# Preoperative CT Quantification of Sarcopenia to Predict Complications and Mobility after Robotic Total Hip Arthroplasty

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INTRODUCTION:

Sarcopenia is the loss of skeletal muscle mass and function. Patients with sarcopenia have lower survival rates from malignancy, longer hospital stays after surgery, and are at higher risk to develop metabolic disorders. Assessment of sarcopenia can be performed on computed tomography (CT) by measuring muscle size and lean muscle content based on Hounsfeld unit (HU) values, and sarcopenia correlates with poorer surgical outcomes after hip fracture surgery. The purpose of this study is to correlate preoperative CT muscle parameters of sarcopenia with surgical and clinical outcomes following robotic total hip arthroplasty (THA).

METHODS:

A retrospective analysis was conducted on 145 patients undergoing primary, unilateral, robotic THA by a single surgeon from 2020 to 2024 who also received a preoperative non-contrast CT scan of the pelvis for surgical planning. Patients undergoing bilateral THA or those without osteoarthritis were excluded from the cohort. The publicly available TotalSegmentator model was used to automatically segment the paravertebral, iliopsoas, and gluteal muscles at 3 axial CT slice levels. Paravertebral and iliopsoas muscles were measured at the L4 vertebrae level. Gluteal muscle parameters were measured at the sacroiliac joint and lesser trochanter levels. **Figure 1** provides a representative example of the segmentation process used to identify and quantify the relevant muscle groups. Skeletal muscle index (SMI) and lean skeletal muscle density (SMD) was measured for each muscle at the 3 levels. SMI is the cross-sectional area of each muscle group by the square of the patient's body mass index (BMI) and Skeletal muscle density (SMD) is measured in HU. SMI and SMD was correlated with categorical (mortality, medical complications, periprosthetic joint infection, 90-day readmission, and transfusion) and continuous outcome measures (length of hospital stay, estimated blood loss, and postoperative distance ambulated). Simple linear regression was used to test the association between SMI and SMD for each muscle with clinical and surgical outcomes. The p-values of coefficients were used to determine if the associations were significant, with 0.05 used as the significance level. All the analyses were done in R 4.4.0.

RESULTS: Gluteus medius SMI was positively associated with higher postoperative ambulation (β = 13.48, 95% CI: [3.71, 23.25], p=0.008). Postoperative distance ambulated was also increased in patients with higher gluteus medius (β = 1.77, 95% CI: [0.26, 3.28], p=0.02) and gluteus maximus (β = 1.25, 95% CI: [0.16, 2.35], p=0.03) SMD. Higher gluteus medius SMI (β = -32.47, 95% CI: [-54.21, -10.73], p=0.004) and SMD (β = -5.49, 95% CI: [-8.88, −2.11], p=0.002) were both associated with lower intraoperative blood loss. Paravertebral and iliopsoas measurements showed no significant association with postoperative outcome measures.

DISCUSSION AND CONCLUSION: Larger gluteal muscle size and more lean muscle correlates with longer distance walked after THA and lower intraoperative blood loss. This may reflect the important role of the gluteal muscles in gait, hip stability, and mobility. Given the importance of same-day or accelerated discharge following THA, early identification of sarcopenia through radiological assessment may facilitate preoperative optimization strategies to improve surgical outcomes and postoperative function. While existing literature supports the use of paravertebral and iliopsoas muscles as radiological markers of sarcopenia, our findings emphasize the importance of assessing anatomically relevant hip musculature to more accurately evaluate the impact of sarcopenia on outcomes following THA.
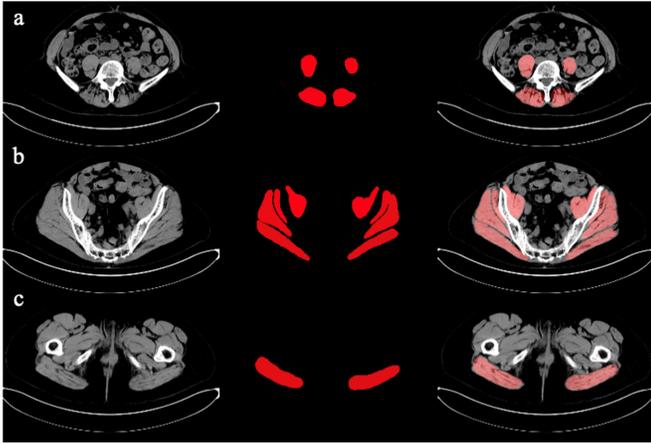
**Figure 1.** CT segmentation technique from TotalSegmentator at the following intervals: a) L4 (demonstrating the paraspinal and psoas muscles) b) sacroiliac joint (demonstrating the iliopsoas, gluteus medius, minimus, and maximus), and c) lesser trochanter (demonstrating gluteus maximus).