

Comparative Evaluation of Subvastus and Medial Parapatellar Approaches in Total Knee Arthroplasty: A Prospective Comparative Study

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ABSTRACT

Background: Total knee arthroplasty (TKA) is an established surgical treatment for advanced osteoarthritis of the knee. Although the medial parapatellar approach is widely used because it offers excellent exposure, it requires incision through the quadriceps mechanism and medial retinaculum, which may delay early recovery. The subvastus approach preserves quadriceps continuity and patellar vascularity and may therefore improve early postoperative rehabilitation. This study compared the clinical and functional outcomes of the subvastus and medial parapatellar approaches in primary TKA.

Methods: This prospective comparative study was conducted from October 2023 to April 2025 in the Department of Orthopaedics, Adichunchanagiri Institute of Medical Sciences, B.G. Nagara. Thirty patients aged more than 55 years with Grade III or Grade IV osteoarthritis of the knee were included. Fifteen patients underwent TKA through the subvastus approach and 15 underwent TKA through the medial parapatellar approach. Baseline demographic and clinical characteristics were recorded. Outcomes included postoperative pain by Visual Analogue Scale (VAS) category, range of motion (ROM), operative duration, intra-operative complications, post-operative complications, and overall functional outcome. Follow-up assessments were performed at 4 weeks, 12 weeks, 6 months, and 12 months.

Results: The two groups were comparable in age, sex, occupational profile, laterality, osteoarthritis grade, and comorbidity status. All patients had severe preoperative pain. At 4 weeks, all subvastus patients and 86.7% of medial parapatellar patients had improved to the moderate pain category. At 12 weeks, all patients in the subvastus group had mild pain compared with 33.3% in the medial parapatellar group ($p < 0.001$). ROM was comparable between groups, although 13.3% of subvastus patients achieved excellent ROM of at least 130 degrees. More than half of subvastus procedures were completed in under 90 minutes, whereas none of the medial parapatellar procedures were completed within that duration band; this difference was statistically significant ($p = 0.002$). Intra-operative and post-operative complications were minimal and similar in both groups. Excellent functional outcome was observed in 66.7% of the subvastus group and 26.7% of the medial parapatellar group (chi-square $p = 0.028$; Fisher exact $p = 0.066$).

Conclusion: Both the subvastus and medial parapatellar approaches were safe and effective for primary TKA in advanced osteoarthritis of the knee. The subvastus approach showed advantages in early pain relief, early functional recovery, and operative efficiency in this series, without compromising one-year outcomes.

Keywords: Total knee arthroplasty; subvastus approach; medial parapatellar approach; osteoarthritis knee; functional outcome; pain assessment.

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INTRODUCTION

Total knee arthroplasty is one of the most successful orthopaedic procedures for end-stage degenerative disease of the knee.³ It is widely performed for advanced osteoarthritis when conservative measures such as analgesics, physiotherapy, lifestyle modification, and intra-articular injections fail to provide adequate pain relief or restore satisfactory function.^{1,3} The aims of TKA are to reduce pain, correct deformity, restore alignment, improve stability, and allow the patient to return to independent daily

activity.^{1,3} With the ageing population and increasing prevalence of obesity, the demand for primary TKA continues to rise globally.^{2,8}

Although implant design, alignment, fixation, and rehabilitation are central determinants of outcome, the surgical approach remains a key intra-operative factor.^{4,6} The exposure used for TKA affects visualization, component positioning, soft-tissue balancing, patellar handling, and the degree of disruption to the extensor mechanism.^{4,6} The conventional medial parapatellar

approach provides broad and familiar exposure and is therefore used by many surgeons as the default arthrotomy for primary TKA.⁶ However, the incision passes through the quadriceps tendon and medial retinaculum, which can contribute to early quadriceps weakness, delayed straight-leg raise, anterior knee discomfort, and slower early mobilization.^{5,7}

The subvastus approach is a quadriceps-sparing alternative in which the knee joint is entered beneath the vastus medialis without incising the quadriceps tendon.^{9,10} The patella is usually subluxed laterally rather than fully everted.¹⁰ Potential advantages of this approach include preservation of extensor mechanism integrity, less soft-tissue trauma, better preservation of patellar vascularity, earlier quadriceps activation, faster ambulation, and reduced early postoperative pain.¹⁰⁻¹² At the same time, the subvastus approach is often considered technically more demanding, especially in obese patients or in knees with significant stiffness or deformity.^{10,13}

The available literature suggests that quadriceps-sparing approaches may offer advantages during early recovery, although the findings are not entirely uniform.^{14,17,20} Some randomized trials and meta-analyses have shown better early pain scores, earlier straight-leg raise, and faster early functional recovery with the subvastus approach, while long-term outcomes often become similar between approaches.^{14,15,17,20,22} Further comparative evaluation in different practice settings remains clinically relevant, particularly in the context of routine arthroplasty services in India.^{27,29} The present study was therefore undertaken to compare the subvastus and medial parapatellar approaches in primary TKA, with particular focus on postoperative pain, range of motion, operative duration, complications, and functional outcome.

MATERIALS AND METHODS

This prospective comparative study was carried out in the Department of Orthopaedics, Adichunchanagiri Institute of Medical Sciences, B.G. Nagara, Mandya District, over a study period from October 2023 to April 2025. Patients

attending the orthopaedic outpatient department with osteoarthritis of the knee were screened for eligibility. Institutional ethics committee approval and written informed consent were obtained before enrolment.

Patients were included if they were older than 55 years, had Grade III or Grade IV osteoarthritis of the knee, and were medically fit for surgery. Exclusion criteria were age less than 55 years, arthrodesis of the knee, revision knee surgery, associated neurovascular injury, and major medical contraindications to surgery or anaesthesia such as significant heart disease, renal failure, or active chemotherapy.

The sample size was 30 patients. Using convenient sampling, 15 patients underwent TKA through the subvastus approach and 15 underwent TKA through the medial parapatellar approach. All patients underwent preoperative history taking, orthopaedic examination, general physical examination, radiographic assessment, and appropriate laboratory work-up. Comorbidities were documented and patients were optimized medically before surgery.

Postoperative assessment included pain evaluation using VAS categories, range of motion assessment, operative duration, intra-operative complications, post-operative complications, and overall functional outcome. Follow-up evaluations were performed at 4 weeks, 12 weeks, 6 months, and 12 months. Categorical variables were compared between the two groups using chi-square or Fisher exact testing as applicable. A p value less than 0.05 was considered statistically significant.

RESULTS

A total of 30 patients with Grade III or Grade IV osteoarthritis of the knee underwent primary total knee arthroplasty and were included in the study. Fifteen patients underwent TKA through the subvastus approach and fifteen underwent TKA through the medial parapatellar approach. Both groups were comparable at baseline, allowing a focused comparison of postoperative outcomes.

Table 1. Baseline demographic and clinical characteristics of the study population

Variable	Subvastus TKA (n=15)	Medial Parapatellar TKA (n=15)	p value
Age group			0.670**
56–60 years	6 (40.0%)	4 (26.7%)	
61–65 years	4 (26.7%)	6 (40.0%)	
66–70 years	5 (33.3%)	5 (33.3%)	
Sex			0.713*
Male	6 (40.0%)	7 (46.7%)	
Female	9 (60.0%)	8 (53.3%)	
Side operated			0.71*
Right	8 (53.3%)	7 (46.7%)	
Left	7 (46.7%)	8 (53.3%)	
Grade of osteoarthritis			1.000*
Grade III	8 (53.3%)	8 (53.3%)	
Grade IV	7 (46.7%)	7 (46.7%)	

*Chi-square test; **Fischer's exact

Figure 1. Baseline demographic and clinical profile of patients undergoing subvastus and medial parapatellar total knee arthroplasty

In the subvastus group, 40.0% of patients were aged 56–60 years, 26.7% were aged 61–65 years, and 33.3% were aged 66–70 years, while the medial parapatellar group showed a similar age distribution. Females predominated in both groups, and laterality of surgery and grade of osteoarthritis were evenly distributed. None of these baseline differences were statistically significant, confirming comparability of the two study arms.

Table 2. Comparison of postoperative pain severity by VAS category at serial follow-up

Time point / VAS category	Subvastus TKA (n=15)	Medial Parapatellar TKA (n=15)	p value
Preoperative			—
Mild (0–3)	0 (0%)	0 (0%)	0.143**
Moderate (4–6)	0 (0%)	0 (0%)	
Severe (7–10)	15 (100%)	15 (100%)	
4 weeks			
Mild (0–3)	0 (0%)	0 (0%)	<0.001**
Moderate (4–6)	15 (100%)	13 (86.7%)	
Severe (7–10)	0 (0%)	2 (13.3%)	
12 weeks			
Mild (0–3)	15 (100%)	5 (33.3%)	0.143**
Moderate (4–6)	0 (0%)	10 (66.7%)	
Severe (7–10)	0 (0%)	0 (0%)	
6 months			
Mild (0–3)	15 (100%)	13 (86.7%)	—
Moderate (4–6)	0 (0%)	2 (13.3%)	
Severe (7–10)	0 (0%)	0 (0%)	
12 months			
Mild (0–3)	15 (100%)	15 (100%)	—
Moderate (4–6)	0 (0%)	0 (0%)	
Severe (7–10)	0 (0%)	0 (0%)	

*Chi-square test; **Fischer's exact

Figure 2. Temporal trend in postoperative pain severity following subvastus and medial parapatellar total knee arthroplasty

Preoperatively, all patients in both groups had severe pain. At 4 weeks, all patients in the subvastus group improved to moderate pain, whereas 13.3% of patients in the medial parapatellar group continued to have severe pain. At 12 weeks, all subvastus patients had mild pain compared with only 33.3% in the medial parapatellar group. By 12 months, all patients in both groups had only mild pain, indicating excellent long-term pain relief irrespective of surgical approach.

Table 3. Comparison of postoperative range of motion, operative duration, and functional outcome

Variable	Subvastus TKA (n=15)	Medial Parapatellar TKA (n=15)	p value
Postoperative ROM			0.143**
Excellent ($\geq 130^\circ$)	2 (13.3%)	0 (0.0%)	
Good (110–129°)	13 (86.7%)	15 (100.0%)	
Surgery duration			0.002**
Short (<90 min)	8 (53.3%)	0 (0.0%)	
Average (90–105 min)	7 (46.7%)	12 (80.0%)	
Prolonged (>105 min)	0 (0.0%)	3 (20.0%)	
Functional outcome			0.028*
Excellent	10 (66.7%)	4 (26.7%)	
Good	5 (33.3%)	11 (73.3%)	

*Chi-square test; **Fischer's exact

Figure 3. Comparison of range of motion, operative duration, and functional outcome between the two approaches

Postoperative range of motion was satisfactory in both groups, with all patients achieving either good or excellent ROM. Operative duration was significantly shorter in the subvastus group, where more than half of the procedures

were completed in under 90 minutes. Functional outcome favored the subvastus approach, with 66.7% of patients achieving excellent recovery compared with 26.7% in the medial parapatellar group.

Table 4. Intra-operative and post-operative complications in the two groups

Complication	Subvastus TKA (n=15)	Medial Parapatellar TKA (n=15)	p value
Intra-operative complications			0.306**
None	15 (100.0%)	14 (93.3%)	
Difficult patellar eversion	0 (0.0%)	1 (6.7%)	
Post-operative complications			0.572**
None	13 (86.7%)	13 (86.7%)	
Mild stiffness	1 (6.7%)	0 (0.0%)	
Delayed quadriceps activation	0 (0.0%)	1 (6.7%)	
Superficial infection	1 (6.7%)	1 (6.7%)	

*Chi-square test; **Fischer's exact

Figure 4. Distribution of intra-operative and post-operative complications following total knee arthroplasty by surgical approach

Complications were infrequent in both groups. No intra-operative complication occurred in the subvastus group, whereas one patient in the medial parapatellar group had difficult patellar eversion. Postoperatively, 86.7% of patients in both groups had no complication. Overall, complication rates were low and comparable, suggesting that both approaches are safe when performed appropriately. Overall, the results of this study show that both the subvastus and medial parapatellar approaches are effective methods for primary total knee arthroplasty in patients with advanced osteoarthritis. However, the subvastus approach demonstrated better early pain relief, significantly shorter operative duration, and a higher proportion of excellent functional outcomes. Range of motion and complication rates were comparable between the two groups, and long-term pain relief was excellent irrespective of the surgical approach used.

DISCUSSION

The present study found that both the subvastus and medial parapatellar approaches are safe and effective techniques for primary total knee arthroplasty in advanced osteoarthritis of the knee. The most important difference between the two approaches in this series was seen in the early postoperative period, when the subvastus approach was associated with better pain improvement and a higher proportion of excellent functional outcomes. These findings are consistent with the concept of a quadriceps-sparing arthrotomy, in which preservation of the extensor mechanism may facilitate earlier rehabilitation.^{10,14,17,20}

The markedly better pain profile in the subvastus group at 12 weeks is clinically meaningful. Pain remains one of the major determinants of early mobilization, physiotherapy participation, and patient satisfaction after TKA.^{1,5} Because the medial parapatellar approach requires incision through the quadriceps tendon and medial retinaculum, it is plausible that it produces greater early soft-tissue trauma and quadriceps inhibition.^{5,7} In contrast, the subvastus

approach preserves quadriceps continuity and may reduce pain during active knee movement and ambulation in the early postoperative period.^{10,12} Several randomized and meta-analytic studies have also reported lower early pain scores and quicker early recovery with subvastus or other quadriceps-sparing approaches.^{14,17,19,20,22,24}

Postoperative ROM was good in both groups, and the small numerical advantage in the subvastus group did not reach statistical significance. This suggests that both approaches can provide satisfactory knee motion when followed by standard rehabilitation. Similar findings have been reported in previous studies, where early recovery parameters favored the subvastus approach but final range of motion showed little or no major long-term difference between the two techniques.^{15,17,20,22,30} In the present study, the main benefit of the subvastus approach appears to have been the speed of functional recovery rather than a major difference in final one-year ROM.

A notable finding was the significantly shorter operative duration in the subvastus group. Much of the published literature describes the subvastus approach as technically more demanding and, particularly during the learning phase, sometimes longer to perform.^{13,17,20,21} The present finding suggests that when the operating team is familiar with the technique, the subvastus approach can be performed efficiently and need not prolong operative time. This is relevant in high-volume settings where both soft-tissue preservation and operating room efficiency are important. A few contemporary comparative studies have also shown that operative duration may vary depending on surgeon experience and case selection rather than on the surgical approach alone.²⁷⁻²⁹

Complication rates were low and comparable in both groups. No major intra-operative complication occurred in the subvastus group, and only one case of difficult patellar eversion occurred in the medial parapatellar group. Post-operative complications were minor and infrequent, consisting of delayed quadriceps activation, mild stiffness,

and superficial infection. These findings are in agreement with published comparative studies showing that both approaches are generally safe in appropriately selected patients and that the subvastus approach does not appear to increase complication rates when performed carefully.14,20,23,29

The overall functional outcome favored the subvastus approach. While the small sample size requires cautious interpretation, the pattern is consistent with the hypothesis that preservation of quadriceps integrity improves early performance and patient confidence after surgery.14,17,20,24 In practical terms, the present findings support selective use of the subvastus approach, particularly when early rehabilitation and faster return to function are priorities. At the same time, both approaches remain acceptable and effective options in primary TKA, and the choice of exposure should continue to depend on surgeon experience, patient morphology, and intra-operative requirements.6,20,22

CONCLUSION

Both the subvastus and medial parapatellar approaches are safe and effective for primary total knee arthroplasty in patients with Grade III and Grade IV osteoarthritis of the knee. In this study, the subvastus approach provided better early pain relief, a higher proportion of excellent functional outcomes, and shorter operative duration, while maintaining satisfactory range of motion and a complication profile comparable to the medial parapatellar approach. These findings support the use of the subvastus approach as a valuable quadriceps-sparing option in appropriately selected patients.

LIMITATIONS

This study had a small sample size and was conducted at a single centre, which limits generalizability and statistical power. Sampling was convenient rather than randomized. Follow-up was limited to 12 months, and therefore long-term implant survivorship, revision rates, and late complications could not be assessed. In addition, the study did not include objective quadriceps strength testing, blood loss analysis, or hospital stay duration, which would have strengthened functional comparison.

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