Psychological Traits Affect Patients' Pain and Function Prior to Anterior Cruciate Ligament Reconstruction: An Analysis of IMPACT Study Group Baseline Data

Andrew J. Sheean[1], Justin Ernat[2], Yuxuan Jin[3], Michael Scarcella[3], Justin Arner[4], Daniel J. Cognetti[5], Clayton Nuelle[6], Steven DeFroda[6], Aravind Athiviraham[7], Lydia Keppler[8], Travis Dekker[9], Keith Knurr,[1] Kurt P. Spindler[3]

[1]University of Wisconsin, Madison, WI, USA, [2] University of Utah, Salt Lake City, NV, USA, [3] Cleveland Clinic, Cleveland, OH, USA, [4] University of Pittsburgh, Pittsburgh, PA, USA, [5] Brooke Army Medical Center, Fort Sam Houston, San Antonio, TX, USA, [6] University of Missouri, Columbia, MO, USA, [7] University of Chicago, Chicago, IL, USA, [8] Geneva Foundation, San Antonio, TX, USA, [9] United States Air Force Academy, Colorado Springs, CO, USA

INTRODUCTION

Background

- ACL injuries affect ~200,000 individuals annually in the United States, resulting in significant pain and disability
- Pre-operative baseline pain and function vary considerably among patients presenting for ACLR
- Psychological factors—**Resilience**, **Pain Catastrophizing**, **General Mental Health**—are emerging predictors of surgical outcomes, but their role at baseline is poorly defined

Purpose

To identify independent predictors of baseline knee pain, quality of life, and function in patients undergoing primary ACLR

Hypothesis

Psychological traits would independently predict pre-operative outcomes beyond structural and demographic variables

METHODS

Study Design

- Multicenter prospective observational
- Level III evidence (cross-sectional analysis at baseline)

Participants

- N = 1,095 patients undergoing primary ACLR
- CCF cohort: N = 752 (KOOS Pain, KOOS QoL)
- Non-CCF cohort: N = 343 (KOOS Pain, KOOS QoL, IKDC, PCS)

Outcome Measures

- KOOS Pain (0–100; higher = less pain)
- KOOS Quality of Life (0–100; higher = better)
- IKDC Subjective Knee Score (non-CCF only)

Predictors

- PROMIS Physical Health & Mental Health (T-scores)
- CD-RISC-10: resilience (0–40; higher = more resilient)
- Pain Catastrophizing Scale (PCS) (non-CCF only)
- Marx Activity Rating Scale
- Age, sex, articular cartilage grade, meniscus status

Statistical Analysis

- Multivariable linear regression with stepwise selection
- Model performance assessed by adjusted R^2

RESULTS

Table 1. Cohort Demographics and Characteristics

Variable	Total (N=1095)	CCF (N=752)	Non-CCF (N=343)	P-value
Age (median [IQR])	23.0 [18.0; 34.0]	20.5 [17.2; 30.7]	30.0 [23.0; 37.0]	< 0.001
Sex (Male, %)	622 (57.4%)	430 (57.2%)	192 (57.8%)	0.894
PROMIS Mental Health	53.3 [48.3; 59.0]	53.3 [48.3; 62.5]	53.3 [45.8; 59.0]	< 0.001
CD-RISC-10	33.0 [29.0; 38.0]	33.0 [29.0; 38.0]	32.0 [28.0; 37.0]	0.031
KOOS Pain	72.2 [58.3; 83.3]	75.0 [63.9; 83.3]	66.7 [52.8; 80.6]	< 0.001
KOOS QoL	37.5 [25.0; 50.0]	43.8 [25.0; 56.2]	25.0 [12.5; 37.5]	< 0.001
Baseline Activity	12.0 [1.0; 16.0]	9.0 [0.0; 16.0]	12.0 [8.0; 16.0]	< 0.001
PROMIS Physical Health	48.1 [44.9; 54.1]	50.8 [44.9; 54.1]	47.7 [42.3; 50.8]	< 0.001

Table 2. Baseline Characteristics by Sex

Variable	Total (N=1084)	Male (N=622)	Female (N=462)	P-Value	N
KOOS Pain	72.2 [58.3; 83.3]	72.2 [61.1; 83.3]	72.2 [58.3; 83.3]	0.437	1079
KOOS QoL	37.5 [25.0; 50.0]	37.5 [25.0; 50.0]	37.5 [18.8; 50.0]	0.518	1079
PROMIS Physical Health	48.4 [44.9; 54.1]	50.6 [44.9; 54.1]	47.7 [44.9; 54.1]	0.681	1082
PROMIS Mental Health	53.3 [48.3; 59.0]	53.3 [48.3; 61.4]	53.3 [48.3; 59.0]	0.050	1084
CD-RISC-10	33.0 [29.0; 38.0]	33.0 [29.0; 37.8]	32.0 [28.0; 38.0]	0.275	1084

Table 3. Summary of Significant Predictors Across Baseline Outcome Models

	Full Cohort (N=1,095)		Non-CCF Cohort (N=343)		
Predictor	**KOOS Pain** (Higher = Less Pain)	**KOOS QoL** (Higher = Better QoL)	**KOOS Pain** (Higher = Less Pain)	**KOOS QoL** (Higher = Better QoL)	**IKDC** (Higher = Better Function)
PSYCHOLOGICAL					
PROMIS Physical Health	**Higher PH** → Less Pain	**Higher PH** → Better QoL	**Higher PH** → Less Pain	**Higher PH** → Better QoL	**Higher PH** → Better Function
PROMIS Mental Health	**Higher MH** → More Pain	*NS*	**Higher MH** → More Pain	*NS*	**Higher MH** → Worse Function
Resilience (CD-RISC 10)	*NS*	**Higher Resilience** → Worse QoL	**Higher Resilience** → More Pain	**Higher Resilience** → Worse QoL	*NS*
Pain Catastrophizing (PCS) †	—	—	**Higher Pain Catastrophizing** → More Pain	**Higher Pain Catastrophizing** → Worse QoL	**Higher Pain Catastrophizing** → Worse Function
DEMOGRAPHIC					
Age	**Older Age** → More Pain	**Older Age** → Worse QoL	**Older Age** → More Pain	**Older Age** → Worse QoL	**Older Age** → Worse Function
Sex	*NS*	*NS*	*NS*	*NS*	*NS*
STRUCTURAL / FUNCTIONAL					
Baseline Activity Score	**Higher Activity** → More Pain	**Higher Activity** → Worse QoL	*NS*	**Higher Activity** → Worse QoL	**Higher Activity** → Worse Function
Articular Cartilage (Grade 3/4)	*NS*	*NS*	**Grade 3/4** → Less Pain	**Grade 3/4** → Better QoL	*NS*
Lateral Meniscus Tear	*NS*	*NS*	*NS*	**LM Tear** → Worse QoL	**LM Tear** → Worse Function
Medial Meniscus Tear	*NS*	*NS*	*NS*	*NS*	*NS*
Adjusted R^2	**0.40**	**0.28**	**0.47**	**0.30**	**0.50**

Blue cells: Significant positive association ($p < 0.05$). **Red cells:** Significant negative association ($p < 0.05$). **NS:** Not significant.

† Pain Catastrophizing Scale (PCS) not collected at CCF sites.

Knee Osteoarthritis Outcome Score; KOOS, KOOS Quality of Life; KOOS QoL, International Knee Documentation Committee Score; IKDC, Patient Reported Outcome Measure Information System; PROMIS, Conor Davidson Resilience Scale 10 Question; CD-RISC 10, Pain Catastrophizing Scale; PCS, Lateral Meniscus; LM, Medial Meniscus; MM

CONCLUSIONS

- Psychological traits are significant independent predictors of pre-operative knee pain and function in ACLR patients
- PROMIS Physical Health was the strongest and most consistent predictor across all five outcome models
- Pain catastrophizing (PCS) provided independent predictive value beyond resilience in the non-CCF cohort
- Pre-operative psychological screening may identify patients at risk for worse baseline status

Acknowledgements: This work was supported by the Arthroscopy Association of North America (AANA), and Military Advanced Surgical Training (MAST) Research Award