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Original Article

The Effect of Preoperative Kellgren–Lawrence Grade on Length of Stay and Early Postoperative Complications After Primary Total Knee Arthroplasty

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ABSTRACT

Introduction: The aim of this study is to investigate the relationship between preoperative Kellgren–Lawrence (KL) grade and hospital length of stay and early postoperative complications in patients undergoing primary total knee arthroplasty (TKA).

Methods: Patients who underwent cemented posterior-stabilized TKA between January 2023 and January 2026 were retrospectively evaluated. Patients aged ≥55 years with a diagnosis of primary knee osteoarthritis (OA), preoperative weight-bearing knee plain radiographs, and at least 6 months of follow-up were included in the study. Valgus deformity, KL grade 2, body mass index (BMI) ≥35, inflammatory arthritis, post-traumatic arthritis, revision surgery, and patients without adequate follow-up or suitable plain radiographs were excluded. Patients were grouped according to their KL grades. All demographic variables, in addition to hospital length of stay and early minor and major complications, were statistically evaluated. Statistical significance was defined as a p value <0.05 for all analyses.

Results: A total of 482 patients were included in the study (KL grade 3: n=254, 52.7%; KL grade 4: n=228, 47.3%). There were no significant differences between the groups in terms of age, BMI, surgical time, American Society of Anesthesiologists score, Charlson comorbidity index, and blood transfusion requirement (for each p>0.05). Hospital length of stay was significantly longer in the KL grade 4 group (p=0.004). The rate of major complications was higher in the KL grade 4 group (p=0.031), while the rates of minor complications were similar (p>0.05).

Conclusion: Increased preoperative radiographic OA severity is associated with longer hospital length of stay and a higher rate of major complications after primary TKA.

Keywords: Kellgren–Lawrence grade, knee osteoarthritis, total knee arthroplasty, length of stay, early postoperative complication

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INTRODUCTION

In knee osteoarthritis (OA), patients' tendency to avoid surgery and their efforts to delay it by resorting to non-surgical alternative treatments can exacerbate limitations in physical activity, potentially increasing the risk of further disability and chronic disease.[1,2] Consequently, total knee arthroplasty (TKA) is often performed at more advanced radiographic stages, particularly in Kellgren–Lawrence (KL) grade 4. When the relevant literature is reviewed, studies comparing patients with advanced-stage KL grades 3 and 4 report that the two groups are often similar with respect to postoperative functional outcomes and patient-reported scores after TKA.[3,4] However, studies evaluating critical outcomes, such as hospital length of stay and early complications, comparing these two grades have been relatively limited.

In KL grade 3 patients, joint deformities and soft tissue contractures are more limited than in KL grade 4 patients. This can affect the level of surgical difficulty, the early postoperative recovery process, and the risk of complications. Therefore, comparing early hospital outcomes in patients with KL grades 3 and 4 is important

clinically and for determining their burden on the healthcare system.

The hypothesis of this study is that patients with KL grade 3 will have a shorter hospital length of stay and lower rates of early postoperative complications compared to patients with KL grade 4.

The aim of this study is to investigate the relationship between preoperative KL grade, hospital length of stay, and early postoperative complication rates in patients undergoing primary TKA.

METHODS

This retrospective study was approved by the İzmir Katip Çelebi University Institutional Review Board (approval number: 0015, date: 15.01.2026). All procedures involving human participants were conducted in accordance with the institutional committee's ethical standards.

Patient Inclusion

In this study, 1057 patients who underwent primary TKA between January 2023 and January 2026 were retrospectively evaluated. Patients who underwent cemented posterior-stabilized TKA for KL grade 3 or 4 primary knee OA; who were ≥55 years of age, had preoperative weight-bearing knee plain radiographs, and had at least 6 months of postoperative follow-up been included in the study. Exclusion criterias for this study were; revision TKA, valgus deformity OA, KL grade 2 OA, body mass index (BMI) ≥35, uncemented or cruciate-retaining TKA, inflammatory arthritis, post-traumatic osteoarthritis, concurrent major joint surgery, tumor or active infection, and lack of suitable radiographs or adequate postoperative follow-up. In total, 482 patients were included in the study (Figure 1).

Surgical Technique and Follow-Up Protocol

All patients underwent surgery under regional anesthesia. A midline skin incision was made with a pneumatic tourniquet, and a medial arthrotomy was performed via a standard medial parapatellar approach. Cemented posterior-stabilized TKA was performed without patellar resurfacing. The hemovac drain was removed on the first postoperative day. Mobilization and active range-of-motion exercises were initiated with full weight-bearing, using walking aids. 5000 IU of low-molecular-weight heparin was administered subcutaneously for 30 days as venous thromboembolism prophylaxis. As antibiotic prophylaxis, 1 g of cefazolin was administered intravenously as a single dose before surgery, followed by three doses within the first 16 hours after surgery. Patients were discharged when pain was controlled with oral medication, functional independence was achieved with walking aids, and prolonged wound drainage requiring hospital follow-up was no longer present. Clinical and radiological follow-ups were performed weekly during the first month, monthly for the next 5 months, and quarterly thereafter.

Patient Evaluation

Detailed demographic and clinical data, such as age, gender, BMI, American Society of Anesthesiologists (ASA) score, Charlson comorbidity index (CCI), surgical time, blood transfusion requirement, and hospital length of stay, were recorded for all patients. Minor and major complications developing during follow-up periods of at least 6 months were recorded. Complications were classified as minor or major according to their clinical severity and the level of treatment required. Classification was performed in accordance with widely accepted surgical complication grading systems and the TKA literature.[5-8]

Minor complications were defined as events that could be managed with conservative treatment or medical support without requiring invasive surgery or intensive care. This group included prolonged serous wound drainage (discharge lasting longer than 72 hours and causing more than 2x2 cm of wetting in the dressing), superficial wound infection (limited to the skin and subcutaneous tissue and resolving with antibiotic treatment), hematoma or seroma (not requiring surgical drainage), limitation of range of motion (ROM), urinary retention or urinary tract infection, electrolyte imbalances, and transient gastrointestinal complications.

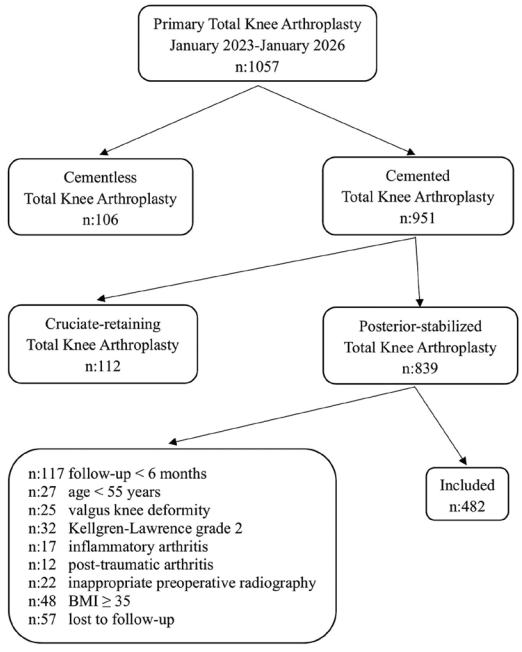

Figure 1. Patient flowchart of the study

BMI: Body mass index

Major complications were defined as life-threatening events requiring surgical, endoscopic, or interventional treatment; requiring intensive care monitoring; or associated with permanent morbidity or mortality. This group included the following: periprosthetic joint infection (requiring surgical debridement, component exchange, or revision); superficial wound necrosis (requiring debridement); intraoperative vascular, nerve, or ligament injuries; venous thromboembolism (deep vein thrombosis or pulmonary embolism); major cardiovascular diseases (myocardial infarction, stroke); acute renal failure; sepsis or septic shock; periprosthetic fractures; complications requiring reoperation such as dislocation; and postoperative mortality.

Radiographic Evaluation

Radiological assessments were performed digitally using the picture archiving and communication system. All patients were evaluated according to the KL grading system using preoperative weight-bearing anteroposterior and lateral plain radiographs of the knee.[9] The presence of numerous osteophytes, significant joint space narrowing, sclerosis, and possible bone deformity was classified as KL grade 3 (Figure 2). Large osteophytes, significant joint space narrowing, severe sclerosis, and definite bone deformity were classified as KL grade 4 (Figure 3). All evaluations were conducted by two independent observers — one orthopedic specialist and one radiologist — and decisions were reached by consensus.

Statistical Analysis

Data were analyzed using the IBM SPSS Statistics Standard Concurrent User V 22 (IBM Corp, Armonk, New York, USA) statistical software package. Descriptive statistics were presented as number of units (n), percentage (%), mean ± standard deviation ($\bar{x}$ ± SD), median, minimum, and maximum (max) values. Normality of the numerical variables was assessed using the Kolmogorov-Smirnov test. The numerical variables did not conform to the assumption of normality. The Mann-Whitney U test was used to compare numerical variables among KL grade groups. The Pearson chi-square test was used to compare categorical variables across KL grades. The statistical significance level was set at $p<0.05$.

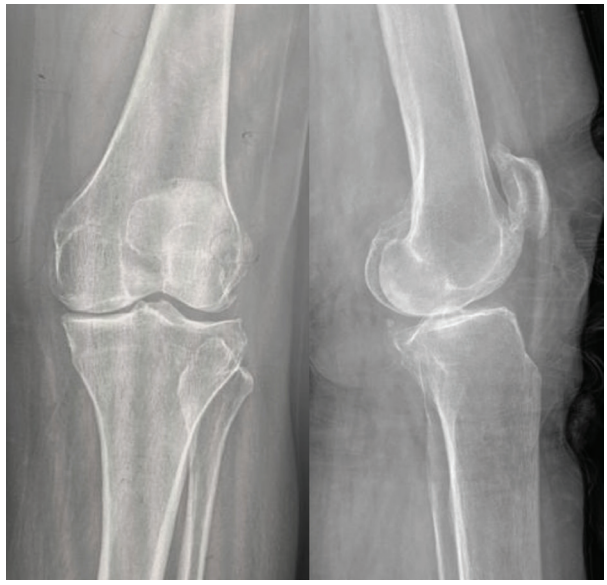

Figure 2. Weight-bearing anteroposterior and lateral knee plain radiographs of a 62-year-old female patient with Kellgren–Lawrence grade 3 knee osteoarthritis

Figure 3. Weight-bearing anteroposterior and lateral knee radiographs of Kellgren–Lawrence grade 4 knee osteoarthritis: (a) 65-year-old female patient; (b) 68-year-old female patient. Significant joint deformity and flexion contracture are observed in (b)

RESULTS

The study included 254 patients with KL grade 3 (52.7%) and 228 patients with KL grade 4 (47.3%). Three hundred and ninety-eight (82.6%) of the patients were female and 84 (17.4%) were male. When all patients were evaluated, the mean age was 67.7±6.7 years, the mean follow-up was 19.4±8.7 months, the mean BMI was 26.6±2.0 kg/m², the mean surgical time was 100.5±24.6 minutes, and the mean hospital length of stay was 5.8±2.2 days. The mean transfusion amount in patients who received blood transfusions was 1.9±0.9 units. When complications were evaluated, no systemic complications affecting major organ systems were detected in any patient. Minor complications were observed in 48 patients (10.0%), and major complications in 54 patients (11.2%) (Table 1).

Prolonged wound drainage developed in 18 patients (3.7%). These cases were managed without surgery by temporarily discontinuing prophylactic low-molecular-weight heparin and repeating dressing changes. Superficial wound infection occurred in 20 patients (4.2%) and was successfully treated with oral antibiotic therapy and local wound care. Eight hematomas (1.7%) that developed in the postoperative period were managed conservatively by aspiration. Two patients (0.4%) experienced a postoperative restricted ROM. One of these patients showed clinical improvement with physical therapy, whereas the other did not. In this case, a 10° extension restriction developed during follow-up, and max knee flexion was limited to 90° (Table 2).

Among major complications, deep vein thrombosis developed in 1 patient (0.2%) and was successfully managed with medical treatment. Intraoperative medial collateral ligament injury was detected in 4 patients (0.8%); these cases were successfully treated with primary repair using screw suture anchors and knee brace immobilization for 6 weeks. In 2 patients (0.4%), surgical debridement was performed because of superficial wound necrosis, and negative-pressure wound therapy, also known as vacuum-assisted closure, was used to promote wound healing. One patient (0.2%) experienced a dislocation following a fall down the stairs during the postoperative period and underwent revision surgery. Additionally, one patient (0.2%) developed an intraoperative tibial periprosthetic fracture; internal fixation was achieved in the same surgical session. Regarding infectious complications, 29 cases (6.0%) that developed early acute infection were treated with debridement, antibiotics, and implant retention with exchange of the polyethylene insert. One patient (0.2%) underwent one-stage revision arthroplasty due to an infection that developed during the second postoperative month. Two-stage revision arthroplasty was performed in 15 patients (3.2%) (Table 2).

No statistically significant differences were found between the groups included in the study with respect to age, gender, follow-up, side (right/left), blood transfusion, surgical time, BMI, ASA score, CCI, and presence of minor complications (for each $p>0.05$) (Table 3).

The presence of major complications differed significantly across KL grades ($p=0.031$). It was found that patients in KL grade 4 developed major complications more frequently than those in KL grade 3. In addition, hospital length of stay showed a statistically significant difference between KL grades ($p=0.004$). It was found that the hospital length of stay was longer in KL grade 4 patients compared to KL grade 3 patients (6.1±2.7 days; 5.5±1.6 days, respectively) (Table 3).

Table 1. Descriptive variables of patients

Variables	n	%
Sex		
Female	398	82.6
Male	84	17.4
Side		
Right	233	48.3
Left	249	51.7
ASA score		
1	11	2.2
2	374	77.5
3	97	20.3
CCI		
0-2	57	11.8
3-4	280	58.1
≥5	145	30.1
KL grade		
3	254	52.7
4	228	47.3

Table 1. Continued		
Variables	**n**	**%**
Blood transfusion		
Negative	180	37.3
Positive	302	62.7
Blood transfusion (unit)		
0	180	37.3
1	124	25.7
2	123	25.5
3	38	7.9
4	10	2.1
5	7	1.5
Minor complication		
Negative	434	90.0
Positive	48	10.0
Major complication		
Negative	428	88.8
Positive	54	11.2
	$\bar{x}$ ± SD	**M (min-max)**
Age (year)	67.7±6.7	68.0 (55.0-87.0)
Follow-up (month)	19.4±8.7	18.4 (6.3-36.2)
BMI	26.6±2.0	27.0 (21.0-34.0)
Surgical time (minute)	100.5±24.6	100.0 (40.0-190.0)
Length of stay (day)	5.8±2.2	5.0 (3.0-27.0)
Blood transfusion (unit)	1.9±0.9	2.0 (1.0-5.0)

n: Number of patients, %: Column percentage, $\bar{x}$ ± SD: Mean ± standard deviation, M: Median, min: Minimum, max: Maximum, BMI: Body mass index, ASA: American Society of Anesthesiologists, CCI: Charlson comorbidity index, KL: Kellgren–Lawrence

Table 2. Distribution of complications in groups						
	All patients		**KL grade 3**		**KL grade 4**	
	n	**%**	**n**	**%**	**n**	**%**
Minor complication	48	10.0	23	9.0	25	11.0
Prolonged wound drainage	18	3.7	11	4.3	7	3.1
Superficial wound infection	20	4.2	8	3.1	12	5.3
Hematoma	8	1.7	3	1.2	5	2.2
Restricted ROM	2	0.4	1	0.4	1	0.4
Major complication	54	11.2	21	8.3	33	14.5
Superficial wound necrosis	2	0.4	-	-	2	0.9
Infection (DAIR)	29	6.0	12	4.7	17	7.5
Infection (two-stage revision)	15	3.2	5	2.0	10	4.4
Infection (one-stage revision)	1	0.2	1	0.4	-	-
DVT	1	0.2	-	-	1	0.4
Dislocation	1	0.2	-	-	1	0.4
Intraoperative periprosthetic fracture	1	0.2	1	0.4	-	-
Intraoperative MCL injury	4	0.8	2	0.8	2	0.9

KL: Kellgren–Lawrence, ROM: Range of motion, DAIR: Debridement, antibiotic, and implant retention, DVT: Deep vein thrombosis, MCL: Medial collateral ligament

Table 3. Comparison of variables according to groups					
Variables	**KL grade 3**		**KL grade 4**		**p value**
	n	**%**	**n**	**%**	
Sex					
Sex	213	83.9	185	81.1	0.432
Male	41	16.1	43	18.9	
Side					
Right	129	50.8	104	45.6	0.256
Left	125	49.2	124	54.4	
ASA score					
1	8	3.1	3	1.3	0.336
2	170	66.9	176	77.2	
3	76	29.9	49	21.5	
CCI					
0-2	24	9.4	33	14.5	0.152
3-4	147	57.9	133	58.3	
≥5	83	32.7	62	27.2	
Blood transfusion (unit)					
0	96	37.8	84	36.8	0.646
1	68	26.8	56	24.6	
2	59	23.2	64	28.1	
≥3	31	12.2	24	10.5	
Blood transfusion					
Negative	96	37.8	84	36.8	0.829
Positive	158	62.2	144	63.2	
Minor complication					
Negative	231	90.9	203	89.0	0.485
Positive	23	9.1	25	11.0	
Major complication					
Negative	233	91.7	195	85.5	0.031
Positive	21	8.3	33	14.5	
	$\bar{x}$ ± SD	**M (min-max)**	**$\bar{x}$ ± SD**	**M (min-max)**	
Age (year)	67.8±6.6	68.0 (56.0-85.0)	67.7±6.9	68.0 (55.0-87.0)	0.830
Follow-up (month)	19.0±9.4	16.9 (6.3-36.2)	19.9±7.8	19.5 (6.5-35.9)	0.105
BMI	26.7±2.0	27.0 (21.0-34.0)	26.5±2.0	27.0 (21.0-29.0)	0.592
Surgical time (minute)	99.7±26.8	100.0 (40.0-190.0)	101.3±22.0	105.0 (45.0-160.0)	0.202
Length of stay (day)	5.5±1.6	5.0 (3.0-15.0)	6.1±2.7	5.0 (3.0-27.0)	0.004
Blood transfusion (unit)	1.9±1.0	2.0 (1.0-5.0)	1.8±0.8	2.0 (1.0-5.0)	0.820

KL: Kellgren–Lawrence, n: Number of patients, %: Column percentage, ASA: American Society of Anesthesiologists, CCI: Charlson comorbidity index. $\bar{x}$ ± SD: Mean ± standard deviation, M: median, min: Minimum, max: Maximum, BMI: Body mass index

DISCUSSION

The results demonstrated that the preoperative radiographic severity of OA in patients undergoing primary TKA was significantly associated with length of hospital stay and early postoperative complications. Hospital length of stay was longer in KL grade 4 patients, and the rate of early-period major complications was significantly higher than that in KL grade 3 patients. One possible explanation for this relationship is that the KL classification exhibits a pronounced ceiling effect in advanced knee OA and does not provide sufficient detail for severe cases. KL grade 4 defines advanced disease, in which the joint space is completely lost; however, it does not sufficiently differentiate among parameters such as the degree of deformity, bone loss, osteophyte burden, and soft-tissue contracture, which can directly affect surgical difficulty and early rehabilitation. Therefore, it is possible for a patient with a completely closed joint space but minimal deformity to be assigned the same grade (KL 4) as a patient with advanced deformity and severe contracture. Keenan et al.[10] have highlighted the limited discriminatory power of the KL grading system in advanced OA. Although the degrees of deformity and soft tissue contracture were not objectively measured in our study, it is likely that cases with more complex deformities and contractures were relatively more prevalent in the KL grade 4 group. In this patient group, more challenging surgical exposure, increased need for ligament balancing, and delayed postoperative rehabilitation may be associated with prolonged hospital stay and increased risk of early postoperative complications.

The observation that KL grade 4 patients had longer hospital stays in our study is an important finding with significant implications for healthcare resource utilisation and costs. A review of the relevant literature shows that prolonged hospital stay is associated with increased rates of complications and readmissions following joint arthroplasty.[10-13] The most important reasons for this are the frequent occurrence of marked joint deformities, widespread osteophyte formation, subchondral bone changes, and capsular contractures in KL grade 4 knee OA. These structural changes can make the surgical procedure more complex from a technical point of view. As a result, postoperative pain control may become more difficult, and early mobilisation may be delayed. The time to achieve functional independence may be prolonged. Consequently, an increase in hospital length of stay may be anticipated. None of the patients in our study experienced complications that prolonged length of hospital stay, except for prolonged wound drainage. All complications, except for medial collateral ligament injury and periprosthetic fracture, developed after discharge. Considering that prolonged wound drainage is a minor complication treated conservatively, the degree of OA is responsible for the longer hospital stay.

Another important finding was that the rate of early major complications was significantly higher among patients with KL grade 4. We believe that there are two reasons for this. The expected progression of OA to the final radiographic grade may increase joint deformity and capsular contracture, thereby making surgery more difficult. Second, in advanced OA, the decline in joint-related functional capacity and lower-extremity muscle strength may lead to deterioration in patients' overall health, making them more susceptible to complications. Indeed, studies have shown that advanced knee OA is associated with frailty syndrome, characterised by a decline in physical reserves and reduced physiological resilience to stress, and may increase frailty.[14] Although traditional risk classification systems such as ASA and CCI reflect the general health status of patients, an advanced radiographic stage of OA may increase the risk of early complications independent of the burden of systemic comorbidity. It should be borne in mind that these indices, which are frequently used in clinical practice, may not be sufficient on their own to predict the risk of early postoperative complications after TKA.

In recent years, insurance companies in many developed countries, particularly the United States, have introduced pre-authorisation criteria for TKA and restricted surgery to patients with KL grade 4 OA.[4] This approach is based on the assumption that the clinical benefit of surgery may be lower for patients with early-grade OA.[15,16] However, our study shows that delaying surgery until the radiographic end-stage may create disadvantages in terms of hospital length of stay and early major complications. The KL classification system cannot clearly distinguish the severity within advanced OA. Therefore, we believe that radiographic grade should not be the sole criterion for surgical decision-making. This approach may lead to the postponement of definitive treatment, particularly in symptomatic KL grade 3 patients. This is an important parameter that may affect early hospital-based outcomes. Our study shows that preoperative radiographic OA severity is associated with early hospital-based outcomes after primary TKA. Longer hospital stays and higher rates of early-period major complications have been observed among KL grade 4 patients. These findings suggest that an advanced radiographic stage may be a clinical indicator affecting not only disease severity but also the early postoperative recovery process and hospital resource utilisation.

This study has some limitations. The retrospective design precludes establishing causal relationships, and unmeasured confounding variables may have influenced the results. The lack of patient-reported outcome measures and long-term functional outcome assessments limits the study to early hospital-based outcomes. Furthermore, the lack of assessment of the inter- and intra-observer reliability of radiographic evaluations may increase the risk of observer bias. Nevertheless, the analysis of a large patient cohort, a homogeneous surgical procedure, and standardised early-period outcomes is among the strengths of this study.

CONCLUSION

This study demonstrates that the preoperative KL grade in patients undergoing primary TKA may create clinically significant differences in hospital length of stay and early postoperative major complications. Patients with KL grade 4 OA were found to have longer hospital stays and higher rates of early major complications. These findings suggest that severe radiographic OA may increase surgical complexity and impair early postoperative recovery, independent of systemic comorbidity scores. Prospective, multicentre studies will support the evaluation of advanced-stage OA through the use of more detailed radiographic classifications and the development of clinical decision algorithms for optimal timing of surgery.

Ethics

Ethics Committee Approval: This retrospective study was approved by the İzmir Katip Çelebi University Institutional Review Board (approval number: 0015, date: 15.01.2026).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: Y.Ö., M.T., T.K., T.B., Concept: Y.Ö., M.T., T.B., Design: Y.Ö., M.T., T.K., Data Collection or Processing: Y.Ö., T.K., Analysis or Interpretation: Y.Ö., T.B., Literature Search: Y.Ö., T.B., Writing: Y.Ö., M.T., T.B.

Conflict of Interest: No conflict of interest was declared by the authors.

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