A Predictive Model for 90-day Postoperative Periprosthetic Fracture Following Primary Total Knee Arthroplasty

Travis Mark Kotzur[1], Aaron Singh, Lindsey Noelle Peng, William Harrison Young, Frank A Buttacavoli[2], Chance C Moore
[1]University of Texas Health San Antonio, [2]University of Texas Health

INTRODUCTION: Periprosthetic fracture (PPFx) is a significant complication after primary total knee arthroplasty (TKA), with a rare incidence of 0.2% but potentially severe consequences. To mitigate this risk, it is crucial to have reliable tools for predicting PPFx . This study aims to evaluate various machine learning models to construct a predictive model using the Elixhauser Comorbidity Index to assess PPFx risk following primary TKA.

METHODS: We analyzed data from 1,166,972 patients who underwent primary elective TKA, sourced from the National Readmissions Database (2016-2020). The data was split into a training set (80%) and a testing set (20%). We applied four machine learning models—logistic regression, gradient boosting (GBM), neural networks (NN), and random forests (RF)—to predict PPFx. Independent variables included the 31 Elixhauser comorbidities, along with patient age and gender. The best model's coefficients were normalized between -5 and 5 to create a risk stratification system. A comprehensive predictive model was then developed based on the entire dataset.

RESULTS: Logistic regression emerged as the most effective model for predicting PPFx, achieving an AUC of 0.786. The performance of the other models was as follows: NN (AUC 0.752), GBM (AUC 0.774), and RF (AUC 0.759). The logistic regression model coefficients were used to assign risk scores to patients, categorizing them into low risk (<10), moderate risk (10-14), high risk (15-19), and very high risk (20+). Moderate-risk patients exhibited a 2.98-fold increased risk of PPFx compared to low-risk patients. High-risk patients had a 13.06-fold increase, and very high-risk patients had a 19.92-fold increase in PPFx risk.

DISCUSSION AND CONCLUSION: Periprosthetic fractures present a critical challenge post-TKA, necessitating effective risk stratification tools to aid in patient management. This study utilized the Elixhauser Comorbidity Index to develop a model that accurately predicts 90-day PPF risk, facilitating better clinical decision-making and patient care.

Periprosthetic Fracture 90-Day Risk

	OR	95% Lower CI	95% Upper CI	*P*
Low Risk	1.00			
Moderate Risk	2.98	2.49	3.57	**<0.001**
High Risk	13.06	10.78	15.82	**<0.001**
Very High Risk	19.92	16.57	23.95	**<0.001**

Odds Ratio