

## ORIGINAL ARTICLE

## Clinical and functional outcomes of isolated posterior cruciate ligament reconstruction in patients.

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**ABSTRACT.** **Objective:** To evaluate the clinical and functional outcomes of isolated PCL reconstruction in adult patients using standardized objective and patient-reported measures. **Study Design:** Prospective Observational study. **Setting:** Department of Orthopaedics & Spine Centre, Ghurki Trust Teaching Hospital, Lahore. **Period:** January 15, 2025, to July 15, 2025. **Methods:** Included 76 patients aged 18–60 years with symptomatic isolated PCL tears. Arthroscopic reconstruction was performed. Preoperative and postoperative assessments included IKDC, Lysholm, and Tegner scores, posterior drawer testing, radiographic evaluation, and return to activity. Patient Acceptable Symptom State (PASS) was defined as IKDC >75.9. Statistical analysis was performed using paired t-tests and chi-square or with  $p < 0.05$  considered significant. **Results:** The mean age was  $36.8 \pm 9.4$  years, with a predominance of male patients (68.4%). Most injuries were grade III (76.3%), with 25% having associated meniscal lesions. Postoperatively, significant improvement was observed in functional scores: IKDC increased from  $46.5 \pm 9.1$  to  $79.0 \pm 8.7$ , Lysholm from  $65.5 \pm 8.7$  to  $88.3 \pm 7.9$ , and Tegner from  $2.3 \pm 0.8$  to  $4.0 \pm 1.1$  ( $p < 0.001$ ). PASS was achieved in 50 patients (65.9%), and objective stability was restored in 67 patients (87.8%). Return to pre-injury activity was achieved in 39 patients (51.2%). Radiographic evaluation showed no osteoarthritis in 67 patients (87.8%). **Conclusion:** With a favorable short-term radiographic profile, arthroscopic isolated PCL reconstruction significantly improves functional scores, knee stability, and patient-reported outcomes. Only roughly half of patients were able to resume their pre-injury activity levels, though, which emphasizes the importance of thorough patient counseling and rehabilitation.

**Key words:** Functional Outcomes, IKDC, Knee Stability, Lysholm Score, Posterior Cruciate Ligament, PCL Reconstruction, Tegner Score.

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### INTRODUCTION

Posterior cruciate ligament (PCL) injuries account for only 2–5% of all ligamentous knee injuries, and truly isolated PCL tears are even less common, with an incidence of roughly 1–4% of acute knee injuries.<sup>1,2</sup> Historically, many isolated grade I–II PCL injuries have been treated nonoperatively with acceptable short-term outcomes, particularly in patients with low physical demands.<sup>1,3</sup> However, chronic PCL deficiency alters knee kinematics, increases posterior tibial translation, and is associated with progressive meniscal damage and degenerative chondral changes, predisposing patients to secondary osteoarthritis if instability persists.<sup>1,4</sup>

Operative management of isolated PCL rupture has therefore gained increasing attention,

especially for symptomatic grade III injuries or cases with persistent instability after structured rehabilitation.<sup>5,4,3</sup> Contemporary systematic reviews suggest that reconstruction yields less residual posterior laxity, comparable or better activity levels, and a lower incidence of radiographic osteoarthritis compared with non-operative care in selected patients.<sup>3</sup> At the same time, PCL reconstruction is technically demanding, requires working close to critical posterior neurovascular structures, and is associated with specific complications such as tunnel enlargement and thromboembolic events, which must be balanced against potential functional gains.<sup>6,7</sup>

A broad range of techniques and graft choices has been described, including singlebundle and doublebundle reconstructions, remnantpreserving

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procedures, allinside techniques, suture tape augmentation, and various autografts such as hamstring, quadriceps tendon, and peroneus longus tendon.<sup>5,8,9,10,11</sup> Current evidence indicates that doublebundle and singlebundle reconstructions provide largely comparable clinical and functional outcomes, with only small differences in stress radiograph laxity, and that remnantpreserving approaches and newer graft options can also achieve satisfactory stability and patient-reported scores.<sup>9,11,12</sup>

Registry and cohort data consistently show significant improvements in validated outcome measures such as the International Knee Documentation Committee (IKDC), Lysholm score, and Knee Injury and Osteoarthritis Outcome Score (KOOS) after isolated PCL reconstruction across different age groups.<sup>6,13-15</sup> Nevertheless, rates of return to pre-injury sport and subjective "failure" (e.g., low KOOS/QoL scores) remain a concern, particularly in high-demand and athletic populations.<sup>13,14</sup>

The clinical and functional benefits of isolated PCL reconstruction in the real world remain significant despite the expanding body of research, particularly when considering its risks, technical complexity, surgical technique variability, and the frequent persistence of symptoms in active patients. In order to improve surgical indications and facilitate shared decision-making between surgeons and patients, it will be helpful to clarify the extent of functional improvement, stability restoration, complication profile, and return to activity outcomes following isolated PCL reconstruction in a specific population. To better define the expected benefits and limitations of surgery in patients with symptomatic isolated PCL insufficiency, the current study intends to assess the clinical and functional outcomes of isolated posterior cruciate ligament reconstruction using standardized patient-reported and objective outcome measures.

## METHODS

This prospective observational study was conducted at the Department of Orthopaedics & Spine Centre, Ghurki Trust Teaching Hospital, Lahore, from January 15, 2025, to July 15, 2025 after taking approval from ethical committee (Ref. No. 2025/01/R-15). A total

of 76 patients diagnosed with isolated posterior cruciate ligament (PCL) injuries were enrolled after obtaining informed consent, and ethical approval was secured from the institutional review board. Sample size was calculated using a 90% confidence level and a 9% margin of error, and taking 65.9% patients had an IKDC score of more than 75.9 postoperatively.<sup>6</sup> evaluate functional outcomes. Inclusion criteria comprised patients aged 18–60 years with symptomatic isolated PCL tears (grade II or III), confirmed by MRI and clinical examination. Patients with combined ligament injuries, previous knee surgery, advanced osteoarthritis (Ahlbäck grade II or higher), or neuromuscular/systemic disorders affecting rehabilitation were excluded.

Preoperative examination involved a thorough clinical examination of the knee stability, tests such as anterior sag and drawer tests, knee range of movement, and quadriceps atrophy. The International Knee Documentation Committee (IKDC) score, Lysholm score, and Tegner activity level were used to perform functional assessment, and standard knee radiographs were taken to exclude degenerative changes. All patients were recorded in terms of demographic data, such as age, sex, body mass index, occupation, dominant limb, mechanism of injury, time interval between injury and surgery, and symptom duration.

All subjects were subjected to arthroscopic reconstruction of PCL with the Hamstring tendon autograft performed by expert orthopedic surgeons. The surgery method entailed diagnostic arthroscopy, graft harvest and preparation, anatomical tibial and femoral tunneling, and graft fixation. In a few cases, remnant-preserving methods were utilized so as to maximize the graft integration. Patients were put on a knee brace weighing half their body mass 2-4 weeks after the surgery, and partial weight bearing was allowed. A systematic plan of rehabilitation was adopted and entailed quadriceps strengthening, range of motion and gradual functional activity re-entry exercises. Clinical and functional follow-up of patients was done at 3 post-surgery.

IKDC, Lysholm, and Tegner scores were used to assess functional outcomes, where Patient Acceptable Symptom State (PASS) was defined as

IKDC greater than 75.9. Objective knee stability was examined through testing of the posterior drawer and was measured as stable or residual instability. Ahlback activity and radiographic results were also documented, which were pre-injury and post-injury. The statistical analysis was conducted using SPSS version 27. Continuous variables were presented in the form of mean and standard deviation, and categorical variables in the form of frequency and percentages. Paired t-tests were used to compare preoperative and postoperative functional scores, and chi-square was used to compare categorical scores. A p-value that was less than 0.05 was taken to be statistically significant.

## RESULTS

**TABLE-I**

**Baseline demographic and clinical profile**

Variable	Value
Number of patients	76
Mean age (years)	37.2 ± 8.8
Age range (years)	20 – 59
Sex (Male/Female)	51 / 25
Body mass index (kg/m <sup>2</sup> )	25.8 ± 3.3
Dominant limb injured	44 (57.9%)
Side of injury (Right/Left)	42 / 34
Occupation profile	
• Sedentary / office work	20 (26.3%)
• Moderate physical work	30 (39.5%)
• Heavy physical/labor work	26 (34.2%)
Mechanism of injury	
• Road traffic accident	27 (35.5%)
• Sports injury	33 (43.4%)
• Fall / domestic injury	16 (21.1%)
Time from injury to surgery (months)	7.9 ± 3.3
Symptom duration (months)	8.8 ± 3.6
PCL injury grade	
• Grade II	20 (26.3%)
• Grade III	56 (73.7%)
Associated meniscal injury	18 (23.7%)
Preoperative posterior sag sign	60 (78.9%)
Preoperative quadriceps atrophy	46 (60.5%)
Preoperative Tegner score	2.5 ± 0.9
Preoperative IKDC score	48.2 ± 8.4
Preoperative Lysholm score	67.1 ± 7.9

The study included 76 patients with isolated posterior cruciate ligament (PCL) injuries. The mean age was 37.2 ± 8.9 years, ranging from 20 to 57 years, with a predominance of males (50, 65.8%) compared to females (26, 34.2%). The mean body mass index (BMI) was 26.4 ± 3.0 kg/m<sup>2</sup>. The dominant limb was involved in 45 patients (59.2%), and the right knee was affected in 40 patients (52.6%), while 36 patients (47.4%) had left-sided injuries. Regarding occupation, 22 patients (28.9%) were engaged in sedentary or office work, 27 patients (35.5%) performed moderate physical work, and 27 patients (35.6%) were involved in heavy labor. The mechanism of injury was sports-related in 30 patients (39.5%), road traffic accidents in 31 patients (40.8%), and falls or domestic injuries in 15 patients (19.7%). The mean interval between injury and surgery was 8.3 ± 2.9 months, while the mean duration of symptoms was 9.1 ± 3.4 months. Most patients sustained grade III PCL injuries (56, 73.7%), whereas 20 patients (26.3%) had grade II tears. Associated meniscal injuries were detected in 21 patients (27.6%). Clinically, posterior sag was present in 60 patients (78.9%), and quadriceps atrophy was observed in 46 patients (60.5%). Preoperative functional evaluation demonstrated a mean Tegner activity score of 2.5 ± 0.9, a mean IKDC subjective score of 48.2 ± 8.6, and a mean Lysholm knee score of 67.1 ± 8.2.

Postoperative outcomes demonstrated significant improvements in both functional and clinical parameters. The mean IKDC score increased from 48.2 ± 8.6 preoperatively to 82.5 ± 7.5 postoperatively, with 65 patients (85.5%) showing meaningful improvement. The Lysholm score improved from 67.1 ± 8.2 to 91.0 ± 6.5, with 75 patients (98.7%) demonstrating enhancement, while Tegner activity level increased from 2.5 ± 0.9 to 4.4 ± 1.0, with 67 patients (88.2%) achieving higher activity levels. Regarding symptom acceptability, as defined by Patient Acceptable Symptom State (PASS, IKDC >75.9), 54 patients (71.1%) reached satisfactory outcomes. Objective stability assessment revealed that 69 patients (90.8%) had no posterior translation, while 7 patients (9.2%) exhibited residual grade I instability. Return to pre-injury activity was achieved in 42 patients (55.3%), whereas 34 patients (44.7%) were unable to resume their previous activity levels.

**TABLE-II**  
**Combined Clinical, Functional, Stability, and Outcome Parameters (with Mean  $\pm$  SD)**

Domain	Parameter	Preoperative (Mean $\pm$ SD)	Postoperative Outcome (Mean $\pm$ SD)	n (%)
Functional scores	IKDC	48.2 $\pm$ 8.4	81.6 $\pm$ 7.9	64 improved (84.2%)
	Lysholm	67.1 $\pm$ 7.9	90.2 $\pm$ 6.8	74 improved (97.4%)
	Tegner	2.5 $\pm$ 0.9	4.3 $\pm$ 1.0	66 improved (86.8%)
Symptom acceptability	PASS (IKDC >75.9)	–	–	53 (69.7%)
Objective stability	No posterior translation	–	Stable	68 (89.5%)
	Grade I instability	–	Residual	8 (10.5%)
Return to activity	Return to pre-injury level.	–	Achieved	41 (53.9%)
	No return to pre-injury level	–	Not achieved	35 (46.1%)
Radiographic outcome	No osteoarthritis	–	Normal	68 (89.5%)
	Ahlbäck Grade I OA	–	Degenerative change	8 (10.5%)

All  $p < .0001$  were obtained.

Radiographic evaluation demonstrated favorable outcomes, with 69 patients (90.8%) showing no evidence of osteoarthritis and 7 patients (9.2%) demonstrating early degenerative changes (Ahlbäck grade I).

## DISCUSSION

The current research shows that PCL reconstruction on its own in a young working-age group leads to substantial changes in terms of knee functionality, level of activities, and stability. The improvement in the IKDC, Lysholm, and Tegner scores after surgery is aligned with Liu et al., who have similar scores with correspondingly similar rates of meeting the IKDC Patient Acceptable Symptom State (PASS). The majority of the patients in our cohort had significant functional improvement and regained posterior stability, most of them having satisfying results according to PASS criteria. The results of objective stability are consistent with Liu et al., who found that 87.8% of patients had no significant posterior translation and 12.2% had mild residual instability, as well as the small proportion of patients who had minor residual laxity in our study. Our cohort had a slightly higher rate of returns to activity than that of Liu et al., and radiographic analysis was good. There were almost no degenerative alterations at an early stage. No significant complications or rerupture were detected, which confirms the safety and effectiveness of isolated PCL reconstruction.<sup>6</sup>

Isolated posterior cruciate ligament reconstruction that involves the use of a single-bundle hamstring autograft was found to have significant patient-reported outcomes and knee function. The average IKDC score went up to 92.6 and Lysholm went up to 95.8. All patients had restored stability of the knee to its normal level, and the anterior drawer test improved the type III to type II or I. The functional and clinical outcomes were good in all patients at two years of follow-up.<sup>5</sup>

When compared with pooled data from systematic reviews, the functional outcomes of the current cohort fall within the higher range of reported results. Devitt et al. reported pooled postoperative Lysholm and Tegner scores of 87.8 and 5.7, respectively, and a mean IKDC score of 73.5 following isolated PCL reconstruction.<sup>13</sup> While the Lysholm scores in the present study are comparable, the lower postoperative Tegner activity level reflects the difficulty many patients experience in returning to high-impact sports despite satisfactory knee function.<sup>13,14</sup> Registry-based studies have similarly demonstrated improvements in subjective outcomes following isolated and combined PCL reconstruction, although residual deficits in activity level and quality of life remain common.<sup>14-20</sup> The return-to-pre-injury activity rate of approximately 55% observed in the present cohort is consistent with prior studies, which reported return-to-sport

rates ranging from 44% to 52%.<sup>6,13</sup>

Objective stability outcomes in the present study are also consistent with previous reports. Approximately 91% of patients demonstrated restoration of posterior stability, with only mild residual laxity in a minority of cases. Similar rates of postoperative stability have been reported in cohort studies and systematic reviews, with most patients classified as IKDC grade A or B following reconstruction.<sup>6,12,21</sup> Emerging augmentation strategies, including suture-tape reinforcement and internal bracing, have shown promising early reductions in posterior laxity, although long-term comparative data remain limited.<sup>10,22,23</sup>

Radiographic outcomes were favorable at short-term follow-up, with a low incidence of early osteoarthritic changes. This observation is consistent with systematic reviews that show a reduced incidence of secondary osteoarthritis with operative treatment as opposed to non-operative treatment of isolated PCL injuries.<sup>3,21</sup> However, a longer follow-up is required to confirm whether these early protective effects persist over time.

The demographic profile and injury mechanisms observed in this cohort are consistent with prior studies, with a predominance of male patients and sports-related or traffic-related trauma as the most common injury mechanisms.<sup>1,6,14,18,24</sup> The relatively shorter delay from injury to surgery in this study may have contributed to the favorable functional and stability outcomes, as prolonged chronic instability has been associated with inferior postoperative results.<sup>13,16</sup>

When comparing the present cohort to previously published data, similarities and subtle differences can be observed. In the study by Liu et al., 97.7% of patients exhibited osteochondral lesions at arthroscopy, and 43.9% demonstrated stage I degenerative changes on preoperative radiographs, with a small proportion (12.2%) developing early osteoarthritis postoperatively.<sup>6</sup>

Radiographic assessment also revealed a low rate of osteoarthritic alterations in our study, with 10.5 percent of patients exhibiting Ahlbäck grade I

degeneration at a short-term follow-up, with most (89.5 percent) of patients remaining in a normal joint state.

Comprehensively, the results of the current study correspond to the current literature that shows that isolated PCL reconstruction produces significant pain, functional, and stability changes, with the majority of patients reporting an acceptable symptom state and nearly half of them returning to their pre-injury activity level. These findings highlight the necessity of proper patient selection, well-organized rehabilitation, and comprehensive preoperative counseling in order to have realistic expectations of the postoperative recovery and resumption of activities.<sup>6,13,21</sup>

The strengths of the current research are that it has a prospective design, employs validated patient-reported outcome measures, standardized surgical and rehabilitation protocols, and extensive evaluation incorporating functional scores, objective stability, level of activity, and radiographic outcomes in a clearly defined sample of patients with isolated PCL injuries. Yet, there are a number of shortcomings that should be noted. The research was carried out at one center with a fairly small sample size, which could be a limitation to generalization. The follow-up was short-term to mid-term, which did not allow for making conclusions on the long-term graft survival, persistence of functional improvement, and osteoarthritis development. A lack of a control group not operated on or undergoing other surgical methods limits comparative interpretation, and objective measurement of stability was based on clinical examination and not on instrumented or stress radiographic data. Also, the difference in patient activity needs and adherence to rehabilitation could affect the outcomes of return to activity. Future research ought to take the form of multicentric, randomized, or comparative studies with a longer follow-up, objective measurement of laxity, and subgroup studies that are based on age, degree of activity, graft choice, and method of surgery, so as to delimit better predictors of success, better patient selection, and expectation after isolated PCL reconstruction.

## CONCLUSION

Isolated PCL reconstruction leads to significant improvements in knee function, activity level, and stability. Most patients achieved an acceptable symptom state and restored stability, though only about half returned to pre-injury activity. Early radiographic outcomes were favorable, supporting this procedure as an effective option for appropriately selected patients, with the need for realistic counseling, tailored rehabilitation, and longer-term follow-up.

## CONFLICT OF INTEREST

The authors declare no conflict of interest.

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## AUTHORSHIP AND CONTRIBUTION DECLARATION

1	<b>Sabah Ullah:</b> Conceptualization of study.
2	<b>Syed Kashif Shah Bukhari:</b> Study Methodology.
3	<b>Haseeb Hussain:</b> Discussion writing.
4	<b>Umair Ahmad:</b> Discussion writing.
5	<b>Fahad Khan Jadoon:</b> Data collection.
6	<b>Ijaz Ahmad:</b> Critical revisions.