Minimal Clinically Important Difference in Obese Patients Undergoing Robotic versus Manual Primary Total Knee Arthroplasty: A Propensity Matched Analysis

Hahn Kang, BSc[1]; Sina Afzal, MD[1]; William Sampson, BA[1]; Carlo Mannina, BSc[1]; Pengwei Xiao, PhD[1]; Oh-Joon Kwon[1]; Muhammad Hamza Ilyas, MD[1]; Margaret Arthur[1]; Oh-Jak Kwon[1]; Michelle Shimizu, MD[1]; Zhijun Li, PhD[1]; Isaiah Freeman, BSc[1]; Young-Min Kwon, MD, PhD[1]
[1]Bioengineering Laboratory, Massachusetts General Hospital/Harvard Medical School, Boston, MA
ymkwon@mgh.harvard.edu

Disclosures: Hahn Kang (N), Sina Afzal (N), William Sampson (N), Carlo Mannina (N), Pengwei Xiao (N), Oh-Joon Kwon (N), Muhammad Hamza Ilyas (N), Margaret Arthur (N), Oh-Jak Kwon (N), Michelle Shimizu (N), Zhijun Li (N), Isaiah Freeman (N), Young-Min Kwon (5- MicroPort; 5- Depuy; 5- Smith & Nephew; 5- Stryker; 5- Zimmer Biomet; 5- Medacta)

INTRODUCTION: Robotic-assisted TKA (RA-TKA) has gained popularity over the past decade, with RA-TKA currently representing approximately 16% of all TKA procedures in the United States according to the 2024 American Joint Replacement Registry. Considering the challenges of TKA in patients with obesity, RA-TKA has the potential to improve precision in component positioning and subsequent outcomes in this challenging and increasingly prevalent subset of patients. However, limited studies to date hasve investigated the potential influence of RA-TKA on PROM scores among patients with obesity. Therefore, this study aims to compare patient-reported outcomes (PROMs) in obese patients undergoing robotic and manual TKA (M-TKA) using propensity matching.

METHODS: This study received IRB approval. From an institutional database, we extracted 11,210 patients who underwent primary TKA. Patients who met the following inclusion criteria were selected for further analysis: 1) obesity defined as having a body mass index (BMI) > 30 kg/m^2, and 2) completed preoperative and postoperative PROM score. The 2,799 patients who met the inclusion criteria were divided into two cohorts: RA-TKA and manual TKA. A 1:3 (RA-TKA to manual TKA) nearest neighbor propensity match was performed based on age, BMI, sex, diabetes, chronic kidney disease, heart failure, osteoporosis, and American Society of Anesthesiologists score. In each cohort, the mean preoperative and postoperative scores and subsequent delta scores for four PROMs (Physical Function Short Form Survey (SF-10a), Patient-reported Measurement Information Systems (PROMIS) Global Physical and Mental Survey, and Knee Disability and Osteoarthritis Outcome Score Physical Function Short Form (KOOS-PS) were calculated. Minimal clinically important differences in improvement (MCID-I) and worsening (MCID-W) were calculated by taking one-half of the standard deviation of the delta score. Complication rates were recorded at 90 days, one year, and two years postoperatively.

RESULTS SECTION: After propensity matching, 93 RA-TKA and 279 M-TKA patients remained for analysis. No differences in demographics were observed between the groups ($p>0.05$). Ninety-day, one-year, and two-year complication rates were similar for RA-TKA and M-TKA patients postoperatively ($p>0.05$). Absolute preoperative scores were higher in the M-TKA group for the SF-10a (36.37 vs 34.59, $p = 0.0046$), PROMIS Physical (39.28 vs 37.35, $p = 0.0479$), and KOOS-PS (54.41 vs 49.09, $p = 0.0083$). Postoperative scores were higher in the SF-10a for M-TKA patients (42.03 vs 40.12, $p = 0.0226$). All delta scores were similar between groups except in the KOOS-PS, where RA-TKA demonstrated a higher mean score (13.64 vs 17.84, $p = 0.0497$). Proportions of improvement and worsening were equal between groups in all PROMs ($p>0.05$). The likelihood of experiencing no change was greater in the M-TKA cohort for the PROMIS Physical (18% vs 8%, $p = 0.0389$), and was equal in all other PROMs ($p>0.05$).

DISCUSSION: Our findings show that RA-TKA may provide greater improvement in select PROMs, while other PROMs show no significant differences when compared to M-TKA. The RA-TKA cohort improved from scoring significantly lower in the KOOS-PS preoperatively, to having similar scores postoperatively, including a greater delta score. This suggests that RA-TKA may be associated with improved knee-specific PROMs following primary TKA. This contrasts the other PROMs, which had similar delta scores and proportions of improvement between groups, indicating that RA-THA may not impact general PROMs significantly.

SIGNIFICANCE/CLINICAL RELEVANCE: Our findings show that Robotic-assisted-TKA may provide greater improvement in select PROMs, while other PROMs show no significant differences when compared to Manual-TKA.

Patient-Reported Outcome Measure	Manual	Robotic-Assisted	P-value
SF-10a	N = 249	N = 91	
Preoperative score	36.37 ± 4.90	34.59 ± 5.25	0.0046
Postoperative score	42.03 ± 7.25	40.12 ± 7.45	0.0226
Delta score	5.67 ± 6.50	5.53 ± 6.89	0.7849
MCID-I	173 (69%)	65 (71%)	0.8307
No change	49 (20%)	22 (24%)	0.4517
PROMIS Mental	N = 256	N = 86	
Preoperative score	48.09 ± 8.33	47.27 ± 9.02	0.6168
Postoperative score	50.51 ± 9.15	49.70 ± 8.75	0.4593
Delta score	2.42 ± 6.66	2.43 ± 7.05	0.8778
MCID-I	139 (54%)	47 (55%)	0.8932
No change	56 (22%)	16 (19%)	0.6236
PROMIS Physical	N = 257	N = 86	
Preoperative score	39.28 ± 7.04	37.35 ± 6.89	0.0479
Postoperative score	45.17 ± 8.16	43.26 ± 7.67	0.0839
Delta score	5.90 ± 7.17	5.91 ± 5.97	0.99
MCID-I	178 (69%)	66 (77%)	0.2347
No change	47 (18%)	7 (8%)	0.0389
KOOS-PS	N = 200	N = 73	
Preoperative score	54.41 ± 12.21	49.09 ± 14.62	0.0083
Postoperative score	68.06 ± 14.93	66.93 ± 15.29	0.5782
Delta score	13.64 ± 15.19	17.84 ± 16.50	0.0497
MCID-I	136 (68%)	57 (78%)	0.1416
No change	44 (22%)	14 (19%)	0.7358

Table 1. Patient-Reported Outcome Measures for obese patients undergoing manual and robotic primary total knee arthroplasty.