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Length of stay and discharge dispositions following robotic arm-assisted total knee arthroplasty and unicompartmental knee arthroplasty versus conventional technique and predictors of delayed discharge

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Aims

In-hospital length of stay (LOS) and discharge dispositions following arthroplasty could act as surrogate measures for improvement in patient pathways, and have major cost saving implications for healthcare providers. With the ever-growing adoption of robotic technology in arthroplasty, it is imperative to evaluate its impact on LOS. The objectives of this study were to compare LOS and discharge dispositions following robotic arm-assisted total knee arthroplasty (RO TKA) and unicompartmental arthroplasty (RO UKA) versus conventional technique (CO TKA and UKA).

Methods

This large-scale, single-institution study included patients of any age undergoing primary TKA (n = 1,375) or UKA (n = 337) for any cause between May 2019 and January 2023. Data extracted included patient demographics, LOS, need for post anaesthesia care unit (PACU) admission, anaesthesia type, readmission within 30 days, and discharge dispositions. Univariate and multivariate logistic regression models were also employed to identify factors and patient characteristics related to delayed discharge.

Results

The median LOS in the RO TKA group was 76 hours (interquartile range (IQR) 54 to 104) versus 82.5 (IQR 58 to 127) in the CO TKA group ($p < 0.001$) and 54 hours (IQR 34 to 77) in the RO UKA versus 58 (IQR 35 to 81) in the CO UKA ($p = 0.031$). Discharge dispositions were comparable between the two groups. A higher percentage of patients undergoing CO TKA required PACU admission (8% vs 5.2%; $p = 0.040$).

Conclusion

Our study showed that robotic arm assistance was associated with a shorter LOS in patients undergoing primary UKA and TKA, and no difference in the discharge destinations. Our results suggest that robotic arm assistance could be advantageous in partly addressing the upsurge of knee arthroplasty procedures and the concomitant healthcare burden; however, this needs to be corroborated by long-term cost-effectiveness analyses and data from randomized controlled studies.

Cite this article: *Bone Jt Open* 2023;4-10:791–800.

Keywords: Total knee arthroplasty, Unicompartmental arthroplasty, Robotic arm assistance, Length of stay, Discharge disposition

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doi: 10.1302/2633-1462.410.BJO-2023-0126.R1

Bone Jt Open 2023;4-10:791–800.

Introduction

As the incidence of TKA and UKA continues to climb, the projected volume of primary UKA and TKA procedures threatens to place an immense financial burden on future healthcare systems.[1] There is mounting evidence to

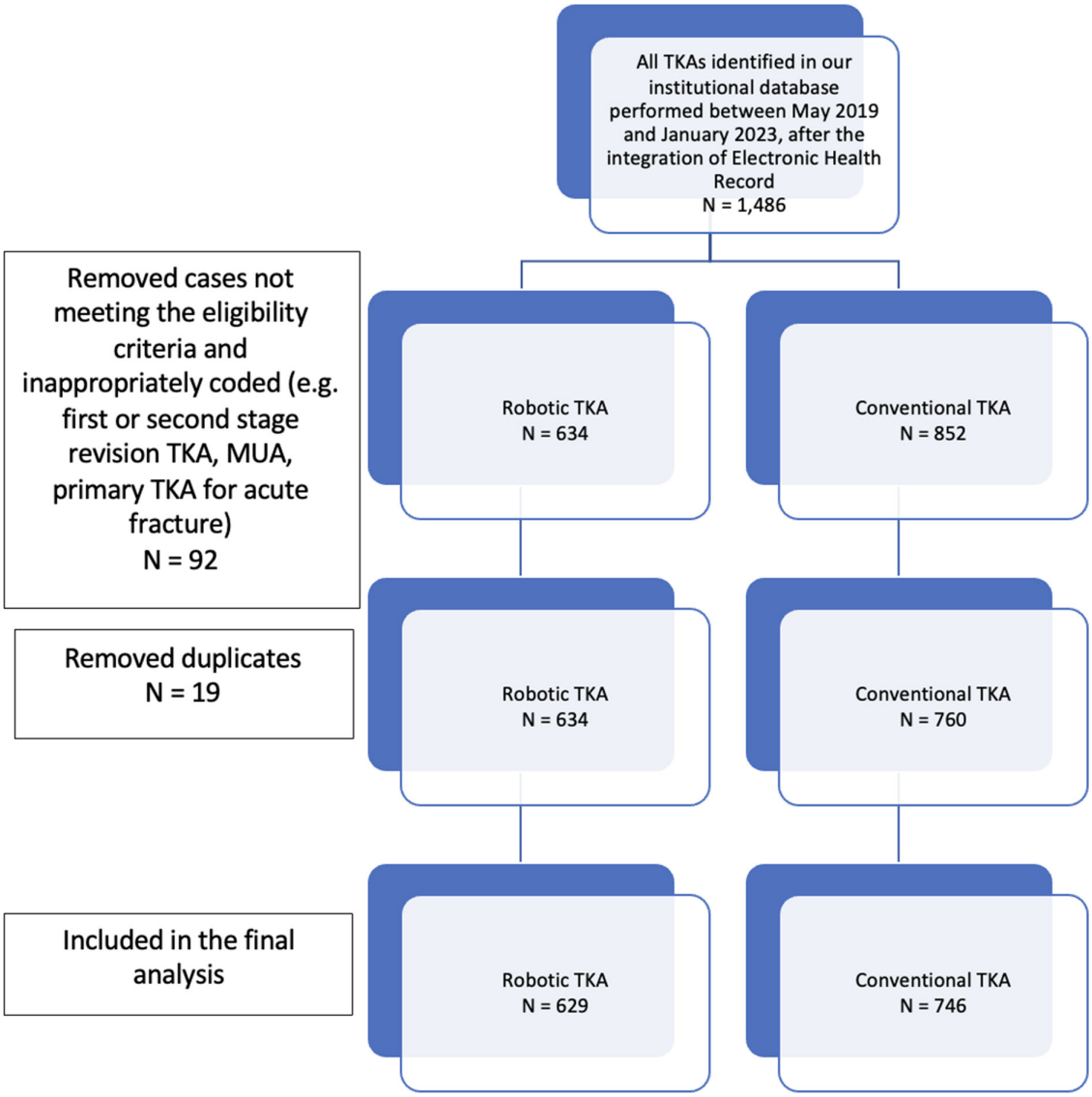

Fig. 1

Flowchart depicting case identification of total knee arthroplasty (TKA) cases and exclusions from final analysis. MUA, manipulation under anaesthesia.

suggest that reducing LOS can combat the cost increase, and it is safe when applied to selected populations, using well-defined discharge criteria.[2-4] Decreased mobility in the immediate postoperative period and pain are well-recognized factors that impede functional recovery, thereby increasing LOS.

Advancements in surgical technology have yielded robotic arm-assisted arthroplasty, first introduced into TKA and UKA at the turn of the 20th century as a potential solution to improve accuracy and patient satisfaction, and tackle the higher revision rates linked to implant malposition.[5,6] Early results suggest that robotic arm-assisted TKA and UKA are associated with superior radiological outcomes and reduction in outliers compared to conventional arthroplasty.[7,8] It has also been suggested that robotic arm-assistance could be associated with improved functional outcomes, reduced postoperative inflammatory response, soft-tissue injury, and pain.[9-13] However, there is very limited literature on the translation of radiological outcomes to improvement in patient-reported outcome measures (PROMs). Furthermore, some studies have suggested an improvement in rehabilitation and recovery with robotic arm assistance,[14-16] however it is unclear whether this translates to a reduction in LOS.

Several patient characteristics and predictors of prolonged LOS and diminished patient satisfaction have been identified. These include, but are not limited to, age, sex, comorbidities, preoperative mobility, BMI, and blood loss.[17,18] Notwithstanding this, very few studies have aimed to evaluate the impact of the surgical technique. Discharge destination following arthroplasty is

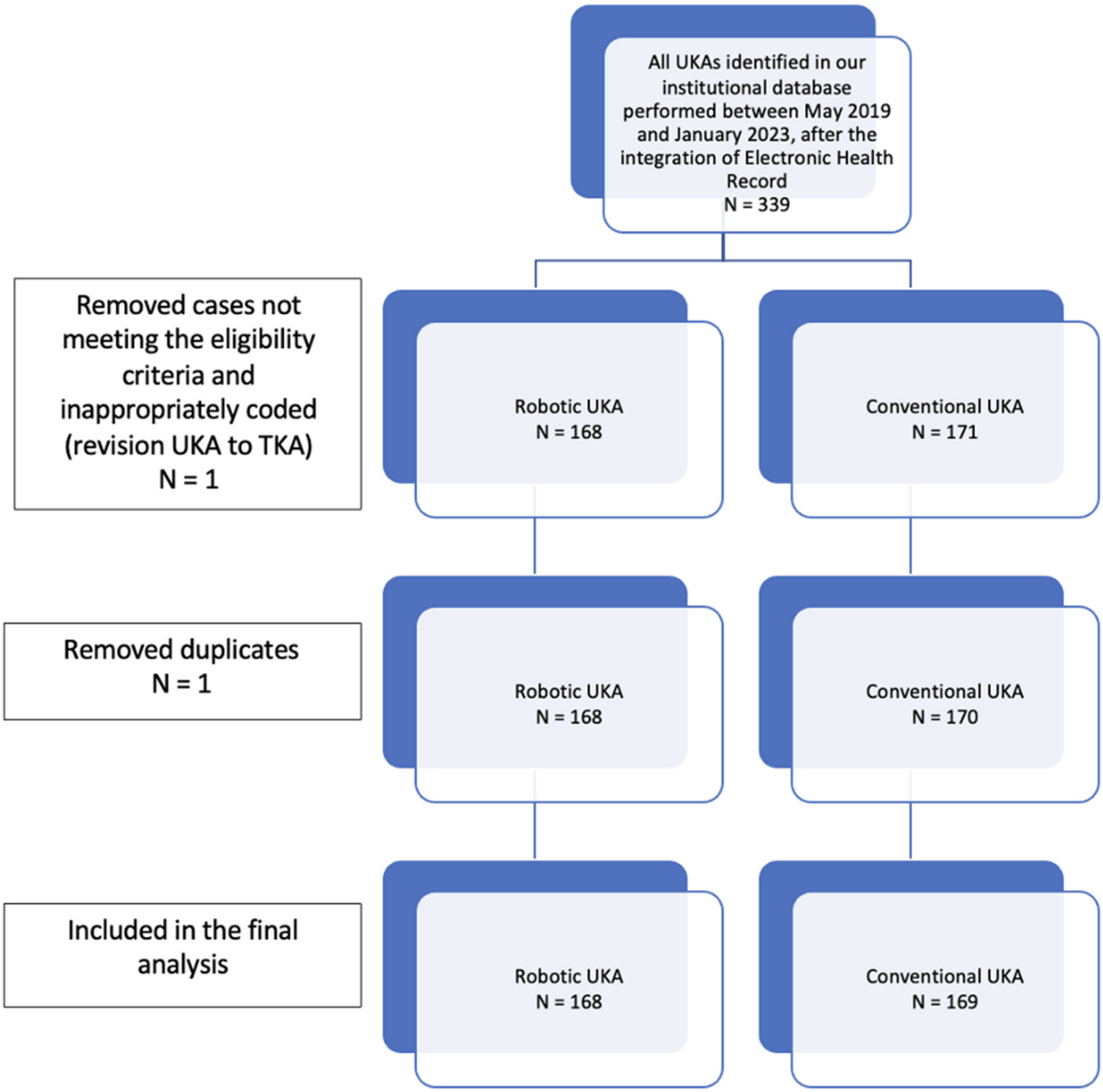

Fig. 2

Flowchart depicting case identification of unicompartmental knee arthroplasty (UKA) cases and exclusions from final analysis. TKA, total knee arthroplasty.

another important metric that has commonly been used as an outcome of interest. Any changes in the setting to which the patient is discharged or LOS could potentially act as a surrogate measure for improvement in patient-oriented outcomes, and have major cost-saving implications for healthcare providers.

As evidence continues to emerge, it is pivotal to identify factors that may be related to an accelerated discharge from hospital. In this vein, we have explored our institutional data over a three-year period to capture a large-scale population and assess whether any differences were evident between conventional and robotic arm-assisted TKA and UKA in relation to inpatient LOS and discharge destinations. In addition, we aimed to identify factors and patient characteristics related to delayed discharge in our study population.

Methods

Study design. This is a large-scale study investigating the LOS and discharge destination of patients undergoing robotic arm-assisted TKA (RO TKA) or UKA (RO UKA) versus conventional jig-based TKA (CO TKA) or UKA (CO UKA) procedures at a single orthopaedic unit. The study included patients of any age undergoing primary TKA or UKA for any cause (osteoarthritis, inflammatory arthritis, post-traumatic joint disease, osteonecrosis). All patients undergoing UKA or TKA, defined by the International Classification of Diseases (ICD)-10 code,[19] between May

Table I. Baseline characteristics and admission characteristics among patients undergoing conventional or robotic arm-assisted total knee arthroplasty.

Variable	Robotic TKA	Conventional TKA	p-value*
Patients, n	629	746	
Sex, n (%)			0.245
Female	440 (70)	500 (67)	
Male	189 (30)	246 (33)	
ASA grade, n (%)			0.238
I	22 (3.5)	31 (4.2)	
II	426 (67.9)	469 (63.7)	
III	179 (28.5)	234 (31.8)	
IV	0 (0)	2 (0.3)	
Index of Multiple Deprivation quintile, n (%)†			0.059
0 to 20%	127 (20.5)	144 (19.5)	
20% to 40%	202 (32.6)	235 (31.8)	
40% to 60%	131 (21.1)	179 (24.2)	
60% to 80%	111 (17.9)	100 (13.5)	
80% to 100%	49 (7.9)	81 (11)	
Anaesthesia type, n (%)			0.990
General	173 (28.2)	191 (28.3)	
Spinal	440 (71.8)	485 (71.7)	
Discharge destination, n (%)			0.953
Usual place	596 (98)	690 (98)	
Hospital	7 (1.2)	9 (1.3)	
Temporary accommodation (care home, nursing home)	5 (0.8)	5 (0.7)	
Readmission within 30 days, n (%)	37 (5.9)	61 (8.2)	0.099
PACU admission, n (%)	33 (5.2)	60 (8)	0.040

*Pearson chi-squared test.
†Group 1 (0 to 20%) represents the most deprived while group 5 (80 to 100%) was the least deprived.
ASA, American Society of Anesthesiologists; PACU, post anaesthesia care unit; TKA, total knee arthroplasty.

Table II. Baseline characteristics and admission characteristics among patients undergoing conventional or robotic arm-assisted unicompartmental knee arthroplasty.

Variable	Robotic UKA	Conventional UKA	p-value*
Patients, n	168	169	
Sex, n (%)			0.407
Female	98 (58.3)	91 (53.8)	
Male	70 (41.7)	78 (46.2)	
ASA grade, n (%)			0.083
I	4 (2.4)	11 (6.7)	
II	131 (78.4)	115 (69.7)	
III	32 (19.2)	39 (23.6)	
IV	0 (0)	0 (0)	
Index of Multiple Deprivation quintile, n (%)†			0.957
0 to 20%	22 (13.8)	23 (13.7)	
20% to 40%	45 (28.3)	53 (31.5)	
40% to 60%	42 (26.4)	40 (23.8)	
60% to 80%	27 (17)	30 (17.9)	
80% to 100%	23 (14.5)	22 (13.1)	
Laterality, n (%)			0.448*
Right	77 (45.8)	88 (52.1)	
Left	88 (52.4)	77 (45.6)	
Bilateral	3 (1.8)	4 (2.4)	
Discharge destination, n (%)			0.218*
Usual place	164 (98.8)	160 (97)	
Hospital	0 (0)	3 (1.8)	
Temporary accommodation (care home, nursing home)	2 (1.2)	2 (1.2)	
Readmission within 30 days, n (%)	7 (4.2)	5 (3)	0.573
PACU admission, n (%)	4 (2.4)	9 (5.3)	0.160
Anaesthesia type, n (%)			0.325
General	69 (42.1)	58 (36.7)	
Spinal	95 (57.9)	100 (63.3)	

*Pearson chi-squared test.
†Group 1 (0 to 20%) represents the most deprived while group 5 (80 to 100%) was the least deprived.
ASA, American Society of Anesthesiologists; PACU, post anaesthesia care unit.

2019 and January 2023 were retrospectively identified from a prospectively collected institutional database. All revision cases were excluded from the analysis. All robotic arm-assisted operations were performed with the MAKO Robotic arm Interactive Orthopaedic (RIO) system (Stryker, USA).

Robotic arm assistance was introduced in our institution in 2018, with an exponential rise in the robotic case load over the past two years. Patients were allocated into each group based on patient's choice, surgeon's confidence and familiarity with the surgical technique, as well as availability of the robotic device. Hence, we included patients undergoing an operation from 2019 onwards to minimize confounders, including the impact of learning curve and any potential dissimilarities in rehabilitation protocols. Furthermore, our Electronic Health Record (EPIC, Epic Systems Corporation, USA) was integrated in 2019, allowing collection of a more comprehensive range of outcomes.

Data extracted included patient demographics, date and timing of admission, LOS in days and hours, need for admission to post anaesthesia care unit (PACU), type of anaesthesia, readmission within 30 days, and discharge destinations. The data fields and definitions applied in this study can be found in Supplementary Table i. This study received institutional approval and was registered as a quality improvement exercise.

Statistical analysis. As continuous variables were noted to violate the parametric distribution, the independent samples Mann-Whitney U test and Kruskal-Wallis tests were used for comparisons. The Pearson chi-squared test was used to assess differences between categorical variables.

Table III. Length of stay and age among patients undergoing conventional or robotic arm-assisted unicompartmental knee arthroplasty.

Variable	Robotic UKA	Conventional UKA	p-value
Patients, n	168	169	
Median LOS, days (IQR)	2 (1 to 3)	2 (1 to 3)	0.030*
Median LOS, hrs (IQR)	54 (34 to 77)	58 (35 to 81)	0.031*
LOS, n (%)			0.090†
≤ 24 hrs	7 (4.2)	2 (1.2)	
25 to 48 hrs	61 (36.3)	52 (30.2)	
49 to 72 hrs	51 (30.4)	49 (29)	
> 72 hrs	49 (29.2)	67 (39.6)	
Median age, yrs (IQR)	66 (59 to 73)	68 (60.5 to 74)	0.206*
Median BMI, kg/m^2 (IQR)	29.24 (25.9 to 32.5)	30.34 (26.7 to 34.12)	0.080*
Median days spent in PACU (IQR)	2 (2 to 2.25)	2 (2 to 3)	1.000*

*Independent-samples Mann-Whitney U test.
†Chi-squared test.
IQR, interquartile range; LOS, length of stay; PACU, post anaesthesia care unit; UKA, unicompartmental knee arthroplasty.

Table IV. Length of stay and age among patients undergoing conventional or robotic arm-assisted total knee arthroplasty.

Variable	Robotic TKA	Conventional TKA	p-value
Patients, n	629	746	
Median LOS, days (IQR)	3 (2 to 4)	3 (2 to 5)	< 0.001*
Median LOS, hrs (IQR)	76 (54 to 104)	82.5 (58 to 127)	< 0.001†
LOS, n (%)			< 0.001†
≤ 24 hrs	1 (0.2)	1 (0.1)	
25 to 48 hrs	88 (14)	64 (8.6)	
49 to 72 hrs	198 (31.5)	149 (20)	
> 72 hrs	342 (54.4)	532 (71.3)	
Median age, yrs (IQR)	69 (63 to 75)	70 (62 to 76)	0.374*
Median BMI, kg/m^2 (IQR)	30.86 (27 to 35.52)	30.8 (27 to 35.63)	0.999*
Median days spent in PACU (IQR)	2 (2 to 2)	2 (2 to 3)	0.042*

*Independent-samples Mann-Whitney U test.
†Chi-squared test.
IQR, interquartile range; LOS, length of stay; PACU, post anaesthesia care unit; TKA, total knee arthroplasty.

The Spearman and Pearson correlation coefficients were employed to assess the correlational relationship between continuous variables. Univariate and multivariate logistic regression analyses were performed to identify significant parameters impacting LOS. All analyses were performed using the IBM SPSS statistics software for Mac v. 29 (IBM, USA). The threshold for statistical significance was set at $p < 0.05$ (two-tailed).

Results

Interrogation of the database yielded a total of 1,486 TKAs and 339 UKAs performed between May 2019 and January 2023. After applying the eligibility criteria and removing duplicates, 1,375 TKAs (n = 629 robotic arm-assisted vs n = 746 conventional) and 337 UKAs (n = 168 robotic arm-assisted vs n = 169 conventional) were included in the final analysis (Figures 1 and 2). Age, sex, BMI, index of multiple deprivation, ASA physical grade scores, and type of anaesthesia were comparable between the robotic and conventional groups for both procedures (Tables I to IV).

Length of stay and discharge destinations. The median LOS was significantly shorter in patients undergoing RO TKA and RO UKA compared with CO TKA and CO UKA. The median LOS in hours was 76 (IQR 54 to 104) in the RO TKA versus 82.5 (IQR 58 to 127) in the CO TKA ($p < 0.001$, chi-squared test) (Table IV and Figure 3).

The median LOS in hours was 54 (IQR 34 to 77) in the RO UKA versus 58 (IQR 35 to 81) in the CO UKA ($p = 0.031$, independent-samples Mann-Whitney U test) (Table III and Figure 4).

No significant differences were noted in the discharge destination of patients, following UKA or TKA, when comparing the robotic and conventional groups.

Readmission rates and PACU admission. The proportion of patients needing PACU admission was significantly higher for patients who underwent conventional TKA (8% vs 5.2%; $p = 0.040$, Pearson chi-squared test) (Table I). A similar trend was evident in patients undergoing UKA, not reaching statistical significance nevertheless (2.4% RO UKA vs 5.3% CO UKA; $p = 0.160$, Pearson chi-squared test) (Table II).

When comparing only patients admitted to PACU, patients who underwent RO TKA had significantly shorter LOS compared with CO TKA ($p = 0.042$, independent-samples Mann-Whitney U test) (Table IV). No differences were evident in the PACU LOS for UKA patients (Table III).

Patients in the RO TKA group had lower percentage of readmissions within 30 days, however this did not reach statistical significance (5.9% vs 8.2%; $p = 0.099$, independent-samples Mann-Whitney U test).

Influence of analyzed variables on LOS. A secondary objective of this study was to identify factors and patient characteristics related to delayed discharge following TKA or UKA. To evaluate the correlational relationship between LOS and age, the Spearman and Pearson correlation coefficients were calculated (Supplementary Tables ii and iii). The analysis yielded a weak positive correlation between LOS and age in patients undergoing TKA and UKA.

To explore whether LOS differed between the various ASA grades and identify the appropriate parameters for the regression model, we compared the distribution of LOS among the different ASA grades, which showed a significantly different distribution both in the UKA and TKA populations ($p < 0.001$, independent samples Kruskal Wallis test).

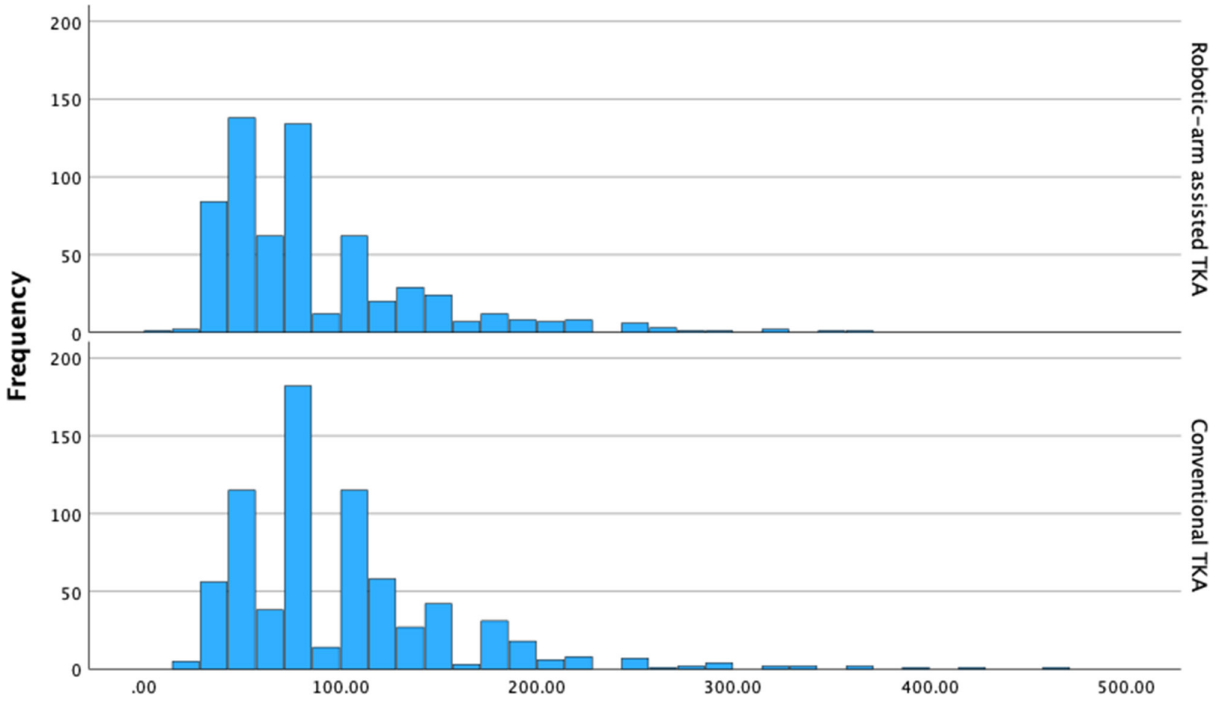

Fig. 3

Histogram depicting length of stay in hours between the two total knee arthroplasty (TKA) groups.

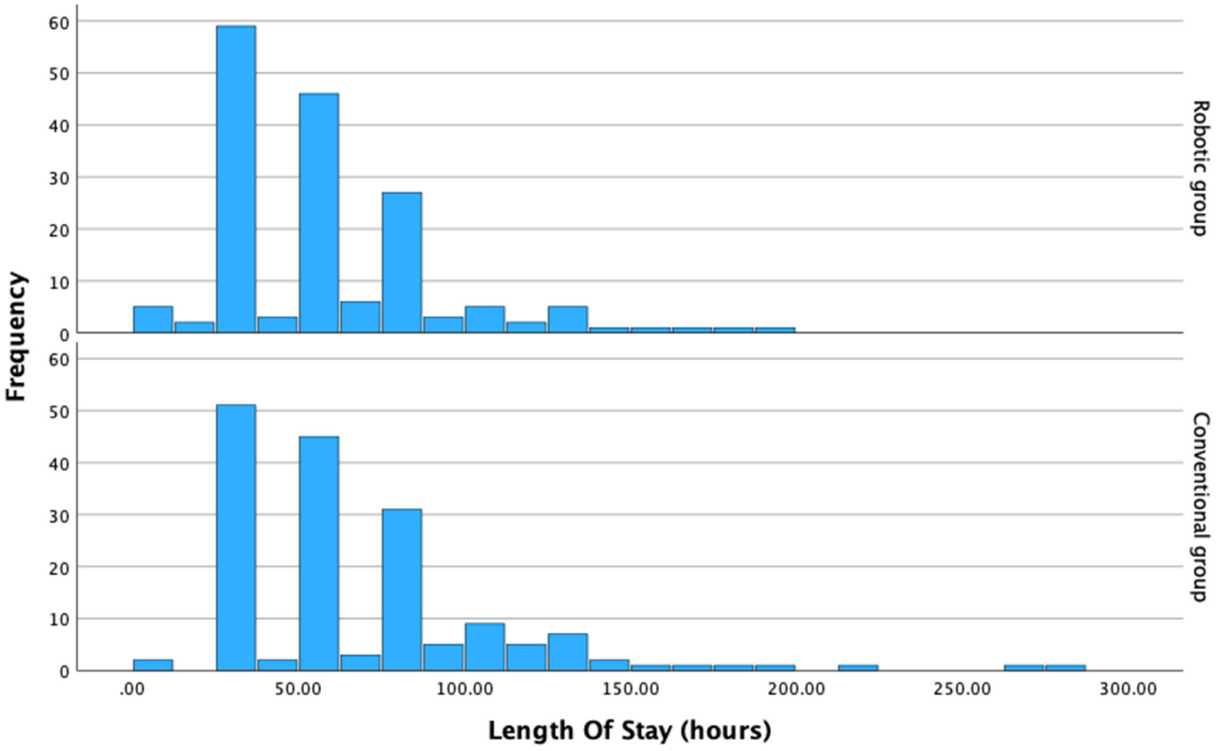

Fig. 4

Histogram depicting length of stay (LOS) in hours between the two unicompartmental knee arthroplasty groups.

Furthermore, when evaluating the distribution of LOS in males and females; females undergoing TKA had longer LOS in hours (median 81 (IQR 57 to 126) vs 78 (IQR 55 to 107, p = 0.020, Mann-Whitney U test). The

Table V. Binary logistic regression assessing the utility of the recorded variables to predict length of stay over three days in patients undergoing total knee arthroplasty: a univariate analysis.

Variable	OR (95% CI)	p-value
Female sex	1.228 (0.972 to 1.552)	0.085
Age	1.032 (1.020 to 1.044)	< 0.001
PACU admission	5.321 (3.225 to 8.698)	< 0.001
Use of conventional technique	1.783 (1.431 to 2.221)	< 0.001
		0.036
ASA grade > II	2.201 (1.745 to 2.791)	
General anaesthetic	1.537 (1.203 to 1.962)	< 0.001
BMI	1.023 (1.005 to 1.042)	0.012

ASA, American Society of Anesthesiologists; CI, confidence interval; OR, odds ratio; PACU, post anaesthesia care unit.

Table VI. Binary logistic regression assessing the utility of the recorded variables to predict length of stay over two days in patients undergoing unicompartmental knee arthroplasty: a univariate analysis.

Variable	OR (95% CI)	p-value
Female sex	1.679 (1.062 to 2.655)	0.027
Age	1.032 (1.008 to 1.057)	0.008
PACU admission	10.849 (2.363 to 49.809)	0.002
Use of conventional technique	1.425 (0.910 to 2.231)	0.121
ASA grade > II	2.559 (1.499 to 4.369)	< 0.001
Laterality (left)	1.348 (0.862 to 2.11)	0.191
General anaesthetic	1.282 (0.808 to 2.034)	0.292
BMI	1.032 (0.989 to 1.077)	0.148

ASA, American Society of Anesthesiologists; CI, confidence interval; OR, odds ratio; PACU, post anaesthesia care unit.

same trend was evident in patients undergoing UKA (p = 0.031). We also noted that patients undergoing spinal anaesthesia had shorter LOS compared with those undergoing general anaesthesia (median 79 (IQR 55 to 108) vs 84 (IQR 59 to 130); p < 0.001 in TKA; 55 (IQR 34 to 79) vs 58 (IQR 35 to 81); p = 0.165 in UKA).

Predictors of delayed discharge. Study participants were divided into two cohorts based on their LOS (LOS ≤ 3 or > 3 days for the TKA population and LOS ≤ 2 or > 2 days for the UKA population). A logistic regression was performed to ascertain the effects of the different variables and surgical technique.

First, a univariate binary logistic regression (Tables V and VI) was performed to identify parameters for inclusion in the multivariate model (all variables with p < 0.1 in the univariate model were included in the multivariate analysis).

In the multivariate logistic regression model, the following variables were significantly associated with a LOS of three days or more in patients who underwent TKA (Table VII).

The probability of staying more than three days increased by 3.4% per year of increasing age (p < 0.001) (OR 1.034, 95% CI 1.020 to 1.048); patients requiring PACU admission had a threefold probability of staying more than three days (p < 0.001) (OR 2.964, 95% CI 1.708 to 5.143); patients undergoing CO TKA had an almost doubled probability of staying more than three days (p < 0.001) (OR 1.960, 95% CI 1.538 to 2.497); patients with an ASA grade > II had a 1.7 times greater probability of staying more than three days (p < 0.001) (OR 1.704, 95% CI 1.298 to 2.236); and patients undergoing general anaesthesia had 1.7 times greater probability of LOS > three days (p < 0.001) (OR: 1.681, 95% CI 1.288 to 2.195).

In the multivariate logistic regression model, the following variables were significantly associated with a LOS of two days or more in patients who underwent UKA (Table VIII).

Females had almost doubled probability of staying more than two days compared to males (p = 0.009) (OR 1.912, 95% CI 1.177 to 3.108); patients requiring PACU admission had an eightfold probability of staying more than two days (p = 0.009) (OR 8.025, 95% CI 1.674 to 38.459); and patients with an ASA grade> II had an almost doubled probability of staying more than three days (p = 0.020) (OR 1.977, 95% CI 1.115 to 3.507).

Discussion

Our findings demonstrated a shorter LOS in patients undergoing UKA or TKA when robotic arm assistance was used. Our results are in concordance with previous studies. Archer et al[4] retrospectively looked at 10,296 patients undergoing robotic arm-assisted (n = 4,303) or conventional (n = 5,993) TKA, and reported a significantly lower mean LOS in the robotic group (1.68 days, standard deviation (SD) 0.86) compared with the conventional (1.86 days, SD 0.94, p < 0.001). Grosso et al[20] also conducted a large-scale study among 4,086 primary TKAs and reported shorter LOS when robotic arm assistance was used (1.46 vs 1.80 days, p < 0.001). Furthermore, four smaller-scale studies have reported LOS with robotic arm assistance.[21–23] In a study conducted in the UK, Sephton et al[24] retrospectively analyzed all UKAs (n = 155 patients) performed over a three-year period to ascertain predictors of prolonged LOS after UKA. The authors reported that participants undergoing robotic UKA (NAVIO; Smith & Nephew, UK) had shorter LOS.

This could reflect the ability of robotic technology to reduce bone and soft-tissue trauma,[13,16] by more accurately executing the preoperative plan using haptic technology.[25] Furthermore, adjusting component positioning to minimize soft-tissue releases is another feature that could conceptually lead to decreased pain scores, better early functional outcomes, and faster rehabilitation. We also found that a smaller percentage of patients who underwent RO TKA required PACU admission, and had shorter PACU stay, compared with CO TKA. Nonetheless, various aetiologies could explain this. Specifically, PACU

Table VII. Binary logistic regression assessing the utility of the recorded variables to predict length of stay over three days in the multivariate model in patients undergoing total knee arthroplasty.

Variable	OR (95% CI)	p-value
Female sex	1.277 (0.979 to 1.666)	0.071
Age	1.034 (1.020 to 1.048)	< 0.001
PACU admission	2.964 (1.708 to 5.143)	< 0.001
Use of conventional technique	1.960 (1.538 to 2.497)	< 0.001
		< 0.001
ASA grade > II	1.704 (1.298 to 2.236)	
General anaesthetic	1.681 (1.288 to 2.195)	< 0.001
BMI	1.018 (0.998 to 1.039)	0.084

ASA, American Society of Anesthesiologists; CI, confidence interval; OR, odds ratio; PACU, post anaesthesia care unit.

Table VIII. Binary logistic regression assessing the utility of the recorded variables to predict length of stay over two days in the multivariate model in patients undergoing unicompartmental knee arthroplasty.

Variable	OR (95% CI)	p-value
Female sex	1.912 (1.177 to 3.108)	0.009
Age	1.022 (0.997 to 1.048)	0.083
PACU admission	8.025 (1.674 to 38.459)	0.009
ASA grade > II	1.977 (1.115 to 3.507)	0.020

ASA, American Society of Anesthesiologists; CI, confidence interval; OR, odds ratio; PACU, post anaesthesia care unit.

admission might indicate increased postoperative care requirements, or it could be influenced by prior comorbidities. However, we aimed to account for this potential bias by examining the ASA grades of participants, which showed no statistical significant differences.

In our study, we found no significant difference in relation to discharge destinations, and a similar proportion of patients in both groups was discharged home following TKA. Our findings are rather discordant with previously published studies conducted in the USA, that insinuate benefits of robotic arm assistance. Archer et al[4] reported a significantly higher proportion of patients undergoing RO TKA were discharged home (91.3% vs 87.4%, $p < 0.001$). Similarly, Hamilton et al[26] showed that more patients in the RO TKA group were discharged home (90.4% vs 79.5%) instead of a subacute rehabilitation facility (9.6% vs 20.5%; 0.051, Pearson chi-squared test and 0.041, Fisher's exact test). In another recent comparative study encompassing 4,086 matched primary TKAs, Grosso et al[20] reported lower rate of discharge to rehabilitation facilities when robotic arm assistance was used (5.5 vs 14.8%, $p < 0.001$). In comparison with the above studies, we found considerably higher rates of home discharges. Nevertheless, these results and the longer LOS are likely to reflect social care deficiency and must be interpreted in light of the study's NHS setting, which could potentially have introduced confounders. Owing to the considerably limited places in nursing and residential homes, it is not uncommon for patients to undergo inpatient rehabilitation.

In our multivariate models, age, need for PACU admission, ASA grade > II, general anaesthetic, and use of the conventional technique were significantly associated with LOS > three days in TKA. In UKA patients, only female sex, ASA grade > II, and need for PACU admission reached statistical significance in our model. Our results are concordant with previous analyses showcasing age, female sex, type of anaesthetic, and increased ASA grade as predictors of longer LOS.[27–29]

Our study features several strengths. To our knowledge, this is only the second large-scale study to explore the impact of robotic technology on LOS and discharge destinations as primary outcomes of interest in TKA, and the first one to look at UKA.[4] Additionally, our study encompasses regression analyses to identify predictors of delayed discharge, and is the first large-scale study presenting data from a publicly funded healthcare system. Furthermore, we aimed to capture variables that could potentially confound our results, including age, sex, BMI, index of deprivation, type of anaesthesia, and medical comorbidities represented by the ASA grade. We found no significant differences in baseline characteristics or demographics.

Our study has several limitations that should be considered when interpreting the results. First, the NHS setting could have introduced potential confounding factors, including delays for social care placement or the implementation of standardized protocols for discharge and rehabilitation. Second, our study could be prone to selection bias, given the selection criteria for UKA or TKA were not formally evaluated, and decision-making regarding robotic assisted surgery involved patient's preference, surgeon's confidence and familiarity with the surgical technique, and availability of the robotic device. However, this reflects pragmatic practice and allows generalizability of our findings. Third, bias could have been introduced as procedures were performed by multiple surgeons, and a shift in culture was noted with robotic cases climbing sharply after 2020, owing to increasing availability of robotics and surgeons gaining experience. This could have had an impact on our results, considering potential improvements in patients' pathways. Furthermore, the potential impact of the learning curve with robotic arm assistance should be considered. Fourth, most robotic TKAs were performed using functional alignment. However, the alignment philosophy that could potentially have impacted soft-tissue releases and trauma was not formally evaluated.[30,31] Fifth, PROMs, postoperative pain scores, and opiate consumption were not formally evaluated. Future studies should gauge these outcomes on a large scale, being considerate of the inherent limitations and confounders, including but not limited to individual pain thresholds, pain scores

variation, and the effect of short-acting intravenous agents in the patient-controlled analgesia.[13]

Overall, this large-scale study evaluated variables that directly impact healthcare costs, such as LOS, discharge destination, and PACU admission, facilitating resource allocation for healthcare services. Our results showed that robotic arm-assisted TKA and UKA were associated with a shorter LOS, and no difference in the discharge destinations, compared with conventional TKA and UKA. It is unclear whether this difference is clinically meaningful, however it indicates that robotic arm assistance could represent a solution to partly address the upsurge of knee arthroplasty procedures and the concomitant healthcare burden. Long-term cost-effectiveness analyses and data emerging from prospective randomized controlled studies, will be key to further evaluate the areas of potential cost savings identified in our study, and ascertain the TKA and UKA procedure that yields optimal patient-oriented outcomes.

Take home message

- This large-scale study evaluated variables that directly impact healthcare costs in arthroplasty, such as length of stay (LOS), discharge destination, and post-anaesthesia care unit admission.
- Results showed that among other baseline characteristics and comorbidities, robotic arm assistance was associated with a shorter LOS in patients undergoing primary unicompartmental (UKA) and total knee arthroplasty (TKA) and no difference in the discharge destinations.
- Findings suggest that robotic arm assistance could represent a solution to partly address the upsurge of knee arthroplasty procedures and the concomitant healthcare burden; however, long-term cost-effectiveness analyses and data from randomized controlled studies need to corroborate this.

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Supplementary material

Tables showing data fields and definitions applied during the interrogation of the database and correlation coefficients for length of stay, age, and sex among patients undergoing unicompartmental and total knee arthroplasty.

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Funding statement:
- The authors received no financial or material support for the research, authorship, and/or publication of this article.

ICMJE COI statement:
- S. Oussedik is Clinical Governance Lead HCA at the Lister Hospital, and a Board Member of *The Bone & Joint Journal*, *AJSM*, and *OJSM*. S. Oussedik also reports consulting fees and speaker payments from Stryker, unrelated to this study. F. S. Haddad reports multiple research study grants from Stryker, Smith & Nephew, Corin, NIHR, and International Olympic Committee, royalties from Smith & Nephew, Stryker, Corin, and MatOrtho, consulting fees from Stryker, speaker payments from Stryker, Smith & Nephew, Zimmer, and AO Recon, and meeting support from Stryker, Smith & Nephew, AO Recon, and *The Bone & Joint Journal*, all of which are unrelated to this study. F. S. Haddad is also Editor-in-Chief of The Bone & Joint Journal, a Trustee of the BOA, and a member of the Bostaa Executive Committee. A. Fontalis reports financial support for their PhD studies from the Onassis Foundation Scholarship (ID: F ZR 065-1/2012-2022).

Data sharing:
- The datasets generated and analyzed in the current study are not publicly available due to data protection regulations. Access to data is limited to the researchers who have obtained permission for data processing. Further inquiries can be made to the corresponding author.

Acknowledgements:
- A. Fontalis would like to thank the Onassis Foundation for the financial support of his PhD studies - Scholarship ID: F ZR 065-1/ 2021-2022.

Ethical review statement:
- This study received institutional approval and was registered as a quality improvement exercise.