## Risk Factors for Not Achieving the Minimal Important Change of Patient Reported Outcomes at 2 Years Following ACL Reconstruction: An analysis from the UK National Ligament Registry

Ayman Gabr, Andreas Fontalis<sup>1</sup>, James Robinson<sup>2</sup>, William Hage, Sean T O'Leary, Tim Spalding<sup>3</sup>, Fares Sami Haddad <sup>1</sup>University College Hospital, <sup>2</sup>The Pump House, <sup>3</sup>University Hospital Coventry

INTRODUCTION:

Over the last decade, there has been a notable shift towards utilising patient reported outcomes measures (PROMs) for evaluating functional outcomes following ACL reconstruction. The minimal important change (MIC) is defined as the smallest change in outcome measure that a patient perceives as significant. There is sparse evidence in the literature regarding the patient characteristics or surgical factors that influence the outcome of ACL reconstruction. Leveraging national registries could provide a substantial population-based dataset, enhancing our understanding of these factors. The aim of this study was to identify patient and surgical risk factors associated with failure to achieve the MIC in PROMs following ACL reconstruction.

## METHODS:

This study included all unilateral primary ACL reconstructions performed from January 2013 to December 2022, as recorded in the UK National Ligament Registry (NLR). Patients completed pre-operatively and at 2-years post-operatively, the Knee injury and Osteoarthritis Outcome Score (KOOS) and the International Knee Documentation Committee Subjective Knee Form (IKDC). The MICs for IKDC, KOOS quality of life (QoL), and KOOS sports and recreation (S&R) were 18.9, 18.3 and 12.1 respectively. Multivariate stepwise logistic regression models were used to evaluate the influence of various factors on achieving the minimal important change (MIC). These factors included surgical variables (graft type and diameter, femoral and tibial tunnel drilling technique, femoral fixation device, surgeon's annual case volume, surgeon's grade and type of healthcare sector: private vs independent), demographic and health related variables (sex, age, BMI, comorbidities and deprivation index) and injury-related variables (presence of meniscal and cartilage pathology, time to surgery).

## RESULTS:

Among 17,492 participants completing pre-operative questionnaires, 4,545 completed the 2-year IKDC form and 4,623 completed the 2-year KOOS questionnaire. The median scores for the KOOS S&R score improved from 40 (Q1: 20, Q3: 60) pre-operatively to 85 (Q1: 70, Q3: 95) at two years, and for KOOS QoL score from 31 (Q1: 13, Q3: 44) to 75 (Q1: 56, Q3: 88). IKDC scores improved from 47.1 (Q1: 35.6, Q3: 58.6) to 83.9 (Q1: 71.3, Q3: 93.1). However, 631 (13.6%) patients failed to achieve the MIC for KOOS S&R, 642 (13.9%) for KOOS QoL, and 796 (17.5%) for IKDC. Multivariate logistic regression models identified several factors associated with higher odds of failing to achieve the MIC after 2 years. Specific to the KOOS S&R Score, predictors of failing to achieve the MIC included higher BMI (OR 1.068, 95% CI [1.026, 1.112]; p=0.001), higher preoperative scores (OR 1.063, 95% CI [1.054, 1.072]; p<0.001) and a lower index of multiple deprivation (quintile 0-40%) (OR 1.931, 95% CI [1.322, 2.821]; p<0.001). For the KOOS QoL Score, factors associated with failure to achieve the MIC included male gender (OR 1.342, 95% CI [1.120, 1.608]; p=0.001), younger age (OR 0.978, 95% CI [0.967, 0.990]; p<0.001), higher BMI (OR 1.030, 95% CI [1.003, 1.058]; p=0.027), smoking (OR 2.229, 95% CI [1.543, 3.221]; p<0.001), higher preoperative scores (OR 1.034, 95% CI [1.027, 1.040]; p<0.001) and a lower index of multiple deprivation (quintile 0-40%) (OR 1.313, 95% CI [1.016, 1.697]; p=0.037). For IKDC, predictors included higher BMI (OR 1.060, 95% CI [1.029, 1.092]; p<0.001), time to surgery over three months (OR 1.656, 95% CI [1.191, 2.301]; p=0.003), higher preoperative IKDC score (OR 1.055, 95% CI [1.045, 1.064]; p<0.001) and smoking (OR 1.788, 95% CI [1.136, 2.814]; p=0.012).

## DISCUSSION AND CONCLUSION:

Higher BMI and lower preoperative PROMs were significant risk factors for not achieving the MIC in IKDC and KOOS QoL and S&R scores at 2 years following ACL reconstruction. Additionally, lower socioeconomic class was associated with failure to achieve MIC in both KOOS QoL and S&R subscales. None of the surgical factors appeared to influence the likelihood of achieving the MIC postoperatively. Understanding this prognostic information is crucial for effective patient counselling and enables surgeons to identify patients that are at risk of suboptimal outcomes. This knowledge can be used to provide targeted information and resources to modify risk factors, thereby aiming to improve clinical outcomes.

Table 1. Baseline characteristics			
	Patients undergoing ACL Reconstruction		
Variable	N+17,492		
Gender			
Female	5000 (28.6)		
Male	12481 (71.4)		
Age, median (range)	27.8 (9.84)		
Operated Side			
Right	9036 (52.6)		
Let	8135 (47.4)		
Sports related injury	9128 (85.7)		
Non-sports related injury	1522 (14.3)		
BMI median (Q1, Q3)	25.5 (23.1, 28.4)		
Time to surpery less than 3			
months	2083 (32.7)		
Index of Multiple Deprivation			
quintle			
0-20%	1790 (14.4)		
20%-40%	2152 (17.3)		
40%-00%	2505 (20.2)		
60%-80%	2817 (22.7)		
80%-100%	3155 (25.4)		
ASA dass			
1	4451 (93.1)		
	313 (6.5)		
1	16 (0.3)		
Smoking status			
Non-smoker	9021 (74)		
Smoker	1516 (12.4)		
Ex-smoker	1656 (13.6)		
Concomitant meniscal pathology	3147 (61.3)		
Concomitant cartilage pathology	4359 (25.9)		
Funding			
NHS	3747 (77.7)		
Private	1078 (22.3)		

Table 2. Servicel Characteristics and Technizees			
Verable	Patients undergoing ACL Reconstruction N±17,402		
solated ACL sargery	8399 (56.4)		
ACL + Medial meniscus repair	1974 (13.3)		
ACL + Medial meniscus resection	2005 (13.5)		
ACL + Lateral meniscus repair	1161 (7.8)		
ACL + Lateral menisous resection	1356 (9.1)		
Type of Anesthesia			
Genesal	16383 (98.5)		
Regional	251 (1.5)		
Use of tourniquet	4158 (83.5)		
Senarce's volume			
Less than 15 cases	1920 (11.6)		
15 to 30 cases	6020 (36.6)		
Over 30 cases	8636 (52.1)		
Sangeon's grade			
Trainee Supervised	592 (3.7)		
Trainee Unsupervised	2 (2.1)		
Fellow	751 (4.7)		
Consultant	14095 (91.5)		
3raft type			
Autopraft	16268 (99)		
Allognaft	126 (0.8)		
Synthetic	28 (0.2)		
Sraft Type			
Hansbing	14656 (90.6)		
Quadriceps	126 (0.8)		
Patella Tendon	1356 (8.6)		
Graft Diameter			
6	46 (0.3)		
6.5	108 (0.8)		
7	1303 (9.4)		
7.5	2045 (14.7)		
8	5922 (36.7)		
0.5	2299 (17.3)		
9	2531 (18.2)		
10	343 (2.5)		
11	19 (0.1)		
Graft 'doubling'			
1 Strand	127 (0.9)		
2 Strands	906 (0.7)		
3 Strands	112 (0.8)		
4 Strands	11927 (80.5)		
5 Strands	1341 (2.1)		
6 Strands	1201 (8.1)		

Allinside	2066 (12.5)
AMPORE	12097 (73.4)
Cursion-in	1508 (7.3)
Trans-Road	1115 (形)的
Ferronal Fination Device	
Suspensory Mechanism	12148 (75.3)
Interletence Screw	2005 (18.6)
Capita Pin	506 (3.1)
Other	466 (2.9)
Tibial Tunnel Drilling Technique	
Allinside	1204 (7.5)
Inside-Out	224 (1.4)
Outside-In	15058 (91.3)
Concomitant meniscal pathology	3147 (61.3)
Concominant cartilage pathology	4359 (25.9)
the second se	

	Odds ratio (Confidence Interval)	p-value
Mala gandar	1.342 (1.120 - 1.608)	0.001
Age	0.878 (0.967 - 0.993)	-0.001
5MI	1.000 [1.003, 1.058]	0.027
Stocker	2,229 [1,543, 3,221]	<0.001
Preoperative KOOG Quality of Life acore	1.034 [1.027, 1.040]	<0.001
Index of Multiple Descivation maintin (2-47%)	1,323 (1,035, 1,697)	0.007
Oral diameter less than 8mm	1.143 (0.885, 1.502)	0.355

	Odes ratio (Confidence Internal)	0 H344
Male gender	1.090 (0.741 - 1.490)	6.78
Age	1.010 (0.994 - 1.009)	42
DMI .	5.060 [5.026, 1.112]	6.00
Time to surgery, months	1.459 (3.946, 2.251)	0.00
Preoperative KOOS Sport and Recreation score	1.053 [1.054, 1.072]	-0.0
Index of Multiple Deprivation quintile (0-40%)	1.931 [1.322, 2.821]	+0.0
Lead surgeon Trainee/Fellow compared to Consultant	0.889 (0.533, 1.481)	0.65

	Odds ratio (55% Confidence Interval)	
Male gender	1,283 (0.982 - 1.676)	0.068
Ace	1.00710.995 - 1.0191	0.242
DM.	1.060 [1.029, 1.092]	<3.901
Time to surgery over 3 months	1.656 [1.191, 2.301]	0.063
Preoperative IKOC score	1.055 [1.045, 1.064]	<3.001
Lead surgeon Trainee/Fellow compared to Consultant	1,05013,717, 1,566	0.771
Smoking	1,708 [1,128, 2,814]	0.012