No Difference in Patient Reported Outcomes Between Customized and Off-the-Shelf Unicompartmental Knee Replacements

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

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

INTRODUCTION: Unicompartmental knee arthroplasty (UKA) is a less invasive, ligament-sparing alternative to total knee arthroplasty (TKA) for patients with isolated compartmental osteoarthritis. Despite its potential benefits in recovery and kinematics, UKA has been associated with higher revision rates than TKA due to technical challenges such as component malposition. Early data has demonstrated promising surgical and patient-reported outcome measures (PROMs) following customized UKA. However, existing studies are limited, and none have directly compared PROMs between customized and off-the-shelf (OTS) implants. This propensity-score matched study aims to compare PROMs between customized and OTS UKA, as well as report on any differences in surgical or medical outcomes.

METHODS: This single-institution retrospective study evaluated a cohort of 3,050 consecutive UKAs following IRB approval. Patients with customized UKA implants were matched in a 1:4 ratio to patients with OTS implants based on age, sex, body mass index (BMI), compartment involvement (medial vs lateral), and status of diabetes, chronic kidney disease, and osteoporosis. The following PROMs were included for analysis: Physical Function Short Form Survey (SF-10a), Patient-reported Measurement Information Systems (PROMIS) Global Physical and Mental Survey, and Knee Injury and Osteoarthritis Outcome Score Physical Function Short Form (KOOS-PS). Delta PROM scores, defined as the difference between pre- and postoperative scores, were used to determine the minimum clinically important difference in improvement (MCID-I) and worsening (MCID-W) thresholds. The incidence of readmissions, complications, and revisions were assessed at 90-day, 1-year, and 2-year time points. The proportion of patients who demonstrated MCID-I, MCID-W, and no clinically meaningful change, as well as differences in complication rates, were compared across cohorts using t-tests and Chi-square analysis.

RESULTS: A total of 73 customized and 292 OTS UKAs were identified after propensity score matching. The matched cohorts had no differences in age, sex, BMI, or comorbidities ($p>0.05$). There was a significantly higher proportion of patients in the customized cohort that experienced no clinically significant change in the PROMIS Global Mental (41% vs 25%, $p = 0.015$). Otherwise, there was no significant difference found between the absolute scores, delta scores, or in the proportion of patients who achieved MCID-I across the measured PROMs. Patients who received a customized UKA had a significantly higher 90-day readmission rate than those who received OTS implants (2.1% vs 6.8%, $p = 0.048$). All other medical and surgical complications rates were comparable across cohorts at 90-day, 1-year, and 2-year follow up.

DISCUSSION: In this study, customized and off-the-shelf UKA implants demonstrated comparable improvements in patient-perceived outcomes across multiple validated PROMs. These findings suggest that the theoretical advantages of customized implants, such as improved anatomical conformity, do not necessarily translate to superior functional outcomes in the early to mid-term postoperative period. Further investigation is warranted to determine whether the observed difference in 90-day readmission rates is due to an unmeasured difference in postoperative protocols, surgical experience, or patient selection, as opposed to differences in implant performance.

SIGNIFICANCE/CLINICAL RELEVANCE: Customized unicompartmental knee arthroplasty implants are not associated with improved patient-perceived outcomes compared to off-the-shelf implants.

Characteristic	**Off-the-shelf**	**Custom**	**P Value**
SF10-a	N = 276	N = 62	
Postop Score	46.00 ± 7.40	46.52 ± 7.18	0.6719
Delta Score	7.33 ± 6.54	7.01 ± 6.25	0.6386
MCID-I	202 (73%)	50 (81%)	0.2906
No Change	55 (20%)	8 (13%)	0.27
PROMIS Global Mental	N = 283	N = 71	
Postop Score	54.34 ± 9.19	56.03 ± 8.83	0.1706
Delta Score	1.75 ± 6.58	3.01 ± 6.86	0.1745
MCID-I	125 (44%)	28 (39%)	0.558
No Change	72 (25%)	29 (41%)	**0.0154**
PROMIS Global Physical	N = 283	N = 71	
Postop Score	49.86 ± 8.60	51.26 ± 8.19	0.3313
Delta Score	6.09 ± 7.00	7.15 ± 7.01	0.3358
MCID-I	193 (68%)	49 (69%)	0.99
No Change	54 (19%)	17 (24%)	0.4538
KOOS-PS	N = 211	N = 41	
Postop Score	75.04 ± 14.60	75.29 ± 14.70	0.9626
Delta Score	17.68 ± 15.76	15.72 ± 12.67	0.4986
MCID-I	164 (78%)	33 (80%)	0.853
No Change	33 (16%)	4 (10%)	0.4636

Table 1. Patient-Reported Outcome Measures for patients with customized and off-the-shelf unicompartmental knee arthroplasty implants.