Manipulation under anaesthetic following primary knee arthroplasty is associated with a higher rate of subsequent revision surgery

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ABSTRACT

Aim

To determine the association between manipulation under anaesthetic (MUA) following primary knee arthroplasty and subsequent revision surgery.

Methods

Patients undergoing primary knee arthroplasty April 2011 to April 2016 with minimum 1-year follow up to April 2017 were identified from the national hospital episode statistics for England. The first arthroplasty per patient, per side, was included; cases with a record of subsequent infection or periprosthetic fracture were excluded. Patients undergoing MUA within 1-year to the same knee were identified, defining the populations for the MUA and non-MUA cohorts. Mortality adjusted Kaplan-Meier survival analysis (revision arthroplasty), was performed to a maximum of 6-years. A Cox proportional hazards model was used to determine the hazard for revision, adjusting for type of primary arthroplasty, gender, age group, year, comorbidity index, obesity, regional deprivation, rurality, and ethnicity.

Results

A total of 309,650 primary arthroplasty cases (309,650 patients) were included. Manipulation under anaesthetic within 1-year was recorded in 6882 patients (2.22%; 95% CI 2.17-2.28) defining the MUA cohort; all others were included in the parallel non-MUA cohort. At 6-years, the mortality-adjusted estimated implant survival rate in the MUA cohort was 91.2% (95% CI 90.0-92.2) in comparison to 98.1% (95% CI 98.0-98.2) in the non-MUA cohort. In the fully adjusted model, this corresponded to an adjusted hazard for revision of 5.03 (hazard ratio [HR]; 95% CI 4.55-5.57).

Conclusion

Patients who underwent MUA within 1-year of primary arthroplasty were at a five-fold increased risk of subsequent revision even after excluding cases of infection or fracture. Further investigation of the aetiology of ‘stiffness’ following primary knee arthroplasty and the optimal treatment options to improve outcomes is justified.

Keywords

Arthroplasty; Knee replacement; Stiffness; Revision; Manipulation under anaesthetic

INTRODUCTION

Knee replacement surgery is an effective and commonly performed procedure, with more than 100,000 cases being performed each year in the UK. The vast majority of patients (80-85%) have a successful outcome with an improved quality of life.[1,2] However, a significant minority continue to experience problems and require further intervention, with a 5-15% lifetime risk of revision surgery in a patient undergoing primary knee arthroplasty between the ages of 60 and 70 years.[2] This risk is higher in men and appears to decrease with increasing age.[3] Apart from obvious complications that warrant revision surgery, such as infection and fracture, other factors associated with an increased risk of revision are poorly understood. Identifying early factors associated with revision would enable closer follow-up and targeted treatment for at-risk patients.

One of the problems that may necessitate revision is post-operative "stiffness", which is characterised by a restricted range of movement (ROM) that negatively impacts function following knee arthroplasty and therefore the patient's quality of life.[4] The definition of knee "stiffness" has been subjective and the underlying aetiology is poorly understood, but recent work has attempted to address this through a consensus exercise, which agreed on the definition "limited ROM in flexion and/or extension, that is not attributable to an osseous or prosthetic block to movement from malaligned, malpositioned or incorrectly sized components, metal hardware, ligament reconstruction, infection (septic arthritis), pain, chronic regional pain syndrome (CRPS) or other specific causes, but due to soft-tissue fibrosis that was not present pre-operatively".[4] Manipulation under anaesthetic (MUA) is often performed following knee arthroplasty to deal with the problem of post-operative stiffness. This is a minimally invasive procedure that has been shown to improve functional outcomes within the first 6-months after the MUA.[5] The long-term outcome of patients undergoing MUA is less clear. Specifically, it is not known whether patients requiring MUA after a primary knee arthroplasty are at greater risk of undergoing subsequent revision arthroplasty.

The purpose of this study was to investigate the incidence of MUA within the first year of primary arthroplasty, patient demographic factors associated with MUA, and the subsequent absolute and relative rate of revision arthroplasty in this population.

METHODS

Data source

National Hospital Episode Statistics (HES) data for England (UK) were obtained from NHS Digital (application DARS-NIC-68703) and linked with the Office for National Statistics (ONS) mortality dataset. These data contain a record of episodes of hospital care funded by the NHS in England and privately funded care undertaken within NHS hospitals in England.[6] The ONS mortality dataset contains national death certificate data, irrespective of whether the death occurred in hospital or in the community.

Procedures

All patients undergoing primary knee arthroplasty in England between April 1, 2011 and March 31, 2016 were identified. Cases with minimum 1-year follow-up until March 31, 2017 were included. Patients under the age of 20-years and cases with a record of subsequent infection or periprosthetic fracture were excluded. Only the first arthroplasty per patient, per side, was included. Cases undergoing MUA within 1-year to the same knee were then identified, defining MUA and non-MUA cohorts. Patient factors were identified from a combination of the HES demographic and geographic fields, International Statistical Classification of Diseases and Related Health Problems (ICD-10) diagnosis fields, Classification of Surgical Operations and Procedures (OPCS-4) operation fields and ONS mortality records.[7–9]

Outcomes

The primary outcome was revision knee arthroplasty, which was confirmed to match with the laterality (left versus right) of the index knee arthroplasty using the OPCS laterality codes. Rates of revision arthroplasty over time were investigated for the MUA (within 1-year) cohort and compared with the non-MUA cohort.

Statistical analysis

Descriptive statistics were used to report demographic data. Rates were reported with confidence intervals corresponding to the proportion of the study sample. A logistic regression model was used to determine the odds of undergoing MUA within 1-year, adjusted by age, gender, type of primary arthroplasty (total knee arthroplasty [TKA] versus unicompartmental knee arthroplasty [UKA]), index of multiple deprivation (quintile derived from regional factors in England including average income, employment, education, housing, and crime; 1=least deprived area, 5=most deprived),[8] ethnicity, modified Charlson comorbidity index (Summary Hospital-level Mortality Indicator Specification; derived with a 5-year diagnosis code lookback period in an extended data extract for this purpose to earliest 2006),[9–11] obesity, year of treatment, ethnicity, and rurality. Rates of revision arthroplasty to maximum 6-years in the MUA versus non-MUA cohorts was analysed with a mortality adjusted Kaplan-Meier survival analysis (failure defined as undergoing revision arthroplasty). A Cox proportional hazards model was used to calculate the hazard for

revision, adjusted by the same patient and implant factors as for the logistic model. Stata v15.1 (StataCorp, College Station, Texas, USA) was used to perform all analyses.

Role of the funding source

The sponsors of the study had no role in the design or conduct of the study. All authors take responsibility for the contents of the study and the decision to proceed to publication.

RESULTS

A total of 309,650 primary arthroplasty procedures (309,650 patients) were included (Figure 1). The mean age of the patient cohort was 68.8 years (SD 9.75) and 56.9% were female. Of these patients, 6882 (2.22%; 95% CI 2.17 to 2.28) underwent MUA within 1-year and 302,768 (97.8%; 95% CI 97.7 to 97.8) did not undergo MUA within 1-year. A histogram for time to MUA following primary knee arthroplasty is presented in the Supplementary Figure A. The median time to MUA was 107-days (interquartile range 70 to 189 days). For all patients with a record of an MUA, 89.8% (6882/7661) underwent MUA within 1-year and were therefore eligible for inclusion in the MUA cohort. The demographics of the cohort are summarised in Table 1.

Manipulation under anaesthetic within 1-year was undertaken at a higher rate in younger patients at 6.22% (59/949; CI 4.77 to 7.95) for those aged 20-39-years in comparison to 2.07% (4454/214986; 95% CI 2.01 to 2.13) in patients aged 60-79-years, corresponding to an adjusted odds ratio [OR] of 4.00 (95% CI 3.05 to 5.24) (Table 1, Table 2). There was also a higher rate of MUA observed in obese patients (OR 1.08; 95% CI 1.01 to 1.15) (Table 2). Patients of Asian ethnicity underwent MUA at a lower rate than the other ethnicity groups recorded in HES (OR 0.49; 95% CI 0.41 to 0.58). Manipulation under anaesthetic was undertaken at a lower rate in patients following UKA at 0.60% (147/24494; 95% CI 0.51 to 0.71) in comparison to TKA at 2.36% (6735/285156; 95% CI 2.31 to 2.42) corresponding to an OR of 0.18 (95% CI 0.16 to 0.22) (Table 2). A higher modified Charlson comorbidity index of 16-30-points was associated with a lower rate of MUA within 1-year (OR 0.63; 95% CI 0.41 to 0.96) (Table 2). In the fully adjusted model, index of multiple deprivation (IMD) was not associated with greater odds of MUA (Table 2). There was no significant difference in the rate of MUA undertaken according to the year of the primary arthroplasty (Table 1, Table 2).

At 6-years, the mortality-adjusted estimated implant survival rate in the MUA patients was 91.2% (95% CI 90.0 to 92.2) in comparison to 98.1% (95% CI 98.0 to 98.2) in the non-MUA patients (Figure 2). This corresponded to a fully adjusted hazard for revision of 5.03 (hazard ratio; 95% CI 4.55 to 5.57). Other factors associated with an increased hazard for revision in the unadjusted and adjusted model are summarised in Supplementary Table A.

DISCUSSION

Principal findings

We report a 2.22% incidence of MUA within 1-year of primary knee arthroplasty and the incidence of MUA remained stable over the 5-year study period. Patients who required MUA within 1-year of primary arthroplasty were at a five-fold increased risk of subsequent revision compared to patients who did not require MUA. Several factors were associated with a higher rate of MUA, including younger age, fewer comorbidities, obesity, and total knee arthroplasty in comparison to unicompartmental arthroplasty.

Comparison with previous studies

The reported incidence of MUA following primary TKA varies from 1-7% in the literature.[12–18] Pferfferle et al. (2014) identified an incidence of 1.5% out of 229,420 patients undergoing primary TKA obtained using the commercially available database Explorys.[17] Werner at al. (2015) reported an incidence of 4.2% in 141,016 patients undergoing primary TKA.[14] Whilst both these studies report the incidence in North America, a recently published Swedish study by Thorsteinsson et al. (2019) identified a 1.7% incidence in 64,840 patients undergoing both TKA and UKA.[18] We report an MUA incidence of 2.36% (95% CI 2.31 to 2.42) within 1 year of primary TKA in comparison to 0.60% UKA patients (95% CI 0.51 to 0.71). It is important to note that the variation in reported incidence may be due to several contributing factors. Werner et al. (2015) recorded the incidence of MUA up to 6-months post-operatively, therefore it is likely that additional MUAs may have occurred after 6 months.[14] Due to the lack of consensus around indications for MUA, intervention rates may also vary between surgeons and in different hospitals. Additionally, variation in the type of primary arthroplasty cases included may affect reported incidence rates. Pferfferle et al. (2014) and Werner et al. (2015) identify the index procedure as solely TKA, whereas the Swedish study and the present series includes patients undergoing both TKA and UKA.[14,17,18]

Despite improvements in surgical technique and the identification of pre-and post-operative risk factors, our data shows little variation in the rate of MUA according to the year of primary arthroplasty. To our knowledge, we are the first to report this trend and this highlights that there may be unknown factors contributing to post-operative stiffness yet to be identified.

We report an estimated 91.2% (95% CI 90.0 to 92.2) 6-year implant survival rate in patients who had an MUA within 1-year of the index arthroplasty in comparison to a 98.1% (95% CI 98.0 to 98.2) survival in those who did not. This corresponded to a five-fold increased adjusted hazard for revision for the patients undergoing MUA. Werner et al. (2015) report similar findings, with an increased revision rate (4.8% within 7-years) in patients who required MUA within six months of their index arthroplasty.[14] These findings are important and highlight the potential morbidity leading to revision knee arthroplasty that is associated with post-operative stiffness warranting MUA. Other factors we found to be independently associated with

revision arthroplasty included younger age, deprivation status, and type of primary arthroplasty, however discussion of the complex reasons for these observations is outside the scope of this study article, and this has been addressed in other studies.[3,19,20]

Although patients with infection or fracture were excluded, it was not possible to further explore the aetiology of knee stiffness in our series. Many factors have been identified to be associated with stiffness following knee arthroplasty which may contribute to the need for MUA.[4] We identified a higher rate of MUA among the 20-39-year age group (6.22%; 95% CI 4.77 to 7.95), and 40-59-year age group (3.98%; 95% CI 3.81 to 4.15) compared to the 60-79-year age group (2.07%; 95% CI 2.01 to 2.13) and over 80-years group (0.70%; 95% CI 0.63 to 0.79). Several other studies also report an increased rate of stiffness in younger patients below the age of 65 years.[14,17,21] It is not clear whether the diagnosis of stiffness and subsequent need for MUA in younger patients is merely due to a higher expectation in a relatively more active population or whether younger age may be associated with the aetiology of arthrofibrosis and more severe pathology. Younger patients undergoing knee arthroplasty may be more likely to have a post-traumatic cause for their osteoarthritis, a factor known to be associated with knee stiffness.[22] We identified a slightly higher proportion of obese patients undergoing MUA (odds ratio 1.08; 95% CI 1.01 to 1.15). Pferfferle et al. (2014) reported similar results, with a significantly increased risk of MUA within 90-days of the initial TKA in patients with BMI greater than 30 (relative risk of 1.33 compared to the general population; 95% CI 1.24 to 1.43).[17] Again, the reasons for this observation are likely to be multifactorial and have been discussed in the past, but are outside of the scope of the present article.[17]

We identified a lower rate of MUA in patients with a greater modified Charlson comorbidity index of 16-30-points in comparison to those with a score of zero-points (odds ratio 0.63; 95% CI 0.41 to 0.96), even after adjusting for patient age. In contrast, Werner et al. (2015) found no significant association between the incidence of MUA and comorbidities including smoking, diabetes, hypercholesterolaemia, coronary heart disease and lung disease.[14] Interestingly, the literature remains conflicted with several studies reporting a higher incidence of MUA in patients with comorbidities such as diabetics and in smokers.[17,23,24] Issa et al. (2014) reported a higher incidence of MUA among diabetics, smokers and patients with high cholesterol.[23] However, limitations of this previous study include a small sample size of 133 patients and a low threshold for MUA (post-operative ROM < 115°), which may potentially capture more patients in comparison to the more widely accepted threshold of a ROM < 90° for performing MUA.[15,21,25] Robertson et al. (2012) reported a significantly higher rate of post-operative knee stiffness and poorer functional outcomes in diabetics versus non-diabetics.[24]

Several studies have assessed the influence of demographic factors on post-arthroplasty stiffness and report similar outcomes, with an increased incidence in younger and female patients.[23,25,26] Non-white ethnicity has been reported as a risk factor for post-arthroplasty stiffness and increased rate of subsequent MUA.[17,23,27]

We identified a lower incidence in patients of Asian ethnicity (odds ratio 0.49; 95% CI 0.41 to 0.58) in comparison to patients of White ethnicity. The reasons for this observation are unknown but may include factors such as access to healthcare or rehabilitation services.[20,28] Limited data exists on the impact of socio-economic factors on post-arthroplasty stiffness.[27,29,30] Barrack et al. (2013) reported poorer functional and patient-reported outcomes in patients who came from low-income households.[27] Fredburger et al. (2011) reported poorer accessibility to post-operative rehabilitation services in low-income patients.[30] We identified a comparable rate of MUA within 1-year of primary arthroplasty in patients irrespective of deprivation status.

Strengths and limitations

To our knowledge, this is the largest cohort addressing outcomes following MUA after primary knee arthroplasty that has been reported in the literature to date, and the first to demonstrate a clear association between MUA and subsequent revision arthroplasty. Our investigation of this association was strengthened by the exclusion of patients who required revision TKA for infection or periprosthetic fracture. Furthermore, we were able to report on and control for a range of patient demographic and procedure factors, including the type of primary arthroplasty undertaken (TKA or UKA).

It is important to acknowledge that whilst this study provides rich data regarding factors associated with post-operative MUA, we are only able to report correlation, not causation, due to the retrospective study design. In addition to cases of infection and periprosthetic fractures (excluded from this study) there are many other factors that may be associated with knee "stiffness" and subsequent need for MUA and revision arthroplasty. These include surgical factors such as implant malalignment or incorrect sizing and biological factors such as the development of soft-tissue fibrosis or heterotopic ossification.[4] These factors could not be measured in this study and further investigation of the aetiology of knee stiffness prior to MUA and the indications for revision in these patients is warranted. Another important limitation of large database-based studies is the quality of the data available to be analysed. Accurate coding of the data used in this study is, however, required for correct hospital renumeration of care delivered, providing a strong incentive for data accuracy. Furthermore, where data validation has previously been undertaken in this database, the findings have been strongly supportive.[31,32]

Manipulation under anaesthetic following primary knee arthroplasty is an objective clinical outcome in relation to satisfactory ROM following arthroplasty. Whilst this is an important measure of outcome, patient-reported outcome measures (PROMs) are equally important in establishing the efficacy of treatment. These data were not available in our study database and there remains a paucity of PROMs data in the context of MUA. Future studies that include PROMs in addition to objective clinical assessments, such as revision rate, are recommended.

Our study is the first to report rates of revision arthroplasty after MUA out to 6-years of follow-up. Important differences in outcome were observed within this time frame, but longer-term outcome data must await further studies.

Conclusion

Manipulation under anaesthetic was performed in 2.22% of patients within 1-year of primary knee arthroplasty. The highest incidence of MUA is seen in younger patients, obese patients, and patients undergoing total knee arthroplasty in comparison to unicompartmental knee arthroplasty. Patients who underwent MUA within 1-year of primary arthroplasty were at a five-fold increased risk of subsequent revision compared to patients that did not undergo MUA. This is a new and significant finding highlighting the potential serious morbidity from post-operative knee stiffness after knee arthroplasty. Further studies are required to better understand the risk factors for developing post-operative knee stiffness. Investigation of appropriately targeted interventions aimed at improving the outcome in this patient group are justified by the findings reported in this study.

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FIGURES

FIGURE 1: Case selection

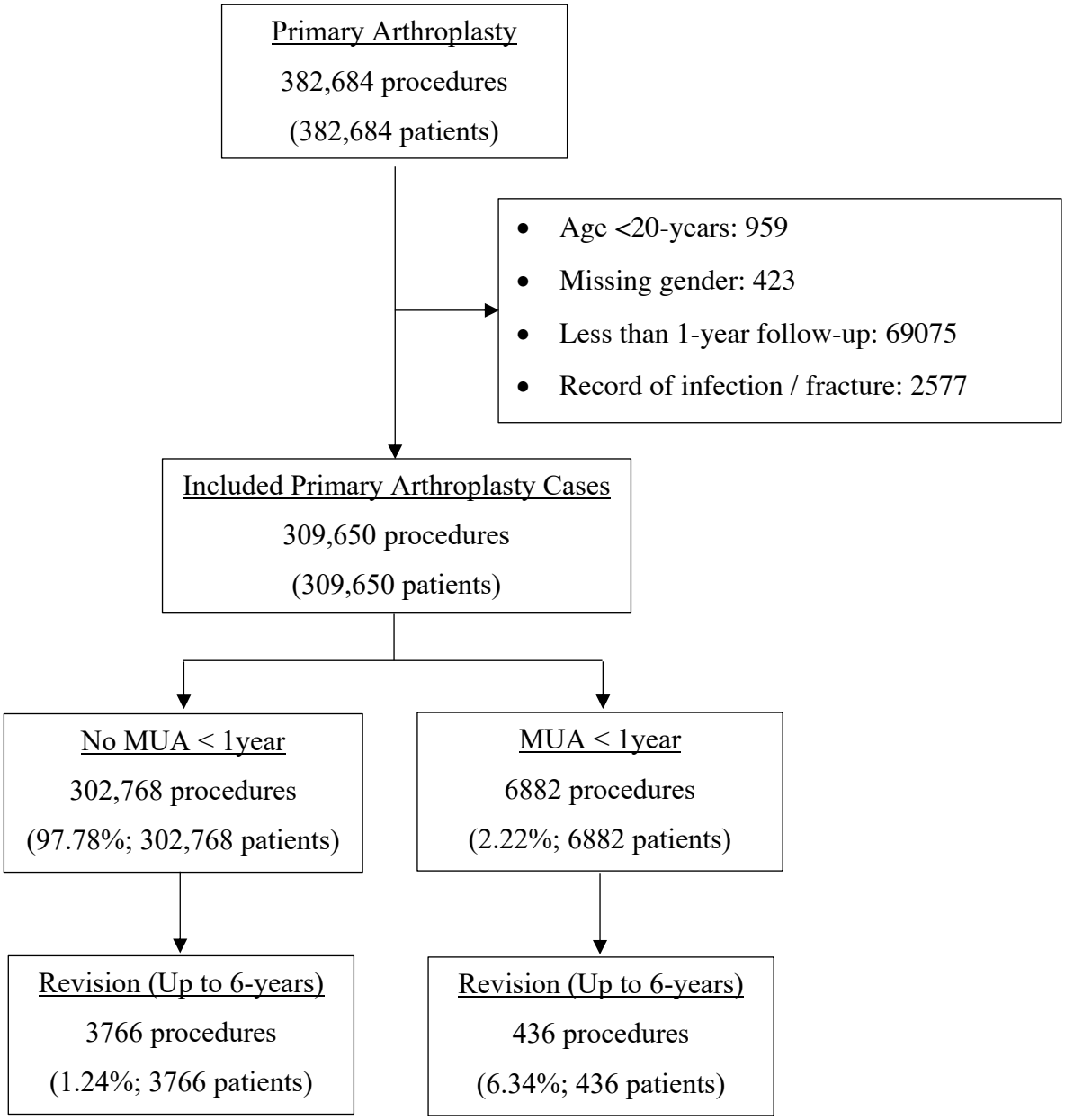
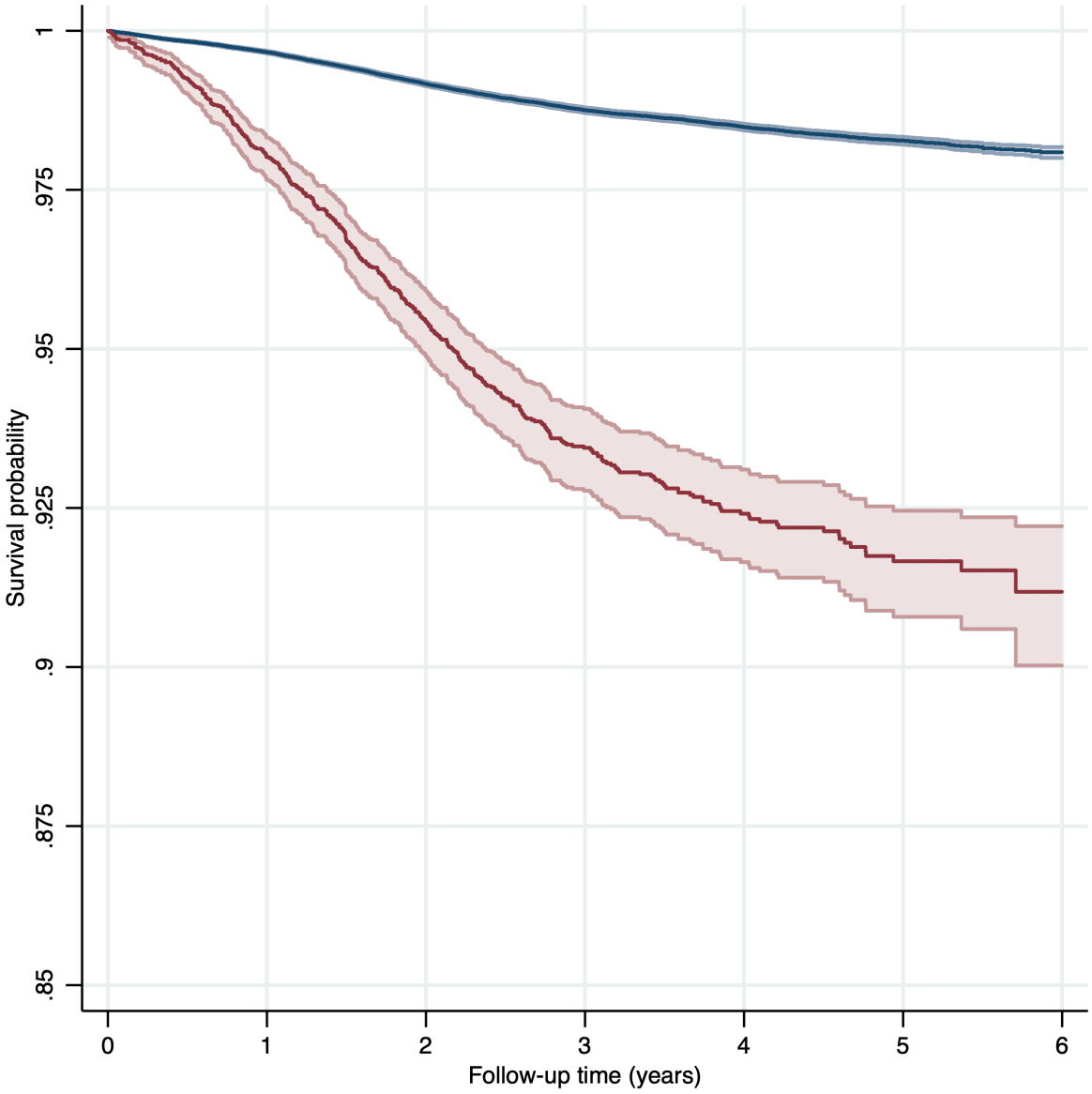


FIGURE 2: Survival curve by record of manipulation under anaesthetic (MUA) within 1-year



	No MUA within 1-year
	MUA within 1-year

Shaded areas represent 95% confidence intervals.

TABLES

TABLE 1: Demographics and rate of manipulation under anaesthetic within 1-year

	All Primary Knee Arthroplasty Cases		Proportion undergoing MUA within 1-year	
	n	**%**	**n**	**Percent (95% CI)**
All procedures				
Total	309,650	100%	6,882	2.22% (2.17, 2.28)
TKA	285,156	92.09	6,735	2.36% (2.31, 2.42)
UKA	24,494	7.91	147	0.60% (0.51, 0.71)
Gender				
Male	133,385	43.08	2,833	2.12% (2.05, 2.20)
Female	176,265	56.92	4,049	2.30% (2.23, 2.37)
Age group (years)				
20-39	949	0.31	59	6.22% (4.77, 7.95)
40-59	52,153	16.84	2,076	3.98% (3.81, 4.15)
60-79	214,986	69.43	4,454	2.07% (2.01, 2.13)
80+	41,562	13.42	293	0.70% (0.63, 0.79)
Modified Charlson comorbidity index				
0	231,879	74.88	5,199	2.24% (2.18, 2.30)
1 - 15	75,711	24.45	1,661	2.19% (2.09, 2.30)
16 - 30	1,994	0.64	22	1.10% (0.69, 1.67)
31 - 50	66	0.02	0	0.00% (0.00, 5.44)
Obesity				
No	260,049	83.98	5,579	2.15% (2.09, 2.20)
Yes	49,601	16.02	1,303	2.63% (2.49, 2.77)
IMD				
1	70,074	22.63	1,514	2.16% (2.05, 2.27)
2	71,141	22.97	1,579	2.22% (2.11, 2.33)
3	66,306	21.41	1,455	2.19% (2.08, 2.31)
4	54,816	17.70	1,218	2.22% (2.10, 2.35)
5	44,981	14.53	1,073	2.39% (2.25, 2.53)
.	2,332	0.75	-	-
Rurality				
Urban	234,388	75.69	5,273	2.25% (2.19, 2.31)
Rural	74,871	24.18	1,604	2.14% (2.04, 2.25)
Missing	391	0.13	-	-
Ethnicity				
White	284,232	91.79	6,429	2.26% (2.21, 2.32)
Asian	11,442	3.70	140	1.22% (1.03, 1.44)
Black	3,790	1.22	119	3.14% (2.61, 3.75)
Mixed	849	0.27	23	2.71% (1.72, 4.04)
Other	1,670	0.54	43	2.57% (1.87, 3.45)
.	7,667	2.48	-	-
Year				
2011	59,861	19.33	1,246	2.08% (1.97, 2.20)
2012	58,372	18.85	1,325	2.27% (2.15, 2.39)
2013	61,577	19.89	1,351	2.19% (2.08, 2.31)
2014	64,427	20.81	1,477	2.29% (2.18, 2.41)
2015	65,413	21.12	1,483	2.27% (2.15, 2.38)

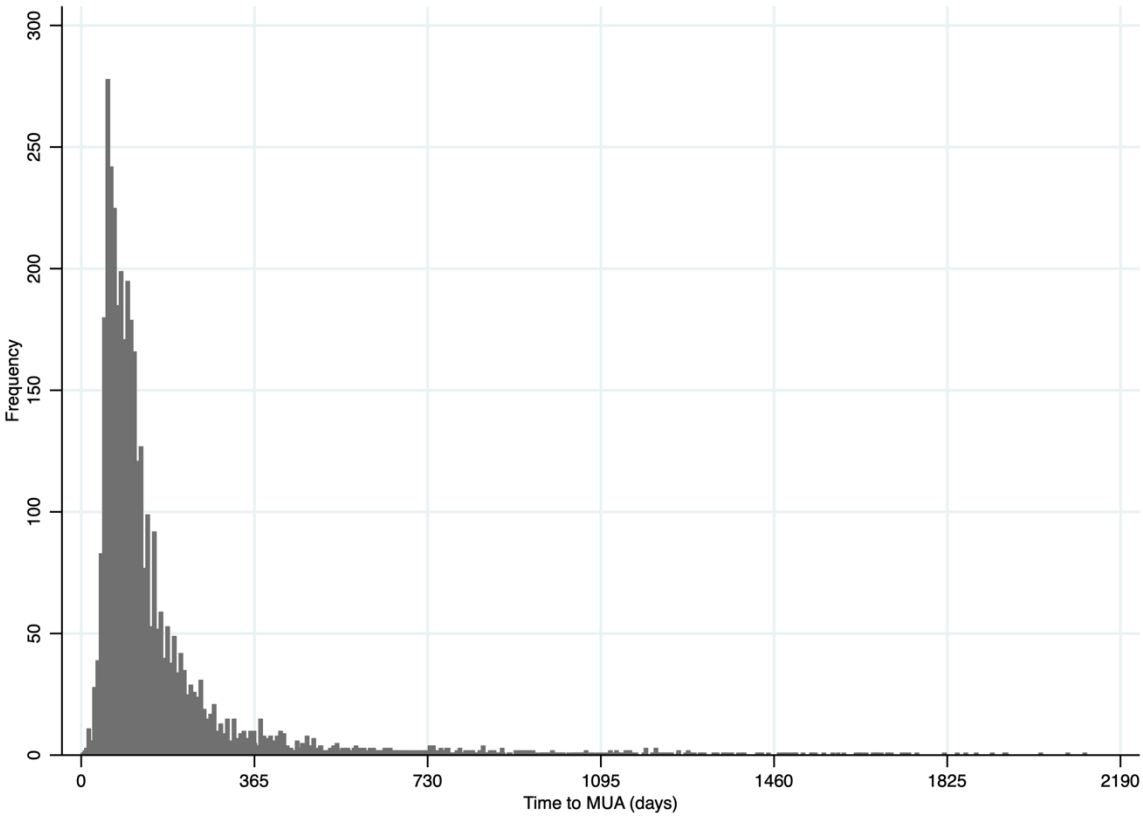
TABLE 2: Odds of undergoing MUA within 1-year of primary knee arthroplasty

	Crude Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI)
Type of arthroplasty		
TKA	1.00	1.00
UKA	0.25 (0.21, 0.29)	0.18 (0.16, 0.22)
Gender		
Male	1.00	1.00
Female	1.08 (1.03, 1.14)	1.08 (1.03, 1.14)
Age group (years)		
20-39	3.13 (2.40, 4.08)	4.00 (3.05, 5.24)
40-59	1.96 (1.86, 2.07)	2.20 (2.08, 2.32)
60-79	1.00	1.00
80+	0.34 (0.30, 0.38)	0.33 (0.29, 0.37)
Year of procedure		
2011	1.00	1.00
2012	1.09 (1.01, 1.18)	1.09 (1.00, 1.18)
2013	1.06 (0.98, 1.14)	1.04 (0.96, 1.12)
2014	1.10 (1.02, 1.19)	1.09 (1.01, 1.18)
2015	1.09 (1.01, 1.18)	1.07 (0.99, 1.16)
Modified Charlson comorbidity index		
0	1.00	1.00
1 - 15	0.98 (0.92, 1.03)	1.03 (0.97, 1.09)
16 - 30	0.49 (0.32, 0.74)	0.63 (0.41, 0.96)
31 - 50	-	-
Obesity		
No	1.00	1.00
Yes	1.23 (1.16, 1.31)	1.08 (1.01, 1.15)
Index of multiple deprivation (quintile)		
1 = least	1.00	1.00
2	1.03 (0.96, 1.10)	1.00 (0.93, 1.07)
3	1.02 (0.94, 1.09)	0.96 (0.89, 1.04)
4	1.03 (0.95, 1.11)	0.92 (0.85, 0.99)
5 = most	1.11 (1.02, 1.20)	0.93 (0.86, 1.01)
Rurality		
Urban	1.00	1.00
Rural	0.95 (0.90, 1.01)	0.97 (0.92, 1.03)
Ethnicity		
White	1.00	1.00
Asian	0.54 (0.45, 0.63)	0.49 (0.41, 0.58)
Black	1.40 (1.17, 1.68)	1.19 (0.98, 1.43)
Mixed	1.20 (0.79, 1.82)	1.05 (0.69, 1.59)
Other	1.14 (0.84, 1.55)	1.05 (0.77, 1.43)

- = *no cases*

APPENDIX

Supplementary Figure A: Histogram of time to MUA following primary knee arthroplasty



Supplementary Table A: Hazards for revision

	Crude Hazard Ratio (95% CI)	Adjusted Hazard Ratio (95% CI)
Underwent MUA within 1-year?		
No	1.00	1.00
Yes	5.24 (4.74, 5.79)	5.03 (4.55, 5.57)
Type of arthroplasty		
TKA	1.00	1.00
UKA	3.45 (3.21, 3.71)	3.09 (2.86, 3.34)
Gender		
Male	1.00	1.00
Female	0.97 (0.91, 1.03)	0.98 (0.92, 1.04)
Age group (years)		
20-39	3.90 (2.87, 5.31)	2.37 (1.73, 3.25)
40-59	2.62 (2.46, 2.79)	2.07 (1.94, 2.22)
60-79	1.00	1.00
80+	0.45 (0.39, 0.51)	0.48 (0.42, 0.55)
Year of procedure		
2011	1.00	1.00
2012	0.79 (0.73, 0.86)	0.77 (0.71, 0.84)
2013	0.62 (0.57, 0.68)	0.61 (0.56, 0.66)
2014	0.42 (0.38, 0.46)	0.40 (0.36, 0.44)
2015	0.20 (0.18, 0.23)	0.19 (0.17, 0.22)
Modified Charlson comorbidity index		
0	1.00	1.00
1 - 15	1.00 (0.93, 1.07)	1.07 (1.00, 1.15)
16 - 30	0.59 (0.36, 0.96)	0.78 (0.48, 1.28)
31 - 50	-	-
Obesity		
No	1.00	1.00
Yes	0.99 (0.91, 1.07)	0.98 (0.90, 1.06)
Index of multiple deprivation (quintile)		
1 = least	1.00	1.00
2	1.04 (0.95, 1.14)	1.04 (0.95, 1.15)
3	1.16 (1.06, 1.28)	1.14 (1.04, 1.25)
4	1.27 (1.15, 1.40)	1.20 (1.09, 1.32)
5 = most	1.41 (1.28, 1.56)	1.27 (1.15, 1.41)
Rurality		
Urban	1.00	1.00
Rural	0.90 (0.84, 0.97)	0.97 (0.90, 1.05)
Ethnicity		
White	1.00	1.00
Asian	0.69 (0.57, 0.84)	0.71 (0.58, 0.86)
Black	1.59 (1.28, 1.97)	1.37 (1.10, 1.70)
Mixed	1.37 (0.84, 2.23)	1.13 (0.69, 1.85)
Other	1.17 (0.80, 1.70)	1.02 (0.70, 1.49)

- = *no cases*