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Original Research

A Comparison of Medial-congruent, Ultracongruent, and Cruciate-retaining Bearings Using a Single Cruciate-retaining Total Knee Design

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A B S T R A C T

Background: Improving outcomes has driven advancements in total knee arthroplasty (TKA) bearing design. The aim of this study was to compare medial-congruent (MC), ultracongruent (UC), and cruciate-retaining (CR) TKA utilizing a single CR total knee system.
Methods: Six surgeons performed 2883 primary TKAs from 2012 to 2022 using the same implant design, comprised of 708 MC, 799 UC, and 1376 CR bearings. Prospectively collected data on clinical and patient-reported outcome measures were compared. Data analyses utilized analysis of variance tests for continuous data, *chi*-square tests for categorical data, and Mantel-Cox tests for survivorship analysis. MC subjects were older (MC = 67.5 vs UC = 65.3 vs CR = 66.7 years; $P < .001$), had lower body mass index (MC = 32.4 vs UC = 33.1 vs CR = 33.2 kg/m^2; $P = .04$), and had shorter mean follow-up (MC = 1.2 vs UC = 2.4 vs CR = 2.9 years; $P < .001$).
Results: All groups experienced similar rates of 90-day complications (MC = 26/708, 3.7% vs UC = 39/799, 4.9% vs CR = 52/1376, 3.8%; $P = .38$) and revisions (MC = 1/708, 0.1% vs UC = 4/799, 0.5% vs CR = 5/1376, 0.4%; $P = .49$). Survivorship was similar at 2 years ($P = .41$) and above 98% at 5 years for all groups. At the 1-year follow-up, MC bearings had significantly greater Patient-Reported Outcomes Measurement Information System Global Health Physical (MC = 47.1 vs UC = 41.5 vs CR = 42.8; $P < .001$) and mental scores (MC = 48.9 vs UC = 41.3 vs CR = 43.7; $P < .001$).
Conclusions: No differences in all-cause complications or revisions were observed for MC, UC, and CR bearings using the same total knee system. Clinically important differences favoring MC bearings were found with Patient-Reported Outcomes Measurement Information System Global Health Physical scores at 1 year; however, longer follow-up is necessary to determine if this trend holds.

Introduction

Significant advancements in total knee arthroplasty (TKA) implant design have been made in recent years with the goal of reproducing native knee kinematics and improving stability of the reconstructed joint [1–3]. Multiple options now exist for TKA bearing surfaces, ranging from designs that sacrifice the posterior cruciate ligament (PCL) to those that retain it (cruciate-retaining [CR]) or substitute its function with either cam-post mechanisms (posterior-stabilized [PS]) or congruent polyethylene inserts (medial-congruent [MC] and ultracongruent [UC]) [1].

Modern MC, UC, and CR implants utilize a common CR femoral component that does not require an intercondylar femoral box cut. Eliminating the box decreases fracture risk and avoids complications specific to the cam-post mechanism, such as increased noise generation, dislocation, breakage, and patellar clunk [2,4,5]. Kinematic and radiostereometric analysis suggests MC designs improve control of paradoxical anterior translation of the femur in flexion and produce a more effective screw-home mechanism during extension than with CR designs [6,7]. It has also been proposed that

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UC designs allow for improved femoral rollback and external rotation during deep flexion. MC designs can be used if the PCL is retained, attenuated, or fully released, whereas UC designs are primarily used with sacrifice of the PCL or when the ligament is nonfunctional [8–10]. Despite the purported benefits of each design, it remains unclear which bearing surface leads to superior clinical and patient-reported outcome measures (PROMs) after TKA.

Over the past 5 years, American Joint Replacement Registry data and national surveys have shown a marked change in current practice trends among fellowship-trained orthopaedic surgeons regarding bearing surface selection [11–13]. Over this time, MC and medial pivot bearings have gone from the least to most utilized implant design, and PS designs have experienced the largest drop-off in use. While previous studies have made indirect comparisons between different manufacturers and older generations of total knee implants [14,15], high-quality data comparing the most common modern TKA bearing surfaces have been lacking.

This investigation is the first large-scale retrospective study that aimed to compare complications, revisions, and PROMs between MC, UC, and CR TKA bearing surfaces from a single, modern CR total knee system. We hypothesized that no differences would be found between groups.

Material and methods

An institutional review board exemption was obtained prior to the start of this investigation. Prospectively collected data in our institutional database were retrospectively reviewed for all primary TKAs using the Persona Total Knee System (Zimmer Biomet, Warsaw, IN, USA) from 2012 through 2022. Six surgeons performed 2883 TKAs, including 708 MC, 799 UC, and 1376 CR cases during the study period. All TKAs utilized the same CR femoral component. PS, constrained posterior stabilized, and constrained condylar knee implants were excluded. The surgeons in this study utilized a standard perioperative protocol including multimodal anesthesia, pain management, and discharge criteria for all cases.

All surgeons included in this study performed mechanically aligned TKA using conventional instrumentation through a straight midline incision and medial parapatellar or midvastus approaches. The distal femur was prepared using an intramedullary rod to establish femoral alignment, and the proximal tibia was cut using an extramedullary guide. The decision to resurface the patella was made intraoperatively and determined by patient anatomy. Polyethylene bearing selection was based on individual surgeon preference and influenced by temporal trends in bearing utilization. The MC bearing was first adopted at our institution in 2016 and progressively grew in popularity, becoming the most utilized design by the end of the study period in 2022. Both CR and UC designs were implanted consistently throughout the study period. The status of the PCL also influenced bearing selection, with CR designs only utilized in patients with an intact ligament.

The primary outcomes were all-cause complications and revisions occurring within 90 days of surgery. Secondary outcomes included total revisions, implant survivorship, range of motion (ROM), and preoperative and postoperative PROMs. The specific PROMs collected were the Knee Society Score (KSS), Knee injury and Osteoarthritis Outcome Score, Joint Replacement (KOOS JR), visual analog scale, and Patient-Reported Outcomes Measurement Information System (PROMIS) Global Health Physical and Mental scores.

Continuous variables were analyzed for descriptive statistics including mean, standard deviation, and interquartile range using analysis of variance testing. Differences among categorical variables were compared using *chi*-square or Fisher's exact tests for small subgroups. Component survivorship between groups was assessed using log-rank (Mantel-Cox) tests. A *P*-value of <0.05 was defined as the threshold for statistical significance. Data analyses were performed using IBM SPSS Statistics for Windows, v28.0 (IBM Corp., Armonk, NY).

Power analysis was performed for the outcomes of interest based on the study population available (MC = 708, UC = 799, and UC = 1376 subjects). It was determined that for the mean 90-day complication rate of 4.1% across all groups and using an alpha value of 0.05, we had enough cases to detect a risk ratio of 1.8 (difference 3.3%) and achieve a power of 81%-89%. For the mean 90-day revision rate of 0.3 and again using an alpha of 0.05, we had the case volume to detect a risk ratio of 4.4 (difference 1.6%) and achieve a power of 80%-87%.

Results

Within the study population, there were statistically significant differences in the MC group compared to UC and CR in age (MC = 67.5 vs UC = 65.3 vs CR = 66.7 years; $P < .001$), sex (MC = 60.6 vs UC = 62.2 vs CR = 68.2% women; $P < .001$), and body mass index (MC = 32.4 vs UC = 33.1 vs CR = 33.2 kg/m^2; $P = .04$); however, absolute differences were small (Table 1). The CR TKAs had the longest mean follow-up time at 2.9 years (0.04-10.3) compared to MC (1.2 years, 0.04-6.7) and UC (2.4 years, 0.03-9.9) ($P < .001$).

Similar rates of 90-day complications (MC = 26/708, 3.7% vs UC = 39/799, 4.9% vs CR = 52/1376, 3.8%; $P = .38$), 90-day revisions (MC = 1/708, 0.1% vs UC = 4/799, 0.5% vs CR = 5/1376, 0.4%; $P = .49$), and revisions with all available follow-up (MC = 7/708, 1.0% vs UC = 10/799, 1.3% vs CR = 15/1376, 1.1%; $P = .89$) occurred across all 3 bearing surfaces (Table 2). Implant survivorship did not differ significantly at 2 years follow-up (MC = 98.2%, 95% confidence interval (CI) 96.9-99.5 vs UC = 98.7%, 95% CI 97.8-99.6 vs CR = 99.2%, 95% CI 98.7-99.7; $P = .41$) and was above 98% at 5 years for all groups (Fig. 1). The most common adverse events within 90 days of surgery were superficial wound complications, excessive knee stiffness, deep vein thrombosis, and infection. Infection was the primary cause of early and all-cause revision; however, these events were rare, and the incidence was similar between groups (Table 3).

Comparing groups at 1-year follow-up, MC bearings had significantly greater PROMIS Global Health Physical (MC = 47.1 vs UC = 41.5 vs CR = 42.8; $P < .001$) and mental scores (MC = 48.9 vs UC = 41.3 vs CR = 43.7; $P < .001$; Table 4). Differences in Knee Society Functional Score met the threshold for statistical significance (MC = 90.1 vs UC = 86.7 vs CR = 86.8; $P = .05$). At the time of the last follow-up, which differed for each group, statistically significant differences were observed in KSS (MC = 90.9 vs UC = 88.5 vs CR = 91.0; $P = .002$), KOOS JR (MC = 75.5 vs UC = 76.6 vs CR = 80.6; $P < .001$), and PROMIS Global Health Physical (MC = 46.4 vs UC = 43.7 vs CR = 45.0; $P < .001$) and Mental (MC = 48.7 vs UC = 45.2 vs CR = 46.8; $P < .001$). Small differences were seen in postoperative ROM at 1 year (MC = 118.3 vs UC = 115.7 vs CR = 117.3; $P < .001$) and maximum follow-up (MC = 117.6 vs UC = 116.3 vs CR = 117.4 degrees; $P = .02$).

Further information on intraoperative decision-making regarding patella resurfacing, posterior cruciate ligament (PCL) management, and implant fixation is shown in Table 5. The most common practices by surgeons in this study were to resurface the patella (MC = 95.8 vs UC = 98.0 vs CR = 98.9%) and utilize cement fixation for both tibial and femoral components (MC = 59.3 vs UC = 84.3 vs CR = 86.2%). PCL management differed by bearing surface group, with most of the MC (76.5%) and all CR (100.0%) cases retaining or balancing the ligament and the majority of UC cases fully resecting the PCL (57.9%). In the remaining UC cases, the

Table 1
Patient characteristics.

Category	Patient population			
	MC	UC	CR	*P* value
% Women	60.6	62.2	68.2	<.001
Age at surgery (y)	67.5 ± 9.2 (33.0-94.1)	65.3 ± 9.2 (38.8-90.6)	66.7 ± 9.0 (40.8-91.1)	<.001
BMI (kg/m^2)	32.4 ± 7.0 (18.0-54.0)	33.1 ± 7.4 (18.0-58.0)	33.2 ± 8.1 (16.0-77.0)	.04
Follow-up time (y)	1.2 ± 0.9 (0.04-6.7)	2.4 ± 1.9 (0.03-9.9)	2.9 ± 2.3 (0.04-10.3)	<.001

MC, medial-congruent; UC, ultracongruent; CR, cruciate-retaining; BMI, body mass index.
Data are presented as % and mean ± standard deviation (range).

surgeons preferred to do a more aggressive recession of the ligament (33.8%).

Discussion

This study evaluated a large cohort of primary TKAs utilizing 3 bearing surface designs within the same CR total knee system over an 11-year period. Our results suggest that MC, UC, or CR polyethylene inserts can be used to achieve similar outcomes, rates of complications, revisions, and survivorship greater than 98% through early-term follow-up.

As advancements in TKA implant design have been made over the past 2 decades, retrospective studies and large joint replacement registry investigations have been conducted to comparatively evaluate bearing surface performance. In one of the largest examples, Dalton et al. utilized the Australian Orthopaedic Association National Joint Replacement Registry to compare survivorship of 67,523 UC, CR, and PS TKAs at 18 years after surgery using an older total knee system (Genesis II, Smith & Nephew, Memphis, TN) [14]. In agreement with our findings, they reported no difference in the rates of cumulative revisions for UC and CR (8.3 vs 9.2%; $P = .27$), and similar indications for revision. A recent meta-analysis expanded on these results to evaluate multiple medially stabilized (MS) designs, including a small number of cases using the MC bearing from the current investigation [15]. They also reported comparable survivorship between MS and more traditional CR or PS designs; however, the length of follow-up was highly variable (1-15 years) depending on which national registry or study data was reported from. In contrast, Ohrn et al. compared data on medial pivot (MP) TKAs from both the Australian and Norwegian registries and found lower overall survivorship for MP compared to commonly used CR designs [16]. However, this difference was due to an increased risk of revision for 2 out of 5 MP designs in the Australian Orthopaedic Association National Joint Replacement Registry only: the Advance II MP (hazard ratio = 1.7; MicroPort Orthopedics Inc, Arlington, TN) and the GMK Sphere (hazard ratio = 2.0; Medacta International SA, Castel San Pietro, Switzerland) [16]. Given the increased constraint of UC and MC constructs and theoretical increased propensity for wear and loosening, it is imperative for investigators to continue publishing mid-term and long-term revision data.

Table 2
Summary of clinical events.

Category	Patient population			
	MC	UC	CR	*P* value
90-d complications	26 (3.7%)	39 (4.9%)	52 (3.8%)	.38
90-d revisions	1 (0.1%)	4 (0.5%)	5 (0.4%)	.49
Total revisions	7 (1.0%)	10 (1.3%)	15 (1.1%)	.89

MC, medial-congruent; UC, ultracongruent; CR, cruciate-retaining.
Data are presented as n (%).

Regarding PROMs, Frye et al. investigated 327 MC, CR, and PS TKAs from the same total knee system as our study and reported no difference in ROM, KOOS, and visual analog scale pain scores between MC and CR through early follow-up, corroborating our findings [17]. In contrast to our results, they reported no difference in PROMIS-10 scores between MC and CR at 1 year; however, they did find significantly improved patient satisfaction and Forgotten Joint Score (FJS-12) with MC bearings compared to CR at this time point. A recent meta-analysis evaluated studies comparing UC to CR bearings and reported no difference in knee flexion ROM or Western Ontario and McMaster Universities Osteoarthritis Index scores through early follow-up [18]. Jones et al. evaluated PROMs and kinematic parameters of MS vs non-MS TKAs in 60 patients at 1-year follow-up [19]. They reported superior PROMs across all measures and significantly greater sagittal stability in the MS group based on KT-1000 arthrometer data and clinical exam findings. In our study, the MC group had statistically higher scores for select outcomes (PROMIS Global Health Physical, Mental, and KSS Functional) at both 1 year and maximum follow-up. However, a recent systematic review by Deckey et al. summarized a large number of newly calculated minimal clinically important difference (MCID) values in the TKA literature [20]. They reported MCID interquartile ranges considering both distribution and anchor-based methods (when available) for PROMs including KSS Functional (range, 6-9), PROMIS Global Health Physical (range, 2.3-3.4), and Mental (range, 3.0-4.3). Based on their findings, and comparing improvements to preoperative baseline, MC outperformed UC (+3.3) and CR (+3.4) in Global Health Physical score at 1 year. Although the margins for this specific score fell within the MCID range, the remaining data did not show clear clinical superiority of any individual design through early follow-up. While increased anteroposterior stability during flexion seen with MC designs may positively impact subjective patient outcomes after TKA, further research with long-term follow-up is needed to define the clinical benefit.

There are important distinctions between the medially stabilized inserts that are used clinically and reported on in the literature. In this study, we reported outcomes of a single, MC

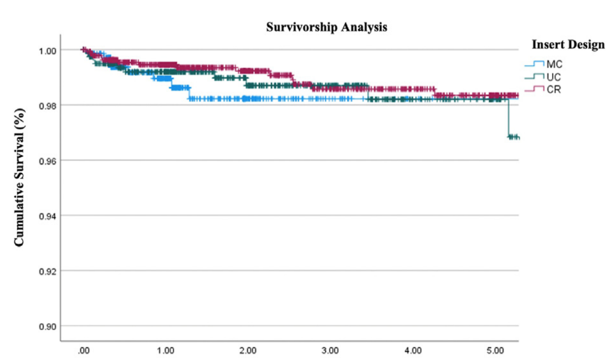

Figure 1. Implant survivorship at follow-up time points.

Table 3
Complication details and indications for revision.

Group	MC	UC	CR
90-D complications			
Population size	708	799	1376
DVT	3 (0.4%)	4 (0.5%)	9 (0.7%)
Effusion	2 (0.3%)	1 (0.1%)	4 (0.3%)
Extensor mechanism	2 (0.3%)	0 (0.0%)	0 (0.0%)
Fracture	2 (0.3%)	2 (0.3%)	1 (0.1%)
Hematoma	0 (0.0%)	0 (0.0%)	1 (0.1%)
Infection	2 (0.3%)	4 (0.5%)	3 (0.2%)
Ligament/soft tissue	1 (0.1%)	1 (0.1%)	1 (0.1%)
Pain	1 (0.1%)	0 (0.0%)	1 (0.1%)
Patellar clunk	0 (0.0%)	1 (0.1%)	0 (0.0%)
Stiffness	8 (1.1%)	6 (0.8%)	16 (1.2%)
Wound	5 (0.7%)	20 (2.5%)	16 (1.2%)
Total 90-d complications	26 (3.7%)	39 (4.9%)	52 (3.8%)
90-d revisions			
Fracture	0 (0.0%)	1 (0.1%)	1 (0.1%)
Infection	1 (0.1%)	3 (0.4%)	3 (0.2%)
Ligament/soft tissue	0 (0.0%)	0 (0.0%)	1 (0.1%)
Total 90-d revisions	1 (0.1%)	4 (0.5%)	5 (0.4%)
All revisions			
Femoral loosening	1 (0.1%)	1 (0.1%)	0 (0.0%)
Femur fracture	1 (0.1%)	0 (0.0%)	2 (0.2%)
Infection	3 (0.4%)	5 (0.6%)	7 (0.5%)
Instability	1 (0.1%)	1 (0.1%)	3 (0.2%)
Other	1 (0.1%)	1 (0.1%)	1 (0.1%)
Tibial loosening	0 (0.0%)	2 (0.3%)	2 (0.2%)
Total revisions	7 (1.0%)	10 (1.3%)	15 (1.1%)

MC, medial-congruent; UC, ultracongruent; CR, cruciate-retaining; DVT, deep vein thrombosis.
Data are presented as n (%).

polyethylene bearing from a single manufacturer. This design utilizes a J-curve femoral design, which aims to replicate the natural medial pivoting of the knee. Therefore, the MC cannot be considered a pure medial pivot design due to the J-curve and lower level of medial constraint on the medial tibial bearing. In contrast, true pivot designs have a single constant femoral radius and function like a “ball-in-socket” in the concave medial surface of the polyethylene [1]. Because of this difference, we cannot comment on how a true medial pivot design would influence clinical and patient-reported outcomes. In our study, we identified minor early functional benefits in select PROMs with MC bearings compared to CR and UC. One prior study using an older generation medial pivot TKA reported superior knee proprioception and improved patient satisfaction compared to PCL-retaining and PS designs [21]. Further research on modern medial pivot TKAs is warranted to determine how the kinematic benefit of these designs impacts outcomes.

There are several limitations of this investigation. It is a retrospective review of prospectively collected data, which creates the potential for detection bias to occur. To mitigate this, extensive measures are taken at our institution to record all adverse events during or after surgery through an established protocol for over 20 years. Still, it is possible that some complications were treated outside our institution or went unreported during the study period. There were 6 surgeons who contributed cases to the study population, enabling variation in surgical technique to impact findings. However, the majority of TKAs included (81%) across all bearing surfaces were performed by 1 senior surgeon, which may indicate greater technical consistency between groups. Over the study period, there were temporal differences in bearing utilization at our institution, starting with mixed use of both UC and CR for the first 6 years. Afterward, MC rose in popularity to become the most utilized design. The more recent adoption of MC bearings meant that fewer cases with long-term follow-up were available for comparison. The variation in implant fixation methods may have also influenced results, with MC cases utilizing a larger proportion of cementless tibial and femoral components compared to UC and CR. At our institution there has been a resurgence of cementless fixation for TKAs over the past 5 years. In this study, we also report that 8.3% of UC cases were performed with retention of the PCL, which goes against the convention of sacrificing the ligament with these bearings, as there is no posterior cutout in the polyethylene. Surgeons at our institution often attempt to preserve fragments of the PCL when possible; however, this number may be due to some reporting bias from cases where a fragment of the ligament was left intact or after aggressive recession was done. Additionally, as PROM collection began during the study period and individual scoring

Table 4
Patient-reported outcome measures (PROMs) and range of motion (ROM).

Category	Patient population			
	MC	UC	CR	*P* value
PROMIS GHM Preoperative	44.4 ± 11.7 [561]	41.2 ± 10.9 [223]	41.9 ± 10.7 [228]	<.001
PROMIS GHM 1 y	48.9 ± 11.6 [331]	41.3 ± 12.4 [232]	43.7 ± 12.1 [237]	<.001
PROMIS GHM Max	48.7 ± 11.2 [635]	45.2 ± 11.5 [504]	46.8 ± 11.4 [704]	<.001
PROMIS GHP Preoperative	40.0 ± 7.3 [553]	37.7 ± 6.2 [221]	39.1 ± 6.3 [224]	<.001
PROMIS GHP 1 y	47.1 ± 9.2 [326]	41.5 ± 9.7 [223]	42.8 ± 9.7 [233]	<.001
PROMIS GHP Max	46.4 ± 9.1 [628]	43.7 ± 9.4 [492]	45.0 ± 9.5 [694]	<.001
KOOS JR Preoperative	49.3 ± 16.2 [533]	47.3 ± 16.2 [207]	46.8 ± 15.5 [218]	.09
KOOS JR 1 y	79.2 ± 14.3 [295]	80.2 ± 15.8 [204]	80.6 ± 16.1 [210]	.56
KOOS JR Max	75.5 ± 15.4 [613]	76.6 ± 17.6 [468]	80.6 ± 17.1 [613]	<.001
VAS Preoperative	5.5 ± 2.5 [559]	5.8 ± 2.5 [223]	5.8 ± 2.4 [227]	.10
VAS 1 y	2.1 ± 2.0 [329]	2.4 ± 2.3 [226]	2.3 ± 2.4 [237]	.36
VAS Max	2.4 ± 2.2 [632]	2.7 ± 2.4 [498]	2.6 ± 2.5 [700]	.07
KSS Knee Preoperative	40.9 ± 13.3 [514]	42.2 ± 13.1 [599]	43.4 ± 13.3 [1186]	.002
KSS Knee 1 y	92.3 ± 10.8 [165]	91.1 ± 10.5 [300]	92.2 ± 9.6 [650]	.28
KSS Knee Max	90.9 ± 11.9 [220]	88.5 ± 13.8 [395]	91.0 ± 11.0 [829]	.002
KSS Functional Preoperative	56.3 ± 13.6 [532]	57.6 ± 15.9 [626]	56.4 ± 15.1 [1225]	.19
KSS Functional 1 y	90.1 ± 15.4 [167]	86.7 ± 16.4 [305]	86.8 ± 17.0 [657]	.05
KSS Functional Max	86.7 ± 18.5 [227]	81.4 ± 20.9 [405]	83.7 ± 20.0 [840]	.005
ROM Preoperative	109.7 ± 8.0 [426]	112.6 ± 8.7 [568]	113.1 ± 9.1 [1009]	<.001
ROM 1 y	118.3 ± 6.7 [163]	115.7 ± 7.5 [302]	117.3 ± 7.3 [645]	<.001
ROM Max	117.6 ± 7.0 [219]	116.3 ± 7.5 [396]	117.4 ± 7.0 [829]	.02

MC, medial-congruent; UC, ultracongruent; CR, cruciate-retaining; PROMIS, Patient-Reported Outcomes Measurement Information System; GHM, Global Health Mental; GHP, Global Health Physical; KOOS JR, Knee Injury and Osteoarthritis Outcome Score, Joint Replacement; VAS, visual analog scale; KSS, Knee Society Score; ROM, range of motion.
Data are presented as mean ± standard deviation [# of responses]. Max values reflect the time of last follow-up.

Table 5
Intraoperative management details by group.

Group	MC	UC	CR
Patella resurfaced			
Population size	708	799	1376
Yes	678 (95.8%)	783 (98.0%)	1361 (98.9%)
No	30 (4.2%)	16 (2.0%)	15 (1.1%)
PCL management			
Recessed (balanced)	212 (29.9%)	270 (33.8%)	272 (19.8%)
Resected/absent	166 (23.4%)	463 (57.9%)	0 (0.0%)
Retained	330 (46.6%)	66 (8.3%)	1104 (80.2%)
Fixation method			
Cementless	199 (28.1%)	95 (11.9%)	116 (8.4%)
Partial cemented (F or T)	89 (12.6%)	30 (3.8%)	74 (5.4%)
Cemented (both)	420 (59.3%)	674 (84.3%)	1186 (86.2%)

MC, medial-congruent; UC, ultracongruent; CR, cruciate-retaining.
Data are presented as n (%).

systems were adopted at different time points, our PROM data does not represent the full study population for each group. To limit the effect of this, PROM collection is included as a standard of care at all regular follow-up appointments following TKA at our institution. Still, it is unclear whether current PROMs are sensitive enough to detect a difference between bearing surfaces. As we continue to compare long-term outcomes between designs, more sensitive measuring tools are needed. As such, adoption of the Forgotten Joint Score is currently under consideration at our institution.

Conclusions

The findings of this investigation demonstrate that choice of TKA bearing surface design does not significantly impact patient outcomes or revision rates through early follow-up. While our results indicate a clinically significant improvement in PROMIS Global Health Physical score with MC bearings compared to UC and CR, longer-term follow-up with sensitive outcome measures is needed to fully understand the potential clinical benefits of this newer design. With more congruent bearing surface designs now available, implant selection and intraoperative management of the PCL, including recessing, resecting, or retaining the ligament, should rely ultimately on surgeon judgment, comfortability with each design, and patient anatomy. It is the opinion of the surgeon authors that MC, UC, and CR bearings can all be utilized as needed without adversely affecting clinical or patient-reported outcomes.

Conflicts of interest

K. Fricka receives stock or stock options from OrthAlign and Pulse Platform; receives royalties, research support, and is a paid speaker and consultant for Smith & Nephew; is a consultant, paid speaker, and receives research support from Zimmer Biomet; is a paid consultant for 2nd MD; receives other financial or material support from Caregiver's Home Health and OrthoCareRN; receives research support from Inova Health Care Services, Smith & Nephew, and Zimmer; and is a board/committee member of the American Association of Hip and Knee Surgeons and Operation Walk Virginia. R. A. Sershon declares that they are a consultant for 2nd MD and Zimmer Biomet. All other authors declare no potential conflicts of interest.

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CRediT authorship contribution statement

Alexander V. Strait: Writing – review & editing, Writing – original draft, Data curation. **Eric J. Wilson:** Writing – review & editing, Project administration, Formal analysis, Data curation. **Henry Ho:** Validation, Software, Methodology, Formal analysis, Data curation. **Kevin B. Fricka:** Writing – review & editing, Supervision, Investigation, Conceptualization. **Robert A. Sershon:** Writing – review & editing, Writing – original draft, Supervision, Investigation, Conceptualization.

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