

Original Research Article

Does the severity of patellofemoral arthritis affect the functional outcomes after total knee arthroplasty without patellar resurfacing: a prospective study

Jude Martin*, Mohamed Shakeeb K. U., Aswinlal K. S., Ashraf Ebrahim

Department of Orthopaedics, MES Medical College, Perinthalmanna, Malappuram, Kerala, India

Received: 22 July 2026

Accepted: 09 September 2026

*Correspondence:

Dr. Jude Martin,

E-mail: judemartin102@gmail.com

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ABSTRACT

Background: The role of patellofemoral (PF) arthritis severity in influencing functional outcomes after total knee arthroplasty (TKA) without patellar resurfacing remains controversial. This study aimed to evaluate the effect of PF arthritis severity on postoperative functional outcomes following primary TKA without patellar resurfacing.

Methods: A prospective observational study was conducted on 37 patients undergoing primary TKA without patellar resurfacing. Patients were stratified based on the severity of PF arthritis using the Iwano classification. Functional outcomes were assessed using the knee society score (KSS) and WOMAC score at 3, 6, and 12 months postoperatively. Statistical analysis was performed to compare outcomes across severity groups.

Results: There was a statistically significant improvement in mean KSS from 55.9 preoperatively to 87.6 at final follow-up ($p < 0.001$). The mean WOMAC score improved from 88 preoperatively to 41 postoperatively ($p < 0.001$). Improvement in range of motion was also significant. No statistically significant difference in functional outcomes was observed between different grades of PF arthritis.

Conclusion: Primary TKA without patellar resurfacing results in significant functional improvement irrespective of the severity of PF arthritis. The severity of PF arthritis does not significantly influence postoperative outcomes.

Keywords: Total knee arthroplasty, Patellofemoral arthritis, Patellar resurfacing, Knee society score, WOMAC

INTRODUCTION

Osteoarthritis (OA) of the knee is a chronic, progressive degenerative disorder characterized by degeneration of the articular cartilage, subchondral bone remodeling, osteophyte formation, synovial inflammation, and varying degrees of soft tissue involvement. It is one of the leading causes of chronic pain, disability, and impaired quality of life among older adults worldwide, with its prevalence increasing because of population aging and obesity. The knee, being a major weight-bearing joint, is particularly susceptible to degenerative changes due to repetitive mechanical loading and its complex biomechanics.¹⁻³ Among the three compartments of the knee medial, lateral, and patellofemoral the PF joint plays a crucial role in knee function by increasing the mechanical advantage of the

quadriceps mechanism and transmitting high joint reaction forces during activities such as stair climbing, squatting, kneeling, and rising from a seated position.⁴⁻⁷ Patellofemoral arthritis refers to degeneration of the articular surfaces between the patella and the femoral trochlea and may occur in isolation or in association with tibiofemoral osteoarthritis.^{4,5} Factors contributing to its development include malalignment, abnormal patellar tracking, trochlear dysplasia, obesity, trauma, instability, and chronic repetitive overload.^{4,7} Patients commonly present with anterior knee pain, crepitus, and difficulty performing activities that increase patellofemoral joint loading, such as climbing stairs, squatting, or rising from a seated position.^{4,6} TKA is considered the gold standard treatment for end-stage osteoarthritis of the knee that is unresponsive to conservative management. The procedure

relieves pain, restores limb alignment, improves function, and provides excellent long-term implant survivorship.⁸⁻¹¹ Despite advances in implant design and surgical techniques, one of the most debated aspects of primary TKA remains whether the patella should be routinely resurfaced.¹²⁻¹⁵ Advocates of patellar resurfacing suggest that it reduces postoperative anterior knee pain, improves patient satisfaction, and lowers the incidence of secondary resurfacing procedures. Conversely, opponents argue that routine resurfacing may increase the risk of complications such as patellar fracture, polyethylene wear, component loosening, osteonecrosis, extensor mechanism injury, instability, and patellar maltracking.¹³⁻¹⁸ Consequently, considerable variation exists among surgeons regarding patellar management during primary TKA. Pavlou et al in his study reported that patellar resurfacing significantly reduced anterior knee pain and reoperation rates, although postoperative functional outcomes remained comparable between resurfaced and non-resurfaced knees. They also emphasized that implant design plays an important role in patellofemoral outcomes.¹² Similarly, Pilling et al demonstrated no clinically significant difference in functional outcomes between resurfaced and non-resurfaced knees but reported a higher incidence of secondary resurfacing in the non-resurfacing group, supporting a selective approach to patellar resurfacing.¹³

More recent studies have reached similar conclusions, demonstrating that while patellar resurfacing may decrease the likelihood of secondary surgery, it does not consistently improve functional outcomes or patient-reported outcome measures.¹⁸⁻²² In patients undergoing TKA without patellar resurfacing, the severity of pre-existing patellofemoral arthritis may influence postoperative pain, anterior knee symptoms, and overall functional outcome. However, improvements in implant design, surgical technique, soft tissue balancing, patelloplasty, circumferential patellar denervation, and restoration of limb alignment have enabled satisfactory outcomes even in patients with advanced patellofemoral degeneration.^{16,18,19,23}

Despite numerous studies evaluating patellar resurfacing, relatively few have specifically investigated whether the radiographic severity of patellofemoral arthritis influences functional outcomes after primary TKA without patellar resurfacing. Therefore, the present prospective study was undertaken to evaluate the effect of preoperative patellofemoral arthritis severity, graded using the Iwano classification, on postoperative functional outcomes following primary total knee arthroplasty without patellar resurfacing.²⁴ Functional outcomes were assessed using the KSS and WOMAC score, which are validated and widely accepted outcome measures in knee arthroplasty research.^{25,26} The findings may assist surgeons in optimizing patient selection, refining intraoperative decision-making, and further defining the role of selective patellar resurfacing in contemporary knee arthroplasty.^{12,13,18-22}

METHODS

This prospective observational study was conducted at a tertiary care orthopaedic center over a period of 18 months. Institutional Ethics Committee approval was obtained before commencement of the study, and written informed consent was obtained from all participants before enrolment. The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and its subsequent amendments.²⁷

A total of 37 consecutive patients with primary osteoarthritis of the knee who underwent primary TKA without patellar resurfacing were included. Patients aged 50 years or older with symptomatic primary knee osteoarthritis who had failed conservative treatment and were willing to comply with the follow-up protocol were considered eligible. Patients with previous surgery on the affected knee, inflammatory arthritis (including rheumatoid arthritis), post-traumatic arthritis, severe deformities requiring constrained implants, fixed flexion deformity greater than 30°, active infection, neuromuscular disorders affecting gait, or those undergoing revision TKA were excluded.^{1,8} All patients underwent a detailed preoperative clinical and radiographic evaluation.

Baseline demographic characteristics, medical history, BMI, and clinical examination findings were documented. Standard radiographic evaluation included weight-bearing anteroposterior, lateral, and Merchant skyline views of the knee.²⁸ The severity of patellofemoral arthritis was graded using the Iwano classification based on Merchant skyline radiographs.²⁵ Preoperative functional assessment included the KSS, the WOMAC, and maximum knee flexion measured using a standard universal goniometer.^{26,29}

All surgical procedures were performed by experienced orthopaedic surgeons using a standardized operative technique. A standard medial parapatellar approach was used in all cases. Posterior-stabilized or cruciate-substituting prostheses were implanted according to institutional protocol. The patella was not resurfaced in any patient. Patellar management consisted of osteophyte excision, circumferential patellar denervation, and selective patelloplasty whenever indicated. Femoral and tibial bone resections were performed using intramedullary and extramedullary alignment guides, respectively. Soft tissue balancing was undertaken to achieve optimal coronal and sagittal stability, and trial components were used to assess knee alignment, range of motion, ligament balance, and patellar tracking before final implantation. Lateral retinacular release was performed only in patients with persistent intraoperative patellar maltracking.^{7,12,14} All patients followed a standardized postoperative rehabilitation protocol. Quadriceps strengthening exercises, ankle pump exercises, and active-assisted range-of-motion exercises were initiated on the first postoperative day. Progressive

mobilization with full weight-bearing as tolerated was encouraged using walker support under the supervision of a physiotherapist. Clinical follow-up was performed at 3, 6, and 12 months after surgery.³⁰ The primary outcome measure was postoperative functional outcome assessed using the KSS.²⁶ Secondary outcome measures included the WOMAC score and maximum knee flexion. These parameters were recorded preoperatively and at each follow-up visit.

Statistical analysis was performed using IBM SPSS Statistics version 26. Continuous variables were expressed as mean±standard deviation (SD), whereas categorical variables were expressed as frequencies and percentages. Normality of data distribution was assessed using the Shapiro–Wilk test. Paired t-tests were used to compare preoperative and postoperative functional outcomes. Comparisons among different grades of patellofemoral arthritis were performed using one-way analysis of variance (ANOVA) for continuous variables and the Chi-square test for categorical variables. A two-tailed p value <0.05 was considered statistically significant.³¹

RESULTS

Figure 2 compares Iwano staging with KSS at different time intervals between pre-operative and post-operative evaluations. In Grade 1, the mean KSS increased markedly from 45 in the pre-operative period to 85 at 3 months post-operatively, further improving to 90 at 6 months, with a slight reduction to 88 at 12 months; this change across time intervals was statistically significant ($F=4.576$, $p=0.017$). In Grade 2, the mean KSS showed a substantial and consistent improvement from 59.66 ± 9.21 pre-operatively to 77.05 ± 6.67 at 3 months, 88.83 ± 2.77 at 6 months, and 85.21 ± 3.17 at 12 months, with a highly significant difference over time ($F=13.622$, $p<0.001$). Similarly, Grade 3 patients demonstrated progressive improvement in mean KSS from 52.83 ± 5.81 pre-operatively to 67.50 ± 5.17 at 3 months, 80.66 ± 5.82 at 6 months, and 83.94 ± 3.38 at 12 months, which was also highly statistically significant ($F=15.089$, $p<0.001$). Overall, when all grades were considered together, the total mean KSS improved from 55.94 ± 8.43 pre-operatively to 72.62 ± 7.80 at 3 months, 84.89 ± 6.08 at 6 months, and 85.59 ± 4.83 at 12 months, showing a highly significant improvement over time ($F=22.146$, $p<0.001$). These findings indicate significant post-operative functional improvement across all Iwano stages, with more pronounced gains observed in patients with higher grades. Figure 3 shows a progressive reduction in WOMAC index scores from the pre-operative period to 3, 6, and 12 months after surgery across all Iwano stages, indicating improvement in pain, stiffness, and function. The overall mean WOMAC score decreased from 88.37 pre-operatively to 65.86 at 3 months, 46.10 at 6 months, and 41.41 at 12 months, which was statistically highly significant ($p<0.001$). Patients with Iwano grade 2 and grade 3 disease demonstrated statistically significant improvement over time (Grade 2: $p=0.014$; Grade 3:

$p<0.001$). Although Grade 1 patients showed a reduction in WOMAC scores, this change was not statistically significant ($p=0.134$). Overall, the findings indicate significant post-operative improvement in symptoms and functional status, particularly in patients with higher Iwano grades.

Figure 4 compares Iwano staging with the maximum range of knee flexion at different time intervals between pre-operative and post-operative evaluations. In Grade 1, the mean maximum range of flexion improved from 88° in the pre-operative period to 105° at 3 months post-operatively and remained unchanged at 6 and 12 months; however, this change was not statistically significant ($F=1.098$, $p=0.345$). In Grade 2, the mean range of flexion increased from 87.22° pre-operatively to 96.94° at both 3 and 6 months, with a further improvement to 104.17° at 12 months, showing a statistically significant difference across the time intervals ($F=3.351$, $p=0.047$). Similarly, Grade 3 patients demonstrated a gradual improvement in mean flexion from 83.61° pre-operatively to 90.12° at 3 and 6 months and to 97.22° at 12 months, which was also statistically significant ($F=3.351$, $p=0.047$). Overall, considering all grades together, the total mean maximum range of flexion increased from 86.46° pre-operatively to 100.81° at 3 and 6 months and was maintained at 100.41° at 12 months, with a statistically significant difference over time ($F=4.265$, $p=0.022$). These results indicate a consistent post-operative improvement in knee flexion across all Iwano stages, with more pronounced and statistically significant gains observed in higher grade.



Figure 1 (a-c): The X-rays taken as a part of pre operative evaluation. X-ray knee AP and LAT view, X-ray knee joint skyline view.

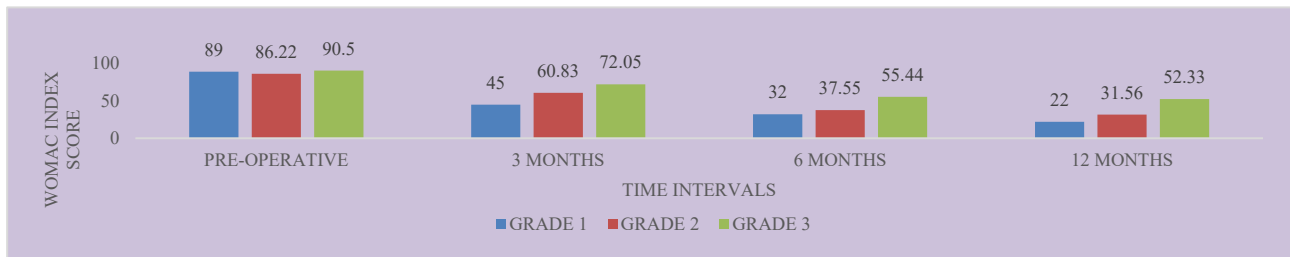


Figure 2: comparison of Iwano staging and knee society score in different time intervals between pre-operative and post-operative evaluation.

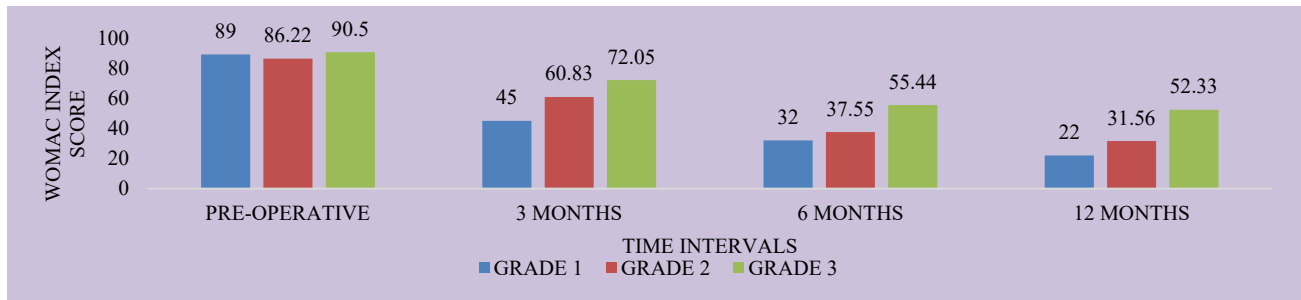


Figure 3: comparison of Iwano staging and WOMAC index score in different time intervals between pre-operative and post-operative evaluation.

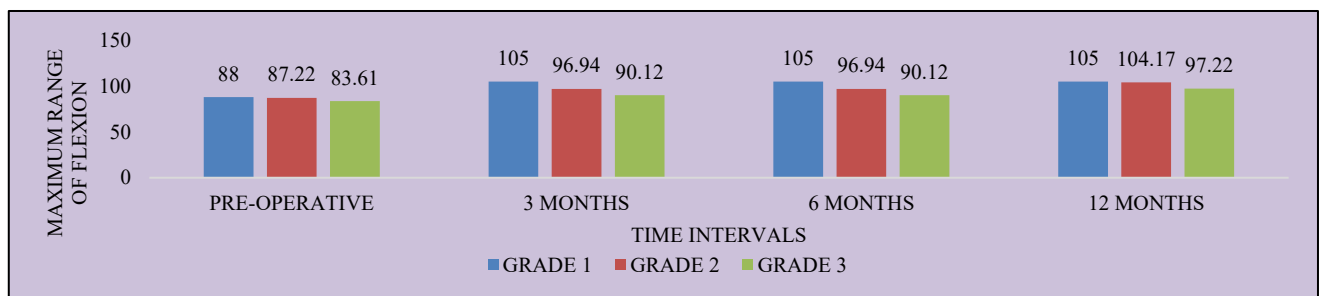


Figure 4: Comparison of Iwano staging and the maximum range of flexion in different time intervals between pre-operative and post-operative evaluation.

DISCUSSION

The present prospective observational study evaluated the influence of the severity of PF arthritis on functional outcomes following primary TKA without patellar resurfacing. The principal finding was that patients experienced significant improvement in KSS, WOMAC score, and range of motion at one year following surgery, irrespective of the preoperative severity of PF arthritis.

Although patients with higher Iwano grades demonstrated relatively lower absolute postoperative scores, these differences were not statistically significant, indicating that radiographic severity of PF arthritis alone does not appear to adversely affect short-term functional outcomes after primary TKA without patellar resurfacing. These findings support the concept that satisfactory clinical outcomes can be achieved with selective patellar management rather than routine resurfacing.¹²⁻¹⁸

Patellar management remains one of the most controversial aspects of contemporary total knee arthroplasty. Theoretical advantages of patellar resurfacing include reduction of postoperative anterior knee pain, improved patellofemoral congruence, and decreased need for secondary resurfacing procedures. Conversely, routine resurfacing may be associated with complications including patellar fracture, polyethylene wear, aseptic loosening, osteonecrosis, extensor mechanism disruption, patellar instability, and increased operative cost.^{14,17,24,30,31} Consequently, many surgeons continue to adopt a selective approach based on intraoperative assessment of patellar cartilage, implant design, patient characteristics, and surgeon preference.

The results of the present study are consistent with those of Pilling et al who demonstrated no clinically significant difference in postoperative functional outcomes between resurfaced and non-resurfaced knees, although secondary patellar resurfacing was more common in the non-

resurfacing group.¹³ Similarly, Pavlou et al concluded that patellar resurfacing reduced anterior knee pain and reoperation rates but failed to demonstrate superior functional outcomes. They further suggested that implant design and surgical technique significantly influence postoperative patellofemoral function.¹² The findings closely parallel these observations, as excellent functional improvement was achieved despite preservation of the native patella.

Recent evidence continues to support these observations. Tang et al concluded that patellar resurfacing reduced reoperation rates but did not consistently improve KSS, WOMAC scores, patient satisfaction, or range of motion compared with patellar retention.¹⁸ Likewise, Koh et al demonstrated comparable mid-term clinical outcomes irrespective of patellar resurfacing status, suggesting that modern prosthesis design and improved surgical techniques may have reduced the historical differences between resurfacing strategies.²² Registry-based studies have also shown that although resurfacing may reduce revision rates in selected patient populations, the overall functional benefit remains modest.²³ Several factors may explain the favorable outcomes observed in the present study despite the absence of patellar resurfacing. Modern femoral component designs incorporate anatomically optimized trochlear geometry, which improves patellar tracking and reduces contact stresses within the patellofemoral joint.^{30,31} Furthermore, meticulous soft tissue balancing, restoration of mechanical alignment, appropriate rotational positioning of components, complete osteophyte excision, circumferential patellar denervation, and selective patelloplasty are all recognized as important determinants of successful patellofemoral function following TKA.^{7,24,30} These technical factors may reduce anterior knee pain independently of patellar resurfacing.

An important observation in the study was that even patients with advanced radiographic PF arthritis achieved significant improvement following TKA without patellar resurfacing. This finding suggests that correction of overall knee biomechanics and restoration of tibiofemoral alignment may play a greater role in determining postoperative function than the radiographic appearance of the patellofemoral joint itself. Similar conclusions have been reported by Burnett et al who found no significant long-term differences in clinical outcomes or anterior knee pain between resurfaced and non-resurfaced knees after more than ten years of follow-up.¹⁶

Although Waters et al and Bentley et al reported higher rates of anterior knee pain and secondary procedures following patellar retention, subsequent meta-analyses have shown that these differences are relatively small and are not consistently reflected in validated functional outcome measures.^{12,13,16,18} From a clinical perspective, the present findings support a selective rather than routine patellar resurfacing strategy. Avoiding routine resurfacing may shorten operative time, reduce implant costs, preserve

patellar bone stock, and eliminate complications unique to the patellar component while still achieving satisfactory functional recovery.^{14,30,31} The present study therefore adds to the growing body of evidence suggesting that preoperative radiographic severity of PF arthritis should not be considered the sole indication for patellar resurfacing during primary TKA.

The strengths of the present study include its prospective design, standardized operative technique, uniform rehabilitation protocol, and use of validated functional outcome measures including the KSS and WOMAC index.^{26,29} Nevertheless, several limitations should be acknowledged.

The study included a relatively small sample size and was conducted at a single tertiary care institution, which may limit external validity. The follow-up period of one year does not permit assessment of long-term implant survival, progression of patellofemoral symptoms, or late secondary resurfacing. Furthermore, the absence of a control group undergoing patellar resurfacing precludes direct comparison between treatment strategies. Future multicenter randomized controlled trials with larger sample sizes, longer follow-up, and patient-reported outcome measures are necessary to establish whether specific subgroups of patients with severe patellofemoral arthritis may derive additional benefit from primary patellar resurfacing.

Overall, the findings of the present study indicate that the severity of preoperative patellofemoral arthritis does not significantly influence short-term functional outcomes following primary total knee arthroplasty without patellar resurfacing, supporting a selective approach to patellar management in appropriately selected patients.

CONCLUSION

Patellofemoral arthritis is a common finding in patients undergoing TKA, and the decision to resurface the patella remains controversial. This study was undertaken to evaluate the effect of preoperative radiological severity of patellofemoral arthritis on functional outcomes following primary total knee arthroplasty without patellar resurfacing. A prospective observational study was conducted on patients with primary osteoarthritis of the knee undergoing TKA without patellar resurfacing. Patients were classified based on the radiological severity of patellofemoral arthritis using the Iwano classification. Functional outcomes were assessed using validated scoring systems at predefined intervals of 6 months and 1 year postoperatively.

The results of the study demonstrated significant improvement in pain relief and functional outcomes across all grades of patellofemoral arthritis following TKA. Although patients with severe patellofemoral arthritis showed relatively lower postoperative functional scores compared to those with mild and moderate disease, these

differences were not clinically significant. No consistent association was observed between the severity of preoperative patellofemoral arthritis and poor functional outcome or increased anterior knee pain.

The findings suggest that correction of overall knee alignment, restoration of biomechanics, appropriate implant positioning, and structured postoperative rehabilitation play a more critical role in determining outcomes than the radiographic severity of patellofemoral degeneration alone. Routine patellar resurfacing based solely on radiographic severity was not found to be necessary in achieving satisfactory short- to mid-term outcomes.

Funding: No funding sources

Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Martin J, Mohamed Shakeeb KU, Aswinlal KS, Ebrahim A. Does the severity of patellofemoral arthritis affect the functional outcomes after total knee arthroplasty without patellar resurfacing: a prospective study. *Int J Res Orthop* 2026;12:1860-6.