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COMPARISON OF SINGLE INJECTION VERSUS DOUBLE INJECTION TECHNIQUE OF SCIATIC FEMORAL NERVE BLOCK IN LOWER LIMB ORTHOPEDIC SURGERIES

Anesthesiology

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ABSTRACT

Introduction: Sciatic femoral nerve block is indicated for lower limb orthopaedic surgery. It is performed by localising sciatic and femoral nerve and injecting the local anaesthetic solution at that location. In this study we compare the two approaches combined sciatic and femoral nerve block with posterior approach of sciatic nerve block and femoral nerve block (single injection v/s double injection), in term of success rate, complication and patient comfort. The approaches used with the help of nerve stimulator are labat's approach for posterior sciatic nerve block and conventional femoral nerve block and chelly's approach for combined sciatic-femoral nerve block.

Aim & Objectives: The study was done to compare success rate of sciatic and femoral nerve block for two different approaches, anterior approach for combined sciatic-femoral nerve block (single injection) v/s posterior approach for sciatic nerve block plus femoral nerve block (double injection).

Material and Methods: A total of 60 patients who were planned to undergo lower limb orthopaedic surgery were divided into two group SF and CSF. Sciatic-femoral nerve block was performed using 50 mm insulated nerve stimulator needle and b.braun stimuplex nerve stimulator with an initial stimulator current of 1.0 mA with 2 hz frequency . The patient belonging to the respective group would receive sciatic femoral nerve block and attaining the evoked muscles response.

Results: After prospective, randomized comparative study which was carried out in 106 patients ,result achieved was that in comparison to the sciatic nerve block via labat's posterior approach plus femoral nerve block, sciatic-femoral nerve block via chelly's anterior approach was associated with lesser number of attempt , time taken to perform procedure was lesser and with rapid onset of motor block.

KEYWORDS

Sciatic-femoral nerve block (anterior approach) , femoral nerve block, sciatic nerve block (posterior approach), sciatic nerve, femoral nerve , nerve stimulator.

INTRODUCTION

There was the era of unending endeavours to control pain, the 'fifth vital sign'! The efforts to manage pain have evolved from the simple topical application of cocaine, through the use of sedation analgesia - the "twilight sleep" and techniques of neuraxial blockade, to the development of nerve blocks that are still in use today, in one form or another and with one eponymous name or another.

Advantages of regional anaesthesia over general anaesthesia[1]
Regional anaesthesia is preferred to avoid the complication of general anaesthesia like trauma to lips, teeth pharynx, vocal cord[2] and its associated with bronchospasm, aspiration, prolonged somnolence, prolonged paralysis from atypical response to neuromuscular blockers, peripheral nerve damage[3], malignant hyperthermia, nausea, vomiting and increased risk of anaphylaxis or anaphyactoid reactions due to use of multiple drugs.[4]

Peripheral nerve blocks are ideally suited for lower limb surgeries because of the peripheral location of the surgical site and the potential to block pain pathways at multiple levels. In contrast to other anaesthesia techniques such as general or spinal anaesthesia, properly conducted PNBs avoid hemodynamic instability and, facilitate postoperative pain management, and assure a timely discharge of the patient.[5]

Sciatic nerve block is time-proven technique to provide analgesia and anaesthesia of the lower extremity. Sciatic nerve block, associated with an appropriate Femoral nerve block, has been described as the peripheral nerve block of choice for operations performed for lower leg.[6]

The Anterior approach, as first described by Beck in 1963 [7], which is helpful in patient with compromised mobility. The anterior approach to the sciatic nerve block (ASB) has recently also received a significant attention as it has several important advantages over the posterior or lithotomy approaches [8,9]. The ASB can be performed with the patient in the supine position. If necessary both sciatic and femoral blocks can be performed with the patient in the supine position. In the anterior approach, the needle is inserted through the antero-medial thigh, inferior to the inguinal ligament, and advanced posteriorly towards the sciatic nerve that lies directly behind the femur.

Chelly et al. have recently described a modification of the Beck's anterior approach to sciatic nerve block using simplified landmarks [10]. The authors emphasized the more practical landmarks which may significantly facilitate nerve localization.

The Single injection technique has several advantage over Double injection technique . It can be performed in supine position , Both femoral and Sciatic nerve block can be given in single injection [11].

However, compared to single injection, double injection may increase both patient discomfort and incidence of neurological complication. While, Single injection offer less pain and discomfort to patient, less chance of Neuroaxial complication by avoiding puncture at multiple site[12].

In this study, we evaluate the two approaches, combined Sciatic and Femoral nerve block through single injection with posterior approach of Sciatic nerve block plus Femoral nerve block through double injection (Single injection v/s Double injection), in term of success rate, complication and patient comfort.

AIM & OBJECTIVES

Aim of the study : The study was done to Compare success rate of Sciatic and Femoral nerve block for two different approaches, Anterior approach for combined Sciatic-femoral nerve block (single injection) v/s posterior approach for sciatic nerve block plus femoral nerve block (Double injection).

Primary Objectives : Two different approaches were compared between two groups of patients who underwent lower limb orthopaedic surgeries and, the ease and feasibility of two approaches were evaluated, i.e., Anterior approach for combined Sciatic-femoral nerve block v/s posterior approach for sciatic nerve block plus femoral nerve block (Nerve Stimulater guided) as well as their suitability for specific factors such as, the patient's position and comfort with respect to surgery.

- Time taken to perform both procedures.
- Number of attempts taken to complete the procedure.
- Time taken for onset of complete motor and sensory block.
- To assess the intensity of sensory and motor block.
- To assess the duration of sensory and motor block.
- Duration of post-operative analgesia.

Secondary Objectives :

- To assess side effects (if any)

MATERIAL AND METHODOLOGY

The present study was undertaken in indoor patients admitted in orthopaedics ward in NSCB Medical College and Hospital Jabalpur(M.P).

Selection of cases

After obtaining institutional and ethics committee approval and written informed consent, 60 patients of both sexes in the age group of 18 yrs – 65 yrs, weight ranging between 45-75 kg belonging to ASA class I and II posted for elective surgeries on lower limb (below knee) were enrolled for the study. A detailed history, thorough physical examination, routine investigation or any especial investigation if required were done for study.

EXCLUSION CRITERIA

- Morbid Obesity
- Patient with history of cardiopulmonary, neurologic, active hepatic and renal diseases, psychiatric disorders.
- Pregnant and lactating women.
- Contraindication for Sciatic and Femoral block such as clotting disorder, cutaneous local infection.
- Sensitivity to local anaesthesia agents.
- Patients not willing for regional block.

SAMPLE SIZE

The adequate required sample size was estimated using following formula-

- $n=z^2pq/d^2$
- where –
- n= sample size
- z= 1.96 (considering 0.05 alpha, 95% confidence limits and 80% beta)
- p= assumed probability of concurrence or concordance of results
- q= 1- p
- d= marginal error (precession)

To calculate the adequate required sample size we have taken assumption suggested by previous literature review that 15 to 45% (15% relative precision) difference between the groups would be observed.

This accumulates 30 by using above given formula. Therefore, minimum 30 subjects in each group will be adequate numbers.

STATISTICAL ANALYSIS

- The data of the present study were recorded / fed into the computers and after its proper validation, checking for error, coding & decoding, was compiled and analysed with the help of SPSS 20 software for Windows. Appropriate univariate and bivariate analysis and ANOVA for comparing more than two mean were carried out and use of Students t-test and x2 test for categorical data will be applied to check the hypothesis according to the type of data i.e continuous and categorical. The VAS scores in two groups were analysed using a non parametric test namely Mann – Whitney U test.
- All mean are expressed as mean $\pm$ standard deviation and the proportion as in percentage (%). The critical value for the significance of the results were considered at 0.05 level.

STUDY DESIGN :

Prospective Randomized double blinded comparative study. For the purpose of study, the patients were randomly allocated by random number table into two group of 30 patients each.

Group (SF)	Sciatic and femoral nerve block via different approach	30 Patients
Group (CSF)	Sciatic and femoral nerve block via Combined approach	30 Patients

DRUG USED :

- 0.5% Ropivacaine[13]

In Group SF and CSF, patients received 18 ml of 0.5% Ropivacaine for Femoral nerve block and 27 ml of 0.5% Ropivacaine for Sciatic nerve block.

Material Required :

1. Sterile Tray
2. Sterile Towel
3. Sterile Swabs
4. Sponge Holding Forcep
5. Betadine Solution
6. Spirit
7. 10 cc syringes
8. 2 cc Syringes
9. B. Braun Stiumplex nerve stimulator
10. Braun stiumplex insulated needle (22 G X 15 cm,10 cm, 5 cm)

For unanticipated complications :

- Emergency drugs
- Intubation kit
- Resuscitation equipment

- **Technique :**

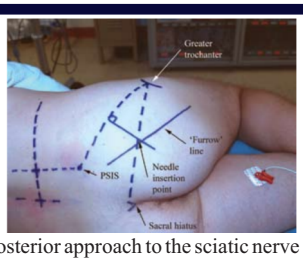
The patient was placed on the operation table in supine position. Before starting the procedure all the monitoring equipment (NIBP cuff, pulse oximetery probe, ECG) were attached to the patient and baseline value of BP, HR, SPO2 and RR were recorded an IV cannula 18 G was inserted. No pre-medication was given.

TECHNIQUE FOR NERVE BLOCK VIA DIFFERENT APPROACH IN GROUP SF :

In group SF, patients received sciatic nerve block via classical labat's approach [14] and femoral nerve block[15] separately (Double injection technique).

Sciatic Nerve block via classical Labat's approach:

- The patients were placed in lateral decubitus position (operative side up), and the leg is flexed at the knee, and lines were drawn between the greater trochanter to the posterior superior iliac spine (PSIS). Second line drawn from the greater trochanter to the patient's sacral hiatus . A line drawn perpendicular from the midpoint of the first line to its intersection with the second line. The triangle formed by the first, second, and the intersection lines defines initial needle placement. The insulated needle was inserted at this point ,the stimulating current was set initially at 1.0 to 1.5 mA. Stimulation of the patient's gluteus maximus muscle is often encountered just before sciatic nerve stimulation. Patients often find this uncomfortable, and the needle should be advanced through gluteus stimulation without pause. Successful needle placement in proximity to the sciatic nerve is observed with plantar flexion/inversion (tibial nerve) or dorsiflexion/eversion (common peroneal nerve) with 0.5 mA or less of current. Occasionally, hamstring muscle twitching was noted, which suggests the needle tip has been placed too medial. Slight adjustment of the needle tip laterally result in successful localization of the sciatic nerve. Afterward, 27 ml of 0.5% Ropivacaine was injected slowly after negative aspiration for blood.



Landmarks for posterior approach to the sciatic nerve

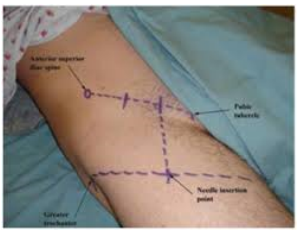
Femoral Nerve block :
The patient is in the supine position with both legs extended. In obese patients, a pillow placed underneath the hips can facilitate palpation of the femoral artery and the block performance.

Rough preparation of the area with an antiseptic solution, local anaesthesia is infiltrated subcutaneously at the estimated site of needle insertion. The injection for the skin anaesthesia should be shallow and in a line extending laterally to allow for a more lateral needle reinsertion when necessary. The anesthesiologist should stand at the side of the patient with the palpating hand on the femoral artery. The needle is introduced immediately at the lateral border of the artery and advanced in sagittal, slightly cephalad plane .

After initial stimulation of the femoral nerve is obtained, stimulating current is gradually decreased until twitches are still seen or felt at 0.2 to 0.4 mA, which typically occurs at a depth of 2 to 3 cm. After aspiration test for blood, 18 mL of local anaesthesia is injected slowly.

Group CSF : In group CSF, patients receivedcombined sciatic and femoral nerve block via single injection technique **(Modified Chelly approach).**[16]

Anatomic Landmarks
With the patient supine and the lower extremity in the neutral position, a line was drawn between the inferior border of the anterosuperior iliac spine and the superior angle of the pubic symphysis tubercle. From this anterosuperior iliac spine–pubic symphysis line, a perpendicular dissector line was drawn in the middle and extended 8 cm caudal to define the site of introduction of the needle.under aseptic precaution, a 15-cm insulated b-beveledStimuplex needle (B-Braun/ McGaw Medical, Bethlehem, PA) connected to a Stimuplex-Dig nerve stimulator (B-Braun/McGaw Medical) was introduced perpendicu larly to the skin after subcutaneous local anaesthesia with 1 ml lidocaine. The needle on its way to the sciatic nerve might come in proximity to the femoral nerve. Therefore, the nerve stimulator was initially set-up to deliver a current of 1.0 mA. At a depth of 3–5 cm, movements of the patella were observed. Because patella movements might represent the motor response to the stimulation of the femoral nerve, the current was gradually decreased until twitch are still seen or felt at 0.6-0.3 mA and after aspiration test for blood 18 ml of anaesthetic solution was injected. Afterward, the needle was withdrawn upto the subcutaneous tissue rotate slightly medialy and laterally and further reintroduced 8-13 cm deeper, with the current of the nerve stimulator increased to 0.5-1 mA. Within a depth of 9.5–13 cm, the sciatic nerve was identified via the motor response related to the stimulation of its common peroneal nerve component (dorsiflexion or eversion of the foot or extension of the toes) or its tibial nerve component (plantar flexion and inversion of the foot and flexion of the toes) and at this point the current was gradually decreased until twitch are seen or felt at 0.3-0.6 mA and after aspiration test for blood 27 ml of anaesthetic solution was injected.


Comparisons of our anatomic landmarks and those described by Beck.10ASIS 5 anterosuperior ischemic spine; GT 5 greater trochanter; LT 5 lesser trochanter; PT 5 pubic tuberosity; PS 5 pubic symphysis; LB 5 lower border.

EVALUATION :
- Onset of sensory and motor block was assessed every 5 min after injection up to 30 min using below mentioned scale.

ASSESSMENT OF SENSORY BLOCKADES
The sensorial blockade was assessed by the loss of pain (pinprick test) at each minute after completion of drug injection in the dermatomal area corresponding to the tibial nerve (planter aspect of the foot), common peroneal nerve (lateral cutaneous side of the calf or dorsal aspect of the foot) till complete blockade.

SCALE : Pinprick test was used and the results were reported by 4 points score.
- 0 = No loss of sensation to pinprick.
- 1 = Patient feel touch and moderate pain on pinprick.
- 2 = Patient feel touch and mild pain on pinprick.
- 3 = Patient even notfeel touch and pain on pinprick.

ASSESSMENT OF MOTOR BLOCKADES
- Femoral nerve-Patellar contraction
- Tibial nerve-Planter flexion and inversion of the foot and flexion of the toe.
- Common Peroneal nerve - Dorsiflexion or eversion of foot and extension of the toe.

SCALE : ModifiedBromage score method was used.
- 0 = Normal motor function with full extension and flexion of great toe.
- 1 = Decreased motor strength in both extension and flexion of great toe.
- 2 = Decreased motor strength with loss of extension and mild flexion of great toe.
- 3 = complete motor blockade with absence of both extension and flexion of great toe.

- Time to perform the regional nerve block was evaluated in both groups.
- Number of attempts to perform the procedure were recorded.
- Time between the injection of local anaesthetic and the end of the surgery wasrecorded.
- Time of onset for sensory block was assessed by the time from injection of local anesthesia (LA) to point 1 scale of sensory block on two separate area supplied by femoral and sciatic nerve.
- Time of onset for motor block was assessed by the time from injection of local anesthesia (LA) to point 1 scale of Modified Bromage.
- Duration of analgesia was assessed by the time interval between the onset of complete sensory block to the post-operative VAS score> 4.

Visual Analogue Scale: (VAS)
Pain intensity was evaluated using 10 cm visual scale where '0' represents no pain and '10' represents worst possible pain. Rescue analgesia with intramuscular diclofenac injection 75 mg was given if VAS was >4. VAS score was recorded postoperatively at 0, 2, 4, 8, 12, 12.30, 13, 13.30, 14, 14.30, 15, 16 hrs.

- Side effect were observed during surgeries.
- Fatal arrhythmias
- Convulsion
- Vascular puncture
- Tingling and numbness
- Nerve injury
- LA toxicity
- Nausea / vomiting

OBSERVATION & RESULTS

Table.1: Mean age of the patient in the study groups		
Group	**SF**	**CSF**
mean value (years)±SD	38.10±14.45	33.52±14.54

Table.2: Sex wise distribution of patient in the study groups		
Group	**SF**	**CSF**
Male (%)	24 (80)	25(81)
Female (%)	06 (20)	5(19)
Total (%)	30	30

Table.3: Efficacy of two approaches		
Group	**SF**	**CSF**
Number of attempts		
1	5(16.66%)	23(76.60%)
2	19(63.33%)	6(20.40%)
3	4(13.33%)	1(3.33%)
4	2(6.66%)	0
mean value ±SD	2.1±0.75	1.26±0.52

Table 4 : Time taken to perform procedure (in minutes)		
Group	**SF**	**CSF**
mean value±SD	9.23±1.073	4.73±0.828

Table.5: Time taken for onset of sensory block (in minutes)		
Group	**SF**	**CSF**
mean value ±SD	22±1.486	21.5±1.225

Table.6: Time taken for onset of motor block (in minutes)		
Group	**SF**	**CSF**
mean value ±SD	21.67±1.583	20.67±0.802

Table.7: Duration of sensory block (in minutes)		
Group	**SF**	**CSF**
mean value ±SD	452±34.281	452±34.281

Table.8: Duration of motor block (in minutes)		
Group	**SF**	**CSF**
mean value ±SD	184±29.196	184±29.196

Table.9: Intensity of motor block		
Group	**SF**	**CSF**
Score	NO.(%)	NO.(%)
0	6(20%)	2(6.66%)
1	7(23.33%)	8(26.67%)
2	8(26.67%)	9(30.00%)
3	9(30.00%)	11(36.67%)
Chi-sqare value=2.235, degree of freedom=3		

Table.10: Intensity of sensory block		
Group	**SF**	**CSF**
Score	NO.(%)	NO.(%)
0	6(20%)	2(6.66%)
1	7(23.33%)	8(26.67%)
2	8(26.67%)	9(30.00%)
3	9(30.00%)	11(36.67%)
Chi-sqare value=2.235, degree of freedom=3		

Table.11: Duration of analgesia in minutes		
Group	**SF**	**CSF**
mean value ±SD	451±33.87	452±34.28

Table.12: Median VAS score		
Group	**SF**	**CSF**
VAS at 4 hours	0	0
VAS at 8 hours	0	0
VAS at 12 hours	3	0
VAS at 12.5 hours	3	2
VAS at 13 hours	3	3
VAS at 13.5 hours	5	5
VAS at 14 hours	5	5
VAS at 14.5 hours	5	5
VAS at 15 hours	6	6
VAS at 16 hours	6	6

Results of our study showed no statistically significant differences (p >0.05) between the two groups with regards to demographic distribution and those related to the duration of surgery.

The mean time taken for performing the procedure in group SF was (9.23± 1.073) seconds and mean time taken for performing the procedure in group CSF was (4.73±0.82) seconds. There was statistically significant difference (p = 0.001) in terms of time taken for performing the procedure between both the groups.

The mean value of number of attempts in Group CSF (range from 1to 3) was 1.267 and standard deviation of 0.52. In Group CSF (range from 1 to 4) with mean value of 2.1 and standard deviation of 0.75. The difference was statistically significant (p = 0.0001).

The mean time taken for onset of sensory block in group SF was (22±1.48)seconds and mean time taken for onset of sensory block for group CSF was (21.5±1.22)seconds and there was no statistically significant difference (p = 0.160) in terms of time taken for sensory onset between both the groups.

The mean time taken for onset of full motor blockade in group SF was (21.67± 1.58)seconds while, for group CSF was (20.67±0.80)seconds and there was statistically significant difference (p = 0.003) in terms of time taken for onset of full motor blockade between both the groups.

Intensity of motor block assessed in group SF and Group CSF was scored according to modified bromage scale and did not show statistically significant differences as compared to each other.

As regard to the intensity of sensory block assessed in group SF and CSF, there were no statistically significant differences in both groups.

The time duration of sensory block in Group SF and CSF was same, it ranges from minimum of 7 hours to maximum of 9 hours with mean value of 7.53 and standard deviation of 34.28. There was no statistically significant difference (p = 1). This might be attributed to the pharmacological properties of the drug rather than the type of approach used.

The time duration of motor block in Group SF and CSF was same, it ranges from minimum of 2.5 hours to maximum of 4 hours with mean value of 3.0 and standard deviation of 29.19. There was no statistically significant difference (p = 1). This again might be attributed to the pharmacological properties of the drug rather than the type of approach used.

The mean +SD (in min) duration of analgesia in Group SF and CSF was (451+ 33.871) min and (452 + 34.28)min. On the basis of statistical analysis there was no significant difference in duration of analgesia between both groups. This again might be attributed to the pharmacological properties of the drug rather than the type of approach used.

DISCUSSION

Provision of anaesthesia for any surgery should be such that the technique must meet the demands of the surgery, patient comfort, and proficiency of anaesthesiologist. Combined sciatic and femoral nerve blocks can be a valuable alternative to general anaesthesia and epidural or spinal block for lower limb surgery in compromised patients, with higher degree of patient's satisfaction, surgical outcome and rehabilitation together with lower incidence of side effects.

In our study we compared two different approaches, anterior approach for combined sciatic-femoral nerve block (single injection) v/s posterior Labat's approach for sciatic nerve block plus femoral nerve block (Double injection) and evaluated ease and efficacy in term of patient's position and surgery. Our intention was to avoid multiple puncture which may increase incidence of neurological and vascular complication; obviating the need of repositioning in polytrauma patients with compromised mobility.

We found that the efficacy was significantly higher when the injection was performed via anterior approach (chelly's approach) . sciatic-femoral nerve block were compared. Anterior approach (Group CSF) was performed faster than posterior approach for sciatic nerve block plus femoral nerve block (Group SF).Both approaches produce complete block, but number of attempts taken to performed the procedure in Group CSF were significant less when compared with Group SF. We found that time taken to perform the block was significant less in Group CSF (4.73±0.82 min) as compared to group SF (9.23± 1.073 min).Onset time of motor block was faster in group CSF. Whereas, onset time of sensory block, duration and intensity of sensory and motor block , post-operative analgesia were similar in both groups. No complications were observed in both the groups during and after the performance of procedure. This proposed efficacy and feasibility of anterior approach for combined sciatic-femoral nerve block via single injection technique.

Jacques E Chelly,[16] proposed a new anterior approach to the sciatic nerve block in which he determined the appropriate landmarks (ASIS and pubic tubercle) required 1.1 min (0.4–2.0 min). The sciatic nerve

was identified in all patients within 2.9 min (1.2–6.1 min) after two (one to three) attempts, and the sciatic nerve was found at a depth of 10.5 cm (9.5–13 cm). In 13 patients, the common peroneal nerve was first stimulated, whereas stimulation of the tibial nerve was elicited in 9 patients. The current before injection was decreased to 0.5 mA (0.5–0.7 mA). , the overall onset time for a complete sensory block in both the common peroneal and the tibial territories was 12.5 min (5–30 min). The overall duration of the block was 5.0 h (2.5–23.6 h).

Our study showed that, anterior approach is effective for blocking the sciatic nerve. By using the proposed anatomic landmarks and a nerve stimulator, the sciatic nerve was identified in all patients, and a sensory and motor block was obtained in all patients using the modified anterior approach as described by **chelly et al**. In our study we observed that the time of onset of sciatic and femoral nerve block using anterior and posterior approach is approximately 20–24 min. This is most likely related to the large size of the nerve, necessitating more time for diffusion of the local anaesthetic solution. In our study, using different pelvic landmarks identified the site for introduction of the needle. In 23 out of 30 patients , single attempt was taken for the identification of the sciatic and femoral nerve. The needle first encountered the femoral nerve and ended its course on sciatic nerve which is 8-13 cm deep from skin puncture site. Furthermore, at the level of the lesser trochanter, the position of the sciatic nerve is known to be medial and posterior to the femur.

CONCLUSIONS

In conclusion, it was found that the anterior approach for combined sciatic femoral nerve block is the easiest technique, that, can be used and performed successfully even in patients with limited movements, such as, those with multiple fracture and compromised mobility. The anterior approach was found to be the best for the patients in supine position, with best results as regard to patient's satisfaction and sensory and motor blockade. This easy and reliable anterior technique for performing sciatic and femoral nerve blocks in supine position, in a single puncture is an alternative to the more traditional approaches, especially in co-morbid patients with limited mobility. This approach should therefore, facilitate the performance of sciatic femoral nerve blocks. Our study demonstrated that Combined Sciatic femoral nerve block via anterior approach may be an interesting alternative to conventional posterior approach of sciatic nerve block and femoral nerve block.

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