

# Outcomes After Total Knee Arthroplasty in Patients With a History of Patella Fracture: A Propensity Score–Matched Analysis

Brian P. McCormick, MD 

Sean B. Sequeira, MD

Mark D. Hasenauer, MD

Robert P. McKinstry, MD

Frank R. Ebert, MD

Henry R. Boucher, MD

From the Department of Orthopaedic Surgery, MedStar Union Memorial Hospital, Baltimore, MD

Correspondence to Dr. McCormick: brian.p.mccormick1@gmail.com

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## ABSTRACT

**Background:** Posttraumatic osteoarthritis is a common indication for total knee arthroplasty (TKA). The purpose of this study was to evaluate the association between a history of patella fracture and postoperative complication rates after TKA.

**Methods:** Patients diagnosed with a patella fracture before undergoing TKA were identified from a large national database and matched to a control cohort using propensity scoring. Rates of medical complications occurring within 90 days of TKA and surgery-related complications occurring within 1 year of TKA were compared using odds ratios. Healthcare utilization outcomes including 90-day emergency department (ED) presentation, hospital readmission, and total cost were also compared.

**Results:** Compared with a propensity-matched control cohort, TKA patients with a history of patella fracture had a lower incidence of pulmonary embolism (OR 0.74,  $P = 0.0442$ ) and higher incidences of periprosthetic joint infection (OR 1.68,  $P < 0.0001$ ), revision surgery (OR 1.84,  $P < 0.0001$ ), dislocation (OR 1.61,  $P = 0.026$ ), lysis of adhesions (OR 2.21,  $P = 0.0082$ ), and wound disruption (OR 1.52,  $P < 0.0001$ ). A history of patella fracture was also associated with an increased rate of ED presentation (OR 1.08,  $P = 0.0454$ ) and increased total cost (\$14,359 vs. \$12,786,  $P = 0.0003$ ).

**Conclusion:** A history of patella fracture is associated with early surgery-related complications after TKA including periprosthetic joint infection, revision surgery, dislocation, lysis of adhesions, and wound disruption. Healthcare utilization is increased among these patients with higher rates of ED presentation and increased total cost. These findings allow for more accurate risk stratification and counseling of patients.

**Level of evidence:** III, Retrospective review.

**T**otal knee arthroplasty (TKA) is a reliable treatment option for patients with end-stage arthritis who have failed other treatment modalities.<sup>1</sup> Posttraumatic osteoarthritis (PTOA) is a common cause of degenerative joint disease, and 12% of symptomatic osteoarthritis (OA) can be attributed to PTOA.<sup>2</sup> Previous studies have demonstrated poorer outcomes and increased complication rates among patients undergoing TKA for treatment of PTOA, although most of these studies have investigated patients with previous distal femur or proximal tibia fractures.<sup>3-5</sup>

The patella is a sesamoid bone in the extensor mechanism that functions as a lever to augment the force of the quadriceps.<sup>6</sup> Goals of treating patella fractures include maintaining patellofemoral joint congruity and extensor mechanism function. Nonsurgical treatment is, therefore, a viable option among patients with an intact extensor mechanism and minimal articular step-off. Osteosynthesis is recommended for fractures with notable displacement of the articular surface and can be performed with a tension band construct, lag screws, or a locking plate depending on the fracture pattern.<sup>7,8</sup> Patella fractures often result in poor functional outcomes and PTOA,<sup>6,9</sup> and the incidence of TKA among this patient population is higher than in the general population.<sup>10</sup> Furthermore, patella fractures are potentially devastating complications after TKA and often require revision surgery, although there are few previous studies investigating a history of patella fracture as a risk factor of complications after TKA.<sup>11</sup>

It is important to identify risk factors of sustaining postoperative complications after TKA so that patients may be counseled appropriately. Identifying risk factors may also open the doors to future research to discover new ways to mitigate perioperative risk among specific patient populations. Given the lack of data regarding complications after TKA among patients with a history of patella fracture, it is important to better understand the risks associated with this injury. The purpose of this study was to evaluate the association between previous patella fracture and postoperative complication rates after TKA.

## Methods

This is a retrospective cohort study using the commercially available M157Ortho database by PearlDiver (PearlDiver Inc.). This database contains deidentified records of 157 million patients in the United States in accordance with the Health Insurance Portability and

Accountability Act. Patient records were queried using International Classification of Diseases (ICD) codes and Current Procedural Terminology codes. This study was deemed exempt from our institution's review board because all queried data were already deidentified in accordance with the Health Insurance Portability and Accountability Act.

Patients who underwent primary TKA with at least 1 year of postoperative follow-up were identified using Current Procedural Terminology and ICD codes. A test group of patients with a diagnosis of patella fracture before their index procedures was identified using ICD codes. Patients in the test group were matched to a control cohort using a propensity-scoring methodology based on Charlson Comorbidity Index (CCI) and Elixhauser Comorbidity Index (ECI) scores. These comorbidity index scores were compared between cohorts using means and standard deviations to ensure that the propensity-scoring methodology was successful in creating similar groups (Table 1).

90-day incidences of deep vein thrombosis, pulmonary embolism (PE), urinary tract infection, acute kidney injury, pneumonia, sepsis, cerebrovascular accident (CVA), and myocardial infarction were evaluated as medical complications. 1-year surgery-related complications were evaluated, including periprosthetic joint infection (PJI), revision surgery, dislocation, manipulation under anesthesia (MUA), lysis of adhesions (LOA), implant loosening, and wound disruption. Average total cost and 90-day incidences of emergency department (ED) presentations and hospital readmissions were evaluated as healthcare utilization outcomes. Hospital readmission was defined as occurring between 2 and 90 days postoperatively to avoid capturing patients who had planned postoperative admissions. Odds ratios (ORs) and 95% confidence intervals were calculated for each variable using R (University of Auckland, New Zealand). A *P*-value less than 0.05 was considered statistically significant.

## Results

8,519 patients with a history of patella fracture were matched to 8,115 control patients using propensity scoring. The patella fracture cohort contained a lower percentage of women and tended to be younger compared with the control cohort, although ECI and CCI scores were similar between groups, as presented in Table 1. Patients with a history of patella fracture had a lower incidence of PE (OR 0.74, *P* = 0.0442) (Table 2)

**Table 1. Patient Demographics and Comorbidity Indices**

	Patella Fracture (n = 8519)	Control (n = 8115)	OR	95% CI	P
Age					
30-39	94	33	<b>2.73</b>	<b>1.84-4.07</b>	<b>&lt;0.0001</b>
40-49	461	350	<b>1.27</b>	<b>1.10-1.46</b>	<b>0.01</b>
50-59	1759	1659	1.01	0.94-1.09	0.7444
60-69	2933	3182	<b>0.81</b>	<b>0.76-0.87</b>	<b>&lt;0.0001</b>
70+	3548	3789	<b>0.81</b>	<b>0.77-0.87</b>	<b>&lt;0.0001</b>
Female sex	5762	5798	<b>0.84</b>	<b>0.78-0.89</b>	<b>&lt;0.0001</b>
ECI, mean (SD)	5.89 (3.84)	5.98 (3.98)	—	0.1377	
CCI, mean (SD)	2.27 (2.49)	2.29 (2.53)	—	0.6074	

CCI = Charlson Comorbidity Index, ECI = Elixhauser Comorbidity Index, Bold entries indicate that the result is statistically significant with a P value <0.05.

and higher incidences of PJI (OR 1.68,  $P < 0.0001$ ), revision surgery (OR 1.84,  $P < 0.0001$ ), dislocation (OR 1.61,  $P = 0.026$ ), LOA (OR 2.21,  $P = 0.0082$ ), and wound disruption (OR 1.52,  $P < 0.0001$ ) (Table 3). A history of patella fracture was also associated with an increased rate of ED presentation (OR 1.08,  $P = 0.0454$ ) and increased total cost (\$14,359 vs. \$12,786,  $P = 0.0003$ ) with no significant difference in the rate of inpatient readmission (OR 1.03,  $P = 0.554$ ; Table 4).

### Discussion

This study revealed that patients with a history of patella fracture are at increased risk of early surgery-related complications and associated with increased healthcare utilization after TKA. These findings allow for more accurate risk stratification and patient counseling before undergoing this procedure.

The patella serves a vital role in the function of the extensor mechanism whether in a native or prosthetic knee. We found that a history of patella fracture was associated with increased risk of PJI (OR 1.68,  $P < 0.0001$ ), revision (OR 1.84,  $P < 0.0001$ ), LOA (OR 2.21,  $P = 0.0082$ ), and wound disruption (OR 1.52,  $P < 0.0001$ ) after TKA. These findings are consistent with current literature regarding patients with a history of knee surgery before TKA because studies have shown increased risk of postoperative complications among patients with a history of knee arthroscopy,<sup>12</sup> ligamentous knee surgery,<sup>13</sup> fracture, or osteotomy.<sup>14</sup> Previous studies have also shown high complication rates and poor outcomes among patients with PTOA undergoing TKA, although most of these studies have evaluated patients with PTOA secondary to distal femur or proximal tibia fractures,<sup>3-5,15</sup> and we are only aware of one existing study investigating patients with

**Table 2. 90-Day Medical Complications**

	Patella Fracture (n = 8519)		Control (n = 8115)		Statistical Analysis		
	n	%	n	%	OR	95% CI	P
DVT	60	0.70	49	0.60	1.17	0.80-1.71	0.4225
PE	83	0.97	106	1.31	<b>0.74</b>	<b>0.56-0.99</b>	<b>0.0442</b>
UTI	487	5.72	521	6.42	0.88	0.78-1.00	0.0574
AKI	260	3.05	260	3.20	0.95	0.80-1.13	0.5736
PNA	198	2.32	169	2.08	1.12	0.91-1.38	0.2891
Sepsis	69	0.81	51	0.63	1.29	0.90-1.86	0.1679
CVA	38	0.45	32	0.39	1.13	0.71-1.81	0.6067
MI	29	0.34	20	0.25	1.38	0.78-2.45	0.2658

AKI = acute kidney injury, CVA = cerebrovascular accident, DVT = deep vein thrombosis, PNA = pneumonia, UTI = urinary tract infection Bold entries indicate that the result is statistically significant with a P value <0.05.

**Table 3. 1-Year Surgery-Related Complications**

	Patella Fracture (n = 8519)		Control (n = 8115)		Statistical Analysis		
	n	%	n	%	OR	95% CI	P
PJI	359	4.21	207	2.55	<b>1.68</b>	<b>1.41-2.00</b>	<b>&lt;0.0001</b>
Revision	375	4.40	198	2.44	<b>1.84</b>	<b>1.55-2.19</b>	<b>&lt;0.0001</b>
MUA	356	4.18	313	3.86	1.09	0.93-1.27	0.2911
LOA	37	0.43	16	0.20	<b>2.21</b>	<b>1.23-3.97</b>	<b>0.0082</b>
Loosening	57	0.67	36	0.44	1.51	0.99-2.30	0.0529
Wound disruption	270	3.17	171	2.11	<b>1.52</b>	<b>1.25-1.85</b>	<b>&lt;0.0001</b>

PJI = periprosthetic joint infection, MUA = manipulation under anesthesia, LOA = lysis of adhesions  
 Bold entries indicate that the result is statistically significant with a *P* value <0.05.

previous patella fractures.<sup>11</sup> Houdek et al<sup>11</sup> conducted a retrospective chart review study evaluating 113 patients with a history of patella fracture before TKA and found no notable differences in 5-year, 10-year, and 15-year revision-free survival among patients with a history of patella fracture compared with patients undergoing TKA for degenerative osteoarthritis. This contrasts our findings because patients with a history of patella fracture in this study had increased risk of revision surgery (OR 1.84, *P* < 0.0001; Table 3). Houdek et al further reported increased incidences of MUA (9.7% vs. 2.4%, *P* = 0.0001), inability to flex the knee past 90° (16.8% vs. 3.9%, *P* = 0.0001), and arthrofibrosis (4.4% vs. 1.1%, *P* = 0.002) among patients with a history of patella fracture. These findings are consistent with our results as we found that patients with a history of patella fracture were more likely to undergo LOA (OR 2.21, *P* = 0.0082) within 1 year of TKA, although there were no significant differences in rates of MUA (OR 1.09, *P* = 0.2911; Table 3). While both of these studies demonstrate increased risk of surgery-related complications among patients with a history of patella fracture undergoing TKA, advantages of our study include a sample size large enough to detect differences in rates of complications with low incidences such as early revision after TKA. These findings add to the current body of

literature regarding patient-specific risk factors of complications after TKA, allowing for accurate risk stratification and counseling of patients in the preoperative period.

A history of patella fracture was associated with increased healthcare utilization including increased risk of ED presentation within 90 days of TKA (OR 1.08, *P* = 0.0454) and increased total cost (\$14,359 vs. \$12,786, *P* = 0.0003; Table 4). This finding is consistent with previous literature demonstrating increased healthcare utilization including ED presentation among patients with previous knee surgery undergoing TKA.<sup>16</sup> The increased rates of healthcare utilization can likely be attributed to the increased rates of postoperative complications among this patient population.

The rates of medical complications were generally similar between the study and control groups of patients, although patients with a history of patella fracture undergoing TKA were less likely to develop a PE compared with patients in the control group (OR 0.74, *P* = 0.0442; Table 2). Despite similar baseline comorbidities between the cohorts as calculated by ECI and CCI scores, patients in the study group were younger than in the control group (Table 1). Furthermore, patients who sustain a patella fracture may tend to be more active at baseline. The difference in

**Table 4. Healthcare Utilization**

	Patella Fracture (n = 8519)		Control (n = 8115)		Statistical Analysis		
	n	%	n	%	OR	95% CI	P
ED visit	1557	18.28	1387	17.09	<b>1.08</b>	<b>1.00-1.17</b>	<b>0.0454</b>
Inpatient readmission	562	6.60	517	6.37	1.03	0.92-1.17	0.554
Average reimbursement (\$)	14,359 ± 33,168	—	12,786 ± 21,678	—	—	—	<b>0.0003</b>

Bold entries indicate that the result is statistically significant with a *P* value <0.05.

age and hypothetical difference in baseline activity levels may explain the decreased rate of PE noted among patients with a history of patella fracture, although rates of other medical complications were similar between the cohorts.

There are several limitations to this study. International Classification of Diseases codes were used to identify patients with previous patella fractures. We are, therefore, unable to stratify results based on fracture characteristics. As a retrospective database study, our findings are dependent on accurate diagnosis and coding of procedures, although the incidence of inaccuracy is estimated to be less than 1%.<sup>17</sup> The short duration of follow-up presented in this study warrants additional investigations into the long-term outcomes of TKA among this patient population. An advantage of this study is having a sample size large enough to assess for differences in complication rates with low incidences. As a national database study, patients included would have received treatments from a variety of clinicians and environments, making our results broadly applicable to clinical practice.

## Conclusion

Patients with a history of patella fracture are at increased risk of early surgery-related complications after TKA. Healthcare utilization is increased among this patient population with more frequent ED presentations and increased total cost. Clinicians may be guided by this study to accurately risk-stratify and counsel patients with a history of patella fracture before undergoing TKA.

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