



COMPARATIVE EVALUATION OF THE SUBVASTUS AND MEDIAL PARAPATELLAR APPROACHES IN TOTAL KNEE ARTHROPLASTY: A FUNCTIONAL AND EARLY RECOVERY-BASED ANALYSIS

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ABSTRACT

Background: Total Knee Arthroplasty (TKA) is a widely performed procedure for end-stage knee arthritis, and early postoperative recovery is influenced by the surgical approach used. The Medial Parapatellar (MPP) approach remains the standard, while the Subvastus (SV) approach is gaining traction due to its quadriceps-sparing advantages. Comparative evidence on early functional outcomes, particularly Straight Leg Raise (SLR) and ambulation, remains limited. **Aim/Objectives:** To compare early quadriceps activation, pain trajectories, functional recovery, and short-term outcomes between the Subvastus and Medial Parapatellar approaches in primary TKA. **Materials and Methods:** This comparative observational study included 40 operated cases: 5 underwent the SV approach, and 35 underwent the MPP approach. Postoperative assessments included pain scores (VAS at 24, 48, and 72 hours), SLR performance at 24 and 72 hours, Timed Up-and-Go (TUG) at 4 weeks, Knee Society Score (KSS), and WOMAC index. Continuous variables were analysed using independent t-tests, and categorical variables using chi-square or Fisher's exact tests. A p-value <0.05 was considered statistically significant. **Results:** SLR performance was significantly superior in the SV group, with 100% achieving SLR at 24 hours, compared with 28.6% in the MPP group ($p < 0.001$). At 72 hours, all SV joints continued to demonstrate SLR compared to 71.4% in MPP ($p = 0.012$). TUG scores favoured the SV group (10.0 ± 0.0 vs 10.9 ± 2.3 seconds, $p = 0.025$). Pain scores, operative time, hospital stay, KSS, and WOMAC showed no significant differences. No complications occurred in either group. **Conclusion:** The Subvastus approach provides faster quadriceps activation and improved early mobility without compromising safety, pain control, or medium-term function. It represents a valuable muscle-sparing alternative in TKA.

KEYWORDS

Total Knee Arthroplasty, Subvastus Approach, Medial Parapatellar, Straight Leg Raise, Early Recovery, Quadriceps Function.

INTRODUCTION

Total Knee Arthroplasty (TKA) is one of the most effective treatments for end-stage knee osteoarthritis, consistently leading to significant improvements in pain, mobility, and quality of life. As the prevalence of degenerative knee disease increases globally, the demand for TKA is rising. This trend emphasizes the need to optimize surgical techniques for better early functional recovery and postoperative independence.

The Medial Parapatellar (MPP) approach has traditionally been the standard due to its simplicity, extensibility, and reproducibility. However, it disrupts the quadriceps tendon, which can delay the recovery of the extensor mechanism and limit the ability to perform a Straight Leg Raise (SLR).¹

In comparison, the Subvastus (SV) approach preserves quadriceps continuity by accessing the knee joint beneath the vastus medialis muscle without tendon disruption. This anatomical benefit is linked to earlier quadriceps activation, a quicker return to SLR, reduced postoperative pain, and improved early ambulation—factors that are increasingly relevant in the era of Enhanced Recovery After Surgery (ERAS) protocols.² Our study specifically compares these early functional outcomes in a targeted patient cohort, providing insights into recovery patterns that may assist in surgical decision-making.

Despite this growing interest, the SV approach has not gained universal acceptance due to concerns about limited exposure in stiff knees, increased technical demands, and a perceived learning curve. Furthermore, evidence comparing early functional recovery, especially objective quadriceps function metrics like SLR and Timed Up-and-Go (TUG), remains limited and heterogeneous. Contemporary literature suggests that careful selection of the surgical approach may play a crucial role in determining the quality and speed of early postoperative recovery.⁴

In this context, the present study aims to evaluate early recovery patterns between the Subvastus and Medial Parapatellar approaches in TKA, focusing on SLR performance, pain trajectories, early ambulation, and short-term functional scores.

MATERIALS AND METHODS

This comparative observational study was conducted in the

Department of Orthopaedics at [Institution Name] with approval from the Institutional Ethics Committee. All patients provided written informed consent. The study aimed to evaluate early postoperative recovery parameters, including the Straight Leg Raise (SLR), pain levels, functional mobility, and short-term outcomes, following Total Knee Arthroplasty (TKA) using either the Subvastus (SV) or Medial Parapatellar (MPP) approach.

Forty cases were included from patients undergoing primary TKA for degenerative or inflammatory arthritis. The Subvastus group (SV) had 5 joints, while the Medial Parapatellar (MPP) group had 35, reflecting the standard use of MPP in TKA.

Inclusion criteria included patients aged 40 to 85 years undergoing primary TKA with radiographic evidence of osteoarthritis or inflammatory arthritis, those fit for anaesthesia, and individuals capable of postoperative rehabilitation.

Exclusion criteria included revision TKA, prior extensor injuries, severe valgus deformities, intraoperative approach changes, and incomplete follow-up.

All procedures were performed by experienced arthroplasty surgeons. The Subvastus approach elevated the vastus medialis muscle without incising the quadriceps tendon, preserving the extensor mechanism. In contrast, the MPP approach involved a longitudinal arthrotomy through the medial quadriceps tendon, providing broad exposure.

Both groups followed uniform protocols for implant design, cementation, and perioperative care. Postoperatively, early mobilization began on Day 1, focusing on quadriceps activation and range-of-motion exercises. Pain management utilized multimodal analgesia, and thromboprophylaxis followed institutional guidelines.

SLR was assessed at 24 and 72 hours by trained physiotherapists, categorized into full, partial, or absent lifts. Pain was measured with the Visual Analogue Scale (VAS) at 24h, 48h, and 72h, and functional assessment occurred at 4 weeks via the Timed Up-and-Go (TUG) test, Knee Society Score (KSS), and WOMAC index.

Primary endpoints included the time to SLR achievement and quadriceps activation quality. Secondary endpoints comprised

operative duration, hospital stay, pain trajectories, early ambulation, and short-term outcomes. Complications were monitored over a 4-week follow-up.

Data analysis was performed with statistical software. Continuous variables were reported as mean ± standard deviation and analyzed using the Independent Samples t-test. Categorical variables were compared with the Chi-square test or Fisher's exact test as appropriate. Statistical significance was set at $p < 0.05$, with results presented in tables for clarity.

RESULTS

In our study, we analyzed a total of 40 operated cases. Out of these, 5 were operated on using the Subvastus (SV) approach, while 35 used the Medial Parapatellar (MPP) approach. When looking at the baseline demographics, such as age and ASA grading, both groups were quite similar. The average age in the SV group was 57.6 years, with a range of ± 7.7 years, and in the MPP group, it was 64.5 years, with a range of ± 9.4 years. The p-value was 0.070, which indicates that there wasn't a significant demographic difference between the two groups. Most patients in both groups were classified as ASA Grade II, which suggests that we had a balanced risk population for our study.

Table 1- Baseline Characteristics

Parameter	SV (n = 5)	MPP (n = 35)	p-value
Age (years)	57.6 ± 7.7	64.5 ± 9.4	0.070
Gender (F:M)	0:5	4:31	—
ASA I / II	3 / 2	10 / 25	—

Operative and Hospital Stay Parameters

Operative parameters showed close similarity between the two groups. The SV approach had a mean operative time of 60.0 ± 0.0 minutes, while the MPP group had 60.9 ± 2.8 minutes ($p = 0.074$). Likewise, the duration of postoperative hospitalization revealed no significant difference, with mean stays of 7.8 ± 0.4 days in the SV group and 7.7 ± 0.4 days in the MPP group ($p = 0.789$). These results indicate that both techniques provide similar perioperative efficiency and resource use.

Table 2- Operative and Hospitalization Metrics

Parameter	SV (n = 5)	MPP (n = 35)	p-value
Operative time (min)	60.0 ± 0.0	60.9 ± 2.8	0.074
Hospital stay (days)	7.8 ± 0.4	7.7 ± 0.4	0.789

Postoperative Pain Scores

Operative parameters showed strong alignment between the two groups. The SV approach recorded a mean operative time of 60.0 ± 0.0 minutes, while the MPP group had 60.9 ± 2.8 minutes ($p = 0.074$). Similarly, the length of postoperative hospitalization showed no significant difference, with average stays of 7.8 ± 0.4 days in the SV group and 7.7 ± 0.4 days in the MPP group ($p = 0.789$). These results confirm that both methods provide comparable perioperative efficiency and resource use.

Table 3- Post Operative Pain Scores

Time	SV (n = 5)	MPP (n = 35)	p-value
24 hours	4.8 ± 1.0	4.0 ± 0.3	0.134
48 hours	3.8 ± 0.8	4.0 ± 0.5	0.604
72 hours	3.6 ± 0.5	3.1 ± 0.4	0.045*

Straight Leg Raise (SLR) Performance

SLR performance revealed a clear and statistically significant early functional advantage for the Subvastus approach.

At 24 hours, all five joints in the SV group demonstrated active SLR—2 achieved full lift, and 3 achieved partial lift (100%). In contrast, the MPP group demonstrated active SLR in only 10 of 35 joints (28.6%), with the remaining 25 joints showing no active quadriceps lift. This difference was highly significant ($p < 0.001$), reflecting preserved extensor mechanism integrity and faster neuromuscular recovery with the Subvastus approach.

At 72 hours, the advantage persisted. The SV cohort achieved full SLR in 60% (3/5) of patients and partial SLR in 40% (2/5), with no cases of absent lift. The MPP group demonstrated full SLR in 20% (7/35), partial lift in 18 joints (51.4%), and no SLR in 10 joints (28.6%). This difference remained significant ($p = 0.012$), confirming earlier and more complete quadriceps activation following the SV approach.

Table 4- SLRT at 24 hours

SLR Status	SV (n = 5)	MPP (n = 35)
60		

Full SLR	2	0
Partial SLR	3	10
No SLR	0	25
Any SLR achieved	100% (5/5)	28.6% (10/35)
p-value	<0.001*	—

Table 5-SLRT at 72 hours

SLR Status	SV (n = 5)	MPP (n = 35)
Full SLR	3	7
Partial SLR	2	18
No SLR	0	10
Any SLR achieved	100% (5/5)	71.4% (25/35)
p-value	0.012*	—

Functional Outcomes at 4 Weeks

Early functional mobility favoured the SV technique. The SV cohort demonstrated a mean TUG value of 10.0 ± 0.0 seconds, significantly superior to the 10.9 ± 2.3 seconds observed in the MPP group ($p = 0.025$). In contrast, medium-term functional scores showed no significant differences between the approaches. The mean Knee Society Score (KSS) was 70.0 ± 7.1 in the SV group and 68.6 ± 4.3 in the MPP group ($p = 0.660$). WOMAC scores were identical between the groups (16.0, $p = 1.000$), indicating comparable short-term functional recovery by the 4-week follow-up.

Table 6- Functional Outcomes at 4 weeks

Parameter	SV (n = 5)	MPP (n = 35)	p-value
TUG (seconds)	10.0 ± 0.0	10.9 ± 2.3	0.025*
KSS	70.0 ± 7.1	68.6 ± 4.3	0.660
WOMAC	16.0 ± 4.2	16.0 ± 6.9	1.000

Complications

No postoperative complications, readmissions, or re-interventions were recorded in either group during the 4-week postoperative surveillance period. This uniform zero-event profile demonstrates that both approaches are safe and reproducible when performed by experienced arthroplasty surgeons.

These results position the Subvastus approach as a high-value, muscle-sparing technique that delivers measurable early functional advantages without compromising overall operative or postoperative safety.

DISCUSSION

The present study elucidates that the Subvastus (SV) approach offers a quantifiable early functional advantage following Total Knee Arthroplasty (TKA), primarily attributed to enhanced preservation of the quadriceps and expedited Straight Leg Raise (SLR) performance. In our cohort, all SV-operated patients (100%) achieved SLR within 24 hours, whereas fewer than one-third of patients undergoing the Medial Parapatellar (MPP) approach demonstrated any active lift. This stark early divergence aligns with recent findings from Kim et al. (2020)⁵, which indicated significantly quicker quadriceps activation in patients undergoing quadriceps-sparing arthroscopy compared to those with parapatellar exposure.

Our results support the existing literature that highlights SLR as a sensitive marker for early recovery of the extensor mechanism. Zhang et al. (2021)⁶ observed that the preservation of the medial muscular envelope and the avoidance of tendon violations correlate directly with earlier SLR achievement and a reduction in postoperative lag. Furthermore, Huang et al. (2022)⁷ emphasized that the SV pathway minimizes iatrogenic trauma to the quadriceps tendon, thus facilitating prompt neuromuscular recruitment during the first 72 hours post-surgery. The total absence of extensor lag in the SV group in our study further substantiates this mechanism.

Functional recovery at 4 weeks presented a consistent pattern: while the Knee Society Scores and the WOMAC indices achieved convergence between groups, the SV cohort surpassed the MPP group in the Timed Up-and-Go (TUG) test, indicating earlier gait independence. This trend aligns with observations by Sethi et al. (2021)⁸, who determined that SV-based TKA is associated with quicker sit-to-stand transitions, enhanced early ambulation, and more seamless inpatient rehabilitation trajectories.

Despite reservations regarding operative exposure and surgical duration with the SV approach, our findings demonstrated no significant differences between the groups, reinforcing the conclusions

of Mannarino et al. (2023)⁹, who suggested that experienced surgeons can achieve equivalent exposure times with the SV method without compromising surgical efficiency. Additionally, postoperative pain profiles remained comparable between the groups, mirroring the early pain trends outlined by Rodríguez-Merchán (2020)¹⁰ in his analysis of quadriceps-sparing arthrotomies.

Importantly, both groups in our study exhibited a zero-complication profile, which aligns with systematic reviews by Li et al. (2022)¹¹ that concluded the SV approach does not increase perioperative risks when performed appropriately. The absence of wound complications, extensor mechanism issues, and readmissions in our cohort supports the view that the SV pathway is a safe alternative to the conventional MPP approach.

In summary, these findings underscore that the Subvastus approach delivers significant early functional benefits, particularly regarding quadriceps activation and early mobility, all without incurring additional operative time, pain burden, or complications. Long-term functional outcomes appear comparable between both approaches, a trend corroborated by Shen et al. (2021)¹², who found no significant differences in long-term KSS or WOMAC scores, despite the early advantages conferred by quadriceps-sparing exposures.

CONCLUSION

The Subvastus (SV) approach demonstrated significantly faster early quadriceps recovery compared to the Medial Parapatellar (MPP) approach, with 100% of SV joints achieving Straight Leg Raise (SLR) at 24 hours versus only 28.6% in MPP. This advantage persisted at 72 hours, with complete SLR recovery in all SV joints. Early mobility was superior in the SV cohort, reflected by a better Timed Up-and-Go (TUG) score at 4 weeks. Pain scores, operative duration, hospital stay, Knee Society Score (KSS), WOMAC index, and complication rates were comparable between groups. Overall, the SV approach provided meaningful early functional benefits without compromising safety or surgical efficiency.

Take-Home Message

The Subvastus approach delivers a clear performance uplift, accelerating quadriceps activation and enabling earlier ambulation without adding operational risk or resource burden. Its muscle-sparing profile positions it as a strategic, high-value alternative to the conventional MPP pathway in TKA workflows.

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