

# Implant Survivorship among Patients with Sickle Cell Disease following Total Knee Arthroplasty

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## INTRODUCTION:

Over 100,000 individuals living in the United States are affected by sickle cell disease (SCD). One common complication of sickle cell disease is osteonecrosis of the knee causing pain and disability. Sickle cell disease patients with severe symptoms may benefit from total knee arthroplasty (TKA), usually at a younger age than other patients. Current literature regarding outcomes after TKA in sickle cell disease patients is limited to few studies with small sample sizes. Moreover, although patients with sickle cell disease are known to have increased rates of complications following TKA, the range of short-term medical complications following TKA is understudied, and both the revision rates and the mid-term survivorship of TKA implants in sickle cell disease patients is unknown in the literature. Therefore, this study aimed to 1) evaluate the effects of a sickle cell disease diagnosis on revision outcomes and 90-day medical complications and 2) to estimate the 10-year survivorship of TKA implants in patients with sickle cell disease.

## METHODS:

A national insurance claims database was used to perform a retrospective cohort analysis. Patients were identified using Current Procedural Terminology and International Classification of Diseases Revision 9 and 10 codes. Patients who underwent TKA with at least a 2-year follow up were included in the study and were followed for a maximum of 10 years. These patients were further stratified based on whether or not they had sickle cell disease. Patients with sickle cell disease were matched in a 1:10 ratio to patients without sickle cell disease by age and gender. Univariate analysis was conducted on demographic characteristics, comorbidities, and postoperative complications using Pearson chi-square analysis. If a postoperative outcome was significant on univariate analysis ( $p < 0.05$ ), a multivariable analysis using logistic regression was conducted to adjust for other potential risk factors. In order to determine factors for adjustment, demographics and comorbidities with  $p$ -values of  $< 0.20$  were included in the multivariable analysis. Additionally, a 10-year Kaplan-Meier survival analysis was performed to estimate an implant survival curve free from revision for TKA patients with sickle cell disease compared to those without sickle cell disease.

## RESULTS:

A total of 572 patients with sickle cell disease were age- and gender-matched in a 1:10 ratio to 5,720 patients who received TKA without sickle cell disease. Patient demographic information can be found in Table 1. The average follow-up time for TKA patients with sickle cell disease was  $6.66 \pm 2.95$  years and the average follow-up time for TKA patients without sickle cell disease was  $4.93 \pm 3.14$  years. Multivariate logistic regression analysis demonstrated that patients with sickle cell disease had higher incidence of 30-day all-cause revision (OR 10.64; 95% CI 6.68-16.94;  $p < 0.001$ ; Table 2) and 90-day revision (OR 4.00; 95% CI 2.81-5.70;  $p < 0.001$ ; Table 2). Additionally, TKA patients with sickle cell disease had higher rates of 90-day medical complications including surgical site infection, stroke, sepsis, and hospital readmission, all of which remained significant even after multivariate adjustment ( $p < 0.001$  for all; Table 2). Furthermore, TKA patients with sickle cell disease exhibited lower 10-year implant survivorship free from all-cause revision ( $p = 0.04$ ; Fig. 1).

## DISCUSSION AND CONCLUSION:

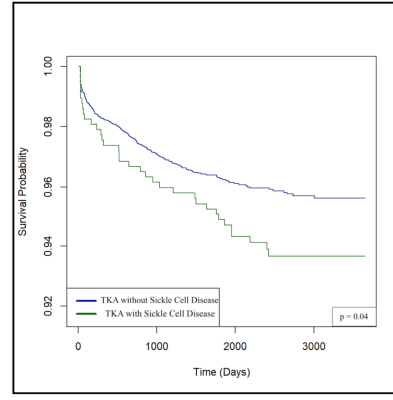
This study shows that patients undergoing TKA with sickle cell disease have increased postoperative risk for all-cause revision, hospital readmission, and several 90-day medical complications. Additionally, over a 10-year period, TKA with sickle cell disease have lower implant survivorship rates free from revision compared to patients without sickle cell disease. This information can help in counseling patients and setting appropriate expectations. Further research is warranted to better understand the etiologies of revision in this patient population so that appropriate interventions can be designed to prevent them from occurring.

**Table 1: Demographics Characteristics of TKA Patients with or without Sickle Cell Disease**

	TKA with Sickle Cell Disease		TKA without Sickle Cell Disease		P-Value
	n	%	n	%	
Total	572	-	5720	-	-
Age (year)	57.0	-	56.9	-	0.802
Gender (male)	123	21.50%	1230	21.50%	1.00
Congestive Heart Failure	168	29.37%	636	11.12%	<b>&lt;0.001</b>
Arrhythmia	296	51.75%	1793	31.35%	<b>&lt;0.001</b>
Valvular Disease	176	30.77%	964	16.85%	<b>&lt;0.001</b>
Pulmonary Circulatory Disorder	168	18.88%	375	6.56%	<b>&lt;0.001</b>
Peripheral Vascular Disease	196	34.27%	963	15.79%	<b>&lt;0.001</b>
Hypertension	453	79.20%	3385	59.18%	<b>&lt;0.001</b>
Paralysis	33	5.77%	106	1.85%	<b>&lt;0.001</b>
Neurological Disorder	84	14.69%	420	7.34%	<b>&lt;0.001</b>
Pulmonary Disease	294	51.40%	1931	33.76%	<b>&lt;0.001</b>
Diabetes Mellitus	277	48.43%	1769	30.93%	<b>&lt;0.001</b>
Hypothyroidism	169	29.55%	1582	27.66%	0.362
Chronic Kidney Disease	191	33.39%	650	11.36%	<b>&lt;0.001</b>
Liver Disease	136	23.78%	853	14.91%	<b>&lt;0.001</b>
Peptic Ulcer Disease	29	5.08%	103	1.80%	<b>0.002</b>
Lymphoma	16	2.80%	65	1.14%	<b>0.002</b>
Metastatic Cancer	30	5.24%	184	3.22%	<b>0.015</b>
Cancer without Metastasis	107	18.71%	800	13.99%	<b>0.003</b>
Rheumatoid Arthritis/Collagen Disorder	177	30.94%	1083	18.93%	<b>&lt;0.001</b>
Copd/emphysema	174	30.42%	752	13.15%	<b>&lt;0.001</b>
Fluid and Electrolyte Disorder	301	52.62%	1661	28.69%	<b>&lt;0.001</b>
Blood Loss Anemia	49	8.57%	280	4.90%	<b>&lt;0.001</b>
Deficiency Anemia	237	41.43%	944	16.50%	<b>&lt;0.001</b>
Alcohol Abuse	15	2.62%	59	1.03%	<b>0.002</b>
Drug Abuse	118	20.63%	543	9.49%	<b>&lt;0.001</b>
Psychoses	45	7.87%	204	3.57%	<b>&lt;0.001</b>
Depression	241	42.13%	2268	39.65%	0.266
Smoking	142	24.83%	1025	17.92%	<b>&lt;0.001</b>
Obesity	192	33.57%	2028	35.45%	0.393

**Table 2: Multivariate Analysis of Surgical Complications and 90-Day Medical Complications for TKA Patients with Sickle Cell Disease**

Outcome	Odds Ratio	95% Confidence Interval	P-Value
<b>Surgical Complications</b>			
2-Year All-Cause Revision	0.84	0.67-1.07	0.152
90-Day All-Cause Revision	4.00	2.81-5.70	<b>&lt;0.001</b>
30-Day All-Cause Revision	10.64	6.68-16.94	<b>&lt;0.001</b>
<b>90-Day Medical Complications</b>			
Hospital Readmission	2.29	1.98-2.65	<b>&lt;0.001</b>
Surgical Site Infection	15.21	11.79-19.61	<b>&lt;0.001</b>
Renal Failure	6.52	4.92-8.65	<b>&lt;0.001</b>
Anemia	1.33	1.19-1.48	<b>&lt;0.001</b>
Atrial Fibrillation	21.89	18.05-26.55	<b>&lt;0.001</b>
Other Arrhythmia	26.97	21.89-33.22	<b>&lt;0.001</b>
Blood Transfusion	44.43	37.21-53.05	<b>&lt;0.001</b>
Death	22.31	6.31-78.85	<b>&lt;0.001</b>
Deep Vein Thrombosis	2.86	2.18-3.76	<b>&lt;0.001</b>
Heart Failure	24.22	17.88-32.80	<b>&lt;0.001</b>
Pulmonary Embolism	8.49	5.75-12.55	<b>&lt;0.001</b>
Pneumonia	95.19	73.01-124.12	<b>&lt;0.001</b>
Respiratory Complications	22.34	13.53-36.86	<b>&lt;0.001</b>
Sepsis	19.29	13.89-26.80	<b>&lt;0.001</b>
Stroke	298.10	170.95-519.82	<b>&lt;0.001</b>
Urinary Tract Infection	10.41	8.91-12.16	<b>&lt;0.001</b>
Bleeding Complications	8.98	5.73-14.06	<b>&lt;0.001</b>



**Fig. 1: Kaplan-Meier implant survivorship curve for TKA patients with or without sickle cell disease.**