A Comparative Study Of Functional Outcome Of Subvastus Vs Medial Parapatellar Approaches In Total Knee Arthroplasty Procedure

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Background: Total Knee Arthroplasty (TKA) is a widely performed surgical intervention for end-stage knee diseases such as osteoarthritis, rheumatoid arthritis, and avascular necrosis. The surgical approach significantly influences early postoperative recovery and functional outcomes.

AIM: To compare the functional outcome of Subvastus vs Medial Parapatellar approaches in Total Knee Replacement procedure

Methods: A hospital-based prospective study was conducted on 30 patients with Grade 3 and 4 osteoarthritis (Kellgren–Lawrence classification) undergoing TKA. Participants were randomly assigned to two groups: Group 1 (Subvastus approach, n = 15) and Group 2 (Medial Parapatellar approach, n = 15). Parameters assessed included intraoperative blood loss, surgical duration, pain (VAS), range of motion (ROM), Knee Society Score (KSS), postoperative complications, straight leg raise (SLR), and length of hospital stay (LOS). Follow-ups were conducted on postoperative day 1, at 14 weeks, 6 months, and 1 year.

Results: The Subvastus approach demonstrated significantly reduced intraoperative blood loss (277 ± 44 ml vs 337 ± 54 ml; $p = 0.002$) and shorter operative time (95 ± 15 min vs 135 ± 13 min; $p < 0.001$) compared to MPA. Early postoperative outcomes—including pain reduction, faster SLR, and shorter LOS—were significantly better in the Subvastus group. At 14 weeks and 6 months, Subvastus patients showed superior KSS and ROM scores. However, at 1-year follow-up, no statistically significant difference was observed between the two approaches in terms of pain, ROM, or functional scores.

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Conclusion: The Subvastus approach in TKA offers superior early postoperative recovery, reduced blood loss, and shorter hospital stay compared to the Medial Parapatellar approach. Nonetheless, long-term functional outcomes between the two approaches remain comparable after one year.

Keywords: Total Knee Arthroplasty (TKA); Subvastus Approach; Medial Parapatellar Approach; Functional Outcome; Knee Society Score (KSS); Range of Motion (ROM); Osteoarthritis; Postoperative Pain; Rehabilitation.

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INTRODUCTION

For terminal knee diseases, Total Knee Replacement (TKR) or Total Knee Arthroplasty (TKA) is a highly effective surgical treatment that can restore function and relieve discomfort. Osteoarthritis is the most prevalent indication for total knee arthroplasty (TKA) globally [1]. Other causes of TKA include rheumatoid arthritis (RA), post-traumatic arthritis, psoriatic arthritis, ankylosing spondylitis, and avascular necrosis [2,3].

OA is a degenerative kind of arthritis that causes pain, stiffness, and loss of function by destroying cartilage. With increasing rates of obesity and an older population, the worldwide OA burden is enormous and continues to increase [4]. The study (2023) of Steinmetz et al., [5] showed the global prevalence of OA is 7.6% (595 million). The global burden of knee OA has risen by 132% since 1990 and is expected to increase by 75% by 2050. Years Lived with Disability (YLD) owing to OA is ninth among the population over the age of 70. Global age-standardized YLD for all OA in 2020 was 255 per lakh, up 9.5% from 1990.

Rheumatoid arthritis (RA) is a chronic autoimmune illness that can cause joint lining destruction as well as knee inflammation. Post-traumatic arthritis refers to arthritis that develops after a knee injury, such as a ligament rupture or fracture. AVN has an influence on the knee joint by causing bone tissue death due to a decreased blood supply [2,3].

The Medial Parapatellar Approach (MPA) is the conventional approach for total knee arthroplasty (TKA), and it allows optimal access to the operating area via an incision to the extension of the vastus medialis muscle and the quadriceps tendon. Though the method improves component implantation, ligament balancing, and patellar tracking, it has a significant downside in that it disrupts the vastus medialis, a critical knee stabilizer and extensor. This muscle damage has been characterized as a possible aetiology of post-operative quadriceps weakness, delayed functional recovery, and limits in early range of motion, which require prolonged rehabilitation procedures [6]. The Subvastus Approach (SA) is a muscle-sparing procedure that is specifically designed to reduce vastus medialis injury. This approach uses a medial arthrotomy to get access to the knee joint by retracting, rather than cutting, the vastus medialis muscle [7]. Theoretically, the benefits include less quadriceps weakness, less post-operative pain, and a faster return to function than the medial parapatellar approach, making it an appealing choice for improving early patient outcomes.

Comparative examinations of subvastus and medial parapatellar approaches produce a perplexing result. Subvastus can improve quadriceps function in early recovery (<6 weeks); however, these benefits are generally lost later [8,9]. Most long-term observations show no difference between the two operations in terms of function, discomfort, or range of motion. Patients report less initial discomfort and higher satisfaction with subvastus, while evidence is not conclusive [10,11].

It should be highlighted that functional results following TKA are multi factorial and impacted by factors other than the surgical procedure. Significant variables include age, functional condition before surgery, comorbidities, surgeon expertise, and rehabilitation .Furthermore, the strength and character of the postoperative rehabilitation plan, pain control systems, and surgeon expertise all influence the overall functional success. More research is needed to determine the impact of surgical procedures on functional results.

AIM:

To compare the functional outcome of Subvastus vs Medial Parapatellar approaches in Total Knee Replacement procedure

PRIMARY OBJECTIVE:

To study and compare the functional outcome between Subvastus vs Medial Parapatellar approach in Total Knee Replacement (TKR) surgery.

SECONDARY OBJECTIVE:

To analyse blood loss, duration of surgery, pain score in post operative period, length of hospital stay and post operative complications.

MATERIALS AND METHODS:

The hospital-based prospective study was done among 30 patients with Grade 3 and Grade 4 of KL score (Kellgren and Lawrence) undergoing TKA for osteoarthritis at the Department of Orthopaedics, Vinayaka Missions Kirupananda Variyar Medical College. Randomly selected 15 of the study participants underwent the subvastus approach for TKA as Group 1 and Group 2.

RESULTS:

Table 1: Age Distribution (N = 30)

Age	Frequency	Percentage
< 60 years	15	50%
≥ 60 years	15	50%

The ages of the study participants < 60 years & ≥ 60 years were equally distributed.

Sex Distribution:

Table 2: Sex Distribution (N = 30)

Sex	Frequency	Percentage
Male	9	30%
Female	21	70%

Nearly three-fourths (70%) of the study participants were males.

Distribution of Occupation: (N = 30)

Table 3: Distribution of Occupation: (N = 30)

Occupation	Frequency	Percentage
Home maker	15	50%
Coolie	8	27%
Other	7	23%

Half (50%) of the study participants were homemakers, more than one-fourth (27%) were coolies, and 23% belonged to other occupations.

Table 4: Mean of variables among the study participants (N = 30):

Variables	Mean ± SD	Median
Age	61.2 ± 5.4	60
Height	159.1 ± 5.9	160
Weight	77.2 ± 8.1	77.5
BMI	30.4 ± 2.9	30

The mean age of the study participants was 61.2 ± 5.4 years with a median of 60 years. Age is distributed normally among study participants. The mean height and weight of the study participants were 159.1 ± 5.9 & 77.2 ± 8.1. The mean BMI was 30.4 ± 2.9 with a median 30.

Distribution of Complaints (N = 30)

Table 5: Distribution of Complaints (N = 30)

Occupation	Frequency	Percentage
Pain	24	80%
Deformity	6	20%

Figure 1: Comorbidity (N = 30)

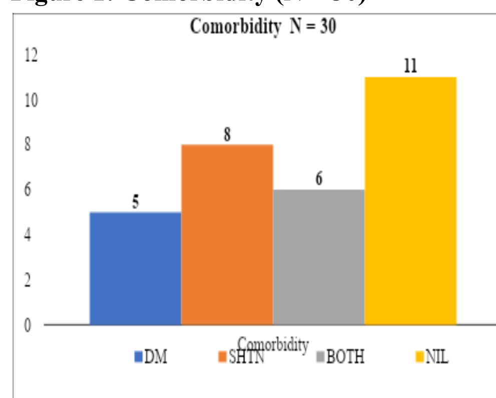


Table 6: Distribution of BMI (N = 30)

BMI	Frequency	Percentage
< 30	15	50%
≥ 30	15	50%

BMI of the participants < 30 & ≥ 30 were equally distributed (50% each)

Table 7: Mean of Pre Operative Findings (N = 50)

Pre Operative Findings	Mean ± SD	Median

KL score	3.6 ± 0.5	4
ROM Flexion in degree	53.7 ± 9.3	50
ROM Extension in degree	11 ± 5.8	10
VAS pain score	7.5 ± 0.6	8
KSS	42.2 ± 6.3	42.5

The mean ± SD of the KL score was 3.6 ± 0.5. The mean ± SD of ROM flexion and extension were 53.7 ± 9.3 degrees and 11 ± 5.8 degrees, respectively. The average VAS pain score was 7.5 ± 0.6, and that of the KSS score was 42.2 ± 6.3.

Table 8: Distribution of KL score (N = 30)

KL score	Frequency	Percentage
3	11	37%
4	19	63%

The majority (19, 63%) had a KL score of 4, and 37% (11) had a KL score of 3.

Figure 2: Pre Operative VAS pain score (N = 30)

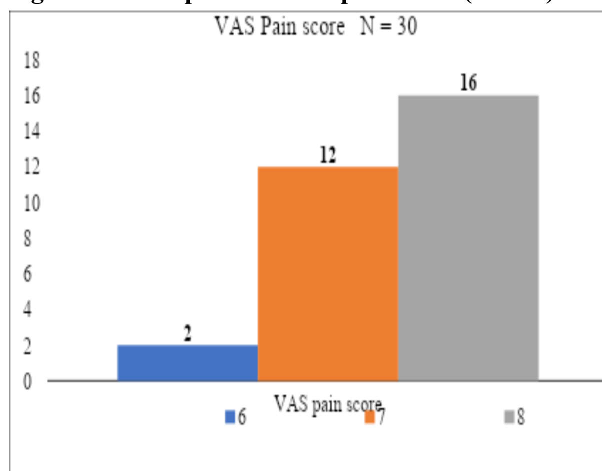
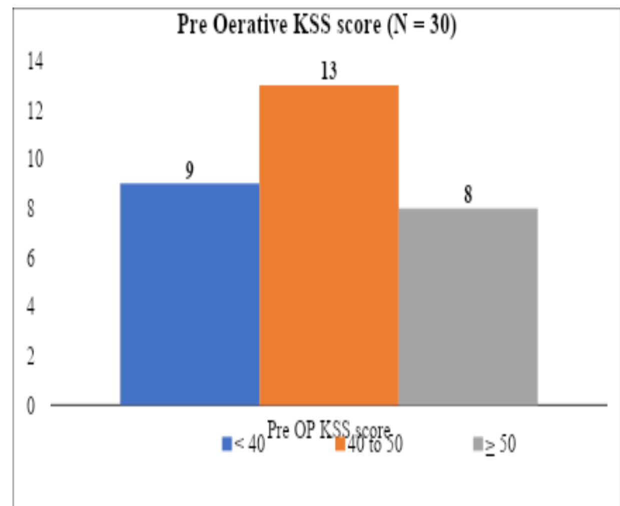


Figure 3: Pre Operative KSS score



Out of 30 study participants undergoing TKA, 15 were randomly selected into Group 1 (subvastus approach) & 15 were in Group 2 (medial parapatellar approach [MPA])

Table 9: Comparison of Age Distribution in Two Groups: (N = 15 in each group)

Age in years	Group 1 (N = 15) n (%)	Group 2 (N = 15) n (%)	p value
< 60	8 (53.3%)	7 (46.7%)	0.7
≥ 60	7 (46.7%)	8 (53.3%)	

Nearly half (53%) in Group 1 & 47% in Group 2 belong to age < 60 years. The age distribution among the two groups was similar with no significant difference (p-value 0.7). The mean ages of Groups 1 & 2 were 60 ± 5.9 & 62 ± 4.7, respectively.

Figure 4: Comparison of Sex Distribution (N = 15 in each group)

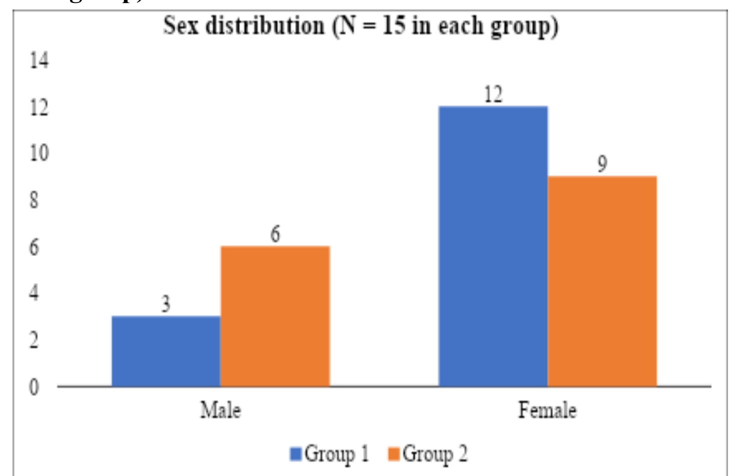


Table 14: Comparison of Comorbidity between two groups: (N = 15 in each group)

Comorbidity	Group 1 (N = 15) n (%)	Group 2 (N = 15) n (%)	p value
DM	3 (60%)	2 (40%)	0.3
SHTN	6 (75%)	2 (25%)	
Both	2 (33%)	4 (67%)	
Nil	4 (36%)	7 (64%)	

There were no significant differences in the distribution of comorbidity among study participants between the two groups (p value 0.3).

Table 15: Comparison of BMI & KL findings between two groups: (N = 15 in each group)

Variables		Group 1 (N = 15) n (%)	Group 2 (N = 15) n (%)	p value
BMI	< 30	6 (40%)	9 (60%)	0.3
	≥ 30	9 (60%)	6 (40%)	
KL score	3	3 (27%)	8 (73%)	0.06
	4	12 (63%)	7 (37%)	

There were no significant differences between the two groups in BMI (p-value 0.3) & KL score (p-value 0.06) distribution between the two groups**.**

Table 16: Comparison of Mean Preoperative ROM Flexion & Extension, VAS Pain Score, and KSS Functional Score Between Two Groups: (N = 15 in each group)

Variables	Mean ± SD		t value	p value
	Group 1 (N = 15)	Group 2 (N = 15)		
ROM Flexion	54.7 ± 10.6	52.7 ± 7.9	0.584	0.6
ROM Extension	9.7 ± 7.2	12.3 ± 3.7	-1.276	0.2
VAS	7.4 ± 0.6	7.5 ± 0.6	-0.574	0.6
KSS	43 ± 6.5	41.3 ± 6.1	0.724	0.5

There were no significant differences in ROM flexion, extension, VAS pain score & KSS functional score between the two groups (p value < 0.05).

Table 17: Comparison of Mean Intraoperative Blood Loss (in ml) & Time (in minutes) between two groups: (N = 15 in each group)

Intra Operative findings	Mean ± SD		t value	p value
	Group 1 (N = 15)	Group 2 (N = 15)		
Blood Loss (in ml)	277 ± 44	337 ± 54	-3.336	0.002*
Intra Operative Time (in minutes)	95 ± 15	135 ± 13	-7.818	<0.001*

The mean intraoperative blood loss was significantly (p value 0.002) higher in Group 2 (337 ml) than in Group 1 (277 ml). Also, mean intraoperative time was significantly (p value <0.001) higher in Group 2 (135 minutes) than in Group 1 (95 minutes). Thus, Group 1 was significantly better than Group 2 intraoperatively.

Table 21: Comparison after one year of surgery between two groups: (N = 15 in each group)

Findings after 1 year of surgery	Mean ± SD		t value	p value
	Group 1 (N = 15)	Group 2 (N = 15)		
ROM Flexion (degrees)	118 ± 4.1	116.7 ± 4.9	0.807	0.4
KSS	97.8 ± 2.5	97.3 ± 2.2	0.62	0.5

After 1 year of surgery, the ROM flexion had no significant difference (p value 0.4) in Group 1 (118 ± 4.1) & Group 2 (116.7 ± 4.9). Functional outcome by KSS score had no significant difference (p value 0.5)

between Group 1 (97.8 ± 2.5) and Group 2 (97.3 ± 2.2) after one year. VAS scores were almost zero in both groups after one year.

Thus, there was no statistically significant difference between the two groups after one year of follow-up.

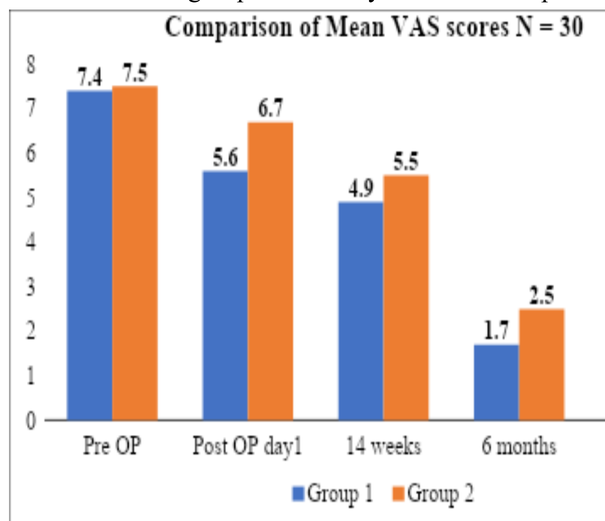


Figure 11: Comparison of mean KSS Functional outcome score between groups at different study periods

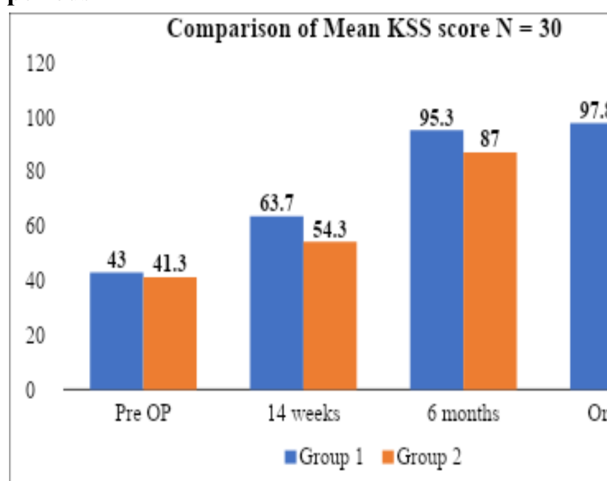
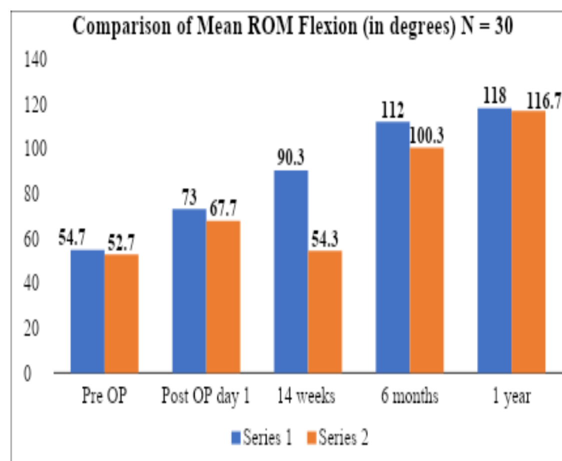


Figure 12: Comparison of mean ROM Flexion (in degrees) between groups at different study periods



DISCUSSION

Demographic details:

The mean age of all the study participants was 61.2 ± 5.4 years (59 - 63). The mean ages of study participants in Groups 1 & 2 were 60 ± 5.9 & 62 ± 4.7 with no significant difference (p value 0.7). There were 21 (70%) females & 9 (30%) males. Out of 21 females, Group 1 had 12 (57%) females, and Group 2 had 9 (43%) females, with no statistically significant differences in sex distribution. Thus, no significant difference in age and sex distribution between participants undergoing subvastus approach & MPA for TKA.

General Characteristics:

Out of 15 obese (BMI ≥ 30) participants, Group 1 had 9 (60%) & Group 2 had 6 (40%) with no statistically significant differences (p value 0.3). Of the 5 participants with DM, 3 (60%) were in Group 1 & 2 (40%) in Group 2; SHTN in Group 1 & Group 2 were 6 (75%) and 2 (25%). The distribution of both DM & SHTN in Group 1 & Group 2 was 2 (33%) & 4 (67%). There is no statistically significant difference (p value 0.3) in the distribution of comorbidity. The majority of the study participants came with complaints of pain (24, 80%) with statistically significant differences between the two groups (p-value 1.0). Thus, no significant difference in distribution of Obesity, Comorbidity, Complaints, Occupation among study participants between two groups undergoing subvastus approach & MPA for TKA.

Preoperative findings:

There is no statistically significant difference in the radiological KL score (p-value 0.06) between the two groups. The mean ROM flexion of Groups 1 & 2 was 54.7 ± 10.6 and 52.7 ± 7.9, respectively, and that of extension was 9.7 ± 7.2 & 12.3 ± 3.7, respectively. The mean preoperative VAS pain scores among participants in Groups 1 & 2 were 7.4 ± 0.6 & 7.5 ± 0.6; the preoperative mean KSS functional scores in Groups 1

& 2 were 43 ± 6.5 & 41.3 ± 6.1. There were no statistically significant differences (p value > 0.05) in ROM flexion, extension, VAS pain score, & KSS functional score between the two groups preoperatively.

Intra Operative findings:

The time duration for surgery in study was 65 ± 7 minutes for Subvastus approach. The average time taken for TKA surgery by the subvastus approach was 95 ± 15 minutes (90 - 100), and by MPA, it was 135 ± 13 minutes (130 - 140). Thus, the subvastus approach was less time-consuming than MPA for TKS with a statistically significant (p value < 0.001) difference. The average blood loss (in ml) for TKA surgery by the subvastus approach was 277 ± 44 ml (261 - 293), and by MPA it was 337 ± 54 ml (318 - 356). Thus, the subvastus approach had less blood loss intraoperatively than MPA for TKS with a statistically significant difference (p-value 0.002). There were no significant differences in intraoperative and post operative complications among both approaches (p-value 0.6**).**

Postoperative findings:

SLR (Straight Leg Raise) & LOS (Length of stay) in Hospital:

The study by Geng et al. [89] showed SLR by Subvastus & MPA for TKA of 1.17 ± 0.4 days & 3.09 ± 0.7. In our study, the mean days SLR after TKA surgery by subvastus approach were 2.4 ± 0.5 days (2.2 – 2.6), and by MPA were 3.1 ± 0.8 days (2.8 – 3.3). Thus, the subvastus approach was less time-consuming than MPA for TKS with a statistically significant (p value < 0.001) difference. In study by Papalia et al. [90] The average LOS in the hospital was less in participants in the Subvastus group [3.4 ± 0.5 (3.2 – 3.6)] than in the MPA group [4.1 ± 0.8 (3.8 – 4.4)], with a statistically significant difference (p value 0.008).

POD 1 (Post Operative Day):

The mean VAS pain score improved significantly (p value < 0.001) on POD 1 in the subvastus approach [5.6 ± 0.7 (5.4 – 5.9)] than in the MPA group [6.7 ± 0.5 (6.5 – 6.9)]. There was no significant difference (p value 0.16) in ROM flexion between the two approaches on POD 1**.**

POD 14 weeks:

The mean VAS pain score improved significantly (p value 0.04) on POD 1 in the Subvastus approach (4.9 ± 0.8) compared to MPA (5.5 ± 0.7). There was a statistically significant difference (p value 0.006) in ROM flexion between the subvastus approach [90.3 ± 6.7 degrees (88 - 93)] and MPA [79 ± 13 degrees (74 - 84)] on POD 14 weeks. The KSS functional outcome score was significantly better among the subvastus approach [63.7 ± 5.5 (62 - 66)] than MPA [54.3 ± 3.7 (53 - 56)] difference (p value < 0.001) on POD 14 weeks.

The study by Lingayat et al. [12]shows the subvastus approach has better early recovery, including pain reduction, ROM improvement, and a lesser duration of hospital stay when compared to MPA for TKA, which is similar to our study result.

6 months after surgery:

The mean VAS pain score, ROM flexion and KSS score of participants by subvastus approach significantly (p value <0.05) improved after 6 months of surgery than MPA.

One year after surgery:

The mean ROM flexion and KSS score of participants had no statistically significant (p value > 0.05) difference after one year of surgery between both approaches. The study by Berstock et al. [13](2018) showed there were early post operative advantage in pain and functional outcome in subvastus approach than MPA but after one year there were no significant differences between two approaches, which is similar to our study outcome**.**

CONCLUSION:

This study was done among 30 willing participants indicated for TKA surgery in the Dept. of Orthopaedics Vinayaka Missions Kirupananda Variyar Medical College. The participants were randomly grouped into two groups of 15 each. The demographic and general characteristics (like occupation, BMI, comorbidity, complaints, etc.), preoperative findings (like average VAS pain score, ROM flexion, extension, KSS functional score, etc.), were statistically similar in both the groups. 15 participants in one group underwent TKA by subvastus approach & 15 in the other group by medial parapatellar approach (MPA).

The intraoperative time taken, blood loss, average days for SLR (Straight Leg Raise), and mean length of stay (LOS) were significantly less in the subvastus approach than in MPA. The pain and functional score were significantly better in the subvastus approach than in MPA on postoperative day 1, 14 weeks, and 6 months after surgery. The average ROM flexion on POD 1 had no significant difference between the two approaches, but the subvastus approach showed significant improvement compared to MPA after the 14th week & 6 months. One year after surgery, there were no significant differences in pain, functional outcome & flexion between the two approaches.

CONFLICT OF INTEREST: NIL

FINANCIAL SUPPORT: NIL

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