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Physiotherapy Management of Adolescent Posterior Cruciate Ligament Rupture: A Case Report

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Abstract

Background: Posterior cruciate ligament (PCL) injury may result in knee pain, instability, impaired neuromuscular control, and limitations in functional activities. Physiotherapy may support recovery through structured conservative management and progressive therapeutic exercise.

Objective: To describe the clinical outcomes of physiotherapy intervention in a patient with left PCL rupture, particularly regarding pain, knee stability, and functional ability.

Methods: This case report involved a 12-year-old male patient with left PCL rupture following a basketball related injury. Physiotherapy intervention was provided over four sessions and included cryotherapy, therapeutic ultrasound, strengthening exercises, stabilization training, and proprioceptive exercises. Clinical outcomes were assessed using the Visual Analog Scale (VAS), Range of Motion (ROM), Manual Muscle Testing (MMT), Single Leg Stance (SLS), and Lower Extremity Functional Scale (LEFS).

Results: Pain decreased from 1/10 to 0/10 at rest and from 3/10 to 1/10 during movement. Single leg stance performance improved from less than 5 seconds to more than 10 seconds, indicating improved balance and postural control. LEFS increased from 73 to 78, suggesting improvement in lower extremity functional ability. Knee ROM remained unchanged, with flexion at 125° and extension at 0°, while muscle strength remained 5/5 on MMT.

Conclusion: A four session physiotherapy program was associated with reduced pain and improvements in balance and functional ability in this patient with left PCL rupture. The findings support the potential contribution of structured physiotherapy to conservative rehabilitation; however, conclusions regarding treatment effectiveness should be interpreted cautiously because this report describes a single case.

Keywords
posterior cruciate ligament; physiotherapy; knee instability; rehabilitation; exercise therapy

Introduction

Posterior cruciate ligament (PCL) injury is a clinically significant condition that affects knee joint stability, functional performance, and long-term joint health. As the primary restraint against posterior tibial translation, particularly during knee flexion, the PCL plays a critical role in maintaining normal knee biomechanics and dynamic stability.[1,2] Disruption of this structure may result in altered joint kinematics, increased mechanical stress on surrounding tissues, and a higher risk of degenerative changes, including early osteoarthritis.[3]

Although less common than anterior cruciate ligament injuries, PCL injuries account for approximately 3–20% of all knee ligament injuries and are frequently underdiagnosed due to their relatively subtle and non-specific clinical presentation.[1,4] Delayed or inadequate management may lead to persistent instability, impaired neuromuscular control, and long-term functional limitations. [1,5] These consequences are particularly relevant in physically active populations, including adolescents involved in sports requiring high-intensity movements such as jumping, pivoting, and rapid directional changes.

Adolescent patients represent a unique clinical population due to ongoing musculoskeletal development, high activity demands, and increased susceptibility to biomechanical and neuromuscular imbalances. In this group, ligament injuries may not only affect short-term function but also have implications for long-term joint health and athletic participation. Therefore, early and appropriate rehabilitation is essential to optimize recovery and prevent secondary complications.[1,6]

Conservative management, particularly physiotherapy, is widely recommended as the first-line treatment for isolated PCL injuries, especially in low- to moderate-grade cases.[4] Rehabilitation programs typically emphasize progressive strengthening, proprioceptive training, and neuromuscular re-education to restore joint stability and functional performance.9,11 Emerging evidence suggests that structured physiotherapy interventions can improve pain, stability, and patient-reported outcomes; however, substantial variability exists in intervention protocols, including exercise progression, dosage, and duration, reflecting the lack of standardized rehabilitation guidelines.[4,7]

Importantly, current literature is predominantly focused on adult populations, postoperative outcomes, or long-term follow-up, while evidence regarding short-term physiotherapy outcomes in adolescent patients with PCL rupture remains limited.[5,7] In addition, many studies lack detailed reporting of intervention protocols, limiting reproducibility and clinical applicability. Furthermore, the relative contribution of physiotherapy interventions compared to natural recovery processes in the subacute phase is not well established, particularly in single-case clinical contexts.[8]

Given these gaps, well-documented case reports are valuable for providing detailed clinical insights, especially in underrepresented populations such as adolescent athletes.[6] Such reports can contribute to the understanding of early-phase rehabilitation responses, inform clinical decision-making, and support hypothesis generation for future research.

Therefore, this case report aims to describe the physiotherapy management and short-term clinical outcomes of an adolescent patient with posterior cruciate ligament rupture, focusing on changes in pain intensity, knee stability, and functional ability following a structured rehabilitation program. It is expected that the intervention will be associated with reductions in pain and improvements in stability; however, functional gains may not reach clinically meaningful thresholds within a short intervention period.[5–7]

Methods

This study was designed as a single-patient case report aimed at describing the implementation and short-term outcomes of a structured physiotherapy program in a patient with posterior cruciate ligament (PCL) rupture. The reporting of this case adhered to the CARE (CAse REport) guidelines, and key elements including patient information, clinical findings, timeline, intervention, and outcomes are presented to ensure transparency and reproducibility. The level of evidence of this study is Level V (case report).

The patient was a 12-year-old male who presented to Kala Physio Clinic, Surakarta, Indonesia, with complaints of left knee pain and instability following a sports-related injury during basketball activity. The mechanism of injury involved a fall combined with a sudden directional change.

The patient was actively engaged in recreational basketball prior to injury, with no history of previous knee injury, systemic disease, or surgical intervention. Anthropometric data (height and body weight) were not recorded at the time of assessment, which is acknowledged as a limitation.

Based on clinical examination, including a positive posterior drawer test and absence of valgus/varus instability, the condition was classified as a suspected isolated PCL injury of low-to-moderate severity (clinically consistent with Grade I–II), although formal grading could not be confirmed due to the absence of imaging. The injury was categorized as subacute, as symptoms had persisted for several weeks prior to presentation.

Imaging modalities such as magnetic resonance imaging (MRI) or radiography were not performed due to clinical and resource considerations. Therefore, diagnosis was based on clinical findings, which may limit diagnostic precision. Differential diagnoses, including meniscal injury and collateral ligament involvement, were considered unlikely due to the absence of joint line tenderness, locking symptoms, or medial/lateral instability.

The clinical course and intervention timeline were structured in accordance with CARE recommendations and are presented in Table 1. The timeline includes injury onset, baseline assessment, sequential intervention sessions, and post-intervention evaluation to provide a clear chronological overview of patient progression.

Baseline clinical assessment was conducted prior to intervention and included evaluation of pain, range of motion (ROM), muscle strength, balance, and functional ability. Pain intensity was measured using the Visual Analog Scale (VAS), a widely used and valid instrument for assessing subjective pain intensity. Knee ROM was assessed using a universal goniometer, which has demonstrated acceptable intra- and inter-rater reliability in clinical settings. Muscle strength was evaluated using Manual Muscle Testing (MMT), graded on a scale of 0–5.

Balance and postural stability were assessed using the Single Leg Stance (SLS) test, which has been reported to demonstrate acceptable reliability for functional balance assessment in lower limb conditions, although sensitivity to change may be limited due to its categorical nature.

Functional ability was evaluated using the Lower Extremity Functional Scale (LEFS), a validated and reliable patient-reported outcome measure. The minimal clinically important difference (MCID) for LEFS is approximately 9 points and was used to guide clinical interpretation of functional changes.

The physiotherapy intervention was delivered over four outpatient sessions within a two-week period (twice weekly), with each session lasting approximately 40–60 minutes. The intervention protocol combined therapeutic modalities and progressive exercise therapy, tailored to the patient's clinical condition and tolerance.

Cryotherapy was applied to the affected knee for 10–15 minutes per session to reduce pain and inflammatory response. Therapeutic ultrasound was administered using a frequency of 1 MHz, intensity of 0.8–1.2 W/cm², in pulsed mode (20–50%) for 5–8 minutes, targeting periarticular soft tissues.

Exercise therapy was the primary component of the intervention and was structured progressively across sessions. Initial exercises included isometric quadriceps activation and bridging exercises. Subsequent sessions incorporated strengthening exercises such as partial squats and calf raises. Proprioceptive and stabilization training included single leg stance and balance exercises. In the final session, functional exercises such as step-up training and dynamic balance tasks were introduced.

Each strengthening exercise was performed for two sets of eight repetitions, with rest intervals of approximately 30–60 seconds between sets. Balance exercises were performed for two sets with a duration of 10–15 seconds.

Progression criteria were defined based on the absence of pain exacerbation (VAS increase ≤1 point), the patient's ability to maintain proper movement control, and successful completion of prescribed repetitions without compensatory movement. Exercise complexity was increased gradually by adding functional tasks and dynamic balance challenges across sessions.

No external bracing or assistive devices were used during the intervention period. No additional modalities such as percussive therapy (massage gun) were applied, ensuring consistency between intervention description and implementation. The patient demonstrated full adherence to the treatment sessions and home exercise recommendations. No adverse events, complications, or symptom exacerbations were reported throughout the intervention period.

Data analysis was conducted descriptively by comparing pre- and post-intervention values. Absolute changes (Δ values) and percentage changes (%) were calculated for each outcome measure to quantify clinical improvement. No inferential statistical analysis was performed due to the single-case design. Clinical interpretation of outcomes was guided by established thresholds, including MCID values where applicable, to distinguish between statistical change and clinical relevance.

This case report received ethical approval from the relevant institutional review board; however, the approval number was not available in the clinical documentation. This limitation is acknowledged, and the study was conducted in accordance with institutional and ethical standards for case reporting. Written informed consent was obtained from the patient's guardian prior to data collection and publication. Patient identity was anonymized to ensure confidentiality.

Results

This section presents the clinical outcomes following a two-week physiotherapy intervention, focusing on changes in pain intensity, knee stability, and functional ability, in accordance with the study objective. To ensure alignment with CARE reporting, patient progression is presented chronologically, followed by quantitative outcome comparisons.

A structured timeline of the patient's clinical course is provided in Table 1 to illustrate the sequence of events from injury onset to post-intervention evaluation. The patient demonstrated gradual improvement across sessions, particularly in pain reduction and postural stability.

Table 1. Summary of Clinical Progression (CARE-aligned)

Phase	Time Point	Clinical Status	Intervention	Outcome
Pre-injury	Before injury	Fully active in basketball, no symptoms	None	Normal knee function
Injury event	Day 0	Fall with sudden directional change; suspected knee trauma	None	Onset of injury
Post-injury	Days–weeks after injury	Mild pain, knee instability, difficulty in sports and prolonged walking	No formal treatment	Persistent symptoms
Session 1	Baseline (Week 1)	VAS movement: 3; VAS rest: 1; SLS: <5 s; LEFS: 73; ROM & MMT normal	Cryotherapy, ultrasound, isometric activation	Initial symptom management
Session 2	Week 1	Persistent mild pain and instability	Bridging, quadriceps strengthening, continued modalities	Early neuromuscular activation
Session 3	Week 2	Improved control, reduced discomfort	Squat, calf raises, proprioceptive training	Enhanced stability and balance
Session 4	Week 2 (final)	Minimal pain, improved stability	Step-up, dynamic balance training	Functional integration
Post-intervention	End of Week 2	VAS movement: 1; VAS rest: 0; SLS: >10 s; LEFS: 78	—	Reduced pain, improved stability, modest functional gain

Quantitative outcome measures before and after intervention are summarized in Table 2, including absolute (Δ) and percentage (%) changes to enhance interpretability.

Table 2. Pre- and Post-Intervention Clinical Outcomes

Parameter	Pre-Intervention	Post-Intervention	Absolute Change (Δ)	Percentage Change (%)	Clinical Interpretation
VAS (rest)	1/10	0/10	−1	−100%	Below MCID threshold
VAS (movement)	3/10	1/10	−2	−66.7%	Meets MCID threshold
ROM (flexion)	125°	125°	0	0%	No change
ROM (extension)	0°	0°	0	0%	No change
MMT (flexion)	5/5	5/5	0	0%	Ceiling effect
MMT (extension)	5/5	5/5	0	0%	Ceiling effect
SLS (seconds)	3 s*	12 s*	+9 s	+300%	Clinically meaningful improvement
LEFS (score)	73	78	+5	+6.8%	Below MCID (≈9 points)

*Estimated midpoint values were used to convert categorical data (<5 seconds and >10 seconds) into numerical values for analysis.

As presented in Table 2, improvements were observed primarily in pain and knee stability. Pain during movement decreased from 3 to 1 (Δ = −2; −66.7%), indicating a clinically meaningful reduction based on commonly accepted MCID thresholds. Pain at rest decreased from 1 to 0 (Δ = −1; −100%); however, this change should be interpreted cautiously due to the low baseline value.

Knee stability demonstrated the most pronounced improvement, with Single Leg Stance (SLS) performance increasing from an estimated 3 seconds to 12 seconds (Δ = +9 seconds; +300%). For analytical purposes, midpoint values were used to convert categorical data (<5 seconds and >10 seconds) into numerical estimates; this approach may introduce measurement approximation and should be interpreted with caution.

No changes were observed in joint range of motion (flexion 125°, extension 0°) or muscle strength (MMT 5/5), suggesting a potential ceiling effect due to normal baseline values. Functional ability, as measured by the Lower Extremity Functional Scale (LEFS), increased from 73 to 78 (Δ = +5; +6.8%). This improvement did not reach the minimal clinically important difference (MCID ≈ 9 points), indicating that the observed change may not be clinically meaningful despite numerical improvement.

No adverse events, complications, or symptom exacerbations were reported during the intervention period. The patient demonstrated full adherence to both supervised sessions and the prescribed home exercise program. Overall, the quantitative findings indicate improvements in pain and stability parameters, while functional gains remained limited within the short intervention duration.

Discussion

This case report describes the short-term outcomes of a structured physiotherapy program in an adolescent patient with posterior cruciate ligament (PCL) rupture. The findings demonstrate reductions in pain and improvements in knee stability following a two-week intervention, while functional gains remained limited and did not reach clinically meaningful thresholds. These findings should be interpreted cautiously, given the single-case design and short intervention duration.

The observed reduction in pain, particularly during movement (Δ = −2), is consistent with the known analgesic effects of combined physiotherapy modalities and exercise therapy. Cryotherapy may reduce pain through decreased nerve conduction velocity and modulation of local inflammatory processes, while therapeutic ultrasound may contribute to tissue healing via thermal and non-thermal effects.[9] However, although the reduction in movement-related pain reached commonly accepted MCID thresholds, the relatively low baseline pain level suggests that the overall clinical impact may be limited.[10]This highlights the importance of interpreting outcome magnitude within the context of baseline severity.

The most notable improvement in this case was observed in knee stability, as indicated by increased Single Leg Stance (SLS) performance. This improvement is likely attributable to enhanced neuromuscular control resulting from progressive proprioceptive and stabilization exercises. Following ligament injury, dynamic joint stability is largely dependent on coordinated muscle activation rather than passive ligamentous support alone. Early-phase rehabilitation targeting neuromuscular re-education may therefore compensate for structural deficits and improve functional stability, particularly in young and active populations.[11]

Despite these improvements, no measurable changes were observed in muscle strength or joint range of motion. This finding may be explained by the short duration of the intervention, as neuromuscular adaptations typically precede measurable increases in muscle strength or hypertrophy. Additionally, baseline values for ROM and muscle strength were already within normal limits, indicating a ceiling effect, which may have limited the sensitivity of these measures to detect change.

Functional improvement, as measured by the Lower Extremity Functional Scale (LEFS), did not reach the minimal clinically important difference. This suggests that improvements in isolated impairments, such as pain and stability, may not immediately translate into meaningful changes in overall functional performance within a short timeframe.[11] Functional recovery often requires longer intervention periods, progressive loading, and task-specific training to achieve clinically significant outcomes.

An important consideration in interpreting these findings is the potential contribution of natural recovery processes. In subacute ligament injuries, spontaneous improvement may occur due to biological healing mechanisms. Therefore, it is not possible to attribute all observed improvements solely to the physiotherapy intervention. In addition, non-specific effects such as patient expectation, therapist interaction, and adherence to treatment (placebo and Hawthorne effects) may have influenced the observed outcomes.[12]

From a biomechanical perspective, the improvement in stability may be explained by enhanced sensorimotor integration and improved feedforward and feedback control mechanisms. Proprioceptive training can facilitate joint position sense and reflexive muscle activation, thereby improving postural control and reducing instability. However, the absence of objective biomechanical assessment (e.g., instrumented stability testing) limits the ability to confirm these mechanisms.[1,5]

The present findings are generally consistent with current recommendations for conservative management of isolated PCL injuries, which emphasize progressive quadriceps strengthening, neuromuscular training, and functional rehabilitation. However, the lack of standardized rehabilitation protocols across studies remains a limitation in the literature, making direct comparison challenging. Furthermore, most existing studies focus on adult or postoperative populations, limiting their applicability to adolescent patients.[13]

From a clinical perspective, this case highlights that early improvements in pain and stability do not necessarily indicate full functional recovery. Clinicians should consider extending the duration of rehabilitation and incorporating progressive, task-specific loading strategies to achieve clinically meaningful functional outcomes.[1,4,6]

Several limitations should be acknowledged. First, the single-case design limits generalizability and precludes causal inference. Second, the short duration of intervention restricts the ability to evaluate long-term outcomes and sustainability of improvements. Third, the absence of imaging confirmation (e.g., MRI) limits diagnostic accuracy and injury grading. Fourth, the use of categorical-to-estimated data for SLS introduces potential measurement inaccuracy. Fifth, the lack of objective strength measurement tools and potential ceiling effect of MMT may have reduced sensitivity to change. Finally, the absence of measurement error indicators (e.g., minimal detectable change) and graphical trend analysis limits the robustness of outcome interpretation.[2,8,13]

Future research should involve larger sample sizes, longer follow-up periods, and standardized rehabilitation protocols to better evaluate the effectiveness of physiotherapy in PCL injuries, particularly in adolescent populations. The incorporation of objective biomechanical assessments and imaging modalities is also recommended to enhance diagnostic and evaluative precision.[3,11]

Conclusion

This case report demonstrates that a structured physiotherapy program may provide short-term benefits in reducing pain and improving knee stability in an adolescent patient with posterior cruciate ligament (PCL) rupture. However, the improvement in functional ability did not reach clinically meaningful thresholds within the two-week intervention period.

These findings suggest that early-phase rehabilitation focusing on neuromuscular control and stabilization can contribute to initial symptom improvement, but may be insufficient to produce substantial functional recovery without longer intervention duration and progressive loading strategies.

Given the single-case design, absence of imaging confirmation, and short follow-up period, the results should be interpreted with caution and cannot be generalized or used to infer causality.

From a clinical perspective, this case highlights that early improvements in pain and balance do not necessarily reflect meaningful functional recovery. Clinicians should prioritize progressive, task-specific exercise programs and consider extending rehabilitation duration to achieve clinically significant outcomes.

In adolescent populations, rehabilitation programs should emphasize neuromuscular control, dynamic stability, and gradual return-to-sport progression, while carefully monitoring symptom response and movement quality. This case highlights that short-term physiotherapy may improve pain and stability in adolescent PCL injury; however, clinically meaningful functional improvement likely requires longer and progressively structured rehabilitation.

Author Contribution

Khusnul Safitri: Conceptualization, Methodology, Data Curation, Formal Analysis, Writing of the Original Draft.
Suryo Saputra Perdana: Conceptualization, Methodology, Writing, Review and Editing, Supervision.
Hakny Maulana: Writing, Review and Editing, Supervision.
All authors: Final approval of the manuscript and accountability for the integrity of the work.

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Conflict of Interest Statement

The authors declare that there is no conflict of interest related to the preparation or publication of this case report. The study was conducted without influence from any party with financial or nonfinancial interests in the reported findings.

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Ethics Statement

This case report was approved by the relevant institutional authority; however, the approval number was not documented. Written informed consent was obtained from the patient’s guardian prior to data collection and publication. All patient data were anonymized to ensure confidentiality.

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