

# Femoral Nerve Block in Anterior Cruciate Ligament Surgery: A Prospective Randomized Trial

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## Abstract

Early painless rehabilitation is essential after anterior cruciate ligament surgery (ACL). Postoperative main management with femoral nerve block (FNB) is a frequently used method, but it is still unknown how to administer this procedure in order to achieve faster and better analgesia.

**Purpose:** To compare effectiveness of pain management after single shot FNB vs. continuous infusion FNB during the first 48 hours after ACL surgery.

**Materials and Methods:** Forty-three patients older than 18 years, ASA I-II, underwent ACL reconstruction with autograft. Patients are prospectively randomized into two separate groups: Group 1 (G1) received single shot FNB with bupivacaine diluted in 10mL saline solution. Group 2 (G2) received continuous infusion FNB with bupivacaine and epinephrine (1:300.000) for 48 hours. Pain was assessed at rest and with controlled passive motion of the knee. High hypoesthesia and need for additional analgesia were evaluated at 6, 12, 24 and 48 hours. Statistical analysis was performed with Fisher's exact test (%) and Mann-Whitney's test (VAS). Statistical significance was considered with P value <0.05.

**Results:** FNB was successful in all patients, and thigh hypoesthesia was present in 100% of G2 vs. 17% in G1 at 24 hours, declining to 74% vs. 0% at 48 hours, respectively. Postoperative pain scores were low and did not differ between both groups. Additional analgesia was required in 33% of patients in G1 vs. 0% in G2. Neither side effects nor complications were related to both methods of FNB.

**Conclusion:** FNB is a safe and successful method for controlling pain after ACL reconstruction, allowing early rehabilitation in both methods of local anesthetic administration. No differences in pain control were found after 48 hours, but continuous infusion FNB decreases need for additional anesthesia at 24 hours of surgery.

**Keywords:** Anterior cruciate ligament; Femoral nerve block; Postoperative pain management

## Introduction

Anterior cruciate ligament (ACL) tears are common sports related injuries in young and active patients. Arthroscopic ACL reconstruction in this population is essential to regain knee stability and get back to competitive sports [1]. Early rehabilitation is essential and associated with better results after ACL reconstruction [2,3]. However, postoperative pain tends to be moderate to severe. Therefore, adequate analgesia is important to allow an accelerated rehabilitation program and early discharge from the hospital [4-8]. In this setting, a femoral nerve block (FNB) seems to be an excellent alternative with low complication rates [7,9,10]. This procedure blocks the femoral, femorocutaneous and obturator nerves but not the sciatic nerve. Even though frequently used, it is not clear which method of administration, single shot or continuous infusion, helps to achieve better and longer lasting analgesia after arthroscopic ACL reconstruction [5,6]. This procedure has a low risk of toxicity because no high dose local anesthetics are required and intravascular placement is a rare complication.

The main objective of this study is to evaluate effectiveness of pain management in the first 48 hours after ACL reconstruction, comparing single shot FNB vs. continuous infusion FNB.

## Materials and Methods

Ethics committee approval was given for this study at our institution and written informed consent for participation, use of personal data and follow-up and was signed by all of the patients.

## Patients

Forty-three patients older than 18 years old, ASA I or II that

underwent arthroscopic ACL reconstruction in 2014 agreed to participate. The same surgical team operated all patients, and two types of autografts were used, bone-patellar tendon-bone (BTB) and quadruple semitendinosus-gracilis (ST-G).

## Intervention

Prior to ACL reconstruction all patients received general or epidural anesthesia with bupivacaine according to Anesthesiologists and patients preference. Patients were randomized into two groups: The control group was defined as G1 for patients receiving only single shot FNB. The intervention group G2 are the patients who additionally received continuous infusion with bupivacaine administered through a femoral catheter for 48 hours.

Both techniques are performed immediately after ACL reconstruction. Insertion site is at the inguinal crease, at a point between the femoral artery and the anterior superior iliac spine (ASIS). The needle tip pierces the fascia iliaca on the superior surface of the femoral nerve at a safe distance of 3cm, therefore peripheral nerve stimulator in

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not necessary. Single shot is performed with bupivacaine 0.5% (15mL diluted with 10mL of saline solution) using a 21g needle (Figure 1). When a catheter was placed, we used a 19g Tuohy tip set, using the same approach. After the initial dose, a continuous infusion of bupivacaine 0.15% with epinephrine (1:300.000) was administered at an infusion rate of 10mL per hour for 48 hours. All patients received concomitant intravenous analgesia with Ketoprofen 300mg, Acetaminophen 2-3 gr per day and additional analgesia with Tramadol or Demerol 1 mg/kg if needed.

### Evaluations

Postoperative pain was evaluated at rest and with controlled passive motion of the knee using the Visual analog scale (VAS) at 6, 12, 24 and 48 hours after surgery. Sensitive peripheral nerve block was assessed with presence of thigh hypoesthesia. Need for additional analgesia was recorded at 6, 12, 24 and 48 hours.

### Statistical analysis

Statistical analysis was performed with Fisher’s exact test (%) and Mann-Whitney’s test (VAS). Statistical significance was considered with P value <0.05.

### Results

Three of the 43 patients that met inclusion criteria were excluded from the study. One patient in the control group G1 was withdrawn because of painful paresthesia at the thigh, and two patients of the intervention group G2 because of allergic reactions to epinephrine and mal positioned femoral catheter. The final number was 20 patients per group, comparable in age, percentage receiving general anesthesia and method of FNB used (Table 1). No systemic toxicity was reported related to local anesthetics. Intra-articular drainage was used in all patients for 48 hours. Pain at rest was comparable in both groups with a mean VAS between 0 and 1.8 in G1 and G2 at 6, 12, 24 and 48 hours (Table 2). Additional analgesic requirements were comparable in both patients at 6, 12 and 48 hours. At 24 hours additional analgesia was required in 30% of the control group (G1) compared to 0% of the intervention group (G2) (P=0.006) (Table 3).

The percentage of patients with thigh hypoesthesia was comparable between both groups after 6 hours (100%), but persistently declined with in control group G1 with respect to the intervention group G2 after 12 hours (70% vs. 100%, P=0.01) after 24 hours (20% vs. 100%, P=0.01) and after 48 hours (0% vs. 75%, P=0.01) (Table 4). Pain during

controlled passive motion of the knee was assessed with VAS. Mean pain values were not statistically different between both groups at 6, 12, 24 and 48 hours (P> 0.05) (Table 5).

### Discussion

Thirty percent of patients undergoing ACL reconstruction will suffer moderate to severe pain, compromising early rehabilitation [2,3,5]. Femoral nerve block is an attractive alternative for these patients because of low morbidity associated to a safe standard technique and low toxicity risks related to local anesthetics. Literature still debated on how the FNB is administrated. Williams et al. [11] in a prospective randomized trial of 233 ASA I-II patients that underwent ACL reconstruction with diverse techniques and received the same multimodal perioperative analgesia were separated into three groups: The control group received a bolus of saline solution and continuous infusion of saline solution with a femoral catheter. Group 1 received bupivacaine and continuous infusion of saline solution and group 2 received a bolus of bupivacaine and later in continuous infusion. Pain was assessed during the first 1-4 days and at 7 days postoperatively. Statistically significant differences between the control group and group 2 (P<0.001) were found in the first two days (Moderate-severe pain in 50% vs. 25%, respectively). The authors concluded that FNB with continuous infusion is a reliable method of maintaining pain at a lower than moderate level during first 2 days after ACL reconstruction. The same authors [11] comment on their experience in 1998-1999 with 129 patients that underwent ACL reconstruction and received postoperative analgesia with single shot FNB. The patients presented mean postoperative VAS score of 1.8 at 12-24 hours, but rebound pain ascended to 5.3 as the effect wore off.

In our study no statistically significant difference in pain relief at rest and with controlled passive controlled motion was found between both

FNB	Single Shot (G1)	Bolus+Continuous infusion (G2)
Number of patients	20	20
Mean age	33	30
General anesthesia	55%	55%
B-T-B	25%	35%
ST-G	75%	65%
Drainage time	48 hrs	48 hrs
Patients excluded	1	2

Table 1: Patient demographics.

Hours	Single shot (G1)	Bolus+Continuous infusion (G2)
6	1.7	1.45
12	1.65	1.6
24	1.8	1.1
48	0.65	0.5

Table 2: Mean values of VAS score at rest for control group (G1) and intervention group (G2) at 6, 12, 24 y 48 hours.

Hours	Single shot (G1)	Bolus+Continuous infusion (G2)	P value
6	50%	40%	0.2
12	10%	25%	0.16
24	30%	0%*	0.006
48	20%	20%	0.31

\*Color highlighted for P value <0.05.

Table 3: Percentage of patients requiring additional analgesia in control group (G1) and intervention group (G2) at 6, 12, 24 y 48 hours

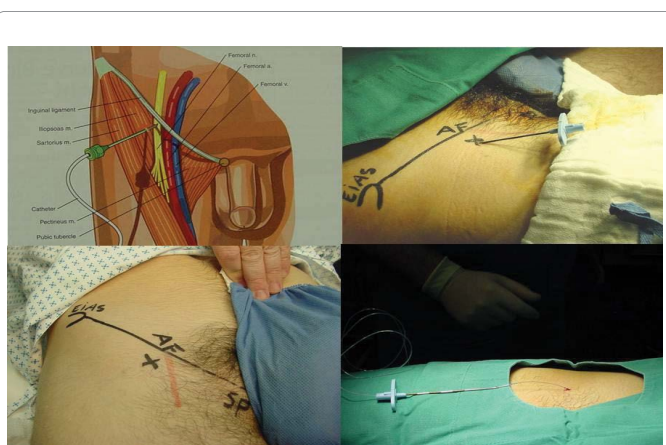


Figure 1: Anatomic references and FNB technique.

Hours	Single shot (G1)	Bolus+Continuous infusion (G2)	P value
6	100%	100%	1
12	70%	100%	0.01
24	20%	100%	<0.01
48	0%	75%	<0.01

\*Color highlighted for P value <0.05.

**Table 4:** Percentage of patients with thigh hypoesthesia in control group (G1) and intervention group (G2) at 6, 12, 24 y 48 hours.

Hours	Single shot (G1)	Bolus+Continuous infusion (G2)
6	2,83	2,85
12	3,61	3,6
24	3,83	2,25
48	2,22	1,8

**Table 5:** Mean values of VAS score with controlled passive motion of the knee for control group (G1) and intervention group (G2) at 6, 12, 24 y 48 hours.

groups. Nevertheless, we observed a significantly higher requirement of additional analgesia in the control group G1 at 24 hours compared to the intervention group G2 (P=0.006). This difference is probably because of a more effective and long lasting effect of continuous infusion vs. single shot FNB. None of the patients requiring additional analgesia were excluded from our study. The postoperative pain follow-up was set at 48 hours because of two reasons; most patients with single shot FNB wear out the analgesic effect at 24 hours, and the majority of patients are ready for hospital discharge without catheter at this time; previous studies did not demonstrate significant differences in pain relief after 48 hours [11].

Williams et al. [12] studied rebound pain after ACL reconstruction. All 84 patients received epidural anesthesia, multimodal perioperative analgesia and FNB with levobupivacaine. Patients were divided in two groups receiving continuous infusion through femoral catheter with saline solution vs. levobupivacaine for 50 hours. Patients who received continuous infusion with saline solution reported mean duration of femoral block of 37 vs. 59 hours in patients that received levobupivacaine (P<0.001). Mean rebound pain ascended to 2 (CI 1.6-2.4). The authors concluded that approximately 33 hours of additional nerve block are required to reduce pain values in 1 point [13-16].

In our study we did not directly measure rebound pain, but we evaluated thigh hypoesthesia as an indicator of sensitive nerve block. Significantly more patients reported thigh hypoesthesia in the intervention group compared to the control group at 12, 24 and 48 hours (P<0.01), although it did not affect rehabilitation. Pain scores were similar in both groups at all-time despite total absence of sensitive nerve block in G1 (Table 4). Our study demonstrates that single shot FNB may require additional analgesia at 24 hours postoperatively, and does not correlate with thigh hypoesthesia.

There are some limitations in this trial; We decided not to evaluate pain immediately after surgery as a basal measurement because all of our patients received epidural or general anesthesia, which may affect pain assessment in the first 6 hours after surgery. Co-administration of the analgesics may influence pain scores in both groups. All patients relentless if allocated to group 1 or 2 received concomitant analgesia with Ketoprofen 300 mg and Acetaminophen 2-3 gr per day, which is the standard method of controlling pain in our institution.

## Conclusion

FNB is a safe and successful method for controlling pain after ACL reconstruction, allowing early rehabilitation in both methods of

local anesthetic administration. No differences in pain control were found after 48 hours, but continuous infusion FNB decreases need for additional anesthesia at 24 hours of surgery.

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