

How much Improvement in Patient-Reported Outcome Measures after Isolated Medial Patellofemoral Ligament Reconstruction is associated with Surgeon-defined satisfactory outcomes? A JUPITER study

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Common PROMs used in Patellar Instability

Kujala Score: Used for knee pain, though not validated for pediatric use

KOOS: Evaluates pain, symptoms, daily living activities, sports/recreation function, and knee-related quality of life

Pedi-IKDC: Designed for youth (ages 10–18) to evaluate symptoms, function, and sports activity. Has been validated for adults as well

BPII 2.0: Covers symptoms, work-related concerns, recreational activity, lifestyle, and social/emotional aspects. Specifically designed for patellar instability

Clinically Meaningful Improvements for evaluation of PROMs

Minimal Clinically Important Difference (MCID): Smallest change in measurement that patients perceive as noticeable

Substantial Clinical Benefit (SCB): Change in measurement that patients perceive as significant improvement.

Patient Acceptable Symptom State (PASS): Postoperative score linked with patient satisfaction

- However, these outcome measures can have limitations, especially for patients with high baseline PROMs (ceiling effects)

Maximal Outcome Improvement (MOI)

- A novel method to evaluate PROMs
- MOI quantifies the improvement in the outcome score as a percentage of the maximum potential improvement that could be achieved from the preoperative state
- Provides a more accurate representation in patients with higher baseline score
- Formula:
$$\frac{(PRO \text{ score at follow-up}) - (Pre\text{-operative PRO score})}{(Highest \text{ possible PRO score}) - (Pre\text{-operative PRO score})} * 100$$

Example

	Patient 1	Patient 2	Patient 3
Baseline score (Max 100)	50	70	30
Follow-up score	75	90	60
SCB (25) achieved?	Yes	No	Yes
MOI	50%	66.6%	42.8%

Study Aim

Primary:

- Define MOI thresholds for PROMs associated with satisfactory outcomes after isolated MPFL Reconstruction (MPFL-R) for patellar instability

Secondary:

- Evaluate factors associated with satisfactory outcomes following MPFL-R

Surgeon-Defined Satisfactory Outcome Criteria:

- Ability to return to sports at the same or higher level as pre-injury
- **AND** No episodes of patellar instability (dislocation or subluxation) at follow-up
- **AND** No additional surgeries to address patellar instability

Method

Study Design: Using data from the **JUPITER (Justifying Patellar Instability Treatment by Results)** cohort, a retrospective study was done using the prospectively maintained JUPITER database across 11 sites. Patient enrollment was from December 2016 to December 2021

Inclusion Criteria:

- Patients (age: ≤ 35 yrs) who underwent MPFL-R for patellar instability and had all four PRO (BPII 2.0, Pedi-IKDC, KOOS, Kujala) completed at baseline and one-year follow-up

Exclusion Criteria:

- Revision MPFL-R, MPFL repair, concomitant bony procedures, lack of available clinical data or PROMs

MRI Measurements and cut off values:

Cut-off values for abnormal radiological measurements were defined as follows: trochlear depth < 3 mm, CDI > 1.45 , TT-TG > 20 mm, and patellar tilt angle > 20 degrees

Results

- 284 consecutive patients underwent isolated MPFL-R and were included in the study
- 183 (66.9%) patients achieved surgeon-defined satisfactory outcomes
- Demographic information, clinical characteristics, MRI measurements and outcomes are listed in the Table

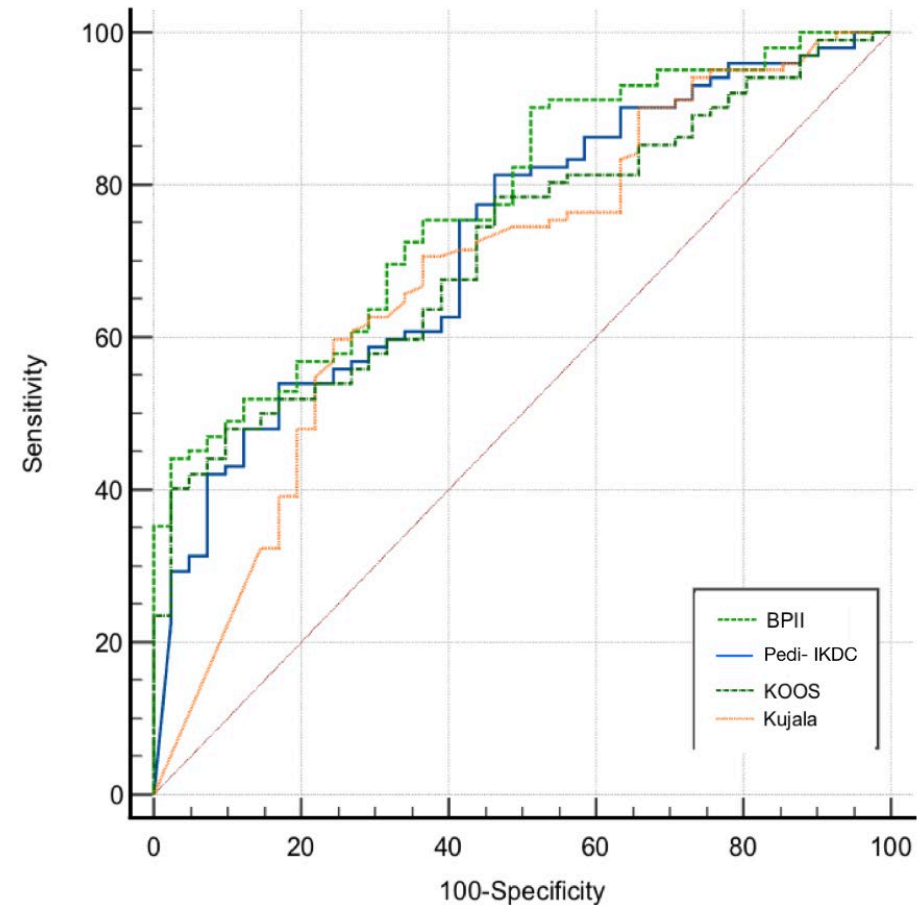
	n (%) or Mean (SD)
Age (years)	19.5(3.9)
Gender- Female	199(70.1)
BMI	24.2(5.7)
Side- Left	157(55.3)
First time dislocation	55(19.4)
Patellar Instability of contralateral knee	80(28.2)
Frequency of dislocations	
<5 episodes	127(68.6)
5-9 episodes	27(14.6)
10 or more episodes	31(16.8)
MRI	
CDI	1.3(0.3)
Patellar tilt	19.9(8.9)
TT-TG distance (mm)	13.7(4.2)
Trochlear depth (mm)	2.2(2.3)
Outcome	
Return to sports	255(89.8)
Return to prior level of sports	203(71.5)
Post-operative subluxation/dislocations	20(7)

Threshold MOI values for PROMs using ROC Analysis

Score	Cut-off threshold	AUC (95% CI)
BPII 2.0	65.86%	0.75 (0.68-0.80)
Pedi- IKDC	62.96%	0.77 (0.71-0.82)
KOOS	61.65%	0.74 (0.67-0.80)
Kujala	85.18%	0.69 (0.62-0.75)

Comparison of PROMs using AUC at threshold MOI values

	Pedi- IKDC (AUC= 0.73)	KOOS (AUC= 0.72)	Kujala (AUC= 0.69)
BPII 2.0 (AUC =0.78)	P = 0.2904	P = 0.1224	P = 0.0454*
Pedi- IKDC (AUC= 0.73)		P = 0.8106	P = 0.3414
KOOS(AUC= 0.72)			P = 0.4227



Multivariate Analysis

Outcome variable	Independent Variable	Odds ratio	95% CI	P- value
Satisfactory Outcome	Age	0.93	0.8190 to 1.0464	0.217
	BMI	0.96	0.8922 to 1.0358	0.300
	Gender [Male vs Female]	2.14	0.8026 to 5.6931	0.129
	Laterality [Right vs Left]	0.74	0.3378 to 1.6284	0.456
	First time patellar dislocation [No vs Yes]	4.09	1.7122 to 9.7892	0.002*
	Frequency of dislocations [5-9 episodes vs. <5 episodes]	0.64	0.1815 to 2.2832	0.495
	Frequency of dislocations [10 episodes or more vs. <5 episodes]	0.12	0.0351 to 0.4407	0.001*
	Participation in Cutting sports [Yes vs No]	0.72	0.3115 to 1.6661	0.443
	CDI [CDI>1.45]	1.37	0.5289 to 3.5296	0.4273
	Patellar tilt [Patellar tilt>20degree]	0.79	0.3521 to 1.7598	0.8464
	TT-TG distance (mm) [TT-TG >20]	1.49	0.2714 to 8.1398	0.2314
	Trochlear depth (mm) [Trochlear Depth <3mm]	1.35	0.5934 to 3.0553	0.6639



Discussion and Conclusion

- Achieving an improvement in the BP11 2.0 score greater than 65.86% of the maximum possible improvement from the preoperative state was associated with a satisfactory outcome
- MOI associated with satisfactory outcomes was 85.18% for Kujala score.
- BP11 2.0 had slightly higher AUC
- In patients with high base line PROMs, BP11 2.0 would be able to provide more meaningful information compared to Kujala score (ceiling effects)
- First time dislocation and >10 or more dislocations were associated with decreased odds of successful outcome
- None of the radiographic parameters were associated with outcomes

Limitations

- There is heterogeneity in data collection and interpretation, along with differences in patient characteristics and treatments, which could introduce bias
- Potential selection bias introduced by including only patients with isolated MPFL-R
- Additionally, the inclusion of minor concomitant procedures, like chondroplasty and lateral retinacular release, posed potential confounding variables

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