

The role of subcutaneous fat and BMI in predicting surgical outcomes and patient reported outcomes in robotic-assisted total hip arthroplasty

Jacob Coleman¹, Madeleine DeClercq², Michael Sacchetti³, Mazen Zamzam¹, Ali Omari⁴, Ehab Saleh⁴, Abdullah Omari⁴

1. Oakland University William Beaumont School of Medicine, 2. Rochester, MI, USA, Corewell Health West, Grand Rapids, MI, USA, 3. Central Michigan University College of Medicine, Saginaw, MI, USA, 4. Department of Orthopedic Surgery, Corewell Health William Beaumont University Hospital, Royal Oak, MI, USA,

Introduction

As obesity prevalence continues to rise in the United States, increasing numbers of patients undergoing total hip arthroplasty (THA) present with elevated body mass index (BMI)¹. Elevated BMI has historically been used to stratify risk for postoperative complications, including surgical site infection (SSI). However, BMI does not account for body composition or fat distribution surrounding the hip joint and may therefore misrepresent patient-specific surgical risk².

Prior studies in general surgery, spine surgery, and total knee arthroplasty suggest that localized body fat measurements may better predict postoperative complications than BMI alone³. Radiographic assessments of hip soft tissue thickness have demonstrated associations with infection risk, though plain radiographs may inadequately represent true fat distribution due to their two-dimensional nature⁴.

With the increasing utilization of robotic-assisted THA, preoperative computed tomography (CT) scans are routinely obtained for surgical planning. Using these scans, we proposed that cross-sectional area of subcutaneous fat in the posterolateral hip would be a better predictor of postoperative outcomes than BMI.

Aims and Objectives

Primary:

To determine whether CT-measured subcutaneous fat (SCF) is predictive of surgical complications in robotic-assisted primary THA.

Secondary:

To compare SCF and BMI as predictors of:

- Surgical site infection (SSI)
- Operative time (time from incision to closure)
- Length of stay
- Transfusion requirements
- Patient-reported outcomes (HOOS scores)

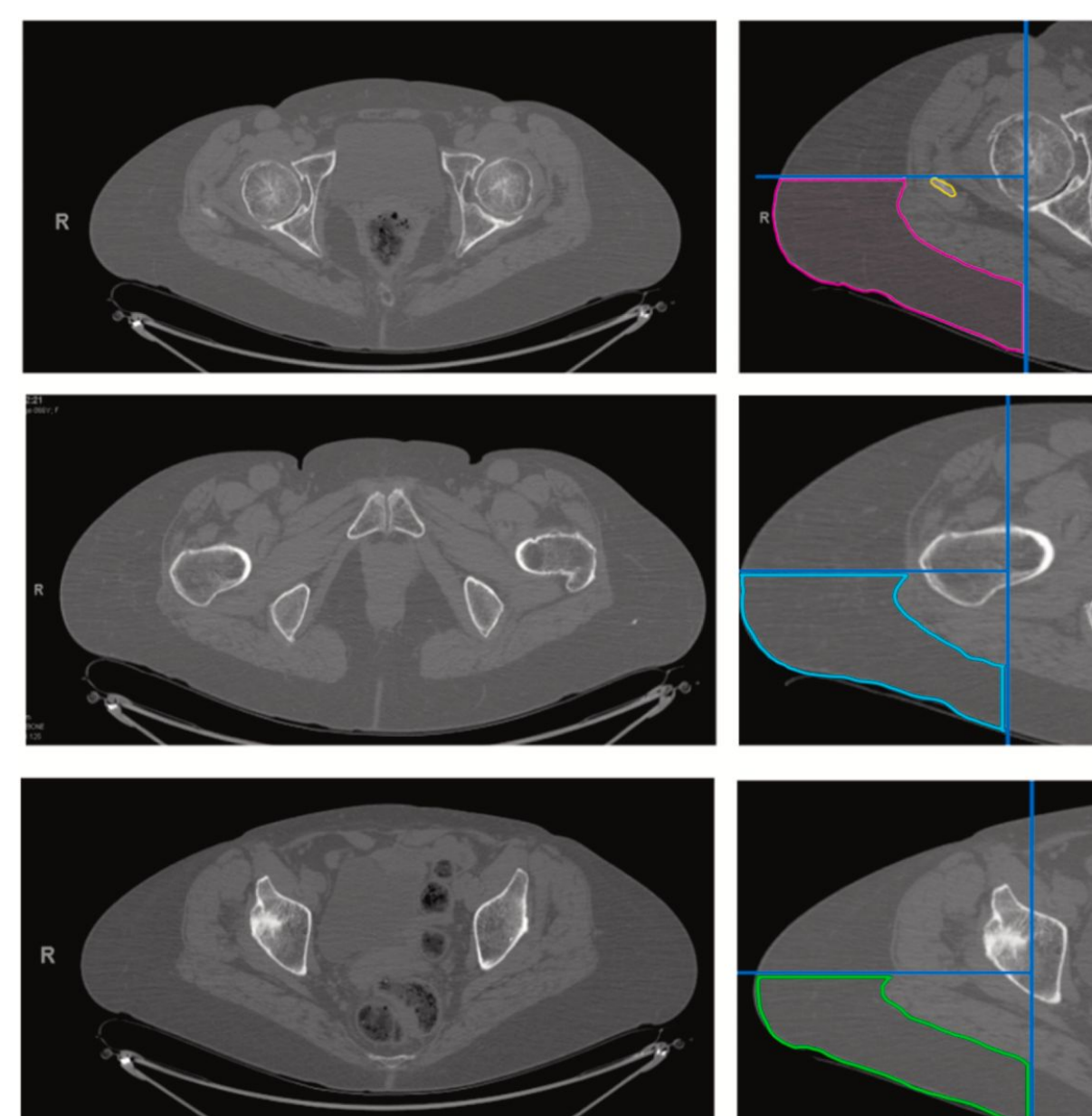
Methods

This was a retrospective Level III cohort study of patients undergoing robotic-assisted primary THA at a single institution from 2018–2020.

- Patients identified through CPT/ICD-10 codes
- Data and 90-day outcomes obtained from the Michigan Arthroplasty Registry Collaborative Quality Initiative (MARCQI).
- Preoperative CT imaging per the MAKO robotic protocol.

A total of 175 patients were included (mean age 63.8 years; mean BMI 30.7 kg/m²; 55.4% female). BMI was categorized into five standard groups: <25, 25–29.9, 30–34.9, 35–39.9, and ≥40 kg/m².

SCF was measured on axial CT scans in the posterolateral quadrant at the level of the greater trochanter, 3 cm proximal, and 3 cm distal. Measurements were normalized to femoral transverse diameter and stratified into quintiles (Q1–Q5).



Outcomes included, surgical site infection, time to closure, transfusions, length of stay, and HOOS scores (preoperative, 14–112 days postoperative, and latest follow-up). Statistical analysis utilized ANOVA, Kruskal–Wallis, and Chi-square testing with significance set at p<0.05. Inter-rater reliability was assessed using intraclass correlation coefficients.

Results

This study included 175 patients undergoing robotic-assisted THA. CT-based subcutaneous fat (SCF) measurement demonstrated **high reliability and was associated with differences in operative time**. No significant differences were observed in surgical site infection, length of stay, or patient-reported outcomes across BMI or SCF groups.

Hip Fat Measurements and Operative Results		
	BMI Category Comparison (p-value)	SCF Category Comparison (p-value)
Average Time to Closure	<0.001	0.004
Transfusion Status	0.703	0.016
Surgical Site Infection (SSI)	*none reported	*none reported

Lower BMI and lower SCF were associated with shorter operative time. No surgical site infections identified in this cohort.

Hip Fat Measurements and HOOS		
HOOS Score	BMI Category Comparison (p-value)	SCF Category Comparison (p-value)
Pre-Op	0.741	0.821
12-114 Days	0.665	0.365
Latest	0.357	0.891

No significant differences in HOOS scores across BMI or SCF groups at any timepoint.

SCF measurement on preoperative CT proved to be highly reliable and provided a localized assessment of soft tissue distribution around the hip. While increased SCF and BMI were associated with longer operative time, this did not translate into differences in infection, length of stay, or patient-reported outcomes in this pilot cohort. These findings reinforce the limitations of BMI as a sole risk stratification tool while also demonstrating a possible clinical impact of localized subcutaneous fat measurement on robotic THA outcomes.

Conclusions

CT-based measurement of hip subcutaneous fat (SCF) demonstrated **high inter-rater reliability** and was predictive of **operative time (incision to closure)** in patients undergoing robotic-assisted total hip arthroplasty. SCF did **not demonstrate superiority over BMI** in predicting surgical site infection, length of stay, transfusion requirements across most groups, or patient-reported outcomes. This pilot study provides a reasonable approach to investigating the impact of local SCF post-operative and patient reported outcomes.

Preoperative CT imaging obtained for robotic-assisted THA offers a **practical opportunity to quantify SCF distribution** without additional testing. Although SCF measurement may better characterize local soft tissue anatomy than BMI alone, further large-scale studies are necessary to determine whether SCF meaningfully enhances preoperative risk stratification and surgical planning.

References

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