Body Mass Index and Subcutaneous Thickness as Predictors of Infection Following Total Knee Arthroplasty

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INTRODUCTION: Total Knee Arthroplasty (TKA) is an increasingly performed procedure, with nearly one million cases being performed in the USA in 2024. The prevalence of obesity in this cohort is over-represented, with studies estimating it to be over 50%. Higher BMI is consistently associated with increased risk of infection, and recent studies have focused on subcutaneous thickness (STT) around the knee as an independent risk factor for periprosthetic joint infection (PJI) after TKA. The incidence of surgical site infection (SSI) after TKA is typically reported between 0.7% and 3.4%. Deep surgical infection (DSI) rates are around 0.7%, while periprosthetic joint infection (PJI) occurs in approximately 2% of cases. Wound dehiscence is less frequently reported but is closely linked to patient factors such as obesity and local tissue characteristics. Increased anterior and medial knee STT may be associated with higher infection rates, even among patients with BMI <30 kg/m². We conducted a retrospective review and collected radiographic information about STT and demographic information to predict SSI, DSI, PJI, and wound dehiscence following TKA.

METHODS: The EPIC Electronic Health Record system was retrospectively reviewed for all nonpregnant patients over 18 years old that had primary elective TKA done at University of Illinois Chicago within a set timeframe (n=534; 69.10% Female, 31.90% Male). Exclusion criteria included traumatic indication for TKA, missing X-Ray, loss to follow-up, and X-Ray images with significant malrotation. Information is stored in a deidentified and secured manner. Demographic data include age, sex, BMI, Hypertension, Diabetes, Immunocompromise, Tobacco use, Steroid or Immunosuppressant use, Hypothyroidism, Chronic Kidney Disease, Heart Failure, Hyperlipidemia, Anticoagulant use, and American Society of Anesthesiologist classification on overall health. Operative details include length of operation, and outcomes recorded are SSI, DSI, PJI, and wound dehiscence within 90 days. To record radiographic measurements at the most recent pre-operative X-Ray: AP weightbearing image used to record Knee Adipose Index (KAI) by dividing the skin-to-skin thickness over the tibial plateau and dividing by the bone-to-bone thickness. Lateral weightbearing image used to record flexion angle of knee, Prepatellar fat thickness ratio (PFTR) by dividing the skin-to-skin thickness above the midpoint of the patella over the bone-to-bone thickness, Femoral periarticular soft tissue index (fPATSI) by dividing the skin-to-skin thickness by the bone-to-bone thickness above the femoral condyles, and Tibial periarticular soft tissue index (tPATSI) by dividing the skin-to-skin thickness by the bone-to-bone thickness above the tibial plateau.

RESULTS: Multivariate logistic regression was used to correlate the overall risk of infection to BMI and each of the measured radiographic variables (Table 1). A best-fit curve was then generated for each risk factor, and the area under the curve (AUC) was measured as a marker of accuracy (Table 2). This model was also plotted (Table 3). Both increased STT and higher BMI were associated with elevated risk of infections, consistent with prior large-scale studies. Notably, the morbidly obese subgroup exhibited over threefold increased risk. However, none of these associations reached statistical significance.

DISCUSSION: This retrospective review analyzed nearly 500 patient charts, and although findings of increased STT and BMI predicting infection correlated with previous literature on this topic, the associations were not statistically significant, likely due to the low incidence of infections and the limited sample size. Differences in flexion angle and X-Ray rotation make radiographic measurements less reliable, and although radiographic measurements were reviewed by multiple researchers, there were still differences of up to 10% in measurement accuracy. Future studies may conduct similar reviews in larger sample sizes to increase power size and may look for ways to standardize measurements among different flexion angles, degrees of rotation, and increase inter-reviewer reliability through collaborative data collection.

CLINICAL RELEVANCE: BMI is useful for predicting complications after TKA, and surgeons impose a BMI cutoff that patients must reach, commonly under 40, to receive TKA. Only 20% of patients denied TKA because they have a BMI over 40 go on to lose the weight required to undergo TKA. Further, the pain and function benefits that TKA provides to patients with a BMI over 40 may outweigh the increased risk of complications. A high STT has more adipose tissue, and this relatively avascular tissue can serve as a site for infectious organisms to grow. BMI is not necessarily indicative of soft tissue envelope thickness, and the concept of "fat distribution" may have more clinical relevance than BMI.

Measure	Any Infection OR (95% CI)	P-value
PFTR	1.15 (0.30, 4.37)	0.84
KAI	1.01 (0.97, 1.06)	0.53
tPASTI	1.01 (0.97, 1.05)	0.6
fPASTI	1.02 (0.98, 1.06)	0.43
Flexion angle	1.02 (0.98, 1.06)	0.44
BMI	1.03 (0.99, 1.08)	0.19
BMI Categorical		
Overweight vs Normal	1.02 (0.25, 4.25)	0.97
Obese vs Normal	0.97 (0.25, 3.72)	0.96
Morbidly Obese vs Normal	3.06 (0.64, 14.71)	0.16

Table 1: Multivariate regression. *OR: Odds Ratio, CI: Confidence Interval

Measure	AUC Infection	95% CI	Model Quality
PFTR	0.43	0.33, 0.54	0.33
KAI	0.45	0.34, 0.55	0.34
tPASTI	0.5	0.40, 0.59	0.4
fPASTI	0.49	0.39, 0.60	0.39
Flexion angle	0.57	0.46, 0.69	0.46
BMI	0.56	0.43, 0.68	0.43

Table 2: Best-fit curve. *AUC: Area under curve

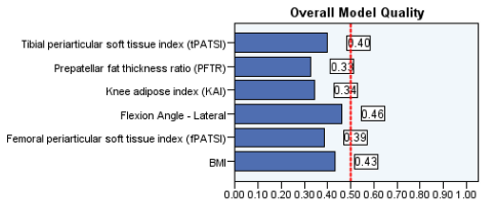

Table 3: Model plotted for each measure