Longitudinal Evaluation using Forgotten Joint Score-12 after Double Bundle Anterior Cruciate Ligament Reconstruction

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INTRODUCTION:

There are several postoperative evaluation methods for anterior cruciate ligament reconstruction (ACLR), including physical examinations such as the anterior drawer test and pivot shift test, functional examinations such as the hop test, and patient-reported outcomes measurement (PROM).

PROM is important for evaluating postoperative clinical results. However, conventional PROMs have a high risk of demonstrating a ceiling effect in post-ACLR procedure assessments and do not accurately reflect functional improvement over time. Therefore, a longitudinal evaluation using PROM with a low risk of ceiling effect is necessary.

The forgotten joint score-12 (FJS) was developed by Behrend et al. in 2012 for clinical evaluation after arthroplasty The FJS consists of 12 questions regarding knee joint awareness during daily activities aimed at achieving a 'forgotten knee' after surgery. (Table 1) It is considered an evaluation method after total knee arthroplasty with a low risk of demonstrating a ceiling effect. However, few studies have used the FJS as an evaluation method after ACLR, particularly those tracking changes over time.

This study aimed to longitudinally evaluate FJS at 1 and 2 years after ACLR, compare its ceiling effect with the knee injury and osteoarthritis outcome score (KOOS) and Lysholm knee scale (LKS), and investigate factors influencing FJS at 1 year after ACLR. We hypothesized that the risk of demonstrating a ceiling effect of the FJS is lower than that of the KOOS and LKS, allowing for a more comprehensive longitudinal assessment of postoperative improvement.

METHODS:

This is a retrospective observational study of postoperative patients using existing data and a questionnaire-based survey. We included patients who underwent primary double-bundle ACLR using standardised surgical techniques between August 2017 and August 2021.

We compared the FJS, KOOS, and LKS scores at 1 and 2 years post-surgery using a paired t-test as primary outcomes. To evaluate longitudinal changes in PROMs, we limited the analysis to cases with PROM data at 1 and 2 years post-surgery. The ceiling effect for each PROM was calculated at 1 and 2 years post-surgery. To identify factors influencing FJS 1 year post-ACLR across all cases, multivariate linear regression analysis was conducted for the FJS with age, sex, BMI, side-to-side difference in anterior tibial translation, presence of meniscal injury, and single leg hop test limb symmetry index (SLH-LSI) groups as independent variables.

Statistical analysis was performed using EZR R (version 4.1.2), with $p < 0.05$ considered statistically significant.

RESULTS:

Finally, 87 patients were included in this study. (Figure 1) Fifty-six participants were women, with an average age of 28.5 ± 11.8 years at the time of surgery and a BMI of 23.2 ± 3.7 kg/m2. Fifty-eight patients with meniscal injuries requiring treatment were observed.

The average FJS at 1 year and 2 years post-surgery were 85.3 ± 16.9 and 90.1 ± 12.4, respectively. The FJS showed a statistically significant improvement from 1 to 2 years ($p = 0.03$). Every subscale of the KOOS also showed a significant improvement from 1 year to 2 years. LKS did not differ significantly between 1 and 2 years. (Table 2)

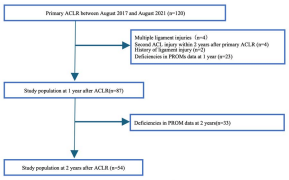
The FJS had the lowest risk of demonstrating a ceiling effect at 1 and 2 years postoperatively.

According to the multivariate linear regression analysis, the FJS score at 1 year post-surgery decreased with increasing age (estimated regression coefficient = -0.49, $t = -2.32$, $p = 0.023$). Additionally, a predictive factor for higher FJS scores at 1-year post-surgery was an improvement in the affected side SLH-LSI to a value close to that of the healthy side (SLH-LSI >0.9) (estimated regression coefficient = 15.37, $t = 3.16$, $p = 0.002$). (Table 3)

DISCUSSION AND CONCLUSION:

Few studies have used the FJS as an evaluation method after ACLR. The most significant finding obtained was the improvement in FJS scores from 1 to 2 years after ACLR, along with the lower ceiling effect of FJS compared to that of other PROM. The FJS demonstrated continued improvement over the 2 years after ACLR, showing a low risk of reaching a ceiling effect. In younger individuals and those with an SLH-LSI of 0.9 or higher, FJS post-ACLR scores were higher. Therefore, the FJS appears to be suitable for evaluating post-ACLR outcomes, particularly in tracking progression from the initial to the subsequent year.

Figure. 1



ACLR, Anterior cruciate ligament reconstruction; PROM, Patient reported outcome measures

Table 1. Questions in Forgotten Joint Score-12

Item	Are you aware of your knee…
1	in bed at night?
2	when sitting on a chair for more than an hour?
3	when you are walking for more than 15 min?
4	when taking a bath/shower?
5	when traveling in a car?
6	when climbing stairs?
7	when walking on uneven ground?
8	when standing up from a low-seated position?
9	when standing for long periods of time?
10	when doing housework or gardening?
11	when taking a walk or hiking?
12	when doing your favorite sport?

Table 2. Longitudinal Patient-Reported Outcome Measures at 1 and 2 Years after ACLR

Postoperative	1 year	Ceiling effect	2 years	Ceiling effect	p
Total FJS	85.3 ± 16.9	20.4 %	90.1 ± 12.4	33.3 %	0.05
KOOS					
Symptoms	87.7 ± 12.6	22.2 %	93.3 ± 9.1	44.4 %	<0.01
Pain	91.9 ± 10.5	27.8 %	94.6 ± 7.8	44.4 %	0.04
ADL	96.8 ± 5.1	48.1 %	98.2 ± 3.2	63.0 %	0.03
sports/rec	82.9 ± 16.9	20.4 %	89.0 ± 13.8	38.9 %	<0.01
QOL	79.3 ± 19.3	25.9 %	86.0 ± 15.0	35.2 %	<0.01
LKS	89.8 ± 15.6	27.8 %	92.9 ± 15.3	44.4 %	0.24

Data expressed as mean ± standard deviation.
FJS, Forgotten Joint Score-12; KOOS, Knee Injury and Osteoarthritis Outcome Score; ADL, Activities of Daily Living; QOL, Quality of Life; LKS, Lysholm Knee Scale.

Table3. A multiple Linear Regression Analysis to Predict FJS 1 Year after ACLR

	Estimated coefficient	Standard deviation	t value	95% CI	p
Intercept	75.97	16.48	4.61	43.07 – 108.87	<0.01
Age (years)	-0.47	0.20	-2.35	-0.87 – 0.07	0.02
Sex (Male = 0, Female: 1)	-3.26	4.87	-0.67	-13.01 – 6.49	0.51
BMI (kg/m²)	0.52	0.66	0.79	-0.80 – 1.84	0.43
Side-to-side difference of tibial translation (mm)	-1.39	0.91	-1.54	-3.21 – 0.42	0.13
SLH-LSI (<0.9 = 0, >0.9 = 1)	15.37	4.87	3.16	5.66 – 25.09	>0.01
Meniscus status (Intact = 0, Injury = 1)	1.03	4.96	0.21	-8.86 – 10.93	0.84

ACLR, anterior cruciate ligament reconstruction; FJS, Forgotten Joint Score-12; BMI, body mass index; SLH-LSI, Limb Symmetry Index of Single Leg Hop; CI, confidence interval.