

Sarcopenia is an Independent Risk Factor for Failure to Achieve the 1-year Minimal Clinically Important Difference of the Knee Injury and Osteoarthritis Outcome Score, Joint Replacement Short Form after Total Knee Arthroplasty

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INTRODUCTION:

Sarcopenia is a progressive and multifactorial condition of decreased muscle strength and mass seen in up to 50% of people over the age of 65 and has recently become an area of interest for surgical research. In many surgical subspecialties, sarcopenia and visceral obesity are more reliably associated with increased lengths of hospital stays, costs, and medical complications following surgical intervention compared to BMI. Furthermore, in primary total knee arthroplasty (TKA), sarcopenia is an independent predictor for falls, revision, infection, and readmissions following surgery. However, little is known about the effect of sarcopenia on patient reported outcome measure (PROM) scoring in TKA. The purpose of this study is to evaluate if various metrics of body composition (muscle mass, visceral fat, and subcutaneous fat) as identified on computed tomography (CT) are independently correlated with achievement of the 1-year MCID of the Knee Injury and Osteoarthritis Outcome Score, Joint Replacement Short Form (KOOS, JR) following primary TKA in a large tertiary healthcare network. We hypothesized that sarcopenia, elevated visceral fat, and elevated subcutaneous fat would be associated with increased risk of failure to achieve the 1-year MCID of the KOOS JR after primary TKA.

METHODS:

A retrospective case-control study was performed utilizing the electronic medical record of patients from a large tertiary hospital network in the United States from the years 2016-2020. We queried our institutional "Biobank" to identify all patients over the age of 18 undergoing primary TKA with available body composition metrics via computed tomography (CT). Patients were reviewed to confirm that both preoperative (<6 months prior to TKA) and 1-year postoperative (6 months – 2.5 years) KOOS JR PROMs were available. Body composition data, inclusive of subcutaneous fat area, visceral fat area, and skeletal muscle mass area were derived through two fully-automated and externally-validated machine learning protocols. The first algorithm selects a singular axial abdominal CT slice through the third lumbar vertebral body level (L3) and the second algorithm automatically determines the area of subcutaneous fat, visceral fat, and skeletal muscle. In order to account for each patient's height, we calculated the skeletal muscle index (SMI), which is the area in cm² of skeletal muscle mass of all muscles at the L3 level (psoas, paraspinals, abdominals, and obliques) divided by the patient's height in meters, squared (cm²/m²). Sarcopenia was defined as males with a SMI less than 53cm²/m² and females with a SMI less than 39cm²/m². We similarly calculated a subcutaneous index and visceral fat index taking into account patient heights (cm²/m²), and also defined visceral obesity as visceral fat area >100cm at the L3 level.

Regarding PROMs, we used a previously described 1-year MCID for improvement value (+15.47) for the KOOS, JR in patients undergoing primary TKA, which was determined through an anchor-based method. Demographic, comorbidity, and surgical variables were also obtained.

In order to analyze the association between patients achieving the 1-year MCID for improvement of the KOOS, JR and patients who did not achieve the MCID, a univariate analysis was performed using Student's T tests, Chi-Square tests, and Fisher Exact tests as appropriate. Variables from our univariate analysis that showed some association, defined as p<0.20, were inserted into a multivariate binary logistic regression to determine predictors of achieving the 1-year MCID for improvement of the KOOS, JR. Odds ratios (OR) and corresponding 95% confidence intervals (CI) were calculated. Statistical significance in both the univariate analysis and regression was defined as p<0.05.

RESULTS:

We identified 140 primary TKAs in 140 patients meeting inclusion criteria. 74 (52.85%) patients achieved the 1-year KOOS, JR MCID for improvement while 66 (47.5%) of patients failed to achieve the MCID. There were 55 males (39.29%) and 85 females (60.71%) in our cohort. Patients who achieved the 1-year MCID for improvement were significantly younger (66.91±7.64 vs 69.89±9.05, p=0.038), were more likely to have commercial health insurance (51.35% vs 28.78%, p=0.011), had shorter lengths of stay (1.98±1.26 vs 2.51±1.43, p=0.022), were more likely to be discharged home compared to rehabilitation or SNF (81.08% vs 62.12%, p=0.015), and had lower preoperative KOOS, JR scores (48.99±14.58 vs 59.38±12.11, p<0.001) compared to patients who failed to achieve the MCID. Regarding body composition metrics, patients who achieved 1-year MCID were less likely to be sarcopenic (12.86% vs 36.51%, p=0.001) compared to those who failed to achieve the 1-year MCID. No other body composition metrics were significantly associated with achievement of the MCID on univariate analysis. In our multivariate regression model including 13 variables, items individually associated with decreased odds of achieving the MCID for improvement included a higher

preoperative KOOS, JR score (OR:0.911, 95% CI 0.870-0.954, $p<0.001$), ischemic heart disease (OR:0.203, 95% CI 0.068-0.602, $p:0.004$), and sarcopenia (OR:0.312, 95% CI 0.100-0.972, $p:0.044$). The only variable positively associated with achievement of the 1-year MCID of the KOOS, JR was discharge to home (OR:4.475, 95% CI 1.103-18.155, $p:0.036$).

DISCUSSION AND CONCLUSION:

This study found that sarcopenia, a modifiable risk factor characterized by decreased muscle strength and commonly seen in the elderly, was independently associated with increased odds of failure to achieve the 1-year MCID of the KOOS, JR PROM after TKA. Arthroplasty surgeons may consider using simple clinical tools to identify patients with high likelihood of having sarcopenia so that they can be offered targeted resistance exercise and nutritional counseling for optimization of their condition in the pre-operative and early post-operative period of TKA.