Robotic assisted conversion of a failed medial UKA to TKA: similar healthcare utilization and 1-year PROMs compared to manual, with fewer revision implants and augments

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INTRODUCTION:

Converting medial unicompartmental knee arthroplasty (mUKA) to total knee arthroplasty (TKA) can be difficult, and specialized techniques are needed. Issues include bone loss, joint-line, sizing, and rotation. Robotic-assisted (RA) conversion may better guide implant placement potentially resulting in lower stem and implant augment utilization and thus greater bone preservation. The current study aimed to compare RA and manual uniconversion in terms of 1) hospital resource utilization, 2) implant stem and augment utilization, and 3) postoperative patient-reported outcome measures (PROMs) at 1-year postoperative.

METHODS:

A prospective study at a large tertiary center of 46 patients undergoing conversion from mUKA to TKA was conducted between January 2016 and March 2023. Of these patients, 30 underwent manual conversion to TKA and 16 RA conversion to TKA. Outcomes of interest included TKA implant data, operative time, length of stay (LOS), discharge disposition (DD), 90-day hospital readmission, 90-day ED visits, 1-year reoperation, and 1-year PROMs: Knee disability and Osteoarthritis Outcome Score for Pain (KOOS Pain), Physical function Shortform (KOOS PS), and Joint Replacement (KOOS JR). Achievement of the Minimal Clinically Important Difference (MCID) and Patient Acceptable Symptom State (PASS) were assessed for each outcome. MCID values were 8.0 for KOOS-Pain delta (1 year minus baseline), 8.0 for KOOS-PS, and 6.8 for KOOS-JR. PASS thresholds were ≥77.7 for 1-year KOOS-Pain, and ≥70.3 for both KOOS-PS and KOOS-JR. To explore differences between groups for continuous variables, the Wilcoxon-Mann Whitney test was applied, while the chi-squared test (or Fisher exact test) was employed for categorical variables. All tests were two sided, assuming a significant level of 0.05.

RESULTS:

There were no significant differences in healthcare resource utilization between RA and manual conversion TKA (**Table 1**). Patients undergoing RA conversion TKA demonstrated lower rates of stemmed tibial and femoral implants, lower rates of tibial implant augments, and lower polyethylene tibial insert thickness when compared to manual conversion patients (**Table 2**). RA conversion had increased achievement of MCID and PASS thresholds in all KOOS domains, however this was not statistically significant. Similarly, satisfaction was higher in the RA conversion group despite being statistically insignificant. (**Table 3**).

DISCUSSION AND CONCLUSION:

RA conversion of a mUKA to a TKA offers lower utilization of stemmed tibial and femoral implants, fewer tibial implant augments, and thinner polyethylene tibial inserts. The healthcare utilization and patient perceived outcomes were comparable between RA and manual conversion. These results suggest that conversion with RA may provide more precise alignment and placement of implants, which can lead to more optimal implant usage. Further research studying larger cohorts for longer terms is necessary to establish the impact on clinical outcomes and survivorship.

Table 1. Healthcare Utilization Outcomes

Variable	Level	All (n=46)	Manual (n=30)	Robotic (n=16)	P-value
Operation Time (Hours)		2.51 [2.40;3.00]	2.63 [2.50;3.04]	2.50 [2.35;2.90]	0.297
LOS		1.00 [1.00;2.00]	1.00 [1.00;2.00]	1.00 [1.00;1.00]	0.298
Discharge Disposition	Home/home health care	44 (97.8%)	29 (100%)	15 (93.8%)	0.352
	Non-home	1 (2.22%)	0 (0.00%)	1 (6.25%)	
90-day Readmission		2 (4.35%)	1 (3.33%)	1 (6.25%)	1.000
90-day ED Visits		4 (8.70%)	2 (6.67%)	2 (12.5%)	0.607
1-year Reoperation		2 (4.35%)	1 (3.33%)	1 (6.25%)	1.000

Continuous variables presented as Median [IQR]. Categorical variables presented as N (%).
LOS – length of stay; ED – emergency department

Table 2. Implant & Augment Utilization

Variable	Level	All (n=46)	Manual (n=30)	Robotic (n=16)
Tibial Stem	Yes	24 (52.2%)	17 (56.7%)	7 (43.8%)
	No	22 (47.8%)	13 (43.3%)	9 (56.3%)
Tibial Stem Fixation	Cemented	45 (97.8%)	29 (96.7%)	16 (100%)
	Cementless	1 (2.2%)	1 (3.3%)	0 (0%)
Tibial Implant Augments	Yes	11 (23.9%)	8 (26.7%)	3 (18.8%)
	No	35 (76.1%)	22 (73.3%)	13 (81.3%)
Tibial Polyethylene Inserts	UC	2 (4.3%)	2 (6.7%)	0 (0%)
	CS	13 (28.2%)	4 (13.3%)	9 (56.3%)
	CR	4 (8.7%)	3 (10%)	1 (6.3%)
	PS	18 (39.1%)	12 (40%)	6 (37.5%)
	TS	9 (19.6%)	9 (30%)	0 (0%)
Tibial Polyethylene Thickness	9-13 mm	37 (80.4%)	21 (70%)	16 (100%)
	14+ mm	9 (19.6%)	9 (30%)	0 (0%)
Femoral Stem	Yes	7 (15.2%)	7 (23.3%)	0 (0%)
	No	39 (84.8%)	23 (76.7%)	16 (100%)
Femoral Stem Fixation	Cemented	44 (95.7%)	28 (93.3%)	16 (100%)
	Cementless	2 (4.3%)	2 (6.7%)	0 (0%)
Femoral Implant Augment	Yes	5 (10.9%)	2 (6.7%)	3 (18.8%)
	No	41 (89.1%)	28 (93.3%)	13 (81.3%)
Femoral Polyethylene Inserts	CR	16 (34.8%)	7 (23.3%)	9 (56.3%)
	PS	20 (43.5%)	15 (50%)	5 (31.3%)
	TS	10 (21.7%)	8 (26.7%)	2 (12.5%)

UC – ultracongruent; CS – condylar stabilizing; CR – cruciate retaining; PS – posterior stabilizing; TS – total stabilizing

Table 3. 1-year Patient-Reported Outcomes

Variable	Level	All (n=30)	Manual (n=20)	Robotic (n=10)	P-value
KOOS-Pain		77.8 [62.5;83.3]	76.4 [65.3;81.3]	80.6 [59.0;99.3]	0.465
KOOS-PS		64.7 [59.7;75.1]	64.7 [60.5;70.3]	64.7 [58.0;75.1]	0.941
KOOS-JR		66.0 [59.4;76.3]	66.0 [59.4;70.7]	71.2 [62.1;77.2]	0.702
MCID for KOOS Pain	Improved	26 (86.7%)	17 (85.0%)	9 (90.0%)	1.000
	Failure	4 (13.3%)	3 (15.0%)	1 (10.0%)	
MCID for KOOS PS	Improved	17 (60.7%)	11 (57.9%)	6 (66.7%)	0.705
	Failure	11 (39.3%)	8 (42.1%)	3 (33.3%)	
MCID for KOOS JR	Improved	22 (78.6%)	15 (75.0%)	7 (87.5%)	0.643
	Failure	6 (21.4%)	5 (25.0%)	1 (12.5%)	
PASS Satisfaction	Yes	23 (79.3%)	15 (75.0%)	8 (88.9%)	0.641
PASS Threshold for KOOS Pain	Improved	16 (53.3%)	10 (50.0%)	6 (60.0%)	0.701
	Failure	14 (46.7%)	10 (50.0%)	4 (40.0%)	
PASS Threshold for KOOS PS	Improved	10 (35.7%)	6 (31.6%)	4 (44.4%)	0.673
	Failure	18 (64.3%)	13 (68.4%)	5 (55.6%)	
PASS Threshold for KOOS JR	Improved	10 (35.7%)	6 (30.0%)	4 (50.0%)	0.368
	Failure	18 (64.3%)	14 (70.0%)	4 (50.0%)	

Continuous variables presented as Median (IQR). Categorical variables presented as N (column %).