

Cost Analysis of Conversion Total Knee Arthroplasty: A Multi-Institutional Database Study

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INTRODUCTION: Total knee arthroplasty (TKA) after prior knee surgery, also known as conversion total knee arthroplasty (convTKA), has been associated with higher complications, resource utilizations, and associated costs. The increased surgical complexity and burden of convTKA may not be reflected by the relative value units (RVU) assigned under the current coding guidelines. The purpose of this study was to compare the RVUs of TKA and convTKA and to calculate the RVU per minute to account for work effort.

METHODS: The American College of Surgeons National Surgical Quality Improvement Project (NSQIP) database was analyzed for the years 2006-2020. CPT codes (27447) and (27447 and 20680) were used to identify patients who underwent primary and convTKA, respectively. After a 1:1 propensity score matching, 1,600 cases were assigned to each cohort. The RVU-to-dollar conversion factor was obtained from the US Centers for Medicare and Medicaid Services (CMS). RVU dollar valuations were calculated per operative time. Univariate analysis on outcome variables were performed utilizing the matched groups. Complication rates were compared using a multivariate logistic regression model controlling for baseline characteristics.

RESULTS: The mean operating time for TKA was 97.8 minutes with a respective RVU per minute of 0.25, while the mean operating time for convTKA was 124.3 minutes with an RVU per minute of 0.19 (p<0.0001). Using the conversion factor of \$36.04 per RVU, this translated to \$8.84 per minute for TKA compared to \$6.90 per minute for convTKA. ConvTKA was associated with increased overall complications (10.9% vs. 7.6%, p<0.0001), higher blood transfusion (6.6% vs. 3.7%, p<0.0001), reoperation (2.3% vs. 1.1%, p<0.0001), and readmission rates (3.7% vs. 2.8%, p<0.0431).

DISCUSSION AND CONCLUSION: The current billing guidelines lead to lower compensation for convTKA, despite its associated complexity. The longer operation times, higher complication rates, and increased resource utilization may disincentivize providers from performing this operation. CPT code revaluation is warranted to reflect the time and effort associated with this procedure.

Table 1
Baseline characteristics for patients undergoing primary TKA versus Conversion TKA. Univariate analysis before and after propensity score matching.

	TKA		ConvTKA		P-value
	No.	Rate (%)	No.	Rate (%)	
Total Patients	102,800	100	35,100	100	
Sex					
Male	242,204	61.7	243,745	61.8	0.91
Female	150,294	38.3	149,815	38.2	0.91
P	2	0	2	0	0.9999
Insurance					
Medicare	105,650	26.5	34,524	98.2	0.0001
Medicaid	56,881	14.5	56,074	16.5	0.0001
Private	188,849	47.5	60,502	17.3	0.0001
Other	15,419	3.9	15,960	4.5	0.0001
Age					
<65 years	13,884	3.5	13,629	3.9	0.33
65-74 years	105,276	26.5	34,524	98.2	0.0001
75-84 years	38,340	9.7	26,209	7.5	0.0001
≥85 years	102,800	26.0	35,100	100	0.0001
P	2	0	2	0	0.9999
Comorbidities					
Hypertension	181,548	45.7	188,914	51.2	0.0001
Diabetes	147,171	37.1	149,815	42.7	0.0001
Dyslipidemia	181,128	45.6	180,151	51.6	0.0001
COPD	87,102	21.9	68,102	19.4	0.0001
Heart Failure	170,101	43.0	177,602	50.6	0.0001
Stroke	118,889	30.0	115,008	32.8	0.0001
Peripheral Vascular Disease	181,128	45.6	180,151	51.6	0.0001
Chronic Kidney Disease	102,800	26.0	35,100	100	0.0001
Pneumonia	102,800	26.0	35,100	100	0.0001
Sepsis	102,800	26.0	35,100	100	0.0001
Blood Transfusion	102,800	26.0	35,100	100	0.0001
Return to the OR	102,800	26.0	35,100	100	0.0001
Readmission	102,800	26.0	35,100	100	0.0001
Death	102,800	26.0	35,100	100	0.0001

Table 2
Work RVU Comparison Between TKA and ConvTKA on matched cohorts.

	TKA	ConvTKA	P-value
	n=102,800	n=35,100	
Work RVU	11,180,276.75	11,243,202.11	0.0001
Operative time	97.8 (±18.7)	124.3 (±14.8)	0.0001
RVU per minute	0.25 (±0.02)	0.19 (±0.02)	0.0001
Dollar per minute	\$8.84 (±1.08)	\$6.90 (±1.07)	0.0001

ConvTKA conversion total knee arthroplasty; TKA, total knee arthroplasty; RVU, relative value unit; 2020 Medicare payment per RVU conversion factor of \$36.04 was used to calculate the dollar amount.

Table 3
Incidence of Adverse Events for Patients Undergoing ConvTKA Versus TKA.

	TKA		ConvTKA		P-value
	Unmatched	Matched	Unmatched	Matched	
Any adverse event	25,534	2.6	174	0.5	<0.0001
SSI	2,668	0.68	20	0.06	0.0001
Wound dehiscence	85	0.2	8	0.03	0.0001
Sepsis	761	0.2	5	0.03	0.0001
Pneumonia	1,168	0.3	3	0.02	0.0001
Intubation	569	0.1	0	0	0.0001
Ischemia	1,862	0.5	2	0.01	0.0001
DVT	3,052	0.8	8	0.02	0.0001
Blood Transfusion	14,534	3.7	106	0.6	0.0001
Acute Renal Failure	205	0.1	0	0	0.0001
UTI	3,009	0.8	18	0.06	0.0001
MI	713	0.2	5	0.03	0.0001
Cardiac Arrest	287	0.1	3	0.02	0.0001
Return to the OR	11,263	2.8	37	0.3	0.0001
Readmission	11,263	2.8	37	0.3	0.0001
Death	271	0.1	2	0.01	0.0001

ConvTKA, conversion total knee arthroplasty; TKA, total knee arthroplasty; SSI, surgical site infection; PE, pulmonary embolism; DVT, deep vein thrombosis; UTI, urinary tract infection; MI, myocardial infarction.

Table 4
Odds of Post-surgical Complications as Related to Patient Demographics and Comorbidities When Comparing ConvTKA to TKA.

Adverse Events	Univariate		Multivariate		P-value
	No.	Percent (%)	Odds Ratio	95% CI	
Any complication	121	3.78	0.6072	1.579	1.2-2.3
SSI	20	1.25	0.0561	1.883	0.089-3.6
Wound dehiscence	8	0.5	0.2089	1.005	0.07-1.3
Blood Transfusion	106	6.65	0.6092	1.715	1.2-2.4
Return to the OR	37	2.61	0.6821	1.385	1.0-1.9
Readmission	37	2.61	0.6094	1.699	1.2-2.3

OR, odds ratio; Any complication: wound, superficial or deep surgical site infection, dehiscence, sepsis, pneumonia, intubation, ischemia, MI, DVT, UTI; SSI, surgical site infection; PE, pulmonary embolism; DVT, deep vein thrombosis; UTI, urinary tract infection; MI, myocardial infarction.