

“Adductor canal block versus femoral nerve block for analgesia after total knee arthroplasty: A randomised comparative study”

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Abstract:

Background: Osteoarthritis is a degenerative joint disease for which after an age people prefer surgery. Post Total knee replacement intervention most patients experience moderate to severe post-operative pain, which results in immobility and prolonged hospitalization related complications. Apart from conventional use of opioids and others, nerve blocks have emerged as newer modality for better pain relief. Femoral nerve block and Adductor canal block provides good pain control and shortens the functional recovery time. However, studies show that blockage of femoral nerve reduces quadriceps muscle strength and there is increased risk of falls whereas Adductor canal block preserves motor strength. In this study we aimed towards comparing the clinical superiority of ACB to FNB in analgesia following TKR along with other parameters.

Materials and Methods: In this prospective randomised comparative double-blind study, 40 patients of ASA grade I and II posted for TKR surgery were randomly divided equally into the adductor canal block group (Group A) and femoral nerve block group (Group F). Both Group A and Group F received postoperatively, 10ml of 0.25% bupivacaine through catheter placed on their respective anatomical position with the help of peripheral nerve stimulator and top ups were given after every 6-hours based on VAS score. The hemodynamic parameters, quadriceps strength, early ambulation, total dose of rescue analgesia required, post-op complications, length of hospital stay and patient satisfaction were observed in both the groups.

Results: The hemodynamic parameters were better for Group F whereas early ambulation, early discharge from hospital and better patients satisfaction were observed in Group A with ($p < 0.05$).

Conclusion: Group A is better in preserving quadriceps motor strength with effective analgesia to enable faster rehabilitation, earlier ambulation and shorter hospital stay as compared to Group F.

Key Word: Total knee replacement, Adductor canal block, Femoral nerve block, Peripheral nerve stimulator, Postoperative analgesia.

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I. Introduction

International Association for the Study of Pain at present describes pain as “an unpleasant sensory and emotional experience associated with or resembling with actual or potential tissue damage¹.” Osteoarthritis is a degenerative joint disease for which after an age people prefer surgery. Post Total knee replacement intervention most patients experience moderate to severe post-operative pain, which results in immobility and prolonged hospitalization related complications². Apart from conventional use of opioids and others, nerve blocks have emerged as newer modality for better pain relief. Femoral nerve block and Adductor canal block provides good pain control and shortens the functional recovery time^{3,4}. Adductor canal block is a relatively newer alternative which provides pure sensory blockade with very minimal effect on quadriceps strength. Anatomical study of the adductor canal demonstrated that along with saphenous nerve other nerves like nerve to vastus medialis, articular branches to the knee joint from the obturator nerve, medial femoral cutaneous nerve as well as the medial retinacular nerve can also be blocked. Hence, the sensory blockade is not only limited to the distribution of the saphenous nerve but also includes the medial and anterior aspects of the knee from the upper pole of patella to proximal tibia. The present study aimed towards comparing the Adductor canal block to Femoral nerve block in various aspects like quadriceps strength, total dose of rescue analgesia required, post-op complications, length of hospital stay and patient satisfaction⁵.

II. Material And Methods

This prospective comparative double-blind study was carried out on patients of Department of Anaesthesia at Bokaro General Hospital, Bokaro Steel City, Jharkhand, India from August 2022- Jan 2024.

Study location: Bokaro General Hospital, Bokaro Steel City, Jharkhand-827004, India

Study Design: Prospective randomised comparative double-blind study

Duration of study: 18 months (August 2022- Jan 2024)

Study population: Patients posted for total knee arthroplasty in Bokaro General Hospital, Bokaro Steel City

Sample size justification: For non-paired qualitative variables study

Sample size: 40 patients.

Sample size calculation: The total orthopaedics surgery in our hospital 833 (near about per year), knee replacement in Bokaro General Hospital around 2.4% (n=20)

Taking the α at 5% and desired power of study as 80%

Confidence level = 95%

Confidence interval = 5%

The sample size for the proposed study is approximately 40.

Study group:

40 patients were randomly divided equally into the adductor canal block group (Group A) and femoral nerve block group (Group F). A computer-generated code was used for randomisation.

Inclusion criteria:

1. Patients under ASA grade I and ASA grade II
2. Patients undergoing unilateral total knee arthroplasty for osteoarthritis
3. Patients giving consent for the surgery and the procedures

Exclusion criteria:

1. Patients who refused to give consent
2. Previous history of local anaesthetics allergy
3. With procedure site infection
4. Deranged coagulation profile or pre-existing coagulopathy
5. ASA III/IV patients
6. Those with history of total hip replacement or knee replacement.

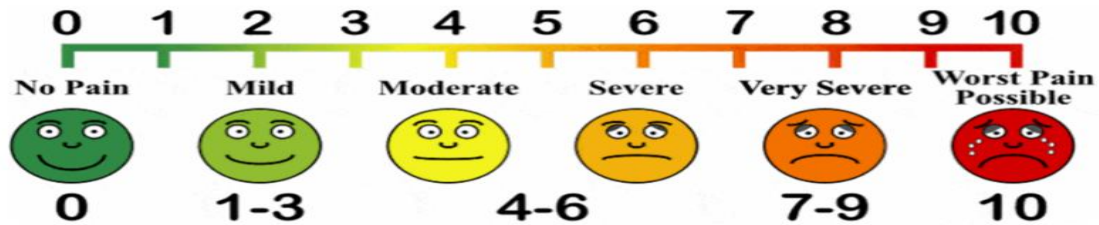
Procedure methodology:

My guide for the study was in control of patient allocation into two group (double blinding) and also did the procedures including nerve blocks using PNS and subarachnoid block. The drugs given in the ward after surgery was well documented by the nursing staff who was unaware of the procedure. Patient's consent was taken and the procedures was explained to them in their own language. A thorough pre anaesthetic checkup and clinical assessment was done. Using landmark technique and a peripheral nerve stimulator, catheter for giving femoral nerve block (Group F) or adductor canal block (Group A) was inserted and secured. 10ml of 0.25% bupivacaine was given as a loading dose in both the groups and then administered postoperatively every 6hourly. The catheter was placed in-situ for 48hours and all the parameters in our study were noted.

Outcomes measured:

To assess the time for joint mobilisation and ambulation calculated as to when the patient can stand from the bed and walk 3m and come back and sit. The test was done only if it was possible to do adequate knee movement and with no significant drain collection. Support of walker was used just to prevent patient from falling.

To find out the length of hospital stay and patient's satisfaction in both the techniques. Also compare the side effects, visual analogue scale every 6 hourly after completion of surgery till 48 hours in both the groups. The VAS score is a continuous scale usually 10 centimetres in length with pain intensity scores ranging for 0 to 10. 10 means worst imaginable pain and 0 means no pain.



Statistical analysis:

All the data was selected randomly and was entered in to the Microsoft excel and tabulated, then the data will be analyzed with appropriate statistical tools “SPSS version 24”. Data was presented as mean with standard deviation or proportions as appropriate. Mean, median, standard deviation and variance was calculated and following statistical significance tests were applied.

1. Student’s paired T-test will be used as the statistical tool to test for significance of observed mean differences.
2. Statistical analysis would be done using “Chi – square Test”.
3. Time to ASA grading and Rescue Analgesia was assessed by using “Wilcoxon Signed rank test”.

Statistical methods would be used to find the significance of homogeneity of study characteristics between the two groups of patients. Finally the calculated values were compared with the tabulated values at a particular degree of freedom and the level of significance was determined.

Their inference will be as follows-

- P > 0.05 statistically insignificant
- P < 0.05 statistically significant
- P < 0.01 statistically highly significant
- P < 0.001 statistically very highly significant

III.OBSERVATION & RESULTS

Table no. : - 01

Comparison of Demographic Parameters between two groups:

		Group - A (n=20)		Group - F (n=20)		P value	Results
		No.	Percentage	No.	Percentage		
Age (years)	50 – 59 year	06	30%	05	25%	0.8124	Not significant
	60 – 69 year	10	50%	12	60%		
	70 – 79 year	04	20%	03	15%		
Gender	Male	09	45%	11	55%	0.5323	Not significant
	Female	11	55%	09	45%		
ASA Grading	I	05	25%	07	35%	0.4956	Not significant
	II	15	75%	13	65%		

Demographic parameters and ASA grading were found to be not significant in both the groups.

Table no. : - 02 Comparison of mean duration of surgery (min) between two Groups

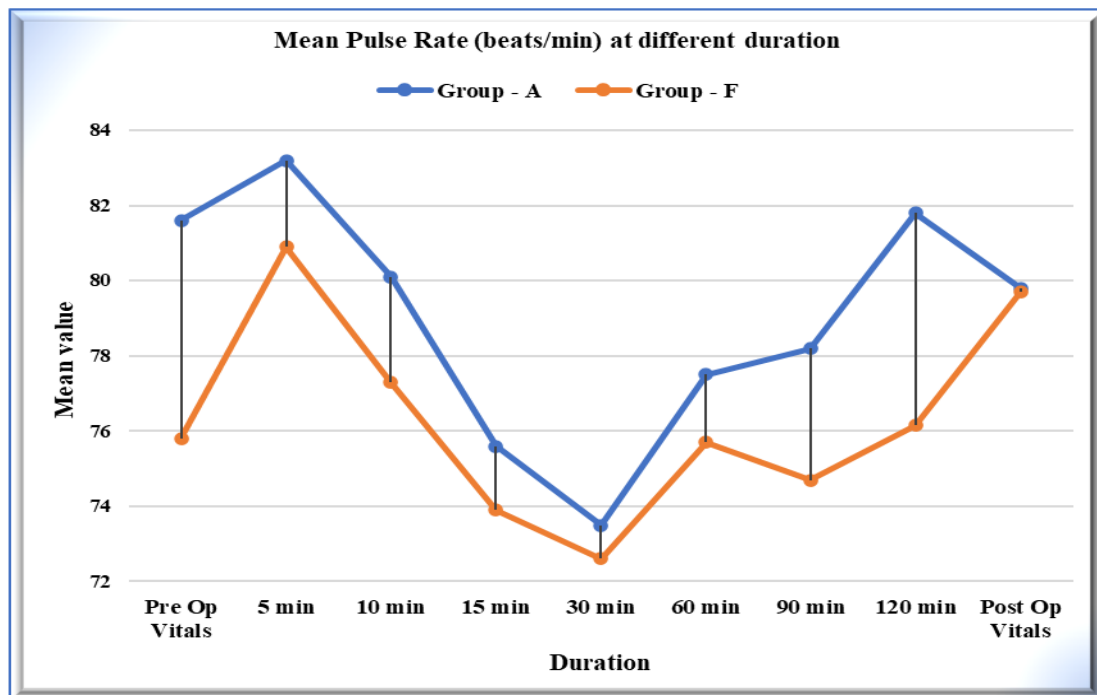
Duration of surgery (min)	Group - A (n=20)	Group - F (n=20)	p-value	Results
Mean ± S.D	150.75 ± 17.19 min	154.05 ± 16.03 min	0.5338	Not Significant

Hence, Group - A is statistically not significant or comparable with Group – F. For, test of significance, here we used “Paired | t | – Test”

Table no. : - 03 Comparison of Pulse Rate (beats/min) between two groups at different point of time

Time intervals	Group - A (n=20)	Group - F (n=20)	t _{cal}	p-value	Results
	Mean ± S.D	Mean ± S.D			
Pre Op Vitals	81.60 ± 13.91	75.80 ± 13.12	1.895	0.0658	Not Significant
At 5 min	83.20 ± 12.13	80.90 ± 10.37	0.645	0.5231	Not Significant
At 10 min	80.10 ± 9.32	77.30 ± 8.59	0.988	0.3294	Not Significant
At 15 min	75.60 ± 8.52	73.90 ± 8.77	0.622	0.5378	Not Significant
At 30 min	73.50 ± 8.87	72.60 ± 7.26	0.351	0.7274	Not Significant
At 60 min	77.50 ± 8.63	75.70 ± 6.40	0.749	0.4583	Not Significant
At 90 min	78.20 ± 7.67	74.70 ± 7.85	1.426	0.1620	Not Significant
At 120 min	81.80 ± 10.50	76.15 ± 9.00	2.018	0.0755	Not Significant
Post Op Vitals	79.80 ± 10.11	79.70 ± 10.08	0.971	0.3376	Not Significant

For test of significance, here we used “Paired | t | – Test”. Comparison of pulse rate was found to be not significant between two groups



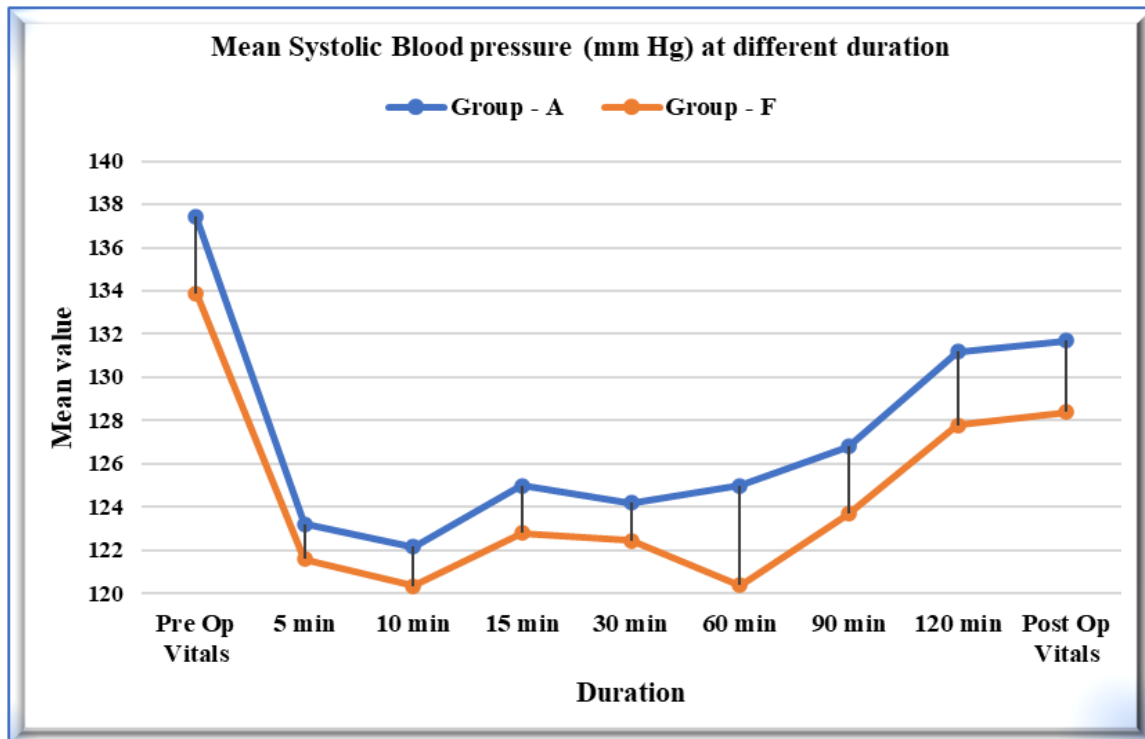
Graph no: 03 Shows comparison of Pulse Rate (beats/min) between two groups at different point of time

Table no. : - 04 Comparison of Systolic Blood pressure (mm Hg) between two groups

Systolic Blood pressure (mm Hg) at different duration	Group - A (n=20)	Group - F (n=20)	t _{cal}	p-value	Results
	Mean ± S.D	Mean ± S.D			
Pre Op Vitals	137.4 ± 16.53	133.90 ± 16.02	0.68	0.5006	Not Significant
At 5 min	123.20 ± 14.52	121.60 ± 13.26	0.364	0.7180	Not Significant
At 10 min	122.15 ± 9.63	120.35 ± 10.03	1.081	0.5660	Not Significant
At 15 min	125.00 ± 9.79	122.80 ± 8.49	0.759	0.4524	Not Significant
At 30 min	124.20 ± 9.69	122.45 ± 7.99	2.530	0.5369	Not Significant
At 60 min	125.00 ± 10.49	120.40 ± 9.53	1.452	0.1548	Not Significant

					Significant
At 90 min	126.80 ± 9.91	123.70 ± 8.88	1.042	0.3041	Not Significant
At 120 min	131.20 ± 11.94	127.80 ± 9.51	0.996	0.3255	Not Significant
Post Op Vitals	131.70 ± 13.24	128.40 ± 11.53	0.841	0.4058	Not Significant

All the above results Group - A is statistically not significant or comparable with Group - F, according to their Systolic Blood pressure (mm Hg) at different duration, with p – value {p> 0.05}. For test of significance, here we used “Paired | t | – Test”

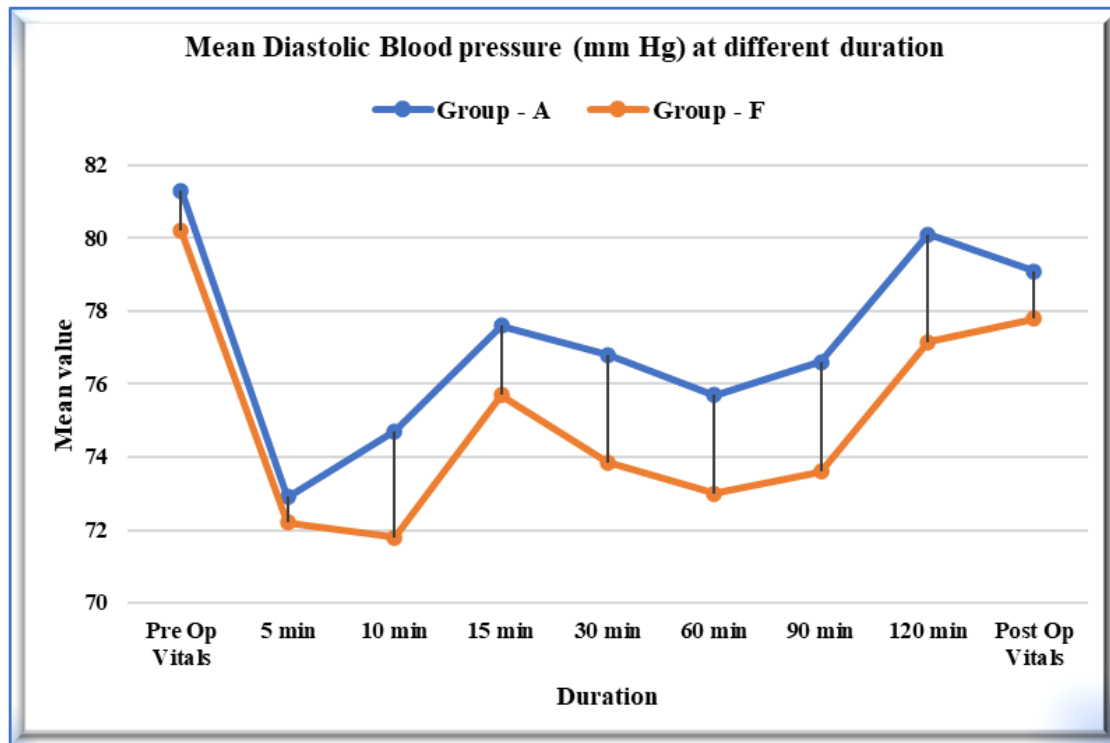


Graph no: 04 Shows comparison of Systolic Blood pressure (mm Hg) between two groups

Table no. : - 05 Comparison of Diastolic Blood pressure (mm Hg) between two groups

Diastolic Blood pressure (mm Hg)	Group - A (n=20)	Group - F (n=20)	t _{cal}	p-value	Results
	Mean ± S.D	Mean ± S.D			
Pre Op Vitals	81.30 ± 11.61	80.20 ± 9.77	0.324	0.7476	Not Significant
At 5 min	72.90 ± 10.06	72.20 ± 8.70	0.235	0.8152	Not Significant
At 10 min	74.70 ± 7.82	71.80 ± 8.36	1.133	0.2643	Not Significant
At 15 min	77.60 ± 6.82	75.70 ± 6.81	0.882	0.3835	Not Significant
At 30 min	76.80 ± 6.40	73.85 ± 6.59	1.436	0.1591	Not Significant
At 60 min	75.70 ± 6.50	73.00 ± 6.91	1.273	0.2108	Not Significant
At 90 min	76.60 ± 6.72	73.60 ± 7.61	1.322	0.1942	Not Significant
At 120 min	80.10 ± 9.23	77.16 ± 7.67	1.096	0.2802	Not Significant
Post Op Vitals	79.10 ± 8.91	77.80 ± 8.13	0.482	0.6326	Not Significant

All the above results Group - A is statistically not significant or comparable with Group - F, according to their Diastolic Blood pressure (mm Hg) at different duration, with p–value {p> 0.05}. For Test of Significance, Here we use “Paired | t | – Test”

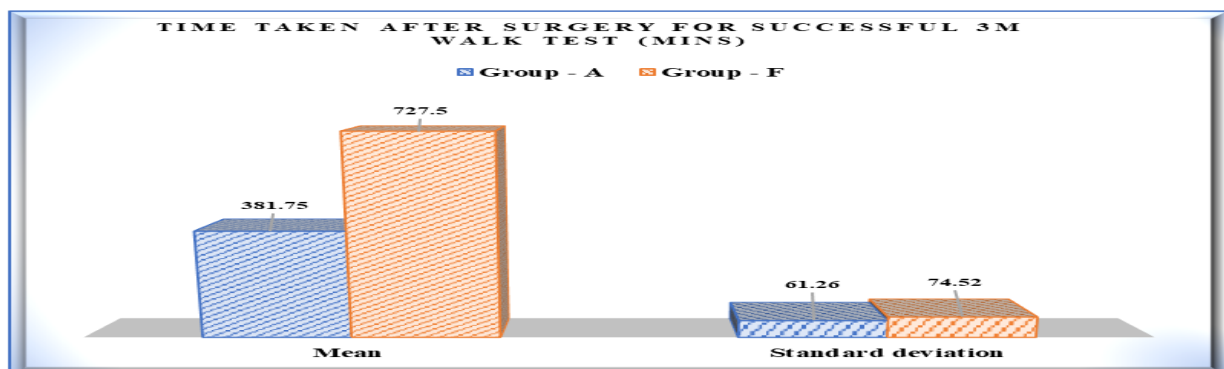


Graph no: 05 Shows comparison of Diastolic Blood pressure (mm Hg) between two groups

Table no. : 06 Comparison of Time taken after surgery for successful 3m walk test (mins)

Time taken after surgery	Group - A (n=20)	Group - F (n=20)	t _{cal}	p-value	Results
Mean ± S.D	381.75 ± 61.26 min	727.50 ± 74.52 min	16.03	<0.0001	Significant

Hence, Group - A is statistically significant than Group - F, according to their mean Time taken after surgery for successful 3m walk test (mins), with P – Value {p<0.0001}. For Test of Significance, Here we use “Paired | t | – Test”



Graph no: 06 Shows comparison of Time taken after surgery for successful 3m walk test (mins)

Table no. : 07 Comparison of mean Length of hospital stay (days)

Length of hospital stay	Group - A (n=20)	Group - F (n=20)	t _{cal}	p-value	Results
Mean ± S.D	3.50 ± 0.61 days	5 ± 0.65 days	7.525	<0.0001	Significant

Hence, Group - A is statistically significant than Group - F, according to their mean Length of hospital stay (days), with P – Value {p<0.0001}. For test of significance, here we used “Paired | t | – Test”

Table no. :- 08 Comparison of Patient satisfaction between two groups

Patient satisfaction	Group - A (n=20)		Group - F (n=20)		P value	Results
	No.	Percentage	No.	Percentage		
Very Satisfaction	09	45%	06	30%	0.0295	Significant
Satisfaction	10	50%	06	30%		
Not Satisfaction	01	5%	08	40%		

Hence, Group - A is statistically significant difference with Group - F, according to Patient satisfaction between two groups, with p – value = 0.0295 {p<0.05}.

Table no. :- 09 Comparison of Post of Median VAS Score at rest

Duration	Group - A (n=20)		Group - F (n=20)		P value	Results
	Mean ± S.D	Median	Mean ± S.D	Median		
At 6 hour	2.55 ± 1.05	2	2.50 ± 1.19	2	0.8887	Not Significant
At 12 hour	2.65 ± 1.04	2.5	2.65 ± 1.18	3	0.7808	Not Significant
At 18 hour	2.35 ± 1.14	2	2.30 ± 1.38	2.5	p>0.05	Not Significant
At 24 hour	1.65 ± 1.18	2	1.65 ± 1.18	2	p>0.05	Not Significant
At 30 hour	2.05 ± 1.43	2	2.10 ± 1.59	2	p>0.05	Not Significant
At 36 hour	1.60 ± 1.31	2	1.60 ± 1.19	2	p>0.05	Not Significant
At 42 hour	1.50 ± 1.24	2	1.55 ± 1.10	2	p>0.05	Not Significant
At 48 hour	1.15 ± 1.09	2	1.20 ± 1.01	2	p>0.05	Not Significant

Hence, all the above results Group - A is statistically not significant or comparable with Group - F, according to their VAS Score, with p – value {p>0.05}. For test of significance, here we used “Wilcoxon Signed Rank Test ”

Other parameters like Comparison of SPO2 and RR in both groups found to be not significant. Also, Comparison of Side effects due to analgesia between two groups and Requirement for rescue analgesia-IV Tramadol (mg) was found to be not significant.

III. DISCUSSION

John Hunter was the first one to describe adductor canal. Lund et al described continuous adductor canal block for post operative analgesia after knee surgeries. Adductor canal is also called as Hunter’s canal or sub-sartorial canal. It is an intermuscular space situated in the medial side of middle one third of thigh triangular in cross section. The canal extends from the apex of the femoral triangle above to the tendinous opening in the adductor magnus below. Adductor canal block preserves quadriceps strength. Femoral nerve is the largest nerve of the lumbar plexus which arises from the dorsal divisions of the L2-L4 ventral rami, but this nerve block does not preserve quadriceps strength. As per result of post-op 3m walk test we found that Group A has taken time of 381.75 ± 61.26 min vs Group F time 727.50 ± 74.52 min which was similar to Pia Jæger et al⁴ who studied in 48 patients with findings of quadriceps strength significantly higher in ACB with 52% vs 18% for FNB. David H. kim³ in his study found that numeric rating scale pain scores was (1.0 [0.0, 3.5] in ACB vs. 0.0 [0.0, 1.0] in FNB or to opioid consumption (32.2 [22.4, 47.5] ACB vs. 26.6 [19.6, 49.0]; P = 0.0115) proving there was no significant statistical difference in dynamometer results, pain scores, or opioid use between the two groups. ACB results in early ambulation. Length of stay in Group A was 3.5days vs 5days for Group F which was similar to Nasr A Hegazy et al⁶.As per analgesic efficacy our study similar to Dong Li et al⁷ in their metaanalysis study based on 9 previous studies of a total of 639 patients regarding the analgesic efficacy and quadriceps strength of adductor canal block versus femoral nerve block following total knee arthroplasty found out that ACB preserved quadriceps muscle strength better than FNB. Study by Yugal Karkhur et al⁸ shows both ACB and FNB had similar clinical efficacy concerning pain scores, patient satisfaction and success rate of the blockade.

VAS score observed for 48hours and was found not significant which was similar to Simon H. Armanious et al⁹ where VAS at rest except at 24 h was significantly lower in FNB group with p value 0.003. Also, Vamshi Krishna et al¹⁰ had found no difference in VAS scores of both the groups. Our limitations of study were that we conducted the study in a small sample size, lack of ultrasound machine use and increased risk of catheter displacement during movement.

IV. CONCLUSION

Hence, TKA patients who received ACB, however, had better quadriceps strength and consequently were less prone to falls. Patients receiving ACB could be mobilized early, has better satisfaction and lower length of hospital stay. Mobilization and ambulation, which are both critical for recovery after TKA were both preserved by ACB. Although ACB and FNB provided equal analgesia at rest, these findings suggested that ACB may be a preferred option for postoperative analgesia after Total knee arthroplasty.

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