Comparing the sciatic nerve block quality of anterior and posterior approaches: A randomised trial

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Abstract

Background: The co-administration of sciatic nerve and femoral nerve blocks may provide anaesthesia and analgesia in patients undergoing lower extremity surgeries. Several approaches to sciatic nerve block have been described, including anterior and posterior approaches.

Methods: Our study included 58 patients, randomly assigned to receive either an anterior (Group A, n = 29) or posterior (Group P, n = 29) approach. After the blocks were performed, we determined sensory and motor block start and end times, the time to first intraoperative fentanyl administration, the total dose of fentanyl required, the time to first diclofenac sodium administration, and the total dose of diclofenac sodium required. The date of trial registration was retrospectively registered in 11.07.2018

Results: Comparison of the two groups revealed that Group P exhibited significantly shorter times to starting the sensory block (12.88±4.87 min for Group A, 7.70±2.05 min for Goup P) p=0.01 and first fentanyl administration (29.20±27.79 min for Group A, 4.05±7.47 min for Group P) p=<0.01, and a significantly lower total dose of fentanyl required (147.75±122.30 min for Group A, 27.75±53.91 min for Group P) p=0.01. Patient satisfaction (p=<0.01), anesthesia quality (p=0.006), and surgical quality (p=0.047) were significantly higher in Group P.

Conclusions: For patients without pain secondary to fractures, the posterior approach to sciatic nerve block is preferable. If patients have pain secondary to fractures, the anterior approach is preferable so as to avoid repositioning.

Introduction

The co-administration of sciatic nerve and femoral nerve blocks provides anaesthesia or analgesia in patients undergoing lower extremity surgeries.[1–3] Sciatic nerve blocks can be applied using different approaches. The anterior sciatic nerve block is one such approach.[4] Anterior sciatic nerve blocks can be performed while the patient is in the supine position, at the same time and from the same region as a femoral nerve block, and turning the patient to one side is not required. After the tourniquet is applied, without moving the patient, the patient can be transferred to the operating room. However, the sciatic nerve is localized deeply and behind the femur,[5,6] which makes the application of the block difficult; consequently, it is considered an advanced nerve block. Posterior sciatic nerve block is another approach.[4] The advantages of this approach include the availability of imaging with ultrasonography (USG) and the fact that performing this type of nerve block is technically easier. One disadvantage is that patients with lower limb fractures will typically experience pain until the block is achieved because the patients must be turned sideways to allow the fractured limb to remain on top.

USG has been used during peripheral nerve block applications as well as classical techniques and generally enhances success during peripheral nerve blocks.[4,7] USG has been successfully used in both anterior and posterior sciatic nerve blocks as well as femoral nerve blocks.[4] Past studies have indicated that the concurrent use of USG and a nerve stimulator increases block success and quality.[8–10] In the present study, we aimed to compare the quality of sciatic nerve blocks performed with anterior and posterior approaches in patients undergoing lower extremity surgeries.

Materials And Methods

The local ethical board committee (Republic of Turkey, health sciences university, Bagcilar training and research hospital Ethics committee for clinical research) approved this study with an ethical approval report dated 03.18.2013 and numbered 2013/125. This study has been prepared in accordance with the Principles of the Helsinki declaration. We obtained written informed consent from each patient. This study was computer-randomized in terms of anterior or posterior sciatic nerve block, single-blinded, and prospectively planned. New patient included when failed block. A single-blinded anaesthesiologist performed all posterior or anterior sciatic nerve and femoral nerve blocks and left the operating room after the nerve block was completed and the patient was repositioned. Another anaesthesiologist followed the patient without knowing what approach had been previously used. Before initiating the study, the required number of participants was determined according to the results of a pilot study that included 10 patients in each group. In this earlier pilot study, the mean time of sciatic nerve sensory block onset ± standard deviation (SD) was 8.88 ± 4.87 min for Group A (anterior approach to sciatic nerve block + femoral nerve block) and 4.70 ± 2.05 min for Group P (posterior approach to sciatic nerve block + femoral nerve block). The sample size was calculated as 29 (n = 29) for Group A and 29 (n = 29) for Group P, with α = 5% and 90% power. Fifty-eight patients were enrolled in the present study. Our study complies with consort rules. Consort checklist submitted as an attachment.

Inclusion criteria:

1. Patients between the ages of 18 and 65 who had lateral and/or medial malleolus fractures.

2.These patients were classified according to the American Society of Anesthesiologists (ASA) I-II groups.

Exclusion criteria:

1. Patients with vascular disease, cardiac disease.
2. Metabolic-renal-hepatic disease.
3. Pregnancy.
4. Hemodynamic instability.
5. Drug use that is likely to cause metabolic acid—-base imbalance.
6. History for steroid use and allergy.
7. Contraindications to regional anaesthesia.
8. Alcohol drug addiction.

9. Those who did not graduate from primary school were excluded from the study
10. Failed block, sciatic nerve was not visualized in patients, patients with delirium

The variables of interest included patients' age; gender; height; weight; operation time; tourniquet time; ASA classification; time to first intraoperative fentanyl administration; total dose of fentanyl administered during the operation; motor and sensory block start and end times after sciatic and femoral block;s time to first diclofenac sodium administration; total dose of diclofenac sodium administered in 24 hours; visual analog scale (VAS) values; patient satisfaction; anaesthetic quality from the point of view of the anaesthesiologist; and surgical quality from the point of view of the surgeon.

Patient satisfaction:

0: failed

1: weak

2: moderate

3: good

4: excellent

Anaesthesia quality (anaesthesiologist) and surgical quality (surgeon)

1: Failed; general anaesthesia was required

2: Moderate; complainant, complementary analgesic was needed

3: Good; little complainant, no need for complementary analgesia

4: Excellent; patients do not complain.

The patients were informed about VAS one day before. The patients having no premed. The patients were taken to the regional block room and given a routine electrocardiogram, and noninvasive arterial blood pressure and peripheral pulse oximeter monitoring were performed. Sciatic nerve blocks using an anterior approach were performed using the Stimuplex® A needle (21G 0.80–150), which was positioned at 30° and isolated, in conjunction with a block nerve stimulator (Stimuplex HNS nerve stimulator; BRAUN, Germany) and ultrasound (Diagnostic ultrasound system, Model SDU 450 XL Class–1 type B; Shimadzu Corporation, Japan). A total of 40 mL of a local anesthetic solution, comprising 15 mL of 0.5% isobaric bupivacaine and 5 mL of 2% lidocaine and 20 mL isotonic sodium chloride, was prepared.

In both approaches, nerve stimulation was performed with a frequency of 2 Hz and with a 1-mA current, and the stimulus intensity was gradually reduced to 0.4 mA as long as a response was obtained.

Femoral nerve block: The nerve was visualized with concurrent USG, and the needle was oriented to the nerve. After the contraction of the vastus medialis, vastus intermedialis, and vastus lateralis muscles were visualized, a local anesthetic mixture of 20 mL was injected, and dissemination of the local anesthetic solution was imaged by USG (linear probe) (Figure 1).

Anterior sciatic nerve block: The sciatic nerve was imaged by USG (convex probe) along the needle route, and the needle was advanced to the nerve. When plantar flexion, dorsal flexion, and eversion of the foot were observed, 20 mL of local anesthetic mixture was administered and the local anesthetic spread was simultaneously imaged by USG (Figure 2).

Posterior sciatic nerve block: The USG probe was placed between the greater trochanter and the coccyx at the entry point of the needle, and the needle was advanced by imaging the nerve. When the plantar flexion, dorsal flexion, and eversion of the foot were observed, 20 mL of local anesthetic mixture was administered and the local anesthetic spread was simultaneously imaged by USG (Figure 3).

After the blocks were completed, the motor block was assessed by monitoring the movement of the ankle joint and knee and the sensory block was assessed using application of cold saline bag every minute; the block start times were recorded. When the patient was not receiving any cold stimulation on the sciatic and femoral stimulation areas, it was recorded as the start time of the full femoral-sciatic sensory block. Once the knee joint could not be moved, the time was recorded as the start time of the full femoral motor block. When the ankle joint was unable to move, it was recorded as the start time of the full sciatic motor block. After the block was fully achieved, a tourniquet was applied to the extremity to be operated and was inflated. Patients underwent surgery 30 min after the block was provided. One μg kg^{-1} fentanyl was injected intravenously in pain. The time when the patient received their first dose of fentanyl and the total dose of fentanyl administered intraoperatively were recorded.

The time to first diclofenac sodium administration and the total dose of diclofenac sodium administered within 24 hours of the postoperative period were recorded. The first postoperative dose of diclofenac sodium was administered when a patient had VAS values of 5 or more.

Statistical analysis: All data were evaluated using SPSS 11.5 for Windows. The normality distribution of the data was assessed by the Shapiro-wilks test. Mean ± SD values for the parametric tests and medians (minimum–maximum) for the nonparametric tests were used. Categorical data were presented as %n. Independent samples t-test was used for binary comparison of group data, and the chi-square test was used for between-group comparisons of categorical data. P values <0.05 were considered statistically significant.

Results

Participant data pertaining to age, height, weight, ASA, tourniquet duration, and surgical duration are given in Table 1. There was no statistically significant difference between Groups A and P with respect to these data.

The sciatic nerve sensory block start and end times and femoral nerve sensory block start and end times of the participants are presented in Table 2. There was a significant difference between Groups A and P in terms of the sciatic nerve sensory block start time, and the sciatic nerve block start time was significantly lower in Group P than Group A. There was no statistically significant difference between the groups in terms of the sciatic nerve sensory block end time and femoral nerve sensory block start and end times.

The sciatic nerve and femoral nerve motor block start and end times for the participants are given in Table 3. There were no statistically significant between-group differences for start and end times of sciatic and femoral nerve motor blocks.

Group comparisons of patient satisfaction, anesthesia quality, and surgical quality are given in Table 4. There was a statistically significant difference between Groups A and P in terms of patient satisfaction, with patient satisfaction being significantly greater in Group P than Group A. There was a statistically significant between-group difference in anesthesia quality, with Group P performing significantly better than Group A. There was a statistically significant between-group difference in surgical quality, with better surgical quality for Group P than Group A.

The total dose of intraoperative fentanyl required, the time to first fentanyl administration, the total dose of diclofenac sodium administered in the postoperative period, and the time to first diclofenac sodium administration are given in Table 5. There was a statistically significant between-group difference in total dose of intraoperative fentanyl required, with the total dose of fentanyl administered intraoperatively to Group P significantly lower than that administered to Group A. There was a statistically significant between-group difference in the time to first intraoperative fentanyl administration, with a significantly shorter time observed in Group P than Group A. There was no statistically significant between-group difference in the total dose of diclofenac sodium administered during the postoperative 24-h period and the time to first diclofenac sodium administration.

Despite local anaesthetic administration, nerve blocks were not achieved in eight of the patients in Group A, and these patients were excluded from the study. In Group A, the sciatic nerve was not visualized in two patients and muscle response was not obtained with stimulation; these patients were excluded from the study. In addition, three patients in Group A were excluded from the study because patients with pain, despite the presence of adequate block and high-dose fentanyl administration.

Despite local anaesthetic administration, in four patients in Group P, nerve blocks were not achieved, and these patients were excluded from the study. Four of the patients in Group P were excluded from the study because patient with pain, despite sufficient block formation and high-dose fentanyl administration. Additionally, one patient in Group P was also excluded from the study because delirium developed during the block. No complications were observed in the groups during the intraoperative and postoperative periods.

Discussion

In the present study, we performed sciatic nerve blocks with two different approaches and used a USG-guided nerve stimulator to minimize the negative effects of the applied technique on the quality of the block. There are several approaches for sciatic nerve block, but if a patient is planned to undergo lower limb surgery and tourniquet application is required, ran anterior or posterio femoral nerve block must be performed. During the anterior approach, the sciatic nerve is deeper than that observed during the posterior approach. However, during the anterior approach, imaging of the sciatic nerve with USG is as possible as it is with other approaches.[4] In addition, there are publications reporting that sensory and motor block quality during the anterior approach is at least as good as that observed during the posterior approach.[4]

In our study, we sought to determine if the anterior and posterior approaches differed in terms of block quality. A statistically significant difference in the anterior and posterior approach was observed when the sensory block start times after the sciatic nerve block was completed, and the sensory block was earlier during the posterior approach (7.70 ± 2.05 min) than the anterior approach (12.88 ± 4.87 min). However, there was no statistically significant difference in sensory block end times. A previous study[11] found that the block start time was 9.42 ± 1.08 min using the anterior approach and 7.75 ± 0.97 using the posterior approach. The block start time for the posterior approach was significantly lower than that for the anterior approach ($P = 0.001$) in that study. The results of the abovementioned study are compatible with the results of our study.

We found no statistically significant difference between the anterior and posterior approaches in terms of motor block start and end times. When comparing patient satisfaction was compared, 20 of 29 patients scaled their satisfaction as “grade 4,” in Group P indicating that patient satisfaction was significantly higher following the posterior approach than the anterior approach (Table 4). The anesthetist who evaluated the quality of anesthesia graded the quality as “grade 4” in 20 of 29 patients, which showed that the anesthetic quality of the posterior approach was significantly higher than that of the anterior approach. The surgeon who assessed the surgical quality graded satisfaction as “grade 4” for 20 of 29 patients in Group P, which showed that the surgical quality was statistically higher in the posterior approach than the anterior approach. The total dose of fentanyl administered intraoperatively was significantly lower with the posterior approach than the anterior approach. This could be explained by the higher quality of the sensory block in the posterior approach or diminished tourniquet pain. However, in the posterior approach, the time to first fentanyl administration was significantly shorter than that observed with the anterior approach. This is due to the pain associated with repositioning of the patients’ fractured extremity. Patients suffering from pain due to fracture were positioned laterally in order to place the fractured limb upwards; therefore, fentanyl administration was required earlier during the posterior approach while the block is expected to be completed.

The sciatic nerves of two patients were not imaged with USG during the anterior approach. During the anterior approach, the sciatic nerve location is significantly deeper than it is during the posterior approach.[4] Ota et al. reported that the sciatic nerve of two patients could not be visualized during sciatic block performed with the anterior approach.[4] We found that there was no difference between the two approaches in terms of sensory and motor block initiation, and it has been stated previously that either of the two approaches can be used depending on preference in minor knee surgery.[4] In contrast, sensory block of the posterior femoral cutaneous nerve, which runs parallel to the sciatic nerve in the gluteal region, is rarely achieved via the anterior approach. However, this is not considered a disadvantage during knee surgery, where a tourniquet is used.[4] In that study, most of the patients could not tolerate the tourniquet pain and fentanyl requirements were similar in the study groups.[4] In another study, posterior femoral cutaneous nerve block did not have any effect on tourniquet pain.[12] In our study, patients experienced increased tourniquet pain associated with the anterior approach and the total dose of fentanyl administered was significantly higher during the anterior approach.

Conclusions

Because the nerve is deep and located behind the femur in the anterior approach, it is not always possible to visualize the nerve, potentially reducing the success of the block. In the posterior approach, the sensory block start time was significantly shorter than that in the anterior approach. The total dose of fentanyl administered intraoperatively was significantly lower with the posterior approach. Time to first intraoperative fentanyl administration was significantly shorter in the posterior approach because of the need to reposition the patient for the block. If lower extremity surgery is performed in cases of fracture, sciatic nerve block can be applied using the anterior approach to avoid repositioning the patient. Because tourniquet pain is less and block quality is better during the posterior approach, this approach can be applied during surgery with patients with no fractures and no risk of pain due to repositioning.

Declarations

1.Ethics committee: Republic of turkey, health sciences university, Bagcilar training and research hospital Ethics committee for clinical research

Consent to participate: We obtained written informed consent from each patient.

2.Consent for publication: Not Applicable

3.Availability of data and materials: The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

4.Competing interests: The authors declare no competing interests.

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6.Author contribution:

AY: Design, work, analiysis, writing, editing, revision

BB: writing, editing, revision

7.Acknowledgements: Not Applicable

10.Author contribution:

Abdulkadir Yektaş: Design, work, analiysis, writing, editing, revision

Bedih Balkan: writing, editing, revision

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Tables

Table 1: Comparison of demographic characteristics, tourniquet duration, surgical duration, ASA and gender distribution of the groups. (mean±SD) or (n)

		Group A (n=29)	Group P (n=29)	p
Age (year)		37.95±12.69	38.95±8.68	0.839
Size (cm)		171.80±14.98	172.30±7.65	0.848
Weight (kg)		78.85±15.22	76.05±11.11	0.511
Tourniquet duration (min)		76.70±32.57	65.55±23.59	0.223
Surgery duration (min)		81.85±30.47	66.35±24.59	0.085
ASA	I (n)	21	22	0.500
	II (n)	8	7	
Gender	Famel (n)	22	16	0.083
	Male (n)	7	13	

ASA: American Society of Anesthesiologists

Table 2: Comparison of sensorial block start and end times after sciatic and femoral nerve block. (mean±SD)

	Group A (n=29)	Group P (n=29)	p
Sensorial block start time for sciatic nerve (min)	12.88±4.87	7.70±2.05	*0.01
Sensorial block end time for sciatic nerve (min)	188.50±69.01	201.85±43.81	0.564
Sensorial block start time for femoral nerve (min)	10.39±3.39	9.90±5.49	0.09
Sensorial block end time for femoral nerve (min)	146.65±78.67	124.50±17.85	0.074

*Statistically significant

Table 3: Comparison of motor block start and end times after sciatic and femoral nerve block.

(mean±SD)

	Group A (n=29)	Group P (n=29)	p
Motor block start time for sciatic nerve (min)	13.55±4.75	10.40±2.13	0.072
Motor block end time for sciatic nerve (min)	115±63.83	109.50±42.17	0.750
Motor block start time for femoral nerve (min)	11.61±4.48	10.16±3.91	0.063
Motor block end time for femoral nerve (min)	99.70±63.83	71.50±18.07	0.061

Table 4: Comparison of patient satisfaction, anesthesia quality and surgical quality in groups.

(n)

					p
		2	3	4	
Patient satisfaction	Group A (n=29)	16	9	4	*<0.01
	Group P (n=29)	4	5	20	
Anesthetic quality	Group A (n=29)	13	7	9	*0.005
	Group P (n=29)	3	6	20	
Surgical quality	Group A (n=29)	8	8	13	*0.026
	Group P (n=29)	3	3	23	

*Statistically significant

Table 5: Comparison of intra-operatively administered total fentanyl amount, first fentanyl requirement time, total diclofenac sodium amount and first diclofenac sodium requirement times in the postoperative first 24-hour periods in the groups. (mean±SD)

	Group A (n=29)	Group P (n=29)	p
Total amount of fentanyl (µg)	147.75±122.30	27.75±53.91	* <0.01
First fentanyl requirement time (min)	31.20±27.79	4.05±7.47	* <0.01
Total amount of diclofenac sodium administered within 24 hours (mg)	86.25±50.31	71.25±66.52	0.426
First diclofenac sodium requirement time (min)	332.15±246.50	293.75±277.00	0.646

*Statistically significant

Figures

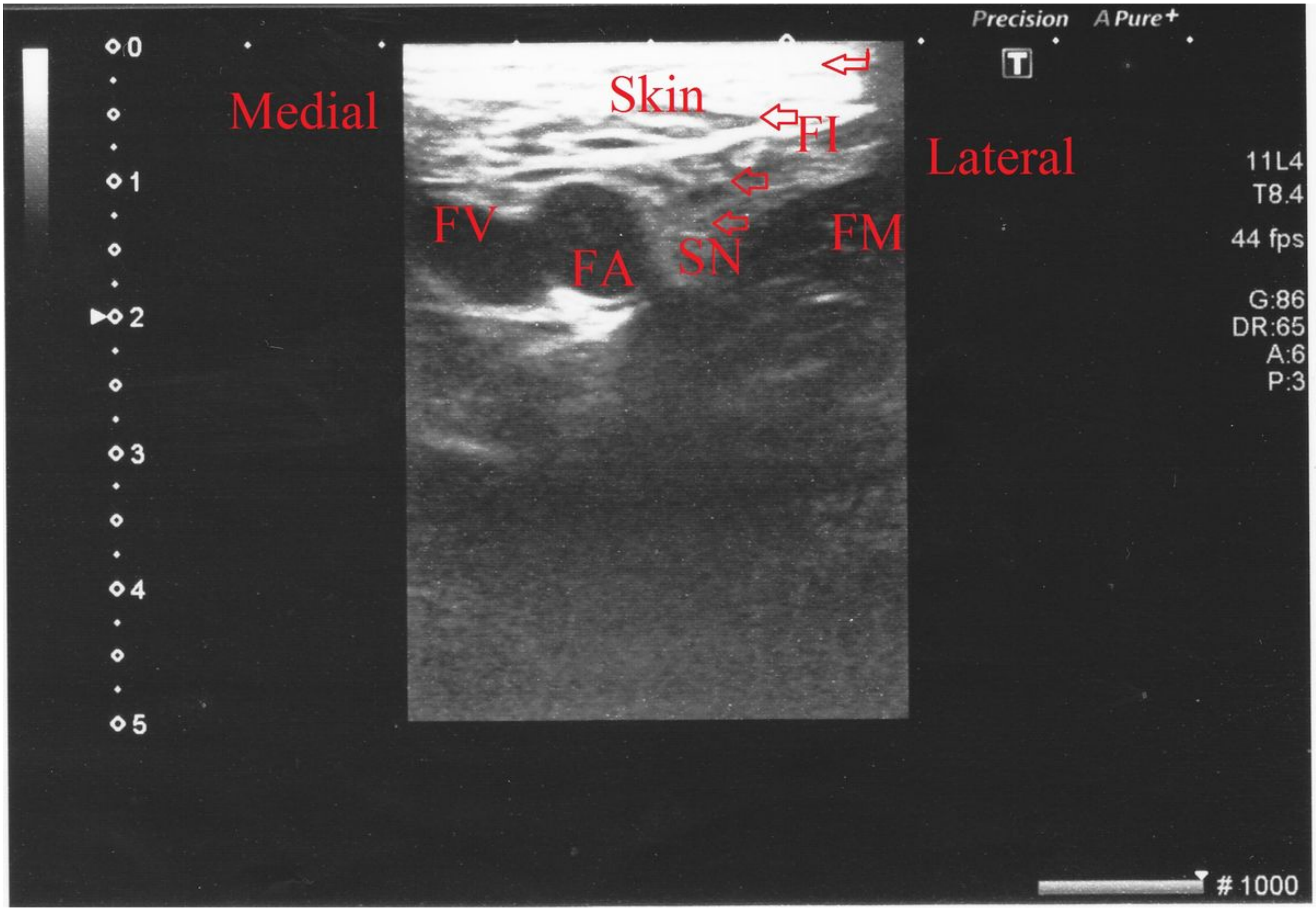

Figure 1

Ultrasound image of the femoral nerve obtained with the anterior approach during the block is shown in the short axis (transverse view) FI: fascia iliaca IM: liopsoas muscle LA: local anesthetic FA: femoral artery FV: femoral vein FN: femoral nerve Arrows: Femoral nerve = needle

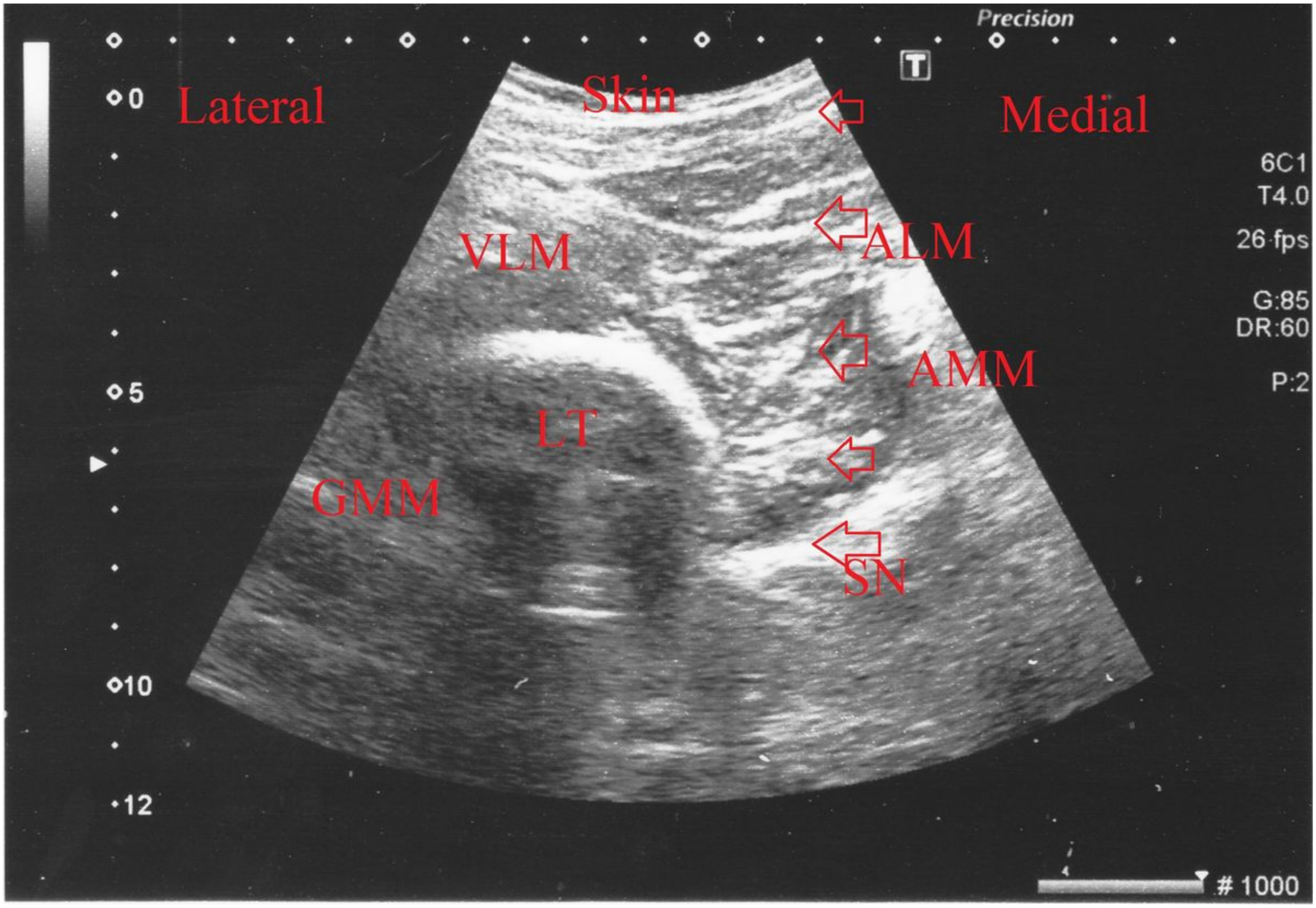

Figure 2

Ultrasound image of the sciatic nerve obtained with the anterior approach during the block is shown in the short axis (transverse view) ALM: adductor longus muscle AMM: adductor magnus muscle GMM: gluteus maximus muscle LT: femur (lesser trochanter) VLM: vastus lateralis muscle LA: local anesthetic Arrows: Sciatic nerve; triangles = needle

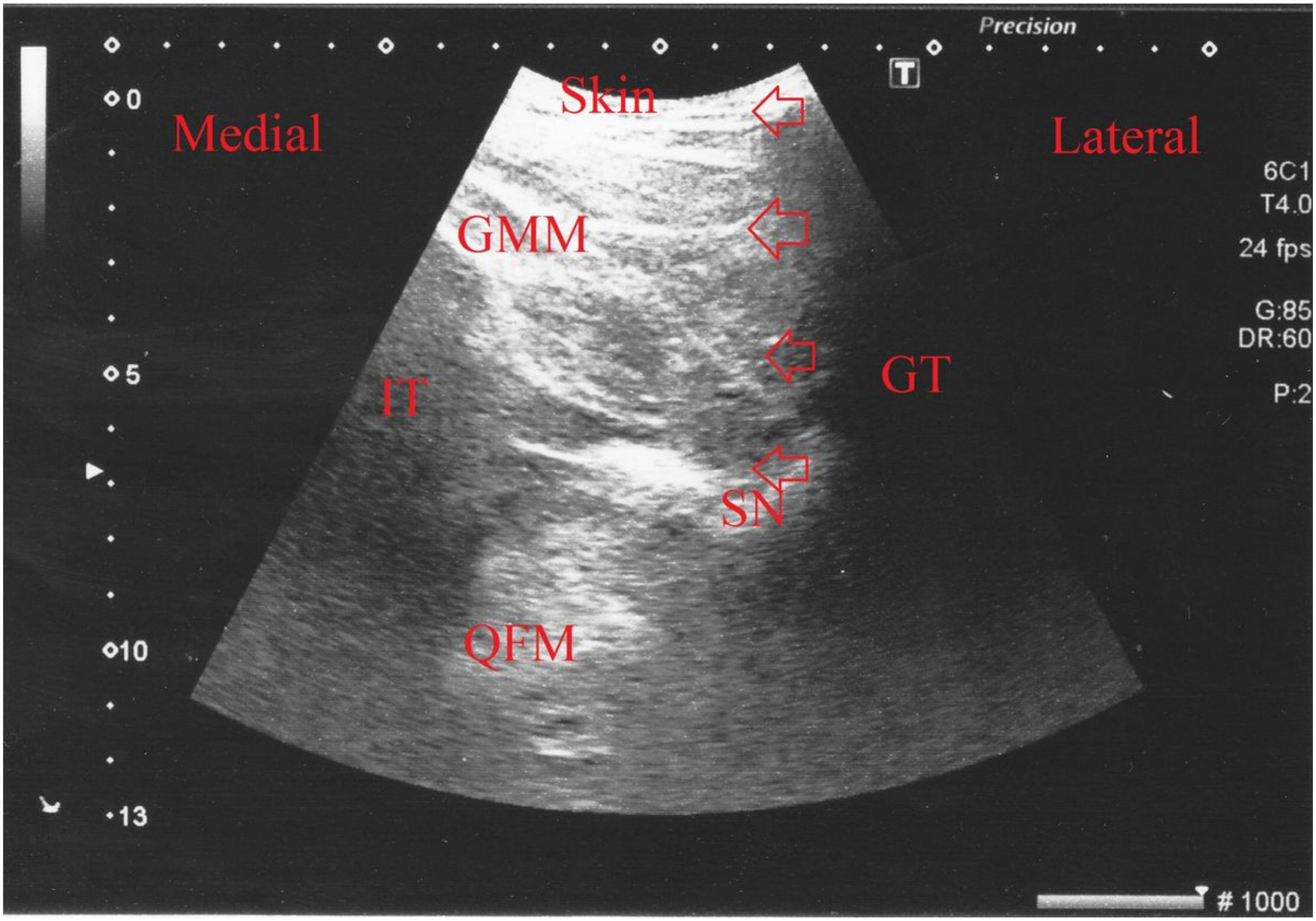

Figure 3

Ultrasound image of the sciatic nerve obtained with the posterior (subgluteal) approach during the block is shown in the short axis (transverse view) GMM: gluteus maximus muscle GT: greater trochanter IT: ischial tuberosity QFM: quatratus femoris muscle LA: local anesthetic Arrows: Sciatic nerve; triangles = needle

Supplementary Files

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- CONSORT2010Checklist.doc