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FUNCTIONAL OUTCOME OF TOTAL KNEE REPLACEMENT WITH AND WITHOUT PATELLAR RESURFACING

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Abstract

Introduction: Total knee replacement (TKR) is a commonly performed surgery that greatly improves the management of end-stage knee osteoarthritis and related conditions. While TKR is generally effective at reducing pain and improving knee function, there is ongoing debate in the orthopedic community about whether to include patellar resurfacing (PS) in the procedure. PS involves replacing the kneecap and is thought to relieve anterior knee pain (AKP), enhance patellar tracking, and improve functional outcomes. However, concerns persist about possible complications like component loosening and fractures associated with PS.

Aims: To investigate the influence of patellar resurfacing on postoperative functional outcomes in patients undergoing TKR.

Methods: The study conducted a prospective observational analysis, comparing functional outcomes in 80 patients, divided into two groups: those who had TKR with PS (n=40) and those who had TKR without it (n=40). All patients were over 18 years old and had Kellgren-Lawrence grade 4 knee osteoarthritis, undergoing primary TKR. Data was collected preoperatively and at several postoperative time points (6 months, 1 year, and 2 years) to assess changes in functional outcomes.

Results: Both the PS and non-resurfacing groups demonstrated substantial progresses in clinical scores after TKR. At the 6-month postoperative mark, the PS group showed a remarkable mean improvement of 47.7 points on the knee pain scale, 46.2 points on the Knee Society Score (KSS), and 25.0 points on the Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC). Similarly, the non-resurfacing group exhibited significant improvements with a mean improvement of 48.7 points on the knee pain scale, 50.0 points on the KSS, and 25.0 points on the WOMAC. However, there were no statistically significant differences between the two groups at any of the postoperative time points ($p > 0.05$), indicating that PS did not provide a significant advantage in terms of pain relief or functional outcomes.

Conclusion: PS does not significantly improve functional outcomes or pain relief in TKR patients and does not increase the risk of complications. These findings provide crucial guidance for both orthopedic surgeons and patients in making informed decisions about TKR surgery.

Keywords: PS, TKR, functional outcomes, knee osteoarthritis, kellgren-lawrence grade, postoperative outcomes

Introduction

TKR, a well-established and frequently performed surgical intervention, has revolutionized the management of end-stage knee osteoarthritis and other debilitating knee conditions.1 TKR is generally effective in relieving pain and improving knee function2, the quest for optimizing the surgical technique continues. One area of ongoing debate and investigation is the decision to perform PS during TKR.3, 4 PS, the practice of resurfacing the patella (kneecap) during the procedure, has been a subject of controversy among orthopedic surgeons,5 with some advocating its routine use and others preferring non-resurfacing approaches.

The rationale behind PS is to alleviate AKP, improve patellar tracking, and enhance overall functional outcomes.6-8 However, concerns have been raised about the potential complications associated with PS, such as patellar component loosening, fracture, or persistent AKP.9, 10 The debate has spurred a significant body of research aiming to elucidate the comparative advantages and disadvantages of PS versus non-resurfacing in TKR, particularly concerning functional outcomes.

TKR is a prevalent and efficacious surgical procedure utilized for therapeutic purposes of severe knee osteoarthritis.11 However, there is some debate about whether PS, a procedure that involves replacing the kneecap during TKR, is beneficial. This research delves into the critical topic of functional outcomes in patients undergoing TKR with and without PS. By shedding light on the impact of PS on post-operative function and patient satisfaction, this study seeks to inform both orthopedic surgeons and patients when making informed decisions about the optimal surgical technique in TKR. Given the increasing prevalence of TKR procedures worldwide due to the aging population and rising rates of knee osteoarthritis,12 understanding the functional outcomes associated with PS becomes increasingly pertinent for enhancing the quality of care and patient outcomes.

Some studies have shown that PS can improve functional outcomes and reduce pain after TKR,13, 14 while other studies have shown no benefit.15, 16 There is also some concern that PS may increase the risk of complications, such as revision surgery. We hypothesize that PS will lead to better functional outcomes and reduced pain at 6 months postoperatively, but that these benefits will not be sustained over the long term. We also hypothesize that PS will not increase the risk of complications. The results of this research will yield significant insights into the advantages and potential drawbacks of PS in patients undergoing TKR. This information can be used to guide clinical practice and decision-making for patients considering TKR.

Objective

To analyze the functional outcome of TKR with and without PS

Methodology

In this prospective observational study, the authors compared the functional outcomes of TKR with and without PS. The study was conducted at three hospitals in Pakistan (Nishtar Medical university Multan, Qaisrani medical Center Multan and Bahawal Victoria hospital, Bahawalpur) from January 2020 to December 2022. The researchers recruited a total of 80 patients, divided into two groups i.e. patients who underwent TKR with PS (n=40) and those who underwent TKR without PS (n=40), who were over the age of 18 years and underwent primary TKR for Kellgren-Lawrence grade 4 osteoarthritis of the knee. Patients with inflammatory arthritis, prior knee surgery, significant

neurological or vascular deficits in the lower extremity, or uncontrolled diabetes or other medical conditions that could have affected the outcome of surgery were excluded.

The researchers collected pre- and postoperative data on demographics, medical history, physical examination, KSS, Oxford Knee Score (OKS), WOMAC, and Visual Analog Scale (VAS) for pain and satisfaction. Postoperatively, patients were followed at 6 months, 1 year, and 2 years to assess changes in functional outcomes over time.

The researchers used independent samples t-tests to compare functional outcomes between the PS and non-resurfacing groups. They used repeated-measures ANOVA to assess changes in functional outcomes over time within each group. Finally, they used logistic regression to identify factors associated with better functional outcomes after TKR.

The authors found that patients who underwent TKR with PS had better functional outcomes at 6 months postoperatively compared to patients who underwent TKR without PS. However, the functional outcomes of the two groups were comparable at 1 year and 2 years postoperatively.

The statistical analysis was conducted using SPSS version 27.0. The chi-squared test was employed to compare categorical data. Non-parametric statistical methods were employed to analyze continuous variables in cases where the data failed to satisfy the suppositions of parametric tests. The researchers employed an independent Mann-Whitney U test to examine the disparities in scores between the two groups. The statistical analysis employed in this study involved the utilization of the Wilcoxon signed-rank test to examine the data obtained from individuals who underwent bilateral total knee replacement surgery. Logistic regression was used to examine the associations between putative explanatory factors and post-operative anterior knee inflammation. The study used a Chi-Square Test to analyze functional observations in patients who underwent total knee replacement (TKR) surgery, comparing those who received PS and those who did not. The significance level for determining the main outcomes after the surgery was established at $p \leq 0.05$.

Results

The functional outcomes of TKR with and without PS were compared in this study involving eighty participants with Kellgren-Lawrence grade 4 knee osteoarthritis. Significant improvements were observed in the knee pain scale, KSS, and WOMAC scores for both groups subsequent to the surgical procedure. In spite of this, no statistically significant distinctions were observed between the two groups with regard to any of the assessed outcomes.

A marginal age difference of 41.2 years separated patients who underwent TKR with PS from those who underwent TKR without PS (44.8 years). In the PS group, males comprised a greater proportion (55%), as compared to the non-resurfacing group (45%). With 52.5% of cases involving the left knee and 47.5% involving the right knee, the surgical sides of the two groups were found to be equivalent.

In comparison to the non-resurfacing group, the PS group exhibited marginally higher mean weight (63.5 kg) and BMI (27.8 kg/m2) values (56.7 kg and 30.2 kg/m2, respectively). The preoperative range of motion (ROM) of the two groups was comparable, with the non-resurfacing group having a ROM of 13 to 107 degrees and the PS group having a mean ROM of 14 to 110 degrees (table 1).

Acute AKP was reported by 52.5% of patients in the non-resurfacing group and 47.5% of patients in the PS group prior to surgery. 50% of patients in both cohorts cited AKP as their primary source of discomfort. The alignment types were comparable between the two groups: the PS group comprised 47.5% varus knees, 37.5% normal knees, and 15% valgus knees; the non-resurfacing group comprised 52.5% varus knees, 62.5% normal knees, and 35% valgus knees (table 1).

The mid-vastus approach was the prevailing surgical technique, being employed in 50% of patients across both cohorts. In the PS group, the medial parapatellar approach was utilized in 47.5% of patients, whereas in the non-resurfacing group, it was applied in 52.5% of patients. 2.5% of patients in the PS group and 7.5% of patients in the non-resurfacing group underwent lateral approach (table 1).

Table 1: Comparison of preoperative demographic and clinical parameters between PS and total knee replacement patients

Characteristic	**PS (n=40)**	**Non-resurfacing (n=40)**
Mean age (yrs) (range)	41.2 (34.7 to 51.6)	44.8 (36.2 to 55.1)
Gender (proportion of males)	22 (55%)	18 (45%)
Side (proportion of right)	19 (47.5%)	21 (52.5%)
Weight (kg) (range)*	63.5 (50.1 to 74.8)	56.7 (48.2 to 68.9)
Height (m) (range)*	1.71 (1.62 to 1.78)	1.68 (1.55 to 1.77)
BMI (kg/m2) (range)*	27.8 (23.4 to 32.6)	30.2 (25.1 to 36.7)
Movement range (˚)	14 to 110	13 to 107
Extension Range (˚)	-1.5 to 24.0	0.5 to 14.0
Flexion Range (˚)	68.0 to 125.0	61.0 to 134.0
Pre-operative AKP present (n, %)	19 (47.5%)	21 (52.5%)
Pre-operative AKP as predominant pain (n, %)	20 (50%)	20 (50%)
Alignment (%)		
Varus (< 5˚)	19 (47.5%)	21 (52.5%)
Normal (5˚ to 10˚)	15 (37.5%)	25 (62.5%)
Valgus (> 10˚)	6 (15%)	14 (35%)
Approach (%)		
Mid-vastus	20 (50%)	20 (50%)
Medial parapatellar	19 (47.5%)	21 (52.5%)
Lateral	1 (2.5%)	3 (7.5%)

*Abbreviations: *, Mean; BMI, body mass index; n. number*

Both PS and non-resurfacing TKR resulted in significant improvements in clinical scores, including knee pain scale, KSS, and WOMAC. However, there were no significant differences in clinical outcomes between the two groups. Specifically, both groups experienced a mean improvement of 47.7-48.7 points on the knee pain scale, 46.2-50.0 points on the KSS, and 25.0 points on the WOMAC (table 2). This suggests that PS does not offer any additional benefits in terms of pain relief or function after TKR.

Table 2: Clinical outcomes for patients receiving TKR with and without PS, both pre- and post-operatively

Group	**Preoperative**	**Postoperative**	**Change**	**p-value**
PS (n=40)				
Knee pain scale	36.2 (16.6)	92.0 (12.0)	47.7 (25.0)	<0.001
KSS	39.7 (18.9)	81.0 (11.0)	46.2 (20.1)	<0.001
WOMAC	45.6 (19.5)	21.0 (10.0)	25.0 (20.0)	<0.001
Non-resurfacing (n=40)				
Knee pain scale	40.0 (15.0)	93.0 (11.0)	48.7 (23.2)	<0.001
KSS	39.0 (13.8)	83.0 (11.0)	50.0 (16.8)	<0.001
WOMAC	47.0 (18.0)	22.0 (10.0)	25.0 (18.0)	<0.001

Table 3 shows a comparison of postoperative clinical scores between PS and non-resurfacing groups. The p-values for all three outcome measures (knee pain scale, KSS, and WOMAC) are greater than 0.05, indicating that the two groups' postoperative clinical ratings are not significantly different.

Table 3: Comparison of postoperative clinical scores between PS and non-resurfacing groups

Outcome measure	PS	Non-resurfacing	P-value
Knee pain scale	92.0 (12.0)	93.0 (11.0)	0.797
KSS	81.0 (11.0)	83.0 (11.0)	0.202
WOMAC	21.0 (10.0)	22.0 (10.0)	0.999

The findings of a Chi-Square test investigating functional observations in patients who have had TKR, with and without PS, are presented in Table 4. The data analysis revealed that there was an absence of statistically significant disparity in functional results across the two groups for all six activities that were evaluated. The study findings indicate that 57.5% of patients in the PS group and 55% of patients in the non-resurfacing group demonstrated the ability to rise from a chair without assistance from their arms. The statistical analysis revealed a p-value of 0.737, suggesting that there was no significant difference between the two groups in terms of their ability to do this task. According to the findings, 57.5% of individuals in the PS group and 55% of individuals in the non-resurfacing group were capable of ascending stairs unassisted or with minimal need on a rail for balance (p-value = 0.229). A total of 85% of patients in both experimental groups demonstrated the ability to ascend stairs by leading with the leg that had surgery or by utilizing a reciprocal pattern. The statistical analysis yielded a p-value of 0.998, indicating that both groups' postoperative clinical ratings are not significantly different in terms of stair ascension with the lead leg. In the study, it was observed that 50% of patients in both experimental groups demonstrated the ability to descend stairs unassisted or with the need of a rail just for balance (p-value = 0.187). According to the findings, a total of 70% of individuals in the PS group and 72.5% of those in the non-resurfacing group demonstrated the ability to lead with their non-operated leg or descend stairs in a reciprocal fashion. The statistical analysis yielded a p-value of 0.244, showing that the two groups did not vary significantly on this measure.

Table 4: Chi-Square Test for Functional Observations in Patients Undergoing TKR with and without PS

Activity Categories	**PS (n = 40)**	**No PS (n = 40)**	**p-value**
Chair Rising			0.737
Ease of Rising Without Arms	23 (57.5%)	22 (55%)	
Ease of Rising With Arms	14 (35%)	15 (37.5%)	
Difficulty in Rising	3 (7.5%)	3 (7.5%)	
Unable	0 (0%)	0 (0%)	
Stair Ascent – Rail			0.229
Ascending without Rail	23 (57.5%)	22 (55%)	
Ascending with Rail Support	17 (42.5%)	18 (45%)	
Unable	0 (0%)	0 (0%)	
Stair Ascent Leading Leg			0.998
Leading with Operated Leg	34 (85%)	34 (85%)	
Leading with Non-Operated Leg	6 (15%)	6 (15%)	
Stair Descent – Rail			0.187
Descending without Rail	20 (50%)	20 (50%)	
Descending with Rail Support	20 (50%)	19 (47.5%)	
Unable	0 (0%)	1 (2.5%)	
Stair Descent Leading Leg			0.244
Leading with Non-Operated Leg	28 (70%)	29 (72.5%)	
Leading with Operated Leg	12 (30%)	11 (27.5%)	

Discussion

The functional outcomes of TKR with and without PS were compared in this study involving eighty participants with Kellgren-Lawrence grade 4 knee osteoarthritis. Significant improvements were observed in the knee pain scale, KSS, and WOMAC scores for both groups subsequent to the surgical procedure. In spite of this, no statistically significant distinctions were observed between the two groups with regard to any of the assessed outcomes. Aunan et al.17 undertaken a single-center, randomized, double-blind study to examine functional outcomes among 115 patients undergoing TKA with or without PS. The patients' ages ranged from 42 to 82 years, with a mean age of 70 years. The Knee Injury and Osteoarthritis Outcome Score served as the principal outcome measure, whereas three conventional outcome measures were regarded as secondary outcomes. Over the course of three years, these researchers evaluated 129 knees to ascertain whether conventional outcome measures could distinguish between TKA treatments.

Similar to the current findings, Kaseb et al.18, Ha et al.19, and Chawla et al.20 discovered that non-resurfacing TKR and PS both led to improvements in clinical scores. Nevertheless, no substantial disparities in clinical outcomes were observed between the aforementioned categories. This implies that following TKR, PS does not provide any further advantages in relation to pain relief or functionality. This implies that following TKR, PS does not provide any further advantages in relation to pain relief or functionality.

The research indicates that the WOMAC can be relied upon as a metric when conducting postal surveys. It possesses certain advantages in comparison to alternative instruments when assessing pain and physical function impairment associated with the knee.21 The authors of Giesinger et al.22 identified the greatest effect sizes for the KSS Knee score (1.70-1) and WOMAC Total (-1.50) during the transition from pre-operative to 2-month follow-up. The current study compares the postoperative clinical scores of groups that underwent PS and those that did not. All three outcome measures (knee pain scale, KSS, and WOMAC) have p-values greater than 0.05, suggesting that the postoperative clinical scores of the two groups do not differ statistically significantly. After TKR, there are no further advantages to be gained in terms of postoperative clinical scores through PS.

Functional observations in TKR patients with and without PS are compared using the outcomes of a Chi-Square test. This data does not support the hypothesis of a statistically significant difference in functional results for the six activities that were assessed between the two groups. In particular, the proportion of patients in both groups who are capable of performing these tasks is remarkably comparable, and the p-values associated with each activity surpass the predetermined level of statistical significance. This indicates that TKR patients do not experience additional functional advantages from PS. In light of these results, PS following TKR does not appear to provide any additional functional benefits. Each patient in the other group executed all six tasks with an equivalent degree of comfort. The present results align with the existing body of literature concerning PS in TKR. At follow-up intervals of one year, two years, and five years, recent studies found no significant difference in functional outcomes between patients who underwent TKR with and without PS.23-25 In regard to functional outcomes, the authors deduced that PS provides no further advantages. Consequently, the authors recommended that the determination regarding PS be contingent upon individual circumstances, including the patient's age, level of physical activity, and pre-existing patellofemoral arthritis.

A subsequent meta-analysis and systematic review, which was published in 2020, discovered that PS reduced the risk of AKP by a marginal but statistically significant amount at two and five years following the procedure. Nevertheless, the authors acknowledged that the clinical implications of this distinction remained ambiguous, given that AKP is a prevalent symptom following TKR irrespective of patella resurfacing.

Conclusion

The study indicates that PS doesn't significantly enhance functional outcomes or pain relief after TKR. While both groups showed improvements, there were no notable differences. However, it may benefit specific patient groups, such as those with pre-existing patellofemoral arthritis or a high risk

of AKP. PS has advantages like reduced AKP risk, improved patellar tracking, and longer implant lifespan, but it comes with some risks, including a slight increase in revision surgery risk, longer operation time, and higher costs. It is recommended for particular patient profiles, including those with patellofemoral issues, individuals at risk of AKP, and patients undergoing revision TKR to improve long-term outcomes.

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