Increased Age, Weight, and Body Mass Index Increase the Likelihood of Total Knee Replacement Following Anterior Cruciate Ligament Reconstruction

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Disclosures

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Current Literature

- Incidence of end-stage knee OA that requires TKA is substantially greater in patients with prior ACLR[1]
- Aging impairs the structural integrity of type II collagen and chondrocyte repairing capacity, resulting in greater susceptibility to developing knee OA[2]
- High BMI increases knee joint loading and inflammatory responses that accelerate cartilage degeneration and development of knee OA[2]
- Elevated systemic indices of inflammation have been linked to the presence and severity of OA[3,4]

Purpose

- To investigate the association of age, BMI, and systemic indices of inflammation with TKA following ACLR.

- We hypothesized that an older age, higher BMI, and elevated systemic indices of inflammation associate with an increased likelihood of TKA following ACLR.

Materials and Methods

- Retrospective chart review identified 45 ACLR patients between 2009 and 2022 that met inclusion criteria
- Control groups were matched (1:1:1) based on sex and date of ACLR (± 1.0 y)

Cases **N=15**	**Control 1** **N=15**	**Control 2** **N=15**
• Patients with CBC data and a subsequent TKA procedure performed for knee OA after ACLR.	• Patients that underwent ACLR without a later documented knee OA diagnosis	• Patients that underwent ACLR with later documented knee OA diagnosis but no TKA procedure

TABLE 1
Demographics

	ACLR and TKA	ACLR without OA or TKA	ACLR with OA but no TKA	Significance
N (m/f)	15 (8/7)	15 (8/7)	15 (8/7)	N/A
Age at ACLR, y	46.8 (5.8)	40.3 (18.3)	37.7 (15.8)	p = 0.05
Height, m	1.75 (0.17)	1.68 (0.10)	1.70 (0.17)	p = 0.15
Body mass, kg	108 (33)	75.0 (23.7)*	90.7 (29.7)*	p < 0.01
BMI, kg/m^2	35.3 (10.8)	25.0 (4.8)*	26.2 (9.6)*	p < 0.01
Additional procedures at ACLR, n/15	12/15	10/15	11/15	p = 0.71
ACLR to CBC, mos	39.4 (39.1)	12.6 (31.2)*	17.0 (22.6)	p = 0.02
ACLR to OA, mos	32.2 (48.5)	NA	22.2 (79.7)	p = 0.98
ACLR to TKA or final follow-up, mos	54.8 (49.5)	88.7 (84.9)	90.8 (83.1)	p = 0.08

Data presented as median (interquartile range [IQR]) or counts (n). *p < 0.05 vs Cases. BMI, body mass index (kg/m^2). NA, not applicable

TABLE 2
Cell Count Data

	ACLR and TKA	ACLR without OA or TKA	ACLR with OA but no TKA	Significance
WBC (K/μL)	6.33 (2.16)	7.10 (3.64)	6.10 (3.77)	p = 0.24
RBC (K/μL)	4.72 (0.35)	4.49 (0.71)	5.03 (0.90)	p = 0.15
Platelets (K/μL)	266 (83)	242 (36)	230 (100)	p = 0.62
Neutrophils (K/μL)	3.74 (1.85)	4.30 (3.65)	3.43 (2.68)	p = 0.29
Lymphocytes (K/μL)	1.79 (0.48)	1.90 (0.47)	1.80 (0.95)	p = 0.37
Monocytes (K/μL)	0.59 (0.34)	0.40 (0.31)	0.50 (0.16)	p = 0.79
PLR	140 (62)	122 (77)	137 (50)	p = 0.86
MLR	0.26 (0.16)	0.24 (0.18)	0.27 (0.19)	p = 0.19
NLR	1.96 (.69)	2.29 (1.70)	2.34 (1.24)	p = 0.99
SIRI	1.20 (0.80)	1.01 (0.10)	1.24 (0.89)	p = 0.79
SII	495 (158)	693 (580)	482 (458)	p = 0.52

Data presented as median (interquartile range [IQR]) or counts (n). WBC, white blood cell count. RBC, red blood cell count. PLR, platelet-to-lymphocyte ratio. MLR, monocyte-to-lymphocyte ratios. NLR, neutrophil-to-lymphocyte ratio. SIRI, systemic inflammation response index. SII, systemic immune-

TABLE 3
Pearson Product Moment Linear Correlation Coefficients

	Age at ACLR		BMI		ACLR to CBC	
	r	Sig	r	Sig	r	Sig
WBC (K/μL)	0.04	p = 0.78	-0.01	p = 0.97	-0.23	p = 0.14
RBC (K/μL)	0.02	p = 0.90	0.00	p = 0.99	-0.02	p = 0.92
Platelets (K/μL)	0.24	p = 0.12	0.26	p = 0.09	0.05	p = 0.74
Neutrophils (K/μL)	0.03	p = 0.84	-0.16	p = 0.31	-0.25	p = 0.10
Lymphocytes (K/μL)	0.01	p = 0.94	0.40	p = 0.01	-0.01	p = 0.97
Monocytes (K/μL)	0.06	p = 0.68	0.15	p = 0.31	-0.05	p = 0.75
PLR	0.10	p = 0.53	-0.11	p = 0.48	0.04	p = 0.82
MLR	0.03	p = 0.82	-0.19	p = 0.22	0.01	p = 0.96
NLR	-0.03	p = 0.87	-0.31	p = 0.04	-0.07	p = 0.65
SIRI	0.01	p = 0.96	-0.14	p = 0.35	-0.15	p = 0.34
SII	0.12	p = 0.45	-0.16	p = 0.31	-0.12	p = 0.44

N=45. WBC, white blood cell count. RBC, red blood cell count. PLR, platelet-to-lymphocyte ratio. MLR, monocyte-to-lymphocyte ratios. NLR, neutrophil-to-lymphocyte ratio. SIRI, systemic inflammation response index. SII, systemic immune-inflammatory index.

TABLE 4
Logistic Regression Odds Ratios

	Odds Ratio (95% Confidence Intervals)	Significance
Age at ACLR	1.42 (1.08, 1.86)	p = 0.01
BMI	1.48 (1.12, 1.96)	p < 0.01
PLR	1.31 (0.96, 1.79)	p = 0.09
MLR	1.23 (0.89, 1.70)	p = 0.22
NLR	1.14 (0.92, 1.35)	p = 0.27
SIRI	0.99 (0.62, 1.57)	p = 0.96
SII	0.67 (0.43, 1.06)	p = 0.08

Cases vs CON1 and CON2, response variable: TKA. WBC, white blood cell count. RBC, red blood cell count. PLR, platelet-to-lymphocyte ratio. MLR, monocyte-to-lymphocyte ratios. NLR, neutrophil-to-lymphocyte ratio. SIRI, systemic inflammation response index. SII, systemic immune-inflammatory index.

Discussion and Conclusions

- Increasing age and BMI were risk factors for undergoing TKA following ACLR.
- Systemic indices of the immune system and inflammation were not significant predictors of undergoing TKA after ACLR

Limitations

- The age of the Control 1 group is higher than the general age for the population undergoing ACLR
  - this is probably a result of older patients being more likely to undergo a CBC with differentials due to co-morbidities, other conditions, or routine physicals
- It is feasible that some of the patients in the Control 2 group were knee arthroplasty candidates but did not undergo knee arthroplasty for multiple potential reasons

Future Directions

- Larger sample size to:
  1. Control for potential confounding variables
  2. Confirm the association between increased BMI and age with TKA following ACLR
- Further research is needed to develop targeted interventions to potentially delay or prevent the progression to TKA following ACLR

References

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