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Comparative Study of Functional Outcome of Subvastus Versus Medial Parapatellar Approach Following Total Knee Arthroplasty

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ABSTRACT

Background: Total knee arthroplasty (TKA) is a common orthopedic procedure aimed at alleviating pain and restoring function in patients with knee osteoarthritis. The choice of surgical approach can significantly impact postoperative outcomes, particularly in terms of recovery speed and pain management.

Methods: This summary synthesizes findings from multiple studies comparing the subvastus (SV) and medial parapatellar (MPP) approaches in TKA. The focus is on early functional outcomes, including quadriceps strength recovery and pain reduction.

Results: Patients undergoing TKA via the SV approach demonstrated a quicker return of quadriceps strength and slightly better pain scores in the immediate postoperative period. Specifically, a 0.8-point improvement in pain scores (95% CI 0.22 to 1.35) was noted in favor of the SV approach compared to the MPP approach.

Conclusion: The SV approach to TKA offers advantages in terms of faster postoperative recovery, particularly with regard to quadriceps strength and pain management. These benefits highlight the role of tissue-sparing surgical techniques in enhancing patient outcomes after knee arthroplasty.

Key Words: *Total knee arthroplasty, Subvastus approach, Medial parapatellar approach, Postoperative recovery, Quadriceps strength, Pain management.*

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INTRODUCTION

Total Knee Arthroplasty (TKA) is a well-established surgical procedure for the management of severe knee osteoarthritis and other degenerative knee diseases, offering significant improvements in pain, function, and quality of life for patients. The success of TKA depends on various factors, including surgical technique, prosthesis design, rehabilitation, and patient-related factors. Among the surgical technique factors, the choice of surgical approach plays a crucial role in determining the postoperative functional outcomes, recovery rate, and complication profile. The Medial Parapatellar (MPP) and Subvastus (SV) approaches are two commonly utilized techniques for accessing the knee joint during TKA. This comparative study aims to scrutinize the functional outcomes of the Subvastus versus Medial Parapatellar approach following Total Knee Arthroplasty, providing evidence-based insights into their relative merits and drawbacks.

The Medial Parapatellar approach, traditionally the most commonly used technique for TKA, involves a medial incision to the quadriceps tendon and requires eversion of the patella to gain access to the knee joint. This approach is favored for its straightforward access to the knee joint and compatibility with various surgical scenarios. However, concerns have been raised regarding its potential to disrupt the blood supply to the patella and affect quadriceps function postoperatively[1].

On the other hand, the Subvastus approach, which preserves the integrity of the quadriceps tendon by passing beneath the vastus medialis obliquus muscle, has gained attention for its potential benefits in terms of reduced postoperative pain, quicker recovery of quadriceps strength, and faster functional recovery[2]. Despite these proposed benefits, the Subvastus approach is technically more demanding and may not provide as extensive exposure as the MPP approach, particularly in obese patients or those with significant deformities[3].

Recent literature has provided mixed outcomes on the comparison between these two approaches. Studies have shown that the Subvastus approach may lead to improved early postoperative functional recovery, with patients experiencing less pain and achieving faster mobilization[4]. Other research highlights that while the Subvastus approach may offer advantages in the immediate postoperative period, the long-term outcomes, including range of motion (ROM), knee strength, and functional scores, may not significantly differ between the two approaches[5].

A systematic review and meta-analysis by Smith et al. [6] compared the functional outcomes and complication rates of the Subvastus and Medial Parapatellar approaches in Total Knee Arthroplasty. The study concluded that the Subvastus approach might offer superior early postoperative outcomes regarding pain and quadriceps strength but did not find a significant difference in long-term functional outcomes or complication rates.

Moreover, the impact on the patellofemoral joint and overall alignment of the knee post-TKA is a critical consideration in the choice of surgical approach. The MPP approach has been associated with a higher incidence of lateral patellar tilt and patellar maltracking, potentially due to the disruption of medial soft tissue structures[7]. Conversely, the SV approach, by preserving the quadriceps mechanism, may contribute to a more balanced patellar tracking postoperatively[8].

Given the evolving nature of Total Knee Arthroplasty techniques and the continuous quest for optimizing patient outcomes, this comparative study seeks to provide a comprehensive analysis of the Subvastus versus Medial Parapatellar approaches. Through a detailed examination of current evidence and clinical outcomes, the study aims to guide surgeons in selecting the most appropriate surgical approach for their patients, ultimately enhancing the overall success of Total Knee Arthroplasty procedures.

Aims and Objectives

The study was designed with the primary aim of comparing the functional outcomes of the subvastus and medial parapatellar approaches for total knee arthroplasty. The objectives set forth to guide this investigation included a detailed comparison of the functional outcomes using the Knee Society Score, assessment of the return of quadriceps function through the Active Straight Leg Raising Test (SLRT) and the ability of patients to rise from a sitting position, alongside an evaluation of the surgical duration and length of hospital stay post-surgery for patients undergoing total knee arthroplasty by either the subvastus or medial parapatellar approach. The hypothesis formulated posited that there would be no significant difference in the functional outcomes between patients undergoing total knee replacement via the subvastus approach compared to the medial parapatellar approach.

Materials and Methods

The methodology adopted for this study was structured as a longitudinal observational study, conducted within the Department of Orthopaedics at the Pushpagiri Institute of Medical Sciences and Research Centre, Thiruvalla. The research spanned a period of 18 months following the receipt of Ethical Committee clearance, ensuring a comprehensive and ethical approach to data collection and analysis. The sample size was meticulously calculated based on the mean Knee Society Scores for the subvastus and medial parapatellar approaches from a preceding study. Employing a Type I error of 5% and a study power of 80%, the sample size necessary for each group was determined to be 14, utilizing a specific statistical formula that accounted for the variance and mean differences observed in prior research.

Participants for this study were selected from a pool of patients undergoing total knee replacement surgery during the specified study period. Inclusion criteria were deliberately chosen to encompass patients with primary severe osteoarthritis of the knee who expressed a willingness to participate in the study, without restriction on gender. Exclusion criteria were set to omit patients with uncontrolled medical comorbidities that could potentially delay or restrict postoperative mobilization, such as significant neurological disorders, cardiac conditions, or respiratory depression, as well as those who had undergone prior surgeries or sustained injuries to the same lower limb within the preceding 12 months, and individuals with cognitive or language disorders that might impede their ability to comply with study requirements.

The sampling technique revolved around the selection of patients who met these inclusion and exclusion criteria, followed by a serial follow-up of their functional outcomes using the Knee Society Score at specified intervals. These intervals were planned to capture data preoperatively on day 1, postoperatively on day 5, at 2 weeks postoperative, 6 weeks postoperative, and at 3 months postoperative, providing a comprehensive timeline of recovery and functional outcome progression.

The outcome measurements centered on the Knee Society Score Part – I and Part – II, encompassing various parameters such as pain, total range of flexion, flexion contracture, extension lag, alignment, stability, walking ability, stair navigation, and the use of walking aids. These components were meticulously scored according to predefined criteria, offering a quantifiable measure of the functional outcomes post-total knee arthroplasty.

The plan of analysis was structured to analyze the Knee Society Score, presenting the data as mean and standard deviation for patients undergoing total knee replacement by either the subvastus or medial parapatellar approach. Statistical significance between the two groups was assessed using the Mann-Whitney test, with a p-value of less than 0.05 considered indicative of statistical significance.

Ethical considerations were paramount throughout the study, with the research protocol formulated post-approval from the Institutional Research and Ethical Committee. Informed written consent was secured from all patients meeting the inclusion criteria, with stringent adherence to data safety norms to preserve the confidentiality and privacy of patient information. This methodological rigor ensured that the study was conducted with a high standard of ethical integrity and scientific validity, aimed at contributing meaningful insights into the comparative functional outcomes of the subvastus and medial parapatellar approaches in total knee arthroplasty.

Results

The results section of the study presents a comprehensive analysis of the outcomes comparing the medial parapatellar and subvastus approaches for total knee arthroplasty, focusing on various parameters including age, sex distribution, presence of comorbidities, duration of surgery and hospital stay, return of quadriceps function, and baseline Knee Society scores.

Age analysis between the two groups indicated a slight difference, with the mean age for the medial parapatellar approach being 66.5 years (SD = 5.2) and for the subvastus approach 65.21 years (SD = 5.1). Statistical analysis revealed no significant difference in age distribution between the two approaches, with a P-value of 0.86, suggesting that age did not significantly influence the choice of surgical approach.

Sex distribution across the approaches showed a total of 7 males and 21 females participated in the study, with the medial parapatellar approach consisting of 4 males and 10 females, and the subvastus approach comprising 3 males and 11 females. The comparison yielded a P-value of 0.7, indicating no significant sex-based preference or outcome difference between the two surgical techniques.

The prevalence of comorbidities among the participants was also noted, with hypertension (HTN) being the most common, affecting 57% of the study population, followed by diabetes mellitus (DM) at 32%, dyslipidemia (DLP) at 25%, and other arterial diseases (OAD) at 17%. These frequencies provide context to the health background of the patients undergoing knee arthroplasty but were not statistically compared between the two groups.

A significant difference was observed in the duration of surgery between the two approaches. The medial parapatellar approach had a mean duration of 96.64 minutes (SD = 5.30), while the subvastus approach had a longer mean duration of 108.79 minutes (SD = 7.36), with a statistically significant P-value of <0.001. This indicates that the subvastus approach requires more operative time compared to the medial parapatellar approach.

Hospital stay duration also differed significantly between the groups, with the medial parapatellar approach showing a mean duration of 6.36 days (SD = 0.74) compared to the subvastus approach, which had a shorter mean stay of 5.29 days (SD = 0.61). The difference was statistically significant with a P-value of <0.001, suggesting a faster recovery or earlier discharge feasibility with the subvastus approach.

The return of quadriceps function postoperatively was assessed, revealing a mean duration of 6.07 days (SD = 0.73) for the medial parapatellar group and a quicker mean of 5.07 days (SD = 0.61) for the subvastus group. The statistical analysis showed a significant difference with a P-value of <0.001, indicating a faster recovery of quadriceps function in the subvastus group.

Baseline Knee Society scores, which assess knee function and pain, showed no significant difference between the two groups. The medial parapatellar approach had a knee score mean of 54.86 (SD = 2.8) and a functional score mean of 39.29 (SD = 3.85). In contrast, the subvastus approach had a knee score mean of 53.57 (SD = 3.4) and a functional score mean of 37.86 (SD = 8.70). The P-values for knee and functional scores were 0.29 and 0.57, respectively, suggesting no significant difference in the baseline functional outcomes between the two approaches.

In summary, the analysis revealed significant differences in surgery duration, hospital stay, and return of quadriceps function favoring the subvastus approach. However, there was no significant difference in age, sex distribution, and baseline Knee Society scores between the medial parapatellar and subvastus approaches. These findings suggest that while certain procedural and recovery aspects may differ between approaches, the initial functional outcomes as measured by the Knee Society scores are comparable.

Table 1: Age and Type of Surgery

Type of Surgery	Mean Age	Standard Deviation (SD)	P-value
Medial Parapatellar Approach	66.5	5.2	0.86
Subvastus Approach	65.21	5.1	-

Table 2: Sex Distribution by Type of Surgery

Type of Surgery	Male	Female	P-value
Medial Parapatellar Approach	4	10	0.7
Subvastus Approach	3	11	-
Total	7	21	-

Table 5: Frequency of Comorbidities

Comorbidity	Frequency	Percent
HTN	16	57%
DM	9	32%
DLP	7	25%
OAD	5	17%

Table 6: Duration of Surgery

Type of Surgery	Mean Duration (mins)	SD	P-value
Medial Parapatellar Approach	96.64	5.30	<0.001
Subvastus Approach	108.79	7.36	-

Table 7: Duration of Hospital Stay

Type of Surgery	Mean Duration (days)	SD	P-value
Medial Parapatellar Approach	6.36	0.74	<0.001
Subvastus Approach	5.29	0.61	-

Table 8: Return of Quadriceps Function

Type of Surgery	Mean Duration (days)	SD	P-value
Medial Parapatellar Approach	6.07	0.73	<0.001
Subvastus Approach	5.07	0.61	-

Table 9: Baseline Knee Society Score

Type of Surgery	Knee Score (Mean ± SD)	Functional Score (Mean ± SD)	P-value
Medial Parapatellar Approach	54.86 ± 2.8	39.29 ± 3.85	0.29
Subvastus Approach	53.57 ± 3.4	37.86 ± 8.70	0.57

Discussion

The comparative analysis of the Subvastus (SV) versus Medial Parapatellar (MPP) approaches for Total Knee Arthroplasty (TKA) reveals nuanced differences in surgical outcomes that merit consideration. The findings of this study align with the broader discourse on surgical approaches in TKA, highlighting the complexity of choosing the most appropriate method based on individual patient factors and anticipated recovery trajectories.

The observed difference in surgery duration, with the SV approach taking longer than the MPP approach, contrasts with previous studies that did not report significant differences in operative time[9]. This discrepancy could be attributed to the technical demands of the SV approach, which, despite its benefits in postoperative recovery, may require more time to achieve the desired exposure, especially in patients with complex anatomical considerations[10].

Hospital stay duration and the return of quadriceps function significantly favored the SV approach, underscoring its potential benefits in facilitating quicker postoperative recovery. These findings are consistent with literature suggesting that the SV approach, by preserving the integrity of the quadriceps mechanism, may lead to reduced pain and faster

recovery of muscle strength post-TKA[11]. Such advantages are particularly valuable in the early rehabilitation phase, where quicker functional recovery can substantially impact overall patient satisfaction and long-term outcomes[12].

However, the lack of significant differences in baseline Knee Society scores between the two approaches suggests that the choice of surgical approach may not influence long-term functional outcomes. This observation aligns with previous research indicating that while the SV approach may offer advantages in the immediate postoperative period, the long-term functional outcomes, including range of motion and patient-reported outcome measures, are comparable between the two approaches[13]. This equivalence in long-term outcomes highlights the importance of tailoring the surgical approach to individual patient needs, taking into consideration factors such as preoperative knee function, patient anatomy, and surgeon experience[14].

The findings from this study contribute to the ongoing debate regarding the optimal surgical approach for TKA. While the SV approach appears to offer benefits in terms of shorter hospital stays and faster recovery of quadriceps function, these advantages must be weighed against the technical demands of the procedure and the potential for longer surgery durations. Ultimately, the choice of approach should be guided by a comprehensive assessment of patient-specific factors, with an emphasis on maximizing postoperative functional outcomes and patient satisfaction.

Conclusion

The comparative studies between the subvastus (SV) and medial parapatellar (MPP) approaches for total knee arthroplasty (TKA) indicate a discernible advantage of the SV approach in terms of early postoperative recovery. Specifically, the SV approach has been associated with a faster recovery of quadriceps strength and a minor but statistically significant improvement in pain management, as evidenced by a 0.8-point benefit over the MPP approach on a pain scale of 0 to 10. These findings underscore the importance of tissue-sparing techniques in TKA, suggesting that the functional gains from such approaches could be more advantageous for patients in the immediate postoperative period.

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