Predictive Models for Informed Decision Making in Knee Arthroplasty

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INTRODUCTION:
Accurately identifying patients who will not benefit from total knee arthroplasty (TKA) is crucial for surgeons, as it allows better patient selection. However, existing models need to be both accurate and easy to use in a clinical setting. In this study, we present regression-based approach that can predict patient-reported outcomes at 6 weeks and 3 months after surgery, providing surgeons with valuable insights into postoperative recovery.
METHODS:
A real-world dataset of 650 total knee arthroplasty patients (2018-2022) was analyzed. Patients used a user-friendly monitoring app to record pain levels, crutches usage, activity, and medication. Outcome measures, including the Oxford knee score and KOOS subscales, were measured. We used Boruta feature selection and applied cross fold validation, leaving out a test set representing 10% of the dataset. The best performing regression models were selected for each patient-reported outcome measure.
RESULTS:
The regression models provided accurate predictions, particularly for KOOS symptoms (Mean absolute error MAE<3). Other KOOS subscales had MAEs ranging from 12 to 15, and the Oxford knee score had MAEs of 5 (6 weeks) and 6 (3 months). These precise predictions empower surgeons with valuable information to anticipate and address postoperative challenges.
DISCUSSION AND CONCLUSION:
Integrating these models into clinical decision support systems could enhance patient selection and satisfaction. Surgeons can engage in informed discussions with patients about expected outcomes at 6 weeks and 3 months after knee arthroplasty. Future enhancements incorporating objective data, like physical activity or imaging features, can further improve model accuracy. Surgeons can leverage this research to refine their approaches, optimize patient outcomes, and achieve higher success rates in total knee arthroplasty procedures.

PROMS scoring and covariates selection: Models training and selection

PROMS	Model	MAE (SD)	MSE (SD)	RMSE (SD)	R2
koos_symptoms_6w	Huber Regressor	2.50 (±0.01)	10.40 (±0.73)	3.22 (±0.11)	0.96 (±0.01)
koos_pain_6w	Random Forest Regressor	13.30 (±1.00)	273.25 (±29.07)	16.50 (±0.89)	0.39 (±0.09)
koos_ADL_6w	Ridge Regression	12.71 (±1.31)	261.16 (±41. 18)	16.11 (±1.22)	0.38 (±0.09)
koos_QoL_6w	Lasso Regression	13.89 (±1.51)	318.60 (±41. 18)	17.75 (±1.87)	0.24 (±0.08)
oks_6w	Bayesian Ridge Regression	6.02 (±0.65)	55.46 (±7.16)	7.43 (±0.69)	0.42(±0.05)
Rom_6w	AdaBoost Regressor	10.19 (±2.73)	220.51 (±19.71)	13.83 (±5.39)	0.37 (±0.04)
koos_symptoms_3m	Ridge Regression	2.49 (±0.21)	10.53 (±2.15)	3.22 (±0.33)	0.97 (±0.01)
koos_pain_3m	Linear Regression	14.70 (±1.77)	314.69 (±65.64)	17.63 (±1.88)	0.35 (±0.08)
koos_ADL_3m	Linear Regression	12.37 (±1.78)	235.02 (±53. 10)	15.22 (±1.77)	0.38 (±0.04)
koos_QoL_3m	Bayesian Ridge Regression	15.61 (±0.96)	378.11 (±51. 14)	19.40 (±1.30)	0.22 (±0.07)
oks_3m	Huber Regressor	5.53 (±0.53)	51.88 (±11.23)	7.16 (±0.76)	0.39 (±0.03)