

Comparison of infracondylar versus subsartorial approach to saphenous nerve block: A randomized controlled study

ABSTRACT

Background and Objectives: Only a few different approaches are currently utilized for saphenous nerve block. Our study aimed to compare two different ultrasound (US)-guided saphenous nerve blocks and designed this study to test the hypothesis that the medial infracondylar approach has more success rate than the subsartorial approach applied in saphenous nerve blockage.

Methods: The study included 76 patients (18–65 years old) with the American Society of Anesthesiologists physical status of I–III, who were scheduled for below-knee surgery by the orthopedics clinic. The patients who underwent US-guided saphenous nerve blockade were randomly divided into two groups: Group S (subsartorial approach) and Group M (medial infracondylar approach). For all patients who had a block procedure, the pinprick test was performed using a blunt needle on the saphenous nerve dermatome. Success rate, time of block performance (TBP), onset time of block (OTB), and duration of sensory blockade (DSB) were recorded using a patient follow-up form.

Results: The US-guided saphenous nerve block success rate was similar (88% vs. 91%) for both techniques. The DSB values were 415.2 ± 65.3 min (95% confidence interval [CI]: 286.3–539.8) for Group S and 369.7 ± 52.2 min (95% CI: 265.6–467.8) for Group M ($P = 0.04$), and no significant differences in the TBP and OTB were observed between the groups.

Conclusion: Both of the different anatomical approaches have equally high success rates. Although the DSB was found to be significantly longer in the subsartorial approach, this is clinically unimportant, and the medial infracondylar approach is still a viable alternative technique during saphenous nerve blockage.

Key words: Medial infracondylar; orthopedic surgery; regional anesthesia; subsartorial; ultrasound guided

Introduction

Regional anesthesia techniques used for orthopedic surgeries have immensely improved, with their applicability increasing almost daily. To avoid common side effects and undesired prolonged effects of neuraxial blocks such as hypotension, nausea, vomiting, and urinary retention, especially in lower extremity surgeries, peripheral nerve blocks may also be

utilized in the surgical region as an effective alternative method for anesthesia. The saphenous nerve originates from the femoral nerve and provides sensory innervation to the medial, anteromedial, and posteromedial aspects of the lower extremity.^[1] A saphenous nerve block combined with a sciatic nerve block may be sufficient in below-knee surgeries instead of the lumbar plexus or femoral nerve

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blocks. Ultrasound (US)-guided saphenous nerve blockade can be performed using various techniques or approaches.^[2-8] In US-guided saphenous nerve blockade, Krombach and Gray^[3] used the femoral artery adjacent to the saphenous nerve below the sartorius muscle at 5–7 cm proximal to the popliteal fold; however, our group previously described applying a saphenous nerve block, a few centimeters below the medial condyle of tibia.^[8] However, the saphenous nerve lies superficially, and it has no vascular adjacent in our technique. According to our experience, medial infracondylar technique has high success rate, long duration time, easily applicable, and low vascular puncture risk. We hypothesized our technique that the medial infracondylar approach has more success rate than the subsartorial approach. In this study, we aimed to compare the medial infracondylar approach to subsartorial approach for saphenous nerve blockage.

Methods

The present study was conducted at Gaziantep University Medical Faculty Hospital with the approval of the Ethics Committee and registered (ACTRN12614000057684, Levent Sahin, January 20, 2014). Each patient included in the study was informed verbally and in writing about the study and provided written consent.

The study included 76 patients (ages 18–65 years), with the American Society of Anesthesiologists (ASA) physical status of I–III, who were scheduled for below-knee lower extremity surgery without cast by the orthopedics clinic. The patients who were using anticoagulants, who had coagulopathy, local infection at the injection site, peripheral neuropathy, who refused regional anesthesia, who were unable to cooperate, and who had below-knee amputation were excluded from the study. Before the operation, each patient's age, height, weight, and ASA physical status assessment were recorded using a patient follow-up form.

The patients who were scheduled for below-knee surgeries at our hospital were randomly divided into two groups. Randomization was performed with the use of a random number generator, and each assignment was placed into a sealed envelopes. After patient preparation and monitoring, the envelopes were opened and viewed by same investigator who has experienced US for 5 years, performing the blocks. Group S included 34 patients who underwent the subsartorial approach during US-guided saphenous nerve blockade, and Group M included 34 patients who underwent the medial infracondylar approach during US-guided saphenous nerve blockade. The saphenous nerve block was performed under

the guidance of B-mode US (Esaote MyLab30, Florence, Italy), using a 36-mm linear transducer with a frequency of 18 MHz.

All patients were placed in the supine position on the operation table and routinely monitored (e.g., electrocardiogram, heart rate [HR], noninvasive mean arterial pressure [MAP], and SpO₂), a vascular access was established by an 18-gauge intravenous (IV) cannula from a proper vein in the dorsum of the hand or antecubital region, and infusion with 0.9% NaCl 5–8 mL/kg/h was initiated. Midazolam (1–1.5 mg IV; Demizolam, Dem Pharmaceuticals, Istanbul, Turkey) was administered to the patients for sedation.

Regarding the patients who received a saphenous nerve block using the subsartorial approach in Group S, the medial femur was cleaned with 10% povidone-iodine through the knee region. After applying gel on the US probe, it was placed into a sterile sheet, and the linear US probe was transversely placed at the anteromedial aspect and lower for the subsartorial saphenous nerve approach [Figure 1a]. The saphenous nerve was viewed among the *Musculus vastus medialis*, *Musculus gracilis*, and *Musculus adductor* below the *Musculus sartorius* [Figure 1b]. An US-guided insulated 22-gauge × 80 mm short bevel plexus block needle (UniPlex NanoLine, PAJUNK®, Geisingen, Germany) was inserted using the in-plane technique, and 5 mL of local anesthetic mixture,

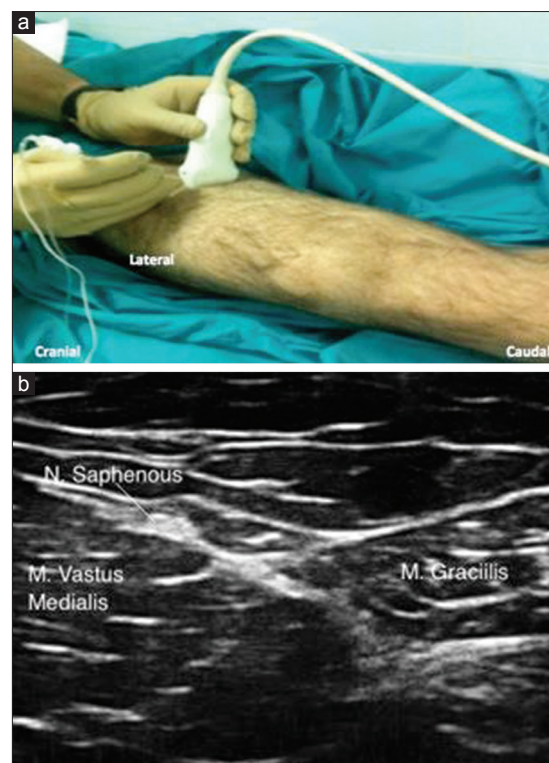


Figure 1: (a) Subsartorial approach to the saphenous nerve block, (b) ultrasound image of the subsartorial approach to saphenous nerve block

containing 0.25% levobupivacaine (Chirocaine®, Abbott, Norway) + 1% lidocaine (Jetmonal Ampoule, Adeka, Turkey), was administered after no blood was observed through negative aspiration. The target tissues and local anesthetic distribution were simultaneously viewed, and the block was performed.

Regarding the patients who received a saphenous nerve block using the medial infracondylar approach in Group M, the medial region of the knee was cleaned with 10% povidone-iodine. The US probe was transversely placed at a few centimeters below the medial condyle of the knee at the knee level to perform the saphenous nerve block [Figure 2a]. After the saphenous nerve was viewed as a hyperechoic point between the aponeuroses of *Musculus sartorius* and *Musculus gracilis*, the 80-mm insulated 22-gauge needle was inserted using the in-plane technique, and 5 mL of the same local anesthetic mixture as described above was administered after observing no blood was observed through negative aspiration. The target tissues and local anesthetic distribution were simultaneously viewed, and the block was performed [Figure 2b].

After the saphenous nerve block, the US-guided sciatic nerve block was performed in all patients with a total of 20 mL of the local anesthetic mixture containing 0.25%

levobupivacaine + 1% lidocaine. The pinprick test was performed using a blunt needle on the anteromedial aspect of the distal lower leg in all the patients who underwent a block procedure. A scoring system was used for evaluation compared with the opposite leg; 0: Absent sensation; 1: Decreased sensation; and 2: Normal sensation (no block).

The primary outcome was block success rate, and the secondary outcomes included duration of sensory blockade (DSB), the time of block performance (TBP), and the onset time of block (OTB). DSB was evaluated every 30 min, by the time the score reached 2 in the postoperative period by a blinded investigator. The TBP was accepted as the time from the placement of the US probe on the skin to the administration of the injection and was recorded by the anesthesia nurse. The OTB was evaluated every 20 s, and the time when any score <2 was recorded. The block was considered unsuccessful if no loss of sensation occurred within 15 min after injection.

Statistical methods

The sample size of the present study was calculated based on block success rate, and the previous study reported 77% for subsartorial approach.¹⁹ We estimated the success rate of 98% for medial infracondylar approach as *a priori* clinical assumption, and to power of 80% and $\alpha = 0.05$, a sample size of $n = 38$ per group was required.

The data obtained from this study were assessed using Mann–Whitney U-test to compare the two independent groups from the nonparametric tests and their 95% confidence intervals (CIs). Descriptive statistics were expressed as the mean \pm standard deviation. SPSS for Windows 11.5 (SPSS Software ver. 10.0 for Windows, SPSS Inc. Chicago, IL, USA) was used for the analyses. $P \leq 0.05$ was considered significant.

Results

This study enrolled 76 patients; however, three patients were excluded due to the change in surgery region, and five patients were excluded due to the lack of data collection [Flow Diagram 1]. The age, gender, body mass index (BMI), and ASA classification of the 68 patients who had saphenous nerve block are provided in Table 1. No demographical differences



Figure 2: (a) Medial infracondylar approach to the saphenous nerve block, (b) ultrasound image of the medial infracondylar approach to the saphenous nerve block

Table 1: Demographics

	Group S (n=34)	Group M (n=34)	P
Age (year)	33.2±13.7	34.9±13.2	0.341
Gender			
Male/female	27/7	24/10	0.346
BMI (kg/m ²)	26.4±4.7	25.9±4.8	0.766
ASA (I/II/III)	11/18/5	10/14/10	0.264

BMI: Body mass index; ASA: American Society of Anesthesiologists

were observed between the groups. The success rate of the saphenous nerve block as primary outcome was 88% (30 of 34) and 91% (31 of 34) (P value) patients in the subsartorial and medial infracondylar groups, respectively. The secondary outcome of DSB values was 415.2 ± 65.3 min (95% CI: 286.3–539.8) for Group S and 369.7 ± 52.2 min (95% CI: 265.6–467.8) for Group M [Table 2]; a significant statistical difference was found between the groups ($P = 0.04$). No significant difference was found between the groups when comparing the TBP and OTB [Table 2]. The records for the pre- and post-operative HR, MAP, and SpO₂ parameters of the patients from both groups were not statistically significant, and no significant difference was observed in the operation types between the groups [Table 3].

No peripheral block complications such as arterial or venous puncture, local anesthetic toxicity, and intraneural injection occurred in the saphenous and sciatic nerve block applications performed in all patients. In addition, no early infection occurred at the injection site.

Discussion

The present study conducted US-guided saphenous nerve block in addition to sciatic nerve block in patients scheduled for below-knee extremity surgery by the orthopedics and traumatology clinic at Gaziantep University Medical Faculty Hospital. Local anesthetic of equal volume and concentration was used during the saphenous nerve block, which was performed using two different anatomical approaches.

This study showed the US-guided saphenous nerve block with a high success rate (88% and 91%) in both groups. Tsai *et al.*^[9] reported a 77% success rate for the subsartorial approach with US-guided technique, and Head *et al.*^[10] reported a 84% success rate for the adductor canal approach. Our success rate looks like higher than Tsai *et al.*'s report for subsartorial approach because they probably reported had experiences in the first cases. We believe that the experience of practitioners has increased in time all around the world.

We also performed blocks which were not affected by the challenges argued by De Mey *et al.*^[11] and the difficulties due to the patients' anatomical variations. They achieved a 100%

success rate in the saphenous nerve blocks performed using 3–4 cm of the saphenous vein tract by starting from below the tibial medial condyle with a paravenous approach in a group of twenty voluntary patients.^[11] This technique was performed based on anatomical landmarks, and the study included patients with a BMI within normal limits, suggesting that the success rate may vary in patients with different anatomical characteristics. Indeed, De Mey *et al.*^[11] argued that this approach would become difficult if the patients who undergo the block are obese or have varicose veins in the lower extremities. Although we did not have comparable results, we believe that US-guided techniques reduce the performance time and improve the success rate compared with techniques that do not use the US. Especially the medial infracondylar technique described by us, application is easier than the others according to our experience.

The DSB was significantly longer in the saphenous nerve block using the subsartorial approach compared with the medial infracondylar approach. This difference may be caused by the location of the saphenous nerve in a thicker and wider sheath within the adductor canal in the subsartorial region, allowing for a minimum level of administered local anesthetic to enter the systemic circulation due to this sheath. Therefore, the contact time of the nerve with the local anesthetic is longer. The shorter of DSB in the medial infracondylar approach may have resulted from the location of the saphenous nerve in a more superficial and thinner sheath, extending along the medial condyle of the tibia, enabling greater absorption of the local anesthetic into the adjacent tissues. Likewise, the nerve diameter is known to have an effect on the absorption and redistribution of local anesthetics, likely prolonging the action time due to the longer redistribution at the proximal region where the nerve diameter is wider. Although there is statistically significant difference in DSB, we believe that result is clinically insignificant. Basically, these two methods are both excellent and clinically interchangeable.

Lundblad *et al.*^[12] performed a US-guided saphenous nerve block in the subsartorial region on ten adult participants by administering 5 mL 0.5% levobupivacaine and recorded the mean DSB as 1626 min for the saphenous nerve block. The present study found a mean DSB of 415 min in the subsartorial approach. The shorter DSB of the present

Table 2: The time to block performance, onset time of sensory blockade, and total duration of sensory blockade for the groups

	Group S (n=34)	Group M (n=34)	P
Time to block performance (s), 95% CI	87.4±14.2, 59.6-114.1	79.6±11.7, 56.3-102.5	0.364
Onset time of block (s), 95% CI	79.8±13.4, 50.4-104.6	77.7±14.3, 49.2-104.7	0.212
Duration of sensory blockade (min), 95% CI	415.2±65.3, 286.3-539.8	369.7±52.2, 265.6-467.8	0.04*

CI: Confidence interval

study compared with the block by Lundblad *et al.*^[12] may be explained by the reduction in the effective concentration of local anesthetic as a result of adding a short-acting local anesthetic such as lidocaine to a long-acting local anesthetic such as levobupivacaine. Furthermore, Lundblad *et al.* recorded a mean OTB of 264 s, whereas the present study recorded a mean OTB of 79.8 s. Lundblad *et al.*^[12] found a longer OTB in the block performed using lipophilic 0.5% levobupivacaine as the local anesthetic agent compared with this study, which has a delayed and longer action. The shorter OTB of the present study may have resulted from the addition to of hydrophilic 1% lidocaine, which acts rapidly and terminates earlier, to the levobupivacaine solution.^[13-15] The OTBs were compared with the subsartorial application and the medial infracondylar application to the saphenous nerve blockade under the US guidance; no statistically significant difference was observed. This finding may be due to the small differences between the

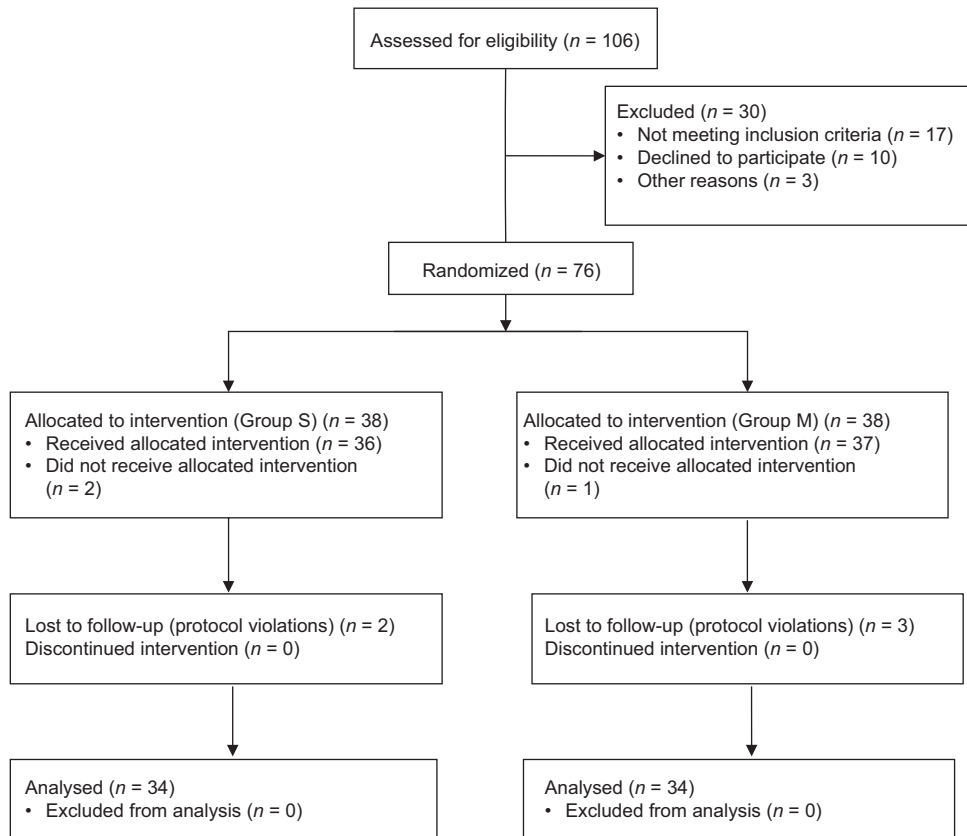
nerve fiber diameters, causing the difference in the OTBs to be insignificant.

Benzon *et al.*^[16] performed a saphenous nerve blockade in a patient group of ten individuals in different anatomical localizations using nerve stimulators to examine the sensory block medial to the leg and reported that the sensory block developed in all ten patients using the transarterial approach, whereas complete sensory block developed in seven of ten patients in the block at the tibial medial malleolar level. In the present study, complete sensory block in the dermatome area innervated by the saphenous nerve was observed 88% and 91%, respectively, in groups. Besides, in the present study, the saphenous nerve to be blocked and the distribution of the local anesthetic around the nerve was displayed with US. The saphenous nerve block studies with nerve stimulators showed that the US-guided blockade facilitated the saphenous nerve block.^[2]

Gray and Collins^[2] blocked the saphenous nerve using the paravenous approach at the distal to the tibial medial condyle under US guidance. Krombach and Gray^[3] performed saphenous nerve blocks using a transarterial approach 5–7 cm proximal to the popliteal fold under US guidance. Tsui and Ozsel^[6] performed a saphenous nerve block based

Table 3: The frequency of operation types by groups

Type of operation	Group S (n=34)	Group M (n=34)	P
Bunionectomy	13	12	0.092
Ganglion cyst excision	9	10	0.156
Implant removal	8	7	0.105
Chevron osteotomy	4	5	0.186



Flow Diagram 1: CONSORT 2010 flow diagram

on the femoral artery 10–12 proximal to the popliteal fold under US guidance. Sahin *et al.*^[8] performed the saphenous nerve block by viewing the saphenous nerve at the distal to medial tibial condyle under US guidance. In the current study, the saphenous nerve block was performed using Krombach and Gray^[3] and Sahin *et al.*^[8] approaches. The present study aimed to minimize the failures due to potential anatomical variation by viewing the saphenous nerve in both approaches. The saphenous nerve was viewed, and the local anesthetic was administered around the nerve in the saphenous nerve block performed by Gray and Collins^[2] using the paravenous approach; therefore, we believe that the success of the block may be adversely affected by anatomical variation. In the subsartorial techniques,^[3,6,9,10] a number of disadvantages exist, including the risk for arterial puncture due to the anatomical adjacencies of the saphenous nerve and the longer viewing time of the saphenous nerve with US due to the location of the nerve far under skin surface. These issues cause the procedure to be painful due to the passing of multiple tissues and muscle layers to advance the block needle through the nerve. For the saphenous nerve block defined by Sahin *et al.*^[8] and used in the present study, no complications such as arterial and venous puncture occurred because of the easier view caused by US due to the nerve localization being closer to the skin surface and the absence of anatomical adjacencies specified in the approaches by other operators. We can apply this technique, especially in vascular anatomical variations and patients with obese.

Several limitations exist in our study. First, not all parameters could be blinded, with only the DSB considered as single blinded. Second, we did not consider patient satisfaction or procedure pain in our analysis because the injection points of two different techniques at different depths may cause significant consequences. Furthermore, we did not consider saphenous nerve ease of visualization under US because we thought that the success rate would be more objective for evaluation. Finally, our study sample size may not accurately reflect the complication and success rate.

Conclusion

The saphenous nerve blockade performed under US guidance with two different anatomical approaches for below-knee surgery has a high success rate equally for both approaches and provided efficient analgesia considering the DSB results. Although the DSB was found to be statistically longer in the subsartorial approach, we believe that result is clinically insignificant. The TBP and OTB of the US-guided blockade of the saphenous nerve using the medial infracondylar approach

were shorter but not significantly different when compared with the subsartorial approach. This finding suggests that the medial infracondylar approach is a good alternative approach and that both of these techniques are comparable.

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Conflicts of interest

There are no conflicts of interest.

References

1. Williams PL, Bannister LH. Gray's Anatomy: The Anatomical Basis of Medicine and Surgery. 38th ed. New York: Churchill Livingstone; 1995.
2. Gray AT, Collins AB. Ultrasound-guided saphenous nerve block. *Reg Anesth Pain Med* 2003;28:148.
3. Krombach J, Gray AT. Sonography for saphenous nerve block near the adductor canal. *Reg Anesth Pain Med* 2007;32:369-70.
4. Horn JL, Pitsch T, Salinas F, Benninger B. Anatomic basis to the ultrasound-guided approach for saphenous nerve blockade. *Reg Anesth Pain Med* 2009;34:486-9.
5. Manickam B, Perlas A, Duggan E, Brull R, Chan VW, Ramlogan R. Feasibility and efficacy of ultrasound-guided block of the saphenous nerve in the adductor canal. *Reg Anesth Pain Med* 2009;34:578-80.
6. Tsui BC, Ozelsel T. Ultrasound-guided transsartorial perifemoral artery approach for saphenous nerve block. *Reg Anesth Pain Med* 2009;34:177-8.
7. Kirkpatrick JD, Sites BD, Antonakakis JG. Preliminary experience with a new approach to performing an ultrasound-guided saphenous nerve block in the mid to proximal femur. *Reg Anesth Pain Med* 2010;35:222-3.
8. Sahin L, Sahin M, Isikay N. A different approach to an ultrasound-guided saphenous nerve block. *Acta Anaesthesiol Scand* 2011;55:1030-1.
9. Tsai PB, Karnwal A, Kakazu C, Tokhner V, Julka IS. Efficacy of an ultrasound-guided subsartorial approach to saphenous nerve block: A case series. *Can J Anaesth* 2010;57:683-8.
10. Head SJ, Leung RC, Hackman GP, Seib R, Rondi K, Schwarz SK. Ultrasound-guided saphenous nerve block – Within versus distal to the adductor canal: A proof-of-principle randomized trial. *Can J Anaesth* 2015;62:37-44.
11. De Mey JC, Deruyck LJ, Cammu G, De Baerdemaeker LE, Mortier EP. A paravenous approach for the saphenous nerve block. *Reg Anesth Pain Med* 2001;26:504-6.
12. Lundblad M, Kapral S, Marhofer P, Lönnqvist PA. Ultrasound-guided infrapatellar nerve block in human volunteers: Description of a novel technique. *Br J Anaesth* 2006;97:710-4.
13. Moore PA, Hersh EV. Local anesthetics: Pharmacology and toxicity. *Dent Clin North Am* 2010;54:587-99.
14. Borgeat A, Aguirre J. Update on local anesthetics. *Curr Opin Anaesthesiol* 2010;23:466-71.
15. Becker DE, Reed KL. Essentials of local anesthetic pharmacology. *Anesth Prog* 2006;53:98-108.
16. Benzon HT, Sharma S, Calimaran A. Comparison of the different approaches to saphenous nerve block. *Anesthesiology* 2005;102:633-8.