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Ultrasound Guided Saphenous Nerve Block versus Femoral Nerve Block for Post Operative Pain in Unilateral Knee Replacement

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Abstract
Background and Aims: *Femoral nerve block for total knee replacement (TKR) patients is one of the renowned techniques for post-operative pain relief,but it delays ambulation. Saphenous nerve block, (sensory branch of femoral nerve) has been used in a few studies to compare analgesia and muscle strength. We aimed at comparing saphenous and femoral nerve blocks for pain relief, sensory block, muscle strength and patient satisfaction score in patients undergoing unilateral TKR.*
Methods: *50 ASA I, II and III patients posted for unilateral TKR were divided into two groups in a randomized double-blind study. Group A received 15 ml of 0.75% ropivacaine in femoral nerve block and group B received the same drug in blocking the saphenous nerve. Duration of analgesia, muscle strength, sensory block and patient satisfaction score were studied.*
Results: *Both the groups were comparable with respect to demographic data. Patients in group B (Saphenous Nerve block) had significant recovery from motor and sensory blockade compared to group A (Femoral nerve Block) but had comparable analgesia as per VAS score. Patient satisfaction was comparable in both the groups.*
Conclusion: *Saphenous nerve block provides comparable analgesia to femoral nerve block but sparing motor power.*

Keywords: *Total knee Replacement, Saphenous Nerve block, Ropivacaine.*

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I. Introduction

Total knee replacement is an effective treatment for degenerated painful knee joints. TKR patients have severe post-operative pain and to manage this, is an essential component of anaesthetic care. Effective postoperative pain relief is a prerequisite for successful early mobilization and rehabilitation. Femoral nerve block (FNB) has gained popularity with little concern of compromise in the muscle strength which delays ambulation. [1,2] Use of the saphenous nerve block or sartorial block is reputable for postoperative pain relief after TKR as there is sparing of motor fibers resulting in better muscle power after surgery. [3]

Due to paucity of literature for saphenous nerve block for TKR, additional research is needed especially in the Indian context wherein a thorough literature search did not reveal studies comparing single shot saphenous and femoral nerve block for post-operative pain relief in unilateral total knee replacement. In the present study we hypothesized saphenous nerve block would provide analgesia comparable to femoral nerve block but at the same time motor sparing in contrast to femoral block.

II. Material And Methods

After obtaining hospital and university ethical committee approval, we conducted double blind randomized prospective study in the department of anaesthesiology of a tertiary care academic institute. This study included 50 ASA I, II and III patients in the age group of 50-80 years undergoing unilateral total knee replacement under spinal anaesthesia. Written informed consent was taken from all patients before the procedure. Patients who refused spinal anaesthesia or femoral or saphenous nerve block, had infection at the block site or allergy to drugs used, coagulation disorders, pre-existing neuropathies, ASA IV and V were

excluded from the study. Patients were divided into two equal groups; A(Femoral nerve block) and group B (Saphenous nerve block or Adductor canal block), using 50 coded envelopes with content written as femoral or saphenous nerve block on them and one was selected randomly each time.After giving block, both the sites of femoral or saphenous nerve block was wrapped with sterile bandage. During pre anaesthetic interview, patients were introduced to visual analogue score(VAS 1-10) for measuring pain in the post-operative period. On the day of surgery, the baseline haemodynamic parameters were recorded.
After preloading with 10 ml/kg of 0.9% Normal Saline solution, all patients were administered spinal block under all aseptic precautions, in the sitting position. 12.5mg of Bupivacaine 0.5% (Hyperbaric) and Fentanyl 25 mcg was injected through the 26-gauge Quincke's spinal needle. Hypotension was treated with iv fluids and mephentermine and bradycardia with atropine sulphate.

After this, as per randomization, ultrasound guided femoral or saphenous nerve block was given using Sonosite (Bothell, Washington, USA) ultrasound machine, as described below and surgery was allowed to commence after achieving a spinal block of height T9 to T10. The onset of sensory block was defined as the absence of pain at the $T_{9\text{-}10}$ dermatome, assessed by pinprick. The highest level of sensory block was evaluated by pinprick at midclavicular line anteriorly. Motor block was assessed using modified Bromage score. [4]
The patient undergoing ultrasound guided femoral nerve block was placed supine with a small hip roll under the side to be blocked to flatten the inguinal crease. Taking all aseptic precautions, a high frequency linear transducer probe (10-13MHz) positioned at the level of the inguinal crease and oriented parallel to the inguinal ligament the femoral artery was identified. A local anaesthetic wheal was raised lateral to the ultrasound transducer using 1% lidocaine. 21G Stimuplex A needle was inserted through this skin wheal using in-plane guidance in a lateral- to-medial direction towards the femoral nerve. Once the tip had transversed the fascia iliaca lateral to the femoral nerve, 15 ml of 0.75% ropivacaine was injected incrementally until visual confirmation of injectate spread surrounding the femoral nerve was achieved.

For patients undergoing ultrasound guided saphenous nerve block, patients were placed in the supine position with the knee slightly flexed and the leg rotated externally enough to expose the distal inner thigh. Using ultrasound guidance with linear probe the femoral artery was identified in the mid-thigh. The femoral artery was traced distally to locate the point just before it starts to dive down to form the popliteal artery, which was approximately 13 cm proximal to the knee. Lateral to the ultrasound probe, wheal was raised using 1% lidocaine. With 15 ml of 0.75% ropivacaine filled syringe attached to the block needle was advanced towards the femoral artery and pierce the fascia on the inner aspect of the sartorius muscle anterolateral and posteromedial to the femoral artery and drug was deposited incrementally until visual confirmation of injectate spread was achieved. The patients were followed up for any nerve block related complication like local anaesthetic toxicity or any neurological symptoms.

In the post-operative period, patient was asked to rate the pain using VAS rulers having markings 0 to 10. Motor power was assessed by asking the patient to lift the operated and non-operative legs alternately and extension of the leg(straight leg raising test). Sensory component of the blocks was assessed using pin prick sensation. All these parameters were assessed by the anaesthetist who was not aware of the type of block given. At any time, VAS >4 was considered as inadequate analgesia and rescue analgesia(Diclofenac 75mg) was given and our study ended. The primary outcome of the study was a comparative pain relief with femoral and saphenous nerve blocks and the secondary outcome was better patient satisfaction and early ambulation with saphenous nerve block after TKR.

STATISTICS: We enrolled 50 patients in our study and these were divided into two equal groups. For parametric values, student t-test and Chi-square test were used. For non-parametric values, Mann-Whitney or U-test were used. A power analysis was done and the effect size was 0.97 and the power of study was 0.92 which is highly strong. G* Power software was used to calculate the power of study. The software used for statistical analysis was SPSS 16.

III. Results

The demographic parameters were comparable in both the groups (Fig:1). It was noted that sensory block started weaning off earlier in Group B (Saphenous nerve block) as compared to Group A (Femoral nerve block) and the difference was significant with p-value of 0.002 in the 5^{th} hour (Table:1). In the 10^{th} hour, in both the groups, the sensory block wore off in all the patients (Fig: 2). We observed following findings in muscle strength:

At 4^{th} hour, group B patients had better motor recovery as compared to group A (Modified Bromage Score 2.64±1.09 versus 3.48±1.00 respectively, p=0.04). Recovery in next hours then lagged behind in Group A as compared to group B. At 18^{th}hour, study was over in Group A and at 22^{th} hour in group B. At that time mean of motor power was 5.50±0.70 in group A and 6.00 in group B (Fig: 3). For the whole study period, the difference in pain score for both the groups remained insignificant (Table:2). In group A, patients had pain at

period of 9.72±4.02 hours versus 9.64±3.29 hours in group B (p=0.762) (Table: 3, Fig:4). 11 patients in group A and 7 patients from group B were partially satisfied whereas 15 out of 25 patients in group B and 9 of group A were fully satisfied. 5 patients of group A and 3 of group B were fully satisfied and told that they will recommend the blocks to others (Table:4, Fig:5). Statistically the difference was insignificant (p=0.23)

IV. Discussion

The International Association for the Study of Pain (IASP) has defined pain as "an unpleasant sensory or emotional experience associated with actual or potential tissue damage, or described in terms of such damage." [5] The Joint Commission on Accreditation of Healthcare Organizations (JCAHO) has made adequate pain management a priority and has deemed monitoring pain as the "fifth vital sign". [6]

This prospective study demonstrated that sensory block started wearing off earlier in saphenous group and it became statistically significant at 5th hour (p= 0.02). All the candidates in saphenous group had sensations to pin prick after 9 hours of putting the nerve block compared to 22 patients in femoral group. For the muscle strength, a considerable difference was noted in two groups. The difference was statistically significant after 4 hours of the nerve block, 3.48±1.00 for saphenous group and 2.64±1.09 in femoral group with p-value 0.04. David H Kim et al also found only the dynamometer readings for the adductor canal block (ACB) to be superior to the readings for the FNB (difference ACB-FNB kgf [98.3% CI], 5.2 [2.7–7.7]; P< 0.0001) and at 6 to 8 h post anesthesia, mean strength during extension of the knee from a starting position of 45-degree flexion was significantly higher for the ACB than the FNB (difference ACB-FNB kgf [95% CI], 5.2 [3.1–7.2]; P< 0.0001).[7] M.T. Jenstrup et al conducted the first study to demonstrate efficacy of adductor block for post knee replacement and results were study (ropivacaine) group performed the time up go (TUG) test at 24 h post-operatively faster than patients in the placebo group (36±17 vs. 50±29 s, respectively, mean ±(SD), P=0.03).[8] The study involved a high dose of local anesthetic (30 ml of 0.75% ropivacaine, 225 mg). This large dose of local anesthetic could cause quadriceps weakness from proximal spread. In the present study we used smaller volumes which appear to give comparable analgesia but more randomized control trials are required for standardizing the drug concentration and volume. In our institution, the orthopedic surgeons do not prefer to ambulate the patients on the day of surgery. So we ambulated the patients after 24 hours and no falls were noted in either group. Ilfeld et al. reported seven falls in 171 patients receiving a peripheral nerve block involving the femoral nerve.[9]Shu Qing et al,in their meta-analysis, compared the analgesic effect of saphenous nerve block with a placebo group after TKR surgeries and found that saphenous nerve block significantly lowered VAS pain score within 24 hrs at movement and at rest compared with placebo group and reduced total morphine consumption[10].Comparing the pain relief by VAS, we observed that saphenous nerve block is comparable to femoral block throughout the study period. David Kim et al in their study concluded that when comparing the NRS pain scores at rest between adductor and femoral groups it was found that the ACB group was not inferior to the FNB group at 6 to 8 h post anaesthesia (difference: ACB-FNB [95% CI], 0.7 [−0.1 to 1.55]; P= 0.0190). At 24 and 48 h, there were no statistically significant difference between groups, noninferiority P= 0.0103 and P= 0.0005, respectively. [7] M.T. Jenstrup et al in their study found that pain scores during 45 degrees flexion of the knee were lower in the ropivacaine group compared with the placebo group (P=0.01). Pain scores at rest were reduced in the ropivacaine group, but this difference did not reach statistical significance (P=0.058).[8]In Jun Koh et al compared the analgesic efficacy of ACB with FNB and found that ACB provides comparable analgesic efficacy and facilitates earlier mobilization by sparing quadriceps strength compared with FNB[11]. A meta-analysis performed by Duan Wang et al provided strong evidence that ACB is an effective alternative to FNB for post TKA patients with respect to muscle strength, pain control, rehabilitation and complications.[12] In this context, emerging evidence suggests that ACB facilitates postoperative rehabilitation compared with FNB because it primarily provides a sensory nerve block with sparing of quadriceps strength. We observed that 11 patients in group A and 7 patients from group B were partially satisfied, whereas 15 out of 25 patients in group B and 9 of group A were fully satisfied. 5 patients of group A and 3 of group B were fully satisfied and would recommend the blocks to others. Statistically the difference is insignificant with p-value 0.236.

V. Conclusion

After our study, we conclude that saphenous nerve block using ropivacaine 0.75% 15 ml provides comparable analgesia to femoral nerve block and early recovery of motor power. The main drawback of our study was the small sample size. We opine that saphenous nerve block should be used for early ambulation and optimal pain relief in TKR and other surgical procedures on knee joint.

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NIL

Conflict of interest
There is no conflict of interest.

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Time	Group A		Group B		p-value
	Number	%age	Number	%age	
2 hrs	0	0%	1	4%	0.312
3 hrs	0	0%	3	12%	0.074
4 hrs	3	12%	7	28%	0.157
5 hrs	3	12%	13	52%	0.002
6 hrs	9	36%	21	84%	0.001
7 hrs	12	48%	23	92%	0.001
8 hrs	16	64%	24	96%	0.005
9 hrs	22	88%	25	100%	0.074
10 hrs	25	100%	25	100%	-
11 hrs	25	100%	25	100%	-
12 hrs	25	100%	25	100%	-
14 hrs	25	100%	25	100%	-
16 hrs	25	100%	25	100%	-
18 hrs	25	100%	25	100%	-
20 hrs	-	-	25	100%	-
22 hrs	-	-	25	100%	-

Table1: Sensory Block Time: number of patients with weaning block

Time (hrs)	Group A		Group B		p-value
	Mean	SD	Mean	SD	
0	0.00	0.00	0.00	0.00	1.000
1	0.16	0.37	0.00	0.00	0.039
2	0.28	0.68	0.00	0.00	0.020
3	0.92	1.08	0.12	0.60	0.000
4	1.52	1.58	0.64	1.22	0.012
5	1.50	1.14	0.83	1.05	0.040
6	2.48	1.69	1.88	1.30	0.196
7	2.13	1.50	2.45	1.63	0.693
8	2.53	1.46	2.53	1.33	0.969
9	3.46	2.03	3.21	1.63	0.786
10	2.71	1.70	3.22	1.86	0.626
11	3.00	1.00	2.40	0.89	0.381
12	2.67	0.58	3.80	1.79	0.273
14	4.00	1.73	4.00	2.83	0.761
16	4.50	0.71	2.00	-	0.221
18	-	-	3.00	-	-
20	-	-	5.00	-	-

Table 2: Post-operative Visual Analogue Score(VAS) among patients in different groups

	Group A		Group B		
	Mean	**Std. Deviation**	**Mean**	**Std. Deviation**	**p-value**
Time after surgery when patient complains of pain (hours)	9.72	4.02	9.64	3.29	0.762

Table 3: Time after surgery when patient complains of pain

Satisfaction level	Group A		Group B		Total		p- value
	No.	%age	No.	%age	No.	%age	
Partially satisfied	11	61.1	7	38.9	18	100.0	0.236
Fully satisfied	9	37.5	15	62.5	24	100.0	
Fully satisfied and would recommend this analgesic technique to others	6	62.5	3	37.5	8	100.0	
Total	25	50.0	25	50.0	50	100.0	

Table 4: Patient satisfaction level

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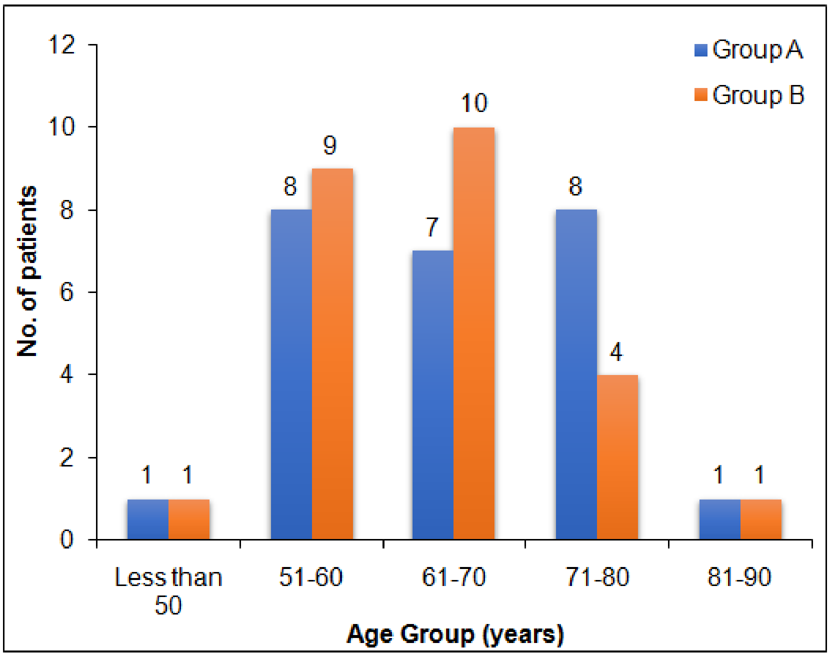

Fig 1: Age Distribution of patients in two groups

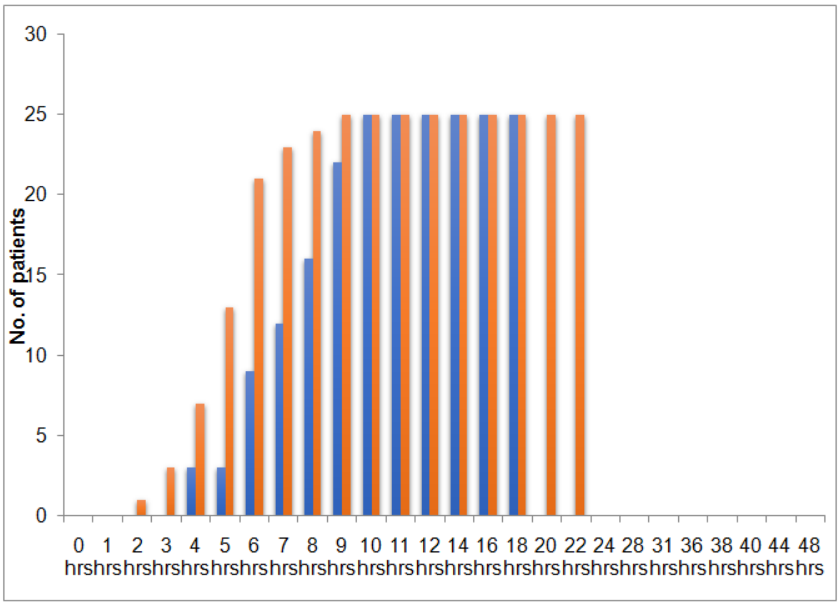

Fig 2: Comparison of recovery from sensory block

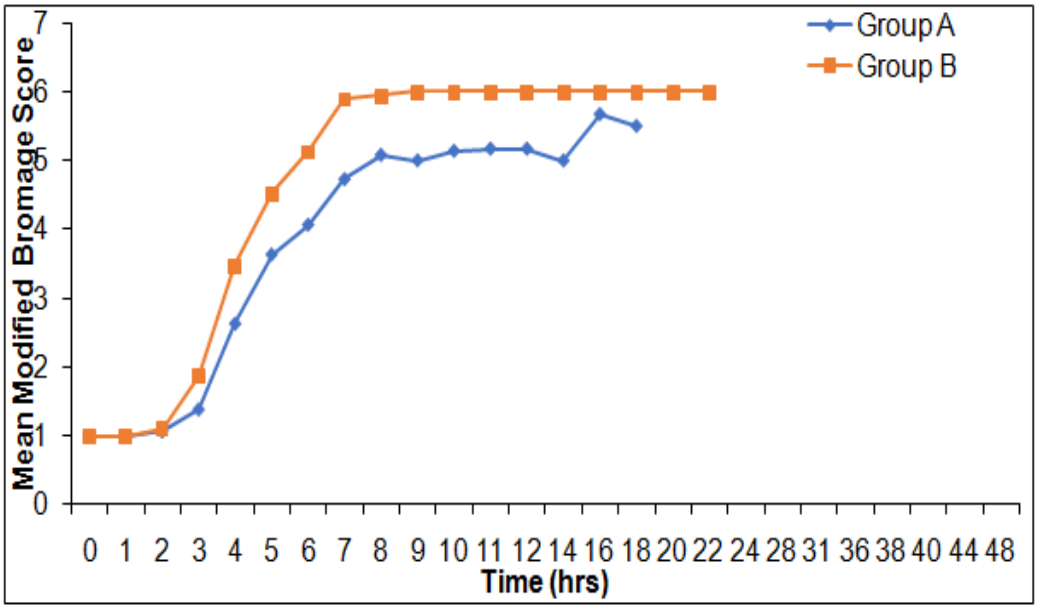

Fig 3: Post-operative Motor blockade among patients in two groups

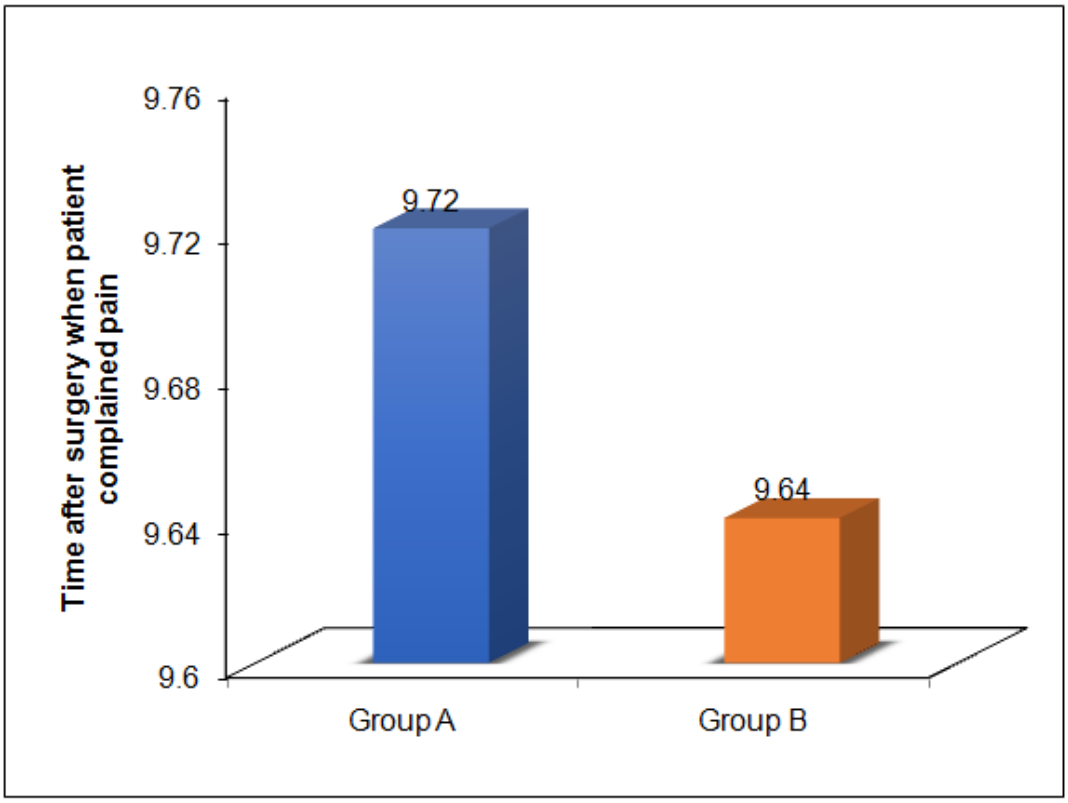

Fig 4: Time after surgery when patient complained of pain

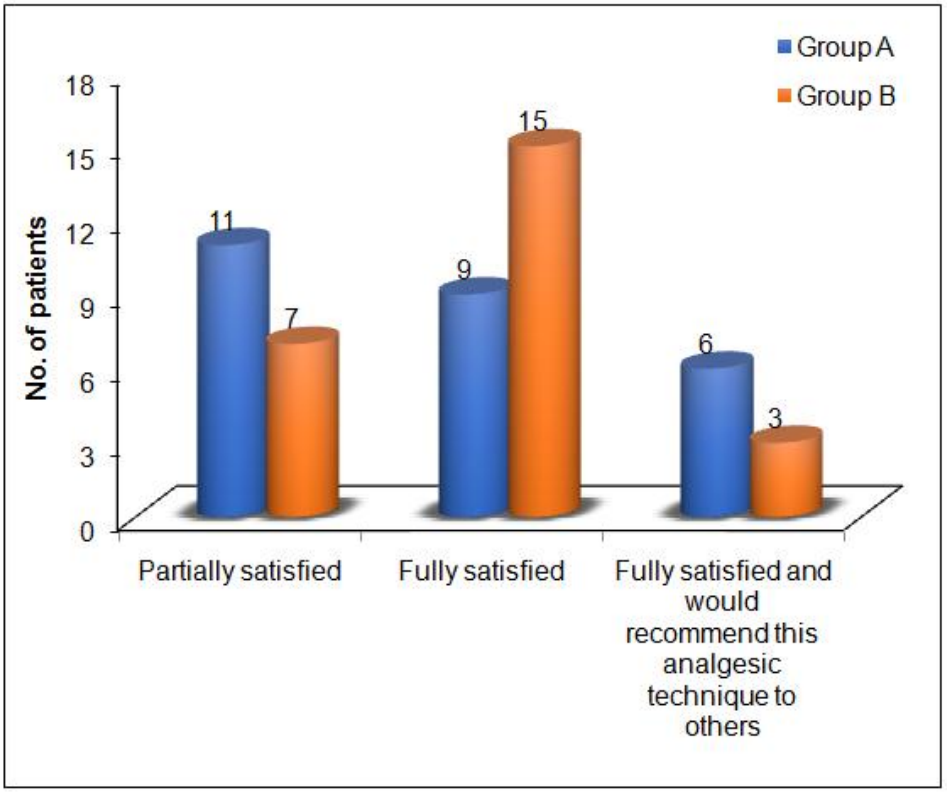

Fig 5: Patient Satisfaction Scale

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