of these 2 nerves at the injection level. However, locating the SN is difficult when using the original landmark-based lateral approach. We have introduced ultrasound guidance to alleviate the technical difficulty of the lateral approach and tested the hypothesis that an ultrasound-guided lateral approach would achieve PFCN block more often than the ultrasound-guided anterior approach for SN block.

Methods: Forty consecutive patients undergoing knee surgery were randomly allocated to receive an SN block using an ultrasound-guided lateral or anterior approach. The primary outcome was the frequency of PFCN block 30 minutes after SN block. Secondary outcomes included the frequency of SN block, nerve depth, needle depth, and time taken to perform the block. We also assessed the spread of injectate by the lateral approach in 4 cadaveric legs.

Results: The frequency of PFCN block 30 minutes after SN block was higher with the lateral approach than with the anterior approach (60% vs 15%, $P = 0.008$). The frequency of SN block was comparable between the groups. Dye reached the PFCN in all cadaveric specimens.

Conclusions: The ultrasound-guided lateral approach for proximal SN block can be performed as successfully as the anterior approach and provides PFCN block more often than the anterior approach.

Clinical Trial Registration: This study was registered at UMIN Clinical Trials Registry, identifier UMIN000026748.

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The sciatic nerve (SN) originates from the lumbosacral plexus at L4–S3 and the posterior femoral cutaneous nerve (PFCN) from S1–S3.[1] After these nerves have formed, both leave the pelvis and enter the gluteal region through the greater sciatic foramen. The 2 nerves run through the gluteal region inferiorly, crossing the posterior surface of the quadratus femoris muscle, and enter the posterior thigh, where the SN passes anterior to the long head of the biceps femoris muscle, while the PFCN passes posteriorly.[1] Local anesthetics injected around the SN proximal to this divergence could produce PFCN block, given the proximity of the 2 nerves.[2–5] Indeed, the ultrasound-guided subgluteal approach for SN block,[5] performed at the level connecting the greater trochanter and the ischial tuberosity in patients placed in the lateral position, produced PFCN block more often than the ultrasound-guided anterior approach performed at the level of the lesser trochanter in patients lying supine.[6]

The PFCN provides cutaneous innervation to the posterior aspect of the thigh and popliteal fossa. In clinical practice, blocking not only the SN but also the PFCN is desirable to ensure complete anesthesia for surgical procedures involving a nociceptive stimulus on the posterior thigh, such as above-the-knee amputation[7] and posterior thigh debridement and skin grafts.[8] However, previously reported ultrasound-guided SN block techniques, which can reliably provide concomitant blockade of the PFCN, including the subgluteal approach, involve extra effort and time because of the need to reposition the patient when surgery is performed in patients lying supine.[5,9] The lateral approach for proximal SN block can be performed in patients lying supine similar to the anterior approach, while local anesthetics are injected at the level of the greater trochanter, which is almost the same as the subgluteal approach.[10] Hence, we have speculated that the lateral approach holds promise in blocking the SN and PFCN simultaneously in patients lying supine. However, the original lateral approach, which is a simple landmark-based technique, is technically difficult for locating the SN.[11] Therefore, we have introduced ultrasound guidance to facilitate identification of the SN with the lateral approach.

The purpose of the present randomized controlled clinical trial is to test the hypothesis that our ultrasound-guided lateral approach for proximal SN block would produce PFCN block more often than the anterior approach.

METHODS

Clinical Evaluation

The clinical component of the study protocol was approved by the Ethics Review Board of Kansai Medical University, Hirakata, Japan (ref: 2016159) and registered at UMIN Clinical Trials Registry (http://www.umin.ac.jp/ctr/index.htm; ref: UMIN000026748) on March 31, 2017, before enrolment commenced. Written informed consent was obtained from all study participants. Patients were included if they had an American Society of Anesthesiologists physical status of 1 to 3 and were scheduled for unilateral knee surgery as the first case on Tuesday or Thursday at Kansai Medical University Hospital (Hirakata, Japan) between April and November 2017. The exclusion criteria were as follows: age younger than 20 years, body weight of less than 40 kg, body mass index of greater than 35 kg/m^2, inability to communicate, allergy to local anesthetics, infection at the injection site, preexisting sensory impairment in the lower extremities, and a surgical history involving the hip or femur on the present operated side.

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Forty consecutive patients were randomly allocated to receive a proximal SN block using either the lateral approach (lateral group) or anterior approach (anterior group) under ultrasound guidance. Randomization was performed using a computer-generated randomization sequence (http://www.randomization.com) in aggregates of 10. Group allocation was concealed in sealed prenumbered opaque envelopes prepared by a research fellow not involved in the study. The operator performing the SN block opened the envelope just before a study patient entered the operating room.

Each enrolled patient underwent standard monitoring on arrival in the operating room. An intravenous line was secured, and 1 to 2 mg of intravenous midazolam was administered as an anxiolytic, while ensuring that the patient could respond to verbal cues. Oxygen was administered at a rate of 3 L/min via a face mask. Subsequently, either the ultrasound-guided lateral or anterior approach for proximal SN block was performed according to group allocation. Both approaches were executed using a 2- to 5-MHz curved array transducer (C60x; Fujifilm SonoSite Inc, Tokyo, Japan) connected to an ultrasound imaging system (M-turbo; Fujifilm SonoSite Inc), by either of 2 anesthesiologists skilled in using these approaches (T.Y., T.N.).

Ultrasound-Guided Lateral Approach

The transducer was placed laterally just beneath the most prominent part of the greater trochanter on the operated side with the patient lying supine with both legs extended and the hip on the operated side slightly internally rotated (Fig. 1, A and B). Once the greater trochanter and the ischial tuberosity were identified by ultrasound, the position of the transducer was adjusted so that the ischial tuberosity was seen in the center of the ultrasound imaging apparatus. Next, the position of the transducer was further adjusted in a superior/inferior direction to obtain an ultrasound image of the origin of the long head of the femoral biceps muscle at the ischial tuberosity. Using this transducer position, the SN was observed lateral to the origin of the biceps femoris muscle, beneath the gluteus maximus muscle, as a hyperechoic image (Fig. 2A). After ensuring asepsis and infiltration of the skin with lidocaine 1%, a short-bevel, 100-mm 21-gauge or (if needed) 120-mm 20-gauge insulated nerve block needle (Echoplex+; Vygon, Écouen, France) connected to an electrical nerve stimulator was inserted between the transducer within a sterile cover and the greater trochanter (Fig. 1, A and B). The nerve stimulator was then set at a pulse duration of 0.1 millisecond with a stimulating frequency of 2 Hz and an initial current amplitude of 1.0 mA and switched on. The needle was advanced toward the posterior aspect of the SN, in plane with the transducer, until its tip was seen in close proximity to the nerve, and dorsiflexion or plantar flexion of the ankle was elicited. The position of the needle tip was further adjusted as needed to confirm loss of dorsiflexion or plantar flexion of the ankle at a stimulating current between 0.2 and 0.7 mA. After negative aspiration for blood, 20 mL of mepivacaine 1.5% was injected without any further adjustments of the needle position (Fig. 2B). Both the needle insertion point for the lateral approach and an assumed insertion point for the anterior approach were covered by opaque adhesive plasters to maintain blinding of assessors.

Ultrasound-Guided Anterior Approach

The patient was placed supine with his/her hip on the operated side slightly flexed and externally rotated. The transducer was then placed perpendicular to the skin approximately 8 cm distal to the inguinal crease (Fig. 3).[6,12] Next, the position of the transducer was adjusted to obtain a clear image of the SN, which was situated beneath the adductor magnus muscle, lateral to the long head of the biceps femoris muscle, and posteromedial to the lesser trochanter (Fig. 4A). After ensuring asepsis and infiltration of the skin with lidocaine 1%, a short-bevel, 100-mm 21-gauge or (if needed) 120-mm 20-gauge insulated nerve block needle connected to the electrical nerve stimulator was inserted, in a lateral-to-medial direction, in plane with the transducer within a sterile cover (Fig. 3). The settings of the nerve stimulator were the same as those used for the lateral approach. The ultrasound image of the SN was kept in the middle of the screen during advancement of the needle. The needle was advanced toward the anterior aspect of the SN, in plane with the transducer, until its tip was seen in the vicinity of the nerve, and dorsiflexion or plantar flexion of the ankle was evoked. The position of the needle tip was further

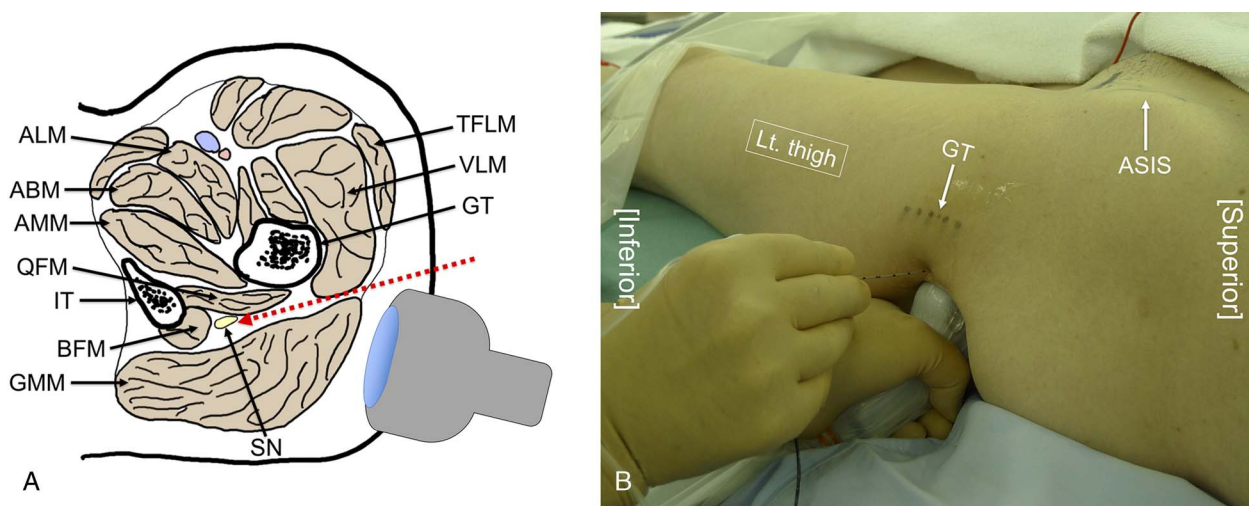

FIGURE 1. The technique used to perform proximal SN block with an ultrasound-guided lateral approach. A, An illustration showing the positional relationship between the greater trochanter, the ischial tuberosity, the SN, and the transducer. The red dotted arrow indicates the estimated needle trajectory toward the SN. B, A photograph showing the patient, ultrasound transducer, and needle position for a left-sided block using the lateral approach. ABM indicates adductor brevis muscle; ALM, adductor longus muscle; AMM, adductor magnus muscle; ASIS, anterior superior iliac spine; BFM, long head of biceps femoris muscle; GMM, gluteus maximus muscle; GT, greater trochanter; IT, ischial tuberosity; QFM, quadratus femoris muscle; TFLM, tensor fascia latae muscle; VLM, vastus lateralis muscle.

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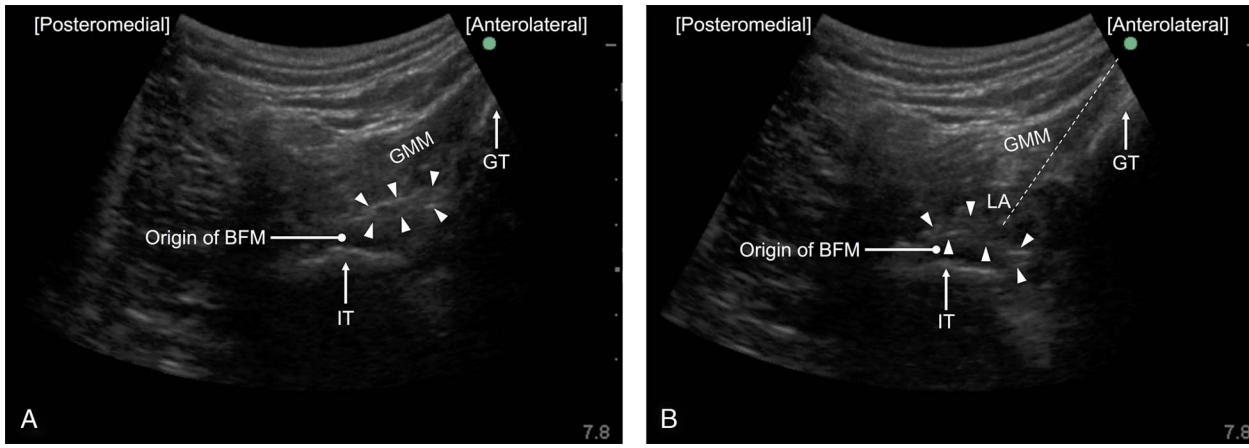

FIGURE 2. Ultrasound images obtained during proximal SN block with an ultrasound-guided lateral approach. A, A preprocedure ultrasound image obtained with the transducer located as in Figure 1B. The SN is seen as a hyperechoic thick oval structure (arrow heads). B, An ultrasound image obtained immediately after injection of local anesthetics in proximity to the SN (arrow heads). The needle is indicated by the dotted line. BFM indicates long head of biceps femoris muscle; GMM, gluteus maximus muscle; GT, greater trochanter; IT, ischial tuberosity; LA, local anesthetics.

adjusted as needed to confirm the loss of dorsiflexion or plantar flexion of the ankle at a stimulating current between 0.2 and 0.7 mA. After negative aspiration for blood, 20 mL of mepivacaine 1.5% was injected without any further adjustments of the needle position (Fig. 4B). Both the needle insertion point for the anterior approach and an assumed insertion point for the lateral approach were covered by opaque adhesive plasters.

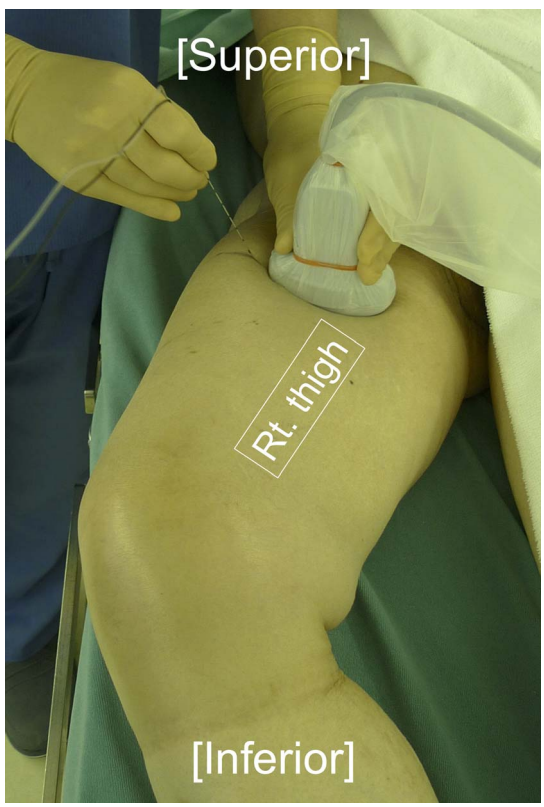

FIGURE 3. A photograph showing the patient, ultrasound transducer, and needle position for a right-sided proximal SN block using an ultrasound-guided anterior approach.

During the SN block procedure, the following data were collected by the operator who performed the SN block: the prescan time (time required from the initiation of transducer placement on the patient to identification of the SN under ultrasound), the time taken to perform the SN block (time from the initial insertion of the block needle to the completion of local anesthetics injection and withdrawal of the needle), the depth of the SN (distance from the skin to the most superficial surface of the SN, which was measured immediately after completion of the prescan, using the built-in software of the ultrasound apparatus), and the needle depth (distance from the skin to the needle tip during injection of local anesthetics). The SN block operator also checked occurrences of inadvertent vessel puncture during the SN block procedure and local anesthetic systemic toxicity after the SN block.

After the SN block had been performed, a femoral nerve block using 20 mL of levobupivacaine 0.25% was performed under real-time ultrasound guidance using a 6- to 13-MHz linear array transducer (HFL38x; Fujifilm SonoSite Inc) as described elsewhere.[13,14] A catheter (Perifix ONE Catheter; B. Braun AG, Melsungen, Germany) was placed for a continuous femoral nerve block in all patients except those undergoing high tibial osteotomy. All femoral nerve blocks were performed by anesthesiology fellows under the supervision of an experienced regional anesthesiologist (T.Y. or T.N.).

Sensation and motor function in the blocked lower extremity were evaluated at 10-minute intervals for 30 minutes after the SN block had been performed. Sensory assessments were carried out on the dorsal side of the foot (superficial peroneal nerve), the plantar side of the foot (tibial nerve), and the center of the posterior aspect of the thigh (PFCN) by pinprick (using an 18-gauge needle). Sensory block was deemed complete when the patient did not feel pain on pinprick. Motor function was assessed by a manual muscle strength test for dorsiflexion and plantar flexion of the ankle. Motor block was deemed present when the muscle strength on the blocked side of the ankle was weaker than that on the nonblocked side. Sensory and motor function was assessed by an investigator who was blinded to group allocation and absent during performance of the SN block.

Following assessment of the aforementioned SN block, general anesthesia was induced by intravenous propofol (1–2 mg/kg) and a continuous infusion of remifentanil 0.25 μg/kg per minute. Intravenous rocuronium (0.4–0.6 mg/kg) was administered to

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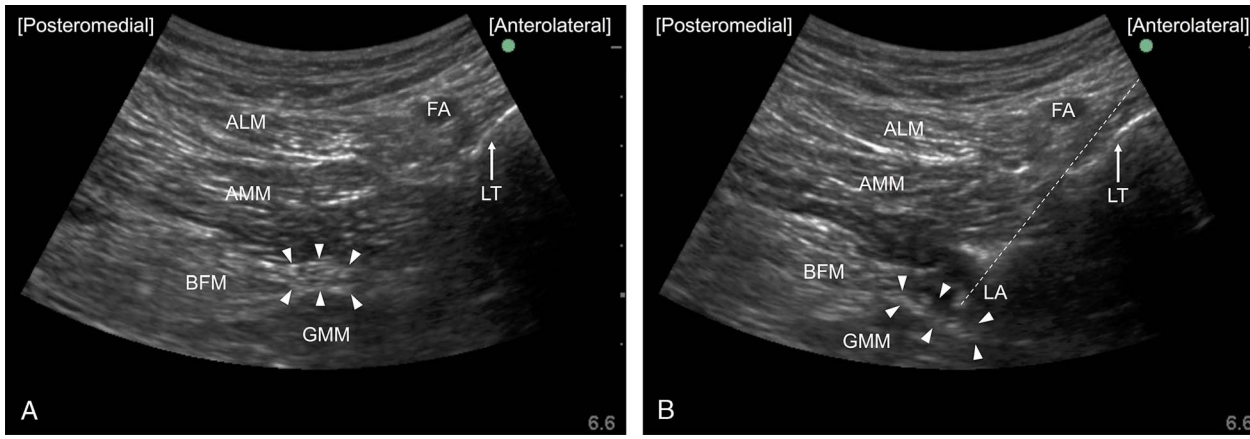

FIGURE 4. Ultrasound images obtained during proximal SN block with an ultrasound-guided anterior approach. A, A preprocedure ultrasound image obtained with the transducer located as in FIGURE 3. The SN is seen as a hyperechoic thick oval structure (arrow heads). B, An ultrasound image obtained immediately after injection of local anesthetics in proximity to the SN (arrow heads). The needle is indicated by a dotted line. ALM indicates adductor longus muscle; AMM, adductor magnus muscle; BFM, long head of biceps femoris muscle; FA, femoral artery; GMM, gluteus maximus muscle; LA, local anesthetics; LT, lesser trochanter.

facilitate insertion of a supraglottic airway device (i-gel; Intersurgical Ltd, Wokingham, United Kingdom). Anesthesia was maintained with inspired desflurane 4% to 6% and remifentanil 0.05 to 0.20 μg/kg per minute. Intravenous fentanyl (0–300 μg) was added at the discretion of the attending anesthesiologist. Blood pressure and heart rate were kept within 20% of the preoperative values by adjusting the infusion rate of remifentanil and administering vasopressor (bolus injection of ephedrine and/or phenylephrine) at the discretion of the attending anesthesiologist. Just before the completion of surgery, a continuous femoral nerve block of levobupivacaine 0.125% was initiated at 4 mL/h using a disposable elastomeric pump (Coopdech Balloonjector 300; Daiken Medical, Osaka, Japan) in patients with the femoral nerve block catheter. The patients undergoing high tibial osteotomy received a continuous infusion of fentanyl 20 μg/h postoperatively. After completion of surgery and emergence from general anesthesia, intravenous sugammadex 200 mg was administered to reverse neuromuscular blockade, after which the supraglottic airway device was removed. Approximately 15 minutes later, patients were transferred directly from the operating room to a ward after confirming their respiratory condition and hemodynamics were stable. Sensation and motor function in the blocked lower extremity were evaluated again when the patient left the operating room. In this study, anesthesia time was defined as the interval between the initial injection of propofol and the time at which the patients left the operating room. Hence, the assessments on leaving the operating room were implemented when approximately 30 minutes in addition to the anesthesia time had passed after the execution of SN block. The blinded assessor once again tested sensation and motor function in the blocked leg approximately 24 hours after the SN block to check the incidence of persistent SN or PFCN block. Ward nurses checked for the presence of infection associated with the SN block or the femoral nerve block catheter every 8 hours during the 72-hour period after surgery.

Study Outcomes and Statistical Analysis

The primary outcome of the study was defined as the frequency of complete blockade of the PFCN when assessed 30 minutes after the SN block was performed. The secondary outcomes included the frequency of complete sensory block in the area supplied by the SN, the frequency of motor SN block, the prescan time required to identify the SN, the time taken to perform the SN block, the depth of the SN, the needle depth during injection of local anesthetics for SN block, and the incidence of adverse effects attributable to the SN block. Sample size calculations were based on the hypothesis that the lateral approach for proximal SN block would produce concurrent PFCN block more often than the anterior approach. To this end, we defined the frequency of complete sensory loss on the posterior aspect of the thigh assessed 30 minutes after SN block as the primary outcome. In a previous study, the frequency of PFCN block evaluated at 30 minutes after an SN block performed using an ultrasound-guided anterior approach was 14.9%, whereas that of the ultrasound-guided subgluteal approach was 68.1%.[6] We assumed that the frequency of PFCN block evaluated 30 minutes after the lateral approach would be similar to that after the subgluteal approach because both approaches are performed at the level connecting the greater trochanter and the ischial tuberosity. To demonstrate this difference using a 2-tailed χ^2 test with a statistical power of 0.8 and an α error rate of 0.05, the minimum sample size required was 16 patients per group. Allowing for potential dropouts, 20 patients per group were enrolled. Normality of distribution of data was assessed using the Shapiro-Wilk test. Differences in categorical data and normally distributed continuous data between the 2 groups were analyzed using Fisher exact test and the 2-tailed Student *t* test, respectively. Differences in non–normally distributed continuous and noncontinuous data between the groups were analyzed using the Mann-Whitney *U* test. $P < 0.05$ was considered statistically significant. All statistical analyses were conducted using R for Mac OS X version 3.0.0 (The R Foundation for Statistical Computing, Vienna, Austria).

Cadaveric Evaluation

The cadaveric evaluation was performed as part of the 3D Anatomy Project in Okayama held by the Department of Human Morphology, Okayama University Medical School (Okayama, Japan) on March 25 to 26, 2017. The cadaveric evaluation was implemented only for the lateral approach for proximal SN block in order to validate the feasibility that injectate administered by using the lateral approach would reach both the SN and the PFCN. The ultrasound-guided lateral approach for proximal SN block was simulated in 4 legs in 3 female adult cadavers using an ultrasound imaging system (Edge; Fujifilm SonoSite Inc) with a 2- to 5-MHz curved array transducer (C60x). All cadavers were embalmed by Thiel method.[15,16] A short-bevel, 100-mm 22-gauge needle

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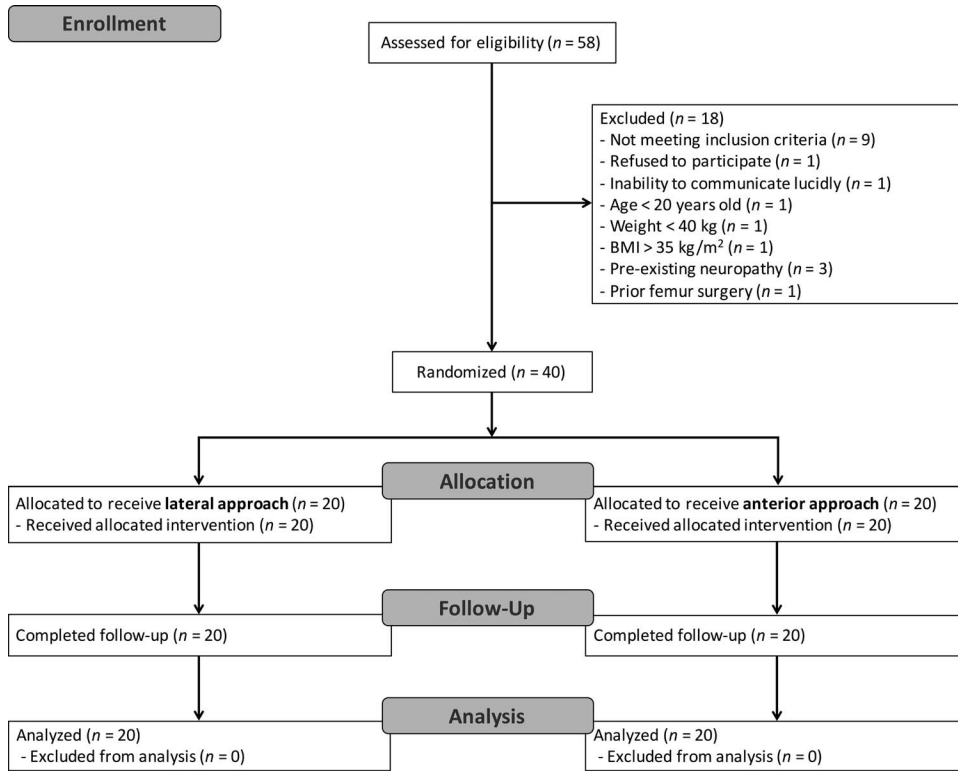

FIGURE 5. CONSORT (Consolidated Standards of Reporting Trials) flow diagram.

(Stimuplex D Ultra; B. Braun AG) was used for the injection. After the needle tip was confirmed under ultrasound guidance to be in close proximity to the SN, 20 mL of water-soluble dye (Sakura Mat Water Colors Multi; Sakura Color Products Corporation, Osaka, Japan) was injected without further adjustments of the needle tip position. Approximately 30 minutes after injection of the dye, the cadaver was placed in a prone position, and the gluteal region and posterior aspect of the thigh were dissected to assess the spread of the injectate.

RESULTS

Clinical Evaluation

Forty consecutive patients were randomized, and all received their allocated interventions; hence, data for 20 patients per group were available for analysis (Fig. 5). The patient demographics at baseline are shown in Table 1.

The frequency of complete blockade of the PFCN at 30 minutes after SN block was significantly higher in the lateral group than in the anterior group (60% vs 15%, $P = 0.008$). Differences in the frequency of complete sensory blockade of the superficial peroneal and tibial nerves were not statistically significant between the groups (Table 2).

The median (interquartile range [range]) time required for the prescan was 29 (16–48 [11–161]) seconds in the lateral group and 31 (19–73 [8–187]) seconds in the anterior group ($P = 0.61$); the median time taken to perform the block was 134 (89–228 [69–552]) seconds and 165 (121–271 [72–693]) seconds, respectively ($P = 0.31$).

The SN was identified under ultrasound guidance in all patients. The mean (SD) depth of the SN was 3.97 (0.99) cm in the lateral group and 5.24 (0.94) cm in the anterior group ($P = 0.0002$). However, there was no significant difference in the mean depth of the needle during injection of local anesthetics between the lateral group and the anterior group (8.6 [1.1] vs 8.7 [1.2] cm, $P = 0.81$). The 120-mm-long needle was used in 2 and 6 patients in the lateral and anterior groups, respectively.

Sciatic nerve block–related complications, such as inadvertent vessel puncture, systemic toxicity from local anesthetics, or infection, did not occur during the aforementioned observation

TABLE 1. Patient Demographic Characteristics at Baseline

	Lateral Group (n = 20)	Anterior Group (n = 20)
Age, y	72 (54–81)	75 (55–84)
Sex, female/male, n	17/3	14/6
Height, cm	152.6 (6.9)	152.4 (8.5)
Weight, kg	60.0 (11.4)	63.3 (14.4)
Body mass index, kg/m^2	25.7 (3.9)	27.0 (4.2)
ASA physical status, 1/2/3, n	2/14/4	1/18/1
Surgical side, right/left, n	10/10	13/7
Surgical procedures, n		
Total knee arthroplasty	13	15
Unicompartmental knee arthroplasty	3	3
High tibial osteotomy	3	2
MPFL reconstruction	1	0
Surgical time, min	107 (35)	98 (20)
Anesthesia time, min	154 (38)	146 (25)

The data are presented as the median (range), the mean (SD), or number. ASA indicates American Society of Anesthesiologists; MPFL, medial patellofemoral ligament.

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TABLE 2. Evaluation of Blockade of Sciatic and Posterior Femoral Cutaneous Nerves

	Group	10 min	20 min	30 min	On Leaving the OR
Sensory blockade					
Superficial peroneal nerve	Lateral	40%	70%	80%	100%
	Anterior	25%	55%	65%	95%
Tibial nerve	Lateral	25%	50%	65%	95%
	Anterior	10%	25%	40%	95%
Posterior femoral cutaneous nerve	Lateral	15%	30%	60%*	100%
	Anterior	5%	15%	15%	85%
Motor blockade					
Dorsiflexion of ankle	Lateral	20%	55%	85%	85%
	Anterior	20%	35%	55%	95%
Plantar flexion of ankle	Lateral	20%	50%	80%	85%
	Anterior	5%	35%	50%	95%

Percentages of patients with complete sensory block of the superficial peroneal, tibial, and PFCNs and motor block of the SN assessed at 10, 20, and 30 minutes after an SN block was performed using ultrasound-guided lateral and anterior approaches. *$P < 0.05$ compared with the anterior approach group. *P* values were calculated using Fisher exact test. OR indicates operating room.

period. No prolonged sensory loss or muscle weakness in the lower extremity lasting for more than 24 hours was observed.

Cadaveric Evaluation

We confirmed that both the SN and the PFCN were stained by the colored dye after the lateral approach in all the 4 cadaver specimens studied (Fig. 6).

DISCUSSION

In this report, we describe an ultrasound-guided lateral approach for proximal SN block. We confirmed that the ultrasound-guided lateral approach produced PFCN block more often than the ultrasound-guided anterior approach, although there was no difference in the frequency of the SN block at each evaluation time point between the 2 approaches. Our cadaveric evaluation supported our clinical finding that local anesthetics injected by the lateral approach reach the PFCN.

According to a previous report, the SN was identified in no more than 80% of cases within 3 attempts using the landmark-based lateral approach, even by an experienced hand using nerve stimulation guidance.[11] Another drawback of the landmark-based lateral approach is the pain caused when the needle comes into contact with the surface of the femur and/or frequent adjustments of needle direction are needed to locate the SN.[11] Ultrasound guidance allows for confirmation of the location of the SN and for direction of the needle trajectory toward the nerve in the lateral approach without the need for these manipulations. Accordingly, we could readily identify the SN under ultrasound guidance in all patients in the lateral group.

Blockade of the PFCN is crucial in surgeries that include a nociceptive stimulus on the posterior aspect of the thigh. For example, if above-the-knee amputation is managed only by peripheral nerve blocks, both SN and PFCN blocks are essential in addition to blockade of the nerves derived from the lumbar plexus.[7,8] According to a previous case series regarding the use of peripheral nerve blocks for lower limb amputation, 2 of 5 patients receiving the anterior approach to SN block felt pain on the posterior aspect of the thigh during above-the-knee amputation because of the lack of PFCN block.[7] Another case series regarding above-the-knee amputation, in which femoral and lateral femoral cutaneous nerve blocks and SN block using the anterior or Labat approach were used, reported that 2 patients receiving the anterior

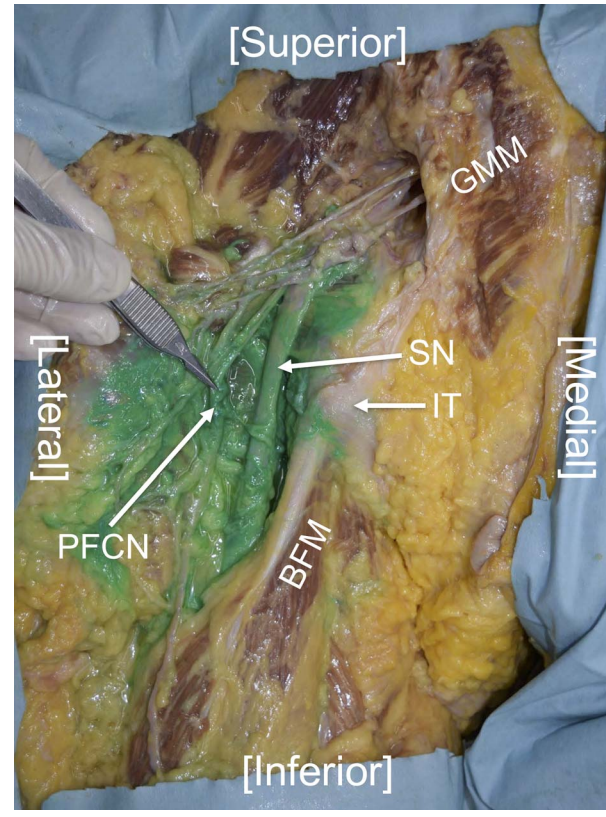

FIGURE 6. Spread of green dye in a cadaveric specimen after the left-sided ultrasound-guided lateral approach for a proximal SN block. The green dye spreads from the level at which the long head of the biceps femoris muscle attaches to the ischial tuberosity. Both the SN and the PFCN (held by a forceps) are surrounded by the dye. The figures are reprinted from the library of photographs held by the 3D Anatomy Project in Okayama with the permission of the Okayama University 3D Anatomy Project (http://www.okayama-u.ac.jp/user/3d/; Okayama, Japan). BFM indicates long head of biceps femoris muscle; GMM, gluteus maximus muscle; IT, ischial tuberosity.

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approach needed an infusion of remifentanil during surgery, whereas the other 2 patients who received the Labat approach did not require an additional analgesic.[17] The Labat approach to SN block is a landmark-based technique performed more proximal to the greater trochanter and blocks the PFCN simultaneously.[18] In the field of pain medicine, postherpetic neuralgia attributable to the sacral roots presents as posterior thigh pain,[19] which could be relieved by SN and PFCN blocks. All the previously described ultrasound-guided SN block approaches, which can reliably provide concomitant blockade of the PFCN (eg, the parasacral and subgluteal approaches[5,9]), require patients to be placed in the lateral or prone position. In contrast, the lateral approach can be implemented in the supine-positioned patient, similar to the anterior approach. Our present findings demonstrate that the lateral approach for SN block is preferable to the anterior approach in respect of providing anesthesia on the posterior aspect of the thigh, in addition to proximal level SN block, especially in patients who have difficulty in changing body position from supine.

It could be argued that the frequencies of complete sensory blockade of the superficial peroneal and tibial nerves 30 minutes after SN block in the present study are much lower than those in a previous study comparing the ultrasound-guided anterior and subgluteal approaches for SN block, despite the previous study using the same local anesthetics as our study.[6] In that study, circumferential spread of local anesthetics around the SN was created using multiple fractionated injections while changing the position of the needle tip. In contrast, we did not move the needle tip after deciding on its position. Circumferential spread of local anesthetics around the nerve under ultrasound guidance has been reported to hasten the onset of peripheral nerve blocks, including the subgluteal SN block.[20–22] We believe that the time to onset of SN block would be improved by circumferential spread of local anesthetics around the SN. In our lateral group, complete sensory blockade of the superficial peroneal, tibial, and PFCNs was eventually confirmed in all patients as they were leaving the operating room, except for a missed tibial nerve block in 1 patient.

We think that the information regarding the depths of the SN and the needle measured in our study can help the operator choose a suitable transducer and an appropriate length of needle to improve visibility of the SN and the needle under ultrasound guidance. Our clinical study excluded patients with a body mass index greater than 35 kg/m^2, so our findings may not be applicable to morbidly obese patients. However, the depth of the SN was significantly shorter in the lateral group than in the anterior group despite the needle depth during injection of local anesthetics being similar between the groups, suggesting that the angle formed by the ultrasound beam and the needle trajectory was larger with the lateral approach than with the anterior approach. A larger angle between the ultrasound beam and the needle allows better visualization of the needle under ultrasound guidance.[23,24] In addition, in obese patients lying supine, the rich subcutaneous adipose tissue on the buttock lifts the position of the greater trochanter anteriorly and provides a broader space between the greater trochanter and the operating table, facilitating placement of the transducer using the lateral approach. Therefore, we presume that the lateral approach would be preferable to the anterior approach in terms of visualizing the SN and the needle under ultrasound, especially in obese patients, although this needs to be validated in a future study.

Our study has a few limitations. First, the patients were not blinded to their treatment allocation. However, performing a sham block for the purposes of blinding a study would be unethical. Second, although the primary outcome of the clinical evaluation was the frequency of PFCN block, we targeted patients undergoing knee surgery, which usually does not induce severe pain in the posterior thigh. Therefore, it may be assumed that this type of block would not have any beneficial effect in these patients. However, most types of knee surgery require application of a tourniquet to the thigh, which often causes thigh pain. A further trial is needed to determine whether a PFCN block is useful for reducing tourniquet-induced thigh pain in patients undergoing knee surgery.

CONCLUSIONS

We devised the ultrasound-guided lateral approach for proximal SN block. This approach can be performed as successfully as the ultrasound-guided anterior approach and provides concomitant blockade of the PFCN more often than the anterior approach.

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