



# Comparison of continuous femoral nerve block with local infiltration for postoperative analgesia in unilateral total knee arthroplasty- a randomized controlled trial

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## ABSTRACT

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**Background & Objective:** Local infiltration of knee joints during knee joint surgery has been used for postoperative analgesia with preservation of motor function of quadriceps muscle, which helps in early mobilization. Femoral nerve block has been incriminated with paralyse of vastus medialis muscle. We aimed to compare postoperative analgesia between femoral nerve block and local infiltration in patients undergoing unilateral total knee arthroplasty (TKA).

**Methodology:** After obtaining institutional ethical approval and written informed consent from the patients, this randomized controlled trial was conducted at Department of Anesthesia at Teerthankar Mahaveer Medical College & Research Centre between July - December 2018. The study was conducted on 60 patients of ASA I and II, undergoing unilateral total TKA. Patients were randomly divided into two groups: Group FB patients underwent femoral nerve block, and Group LI patients underwent local infiltration analgesia. Sedation score, numeric rating scale, motor power and frequency of nausea/vomiting were recorded and statistical analysis done.

**Results:** We observed better pain relief in patients which received femoral nerve block as compared to local infiltration analgesia ( $p < 0.001$ ). Sedation score was higher in Group LI and was statistically significant between the two groups at 4th, 12th, and 48th hour ( $p < 0.05$ ). Group FB patients were associated with higher muscle power grades ( $p < 0.001$ ) as compared to local infiltration analgesia patients. Fentanyl demand was observed to be lesser in Group FB as compared to Group LI ( $p < 0.001$ ).

**Conclusion:** The study concludes that femoral nerve block produces better pain relief in patients posted for unilateral knee arthroplasty as compared to local infiltration of the local anesthetic solution. However, there is gross reduction in range of motion with femoral nerve block.

**Key words:** Femoral nerve block; Local infiltration analgesia; Total knee arthroplasty; Visual analogue scale

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## INTRODUCTION

One of the essential components of any surgery is effective postoperative pain control, with resultant

early mobilization and fast recovery of the patient.

Better control of pain can prevent progression of pain from acute to chronic stage.<sup>1,2</sup>

Multimodal pain control and rehabilitation helps in good and early recovery after surgery. This has led to the concept of 'fast track' surgery.<sup>2</sup> Total knee arthroplasty (TKA) patient requires good pain control for early discharge.

The acute pain may progress to chronic pain as both are interrelated, early analgesic intervention may reduce postoperative chronic pain. Various modalities for post-operative pain relief for TKA include epidural infusion, peripheral nerve blocks (femoral nerve block, saphenous nerve block, genicular nerve blocks), and local wound infiltration.

Local infiltration analgesia (LI) gained popularity as a substitute for pain relief post TKA, as in this technique NSAIDs and local anesthetics are infiltrated in periarticular tissues as well as intraarticular in the knee joint. LI is advantageous over other methods, as in this technique, only the local surgical area is affected by the analgesia, with minimal or no effect on muscle power.

Hence, LI encourages faster recuperation in cases of TKA, along with early discharge from hospital.<sup>3</sup>

Femoral nerve block (FB) is easier to perform, has higher success rate, along with higher safety as compared to other techniques. When compared with intravenous patient-controlled analgesia, intramuscular opioids, or intraarticular analgesia, continuous FB has proved to provide better analgesic effect in cases of TKA. However, in cases of TKA, this technique is equally effective as continuous epidural analgesia or continuous lumbar plexus block, but with lesser complications.

A small number of investigators have compared various above stated methods for analgesia, with LI. The null hypothesis in our study is that FB provides better analgesic efficacy as compared to LI in unilateral TKA. Thus, we conducted this study to assess the quality of postoperative analgesia provided by FB and LI in unilateral TKR.

## METHODOLOGY

After obtaining institutional ethical approval (TMMC/IEC/2018/37) and written informed consent from the patients, the present study was conducted in Department of Anesthesia at Teerthankar Mahaveer Medical College & Research Centre between July - December 2018. The study included patients between 25-65 y of age, belonging to ASA grade I or II, posted for elective unilateral knee replacement.

Patients exceeding 65 y of age, belonging to ASA grade III or IV, having chronic pain or taking chronic opioid medication, or known for allergy to the medications used, or with contraindications to

regional anesthesia, were excluded from the study.

To ensure double-blinding, the test technique was performed by an independent anesthesiologist and he was not allowed to participate further in the study. As both the patients and investigators were unaware of the group allocation and technique used, it prevented bias in results.

After securing IV line, pre-medication was done with inj ondansetron 4 mg, inj tramadol 100 mg and inj midazolam 1 mg IV. Standard monitors were applied to monitor pulse oximetry, electrocardiogram, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and heart rate. After pre-oxygenation with 100% oxygen for 3 min, standard general anesthesia was induced and maintained using oxygen, nitrous oxide, isoflurane (1%), and intermittent boluses of inj vecuronium. A pneumatic thigh tourniquet inflated to a pressure of 300 mmHg was used in all patients to aid the surgery and prevent blood loss.

For random allocation of 60 patients into two groups equally, we used lottery method.

**Group FB:** After cleaning and draping, femoral nerve of operated leg was localized with the help of linear ultrasound probe and then tuohy needle was introduced along the long axis of the probe; while tracing the tip of the needle the position of needle was rechecked by normal saline before injecting drug. Catheter was fixed at 15 cm mark on skin and attached to infusion pump which consisted of ropivacaine 0.1% at 6 ml/h.

**Group LI:** Injectate consisted of 0.2% ropivacaine 2 mg/ml mixed with ketorolac 30 mg and adrenaline 10 µg/ml. We made 150 ml of solution divided into three equal parts and infiltrated at medial, lateral collateral ligaments and posterior capsule before putting the implant in surgery. Before closure, the drug was infiltrated at wound edges and subcutaneous tissues. Catheter tip was left between posterior capsule and medial condyle. The catheter was secured for further infiltration of 25-30 ml subsequently at 20th and 48th h. After administering the drug, drain was clamped for one hour.

Inj fentanyl 15 µg/ml was used as rescue analgesia which was given via PCA pump with a lock out period of 15 min- a patient could press the button maximum three times within 15 min. For easy calculation of the rescue analgesia, we divided fentanyl demand in four groups: nil, less than 5 times, 6-10 times, 11-15 times and 16-20 times. So total fentanyl demand was calculated by the times patient pressed the button.

At the end of the surgery the neuromuscular block was reversed.

Numeric rating scale (NRS), sedation score (SS), and motor power grading (MPG) scoring system were

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recorded and given in Table 1. Early mobilization time (at 24 h of surgery)-time interval from zero to until the first walk, and free mobilization time (at 48 h of surgery)-from zero to independent mobility was observed. The requirement of rescue analgesia was also recorded.

### Statistical analysis:

A total of 60 patients were included in the study, where the minimum required sample in each group was calculated using Epi info (version 7) with an assumed alpha error of 5% and power of 80%. Average pain scores were taken as 2.1 and 1.6 at rest for local infiltration analgesia and femoral nerve block, respectively.<sup>4</sup>

Statistical analysis was performed using the SPSS (version 20.0; SPSS Inc, Chicago, IL). As per the type of data, it was either represented as mean  $\pm$  standard deviation or frequency. All parametric data was evaluated using Student's t-test and non-parametric data using Fischer Test. The value of  $p < 0.05$  was accepted as statistically significant.

## RESULTS

The study included a total of 60 patients, of which most of patients were in the age group 50-60 years i.e., 15 in FB and 18 in LI group. This was followed by the age group of 61-65 years. Out of 60 patients, 18 patients in Group FB and 27 patients in Group LI were female, thus, gender distribution showed female preponderance in both the groups.

Pain score was higher in Group LI, there was a gradual

**Table 1: Numerical Rating Score,<sup>5</sup> Sedation Score<sup>6</sup> and Motor Power Grading (MPG)<sup>7</sup>**

Numerical Rating Score	
0	No Pain
1-3	Mild Pain (nagging, annoying, interfering little with ADLs)
4-6	Moderate Pain (interferes significantly with ADLs)
7-10	Severe Pain (disabling; unable to perform ADLs)
Sedation score	
0	Awake
1	Mild sedation, easy to rouse
2	Moderate sedation, easy to rouse but constantly drowsy
3	Somnolent, difficult to rouse
Motor Power Grading (MPG)	
0	No movement
1	Flicker is perceptible in the muscle
2	Movement only if gravity eliminated
3	Can move limb against gravity
4	Can move against gravity and some resistance exerted by examiner
5	Normal power

decrease in NRS in both the group postoperatively ( $p=0.001$ ) (Table 2).

Sedation score was higher in Group LI and was statistically significant between two groups at 4th, 12th, and 48th hour ( $p < 0.05$ ) (Table 3).

Group LI had higher MPG than Group FB ( $p < 0.001$ ). Muscle power increased with time in postoperative

**Table 2: Comparison of NRS scores**

Group	NRS 4	NRS 8	NRS 12	NRS 16	NRS 20	NRS 24	NRS 48
FB	5.20 $\pm$ 1.38	4.50 $\pm$ 1.36	4.17 $\pm$ 1.18	4.51 $\pm$ 0.73	4.30 $\pm$ 0.70	4.20 $\pm$ 0.65	4.42 $\pm$ 0.78
LI	7.57 $\pm$ 1.05	6.50 $\pm$ 0.92	5.98 $\pm$ 0.78	6.12 $\pm$ 0.92	6.40 $\pm$ 0.82	6.47 $\pm$ 0.71	6.10 $\pm$ 0.86
P value	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*

Data represented as Mean  $\pm$  standard deviation. \* $p < 0.05$  is considered statistically significant.

**Table 3: Comparison of sedation scores**

Group	Score	SS 4	SS 8	SS 12	SS 16	SS 20	SS 24	SS 48
FB	0	10	18	24	28	27	27	26
	1	15	7	6	1	1	4	5
	2	1	1	1	1	0	0	0
LI	0	4	14	15	26	27	25	18
	1	26	17	16	5	3	6	11
	2	0	1	1	2	2	1	0
P value		0.013*	0.179	0.018*	0.129	0.287	0.432	0.037*

Data represented as frequency. \* $p < 0.05$  is considered statistically significant.

**Table 4: Comparison of motor power grading (MPG)**

Group	Score	MPG 4	MPG 8	MPG 12	MPG 16	MPG 20	MPG 24	MPG 48
FB	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	0
	2	2	6	2	1	0	1	1
	3	14	19	26	24	22	16	14
	4	1	2	4	5	8	14	15
	5	0	0	0	0	0	0	0
LI	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	0
	2	0	0	0	0	0	0	0
	3	30	22	15	9	2	0	0
	4	4	12	19	25	28	30	30
	5	0	0	0	0	0	0	0
P value		0.001*	0.001*	0.001*	0.001*	0.001*	0.001*	0.001*

Data represented as frequency. \*p < 0.05 is considered statistically significant.

**Table 5: Comparison of early mobilization time in two groups**

Early Mobilization Time	Type of Analgesia		Total	p-value
	FB	LI		
Affected	4	26	30	0.001*
Unaffected	26	4	30	
Total	30	30	60	

Data represented as frequency. \*p < 0.05 is considered statistically significant.

**Table 6: Comparison of rescue analgesia**

Number of times dose required	Type of analgesia		Total	p-value
	FB	LI		
NIL	17	5	22	0.029*
< 5 times	6	14	20	
6-10 times	4	7	11	
11-15 times	2	3	5	
16-20 times	1	1	2	
Total	30	30	60	

Data represented as frequency. \*p < 0.05 is considered statistically significant

period among both the study groups (Table 4).

Early mobilization was affected (patients were not able to stand with support at 24 hours) in four patients (13.3%) of FB and 26 patients (86.6%) of LI (Table 5). The result was significant (p < 0.001).

Only 6 patients of Group FB demanded rescue analgesia < 5 times. However, in Group LI, 14 patients had requirement of rescue analgesia < 5 times. We established that the rescue analgesia requirement was significantly low in Group FB (P=0.029) (Table 6).

No serious side effects were observed in the

postoperative period.

## DISCUSSION

Present study states that NRS in Group FB was comparatively less as compared to Group LI. MPG is less in FB group, but mobilization time remained equal, although rescue analgesia requirement was high in Group FB. Vadivelu N et al. stated that pain management depends upon the use of accessible medication and appropriate procedures of analgesia.<sup>8</sup> This comprises the mixture of drugs, applicable concentrations, and route of administration in different types of surgery.<sup>8,9</sup> The study revealed that NRS of pain was inversely related to time in both the groups.

Low opioid is required in patients receiving FB as stated by Carli F et al.<sup>10</sup> They also found that in both the methods, there was low pain intensity during the first two days postoperatively. In contrast, our study found that there is a significant difference between the two groups as we matched the NRS

scoring in which pain relief was less in Group LI.

Albrecht E et al. piloted a study to see effectiveness of peri-articular multimodal drug injection in TKA and found noteworthy decrease in NRS scores in LI.<sup>11</sup> Various other researchers also supported this opinion.<sup>12-18</sup>

Toftdahl K et al. presented some data proposing that LI with various drugs like ropivacaine, ketorolac, and epinephrine results in quicker postoperative recovery, e.g. ability to walk on the first postoperative day as compared to femoral nerve block.<sup>16</sup> Carli F et al.

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conducted a study in which Group FB used less PCA ( $p = 0.02$ ) to achieve adequate analgesia, although postoperative 'two minutes walking test' was similar in both groups ( $p = 0.27$ ).<sup>10</sup>

Rescue analgesia was categorized into four groups in the present study according to their requirement in a day. Only 6 patients of Group FB had demand rescue analgesia  $< 5$  times compared to 14 patients in Group LI, We established that the rescue analgesia requirement was strangely low in Group FB. Different studies have shown that FB causes remarkable decrease in requirement of opioids dose.<sup>10,17</sup>

In our study, we found that sedation score was higher in Group LI, which may be correlated with fentanyl dose, which was also higher in Group LI.

## **LIMITATIONS**

Gender distribution in our study showed a female preponderance in both the groups. This may be due to the fact that randomization was done by serial assignment of patients to groups without gender randomization. The study participants were enrolled on first come basis, and after assessing their eligibility,

they were randomized in both the groups, without considering their gender.

Number of night stay in our hospital is 10 days for every patient so we were unable to compare and deduce any differences.

## **CONCLUSION**

Femoral nerve block causes better pain relief compared to local infiltration of local anesthetic solution in patients posted for unilateral total knee arthroplasty. A lesser dose of rescue analgesia together with early mobility was observed in patients receiving femoral nerve block.

**Conflict of interest:** Nil declared by the authors.

### **Authors' contribution:**

RKV: Concept, conduction of the study work and manuscript editing

MKP: Concept, conduction of the study work and manuscript editing

MG: Data collection, drafting and editing of manuscript

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