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CASE REPORT

Delayed Initiation of Structured Rehabilitation After Posterior Cruciate Ligament Reconstruction in a Competitive Sprinter: A Case Report

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ABSTRACT

Background: Rehabilitation after posterior cruciate ligament reconstruction (PCLR) requires a balance between protection of the healing graft and progressive restoration of knee motion, quadriceps function, neuromuscular control, and sport-specific capacity. Delayed initiation of structured rehabilitation may complicate recovery when postoperative stiffness and muscle inhibition are already established.

Case presentation: A 25-year-old male competitive 100-m sprinter sustained a full-thickness posterior cruciate ligament (PCL) tear with a grade 2 anterior cruciate ligament sprain and grade 2 medial meniscal tear following a motor vehicle accident. Arthroscopic PCL reconstruction was performed. Structured physiotherapy was not initiated for approximately six weeks, by which time knee flexion was limited to about 45°. Manipulation under anaesthesia was subsequently performed, after which a 12-week structured rehabilitation programme was commenced.

Intervention: Rehabilitation was progressed in three phases. Early management emphasized swelling and pain control, restoration of knee motion, quadriceps activation, gait retraining, and avoidance of isolated resisted hamstring loading. Intermediate rehabilitation introduced closed-kinetic-chain strengthening and progressive functional loading. The final phase incorporated advanced strengthening, dynamic balance, conditioning, and graded running-related activities.

Outcomes : At rehabilitation baseline, active knee flexion was 60°, passive flexion 70°, and extension lag 15°. Quadriceps and hamstring strength were 3+/5 and 3-/5, respectively, and the patient was unable to complete dynamic functional tests. By week 12, active flexion had increased to 135°, passive flexion to 140°, and extension lag had resolved. Manual muscle testing was 5/5 for both quadriceps and hamstrings. Quadriceps tendon pain decreased from 7/10 to 1/10 and patellar tendon pain from 6/10 to 0/10. The 1-minute squat test improved from inability to perform the test to 48 repetitions. Stork balance time reached 110 seconds on the involved limb. Limb girth improved substantially, although small residual asymmetry remained. Modified Star Excursion Balance Test limb symmetry indices were 94% anteriorly, 75% posteromedially, and 82% posterolaterally at discharge.

Conclusion: Marked gains in knee motion, strength, gait, pain, and functional performance were observed during 12 weeks of structured rehabilitation initiated after postoperative stiffness had developed. The case supports the feasibility of substantial functional recovery despite delayed rehabilitation, but it does not establish treatment efficacy or readiness for unrestricted competitive sprinting. Residual dynamic-balance asymmetry and the absence of longer-term return-to-sport data warrant continued rehabilitation and objective reassessment.

Keywords: Athlete; Posterior cruciate ligament; PCL reconstruction; Rehabilitation; Return to sport; Sprinter

Introduction

The posterior cruciate ligament (PCL) is the principal restraint to posterior tibial translation and also contributes to rotational stability across the knee [1]. PCL injuries are commonly produced by a posteriorly directed force on the proximal tibia with the knee flexed and frequently coexist with other ligamentous, meniscal, or chondral injuries [2].

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Contemporary management therefore depends on injury grade, associated pathology, knee stability, patient symptoms, and activity demands [3].

Postoperative rehabilitation after PCL reconstruction is challenging because the programme must restore mobility and muscle function without exposing the healing graft to excessive posterior tibial shear. Systematic reviews show substantial variation in weight-bearing, range-of-motion progression, bracing, initiation of hamstring strengthening, and return-to-running or return-to-sport timelines [4]. Despite this variability, most protocols emphasize early quadriceps activation, controlled restoration of knee motion, cautious progression of hamstring loading, and staged neuromuscular and functional training [4].

The present case describes a competitive sprinter who began structured physiotherapy only after a six-week postoperative interval and subsequent manipulation under anaesthesia (MUA) for marked knee stiffness. The aim is to document the rehabilitation strategy and serial clinical outcomes while placing the observed recovery in the context of current PCL rehabilitation principles. The report has been organized using the CARE framework where information was available from the clinical record [5].

Case Presentation

A 25-year-old male competitive 100-m sprinter sustained direct anterior trauma to a flexed knee during a motor vehicle accident. Clinical diagnostic assessment identified a full-thickness PCL tear, a grade 2 ACL sprain, and a grade 2 medial meniscal tear. Arthroscopic PCL reconstruction was subsequently performed. The operative record available for this report did not specify graft type, tunnel technique, or whether the associated ACL and meniscal injuries required additional surgical treatment.

Structured postoperative physiotherapy was not initiated for approximately six weeks. During this period, knee motion became markedly restricted, with flexion reported at approximately 45°. MUA was performed for postoperative stiffness before referral for the structured rehabilitation described in this report. MUA is an established option for selected cases of post-traumatic knee arthrofibrosis, although evidence specific to PCLR is limited [6]. The first post-MUA physiotherapy assessment is designated rehabilitation week 0 in this report.

Table 1. Clinical timeline

Stage	Clinical course
Initial injury	Motor vehicle accident with direct anterior trauma to a flexed knee; full-thickness PCL tear, grade 2 ACL sprain, and grade 2 medial meniscal tear documented.
Surgical management	Arthroscopic PCL reconstruction.
Early postoperative period	Approximately 6 weeks without structured physiotherapy; knee flexion reported at ~45° with marked stiffness.
Before structured rehabilitation	Manipulation under anaesthesia performed for postoperative stiffness.
Rehabilitation weeks 0-4	Pain/swelling management, ROM restoration, quadriceps activation, gait retraining, and basic balance work.
Rehabilitation weeks 4-8	Progressive closed-kinetic-chain strengthening, functional loading, gait progression, and cautious introduction of hamstring work.
Rehabilitation weeks 8-12	Advanced strengthening, dynamic balance, conditioning, and graded sport-related activities.
Week 12	Discharge from the documented rehabilitation episode with marked improvement but residual asymmetry on selected dynamic-balance measures.

Baseline Clinical Assessment

At rehabilitation week 0, quadriceps tendon pain was 7/10 and patellar tendon pain was 6/10 on a verbally administered 0-10 numeric pain scale. Active knee flexion was 60°, passive flexion was 70°, and a 15° active extension lag was present.

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Manual muscle testing was 3+/5 for the quadriceps and 3-/5 for the hamstrings. The involved thigh measured 43 cm at 8 cm above the patella compared with 53 cm on the contralateral side, corresponding to a limb symmetry index (LSI) of approximately 81%. At 19 cm above the patella, the involved thigh measured 46.5 cm versus 55.5 cm contralaterally. Calf girth at 18 cm below the patella was 35 cm versus 38 cm.

A clinic-recorded figure-of-eight circumferential measure showed a 6-cm side-to-side difference attributed to swelling. Gait was antalgic, with reduced knee flexion during swing and limited weight acceptance. The patient was unable to perform the 1-minute squat test, Stork single-leg balance test, or modified Star Excursion Balance Test (SEBT). LSI values in this report were calculated as involved-limb performance divided by contralateral-limb performance multiplied by 100.



Figure 1. *Baseline clinical assessment of left-knee active range of motion after manipulation under anaesthesia and before initiation of the 12-week structured rehabilitation programme, demonstrating marked restriction of active flexion (60°).igure caption*

Rehabilitation Intervention

The rehabilitation programme was delivered over 12 weeks in three progressive phases. Progression was based on the observed clinical response, restoration of motion, improved quadriceps control, and increasing tolerance of functional loading. The programme was designed around the biomechanical requirement to limit excessive posterior tibial translation during early graft healing. Published PCLR protocols commonly emphasize quadriceps strengthening and defer isolated resisted hamstring exercise because hamstring contraction can increase posterior shear; however, the exact timing of hamstring progression varies considerably across protocols [4,7,8].

Table 2. Phase-wise rehabilitation programme

Phase	Primary goals	Interventions recorded in the case
Weeks 0-4	Reduce pain/swelling; restore ROM; recover quadriceps activation; normalize basic gait and static control.	Cryotherapy; pulsed ultrasound (1 MHz, 1.2-1.5 W/cm², 10 min); low-level laser therapy (3 J/cm²); gentle patellar glides; quadriceps/hamstring stretching; muscle-energy techniques; quadriceps isometrics with biofeedback; straight-leg raises; assisted overground gait retraining; double-leg static balance. Isolated resisted hamstring exercise was avoided.
Weeks 4-8	Increase closed-chain strength and functional loading; improve gait and eccentric control; begin cautious hamstring loading.	Wall slides (0-45°); leg press (0-60°); step-ups; step-downs; terminal knee-extension band drills; progressive walking without assistive devices; waist-deep aquatic therapy; cautious hamstring strengthening introduced late in the phase after quadriceps control improved.
Weeks 8-12	Develop higher-level strength, neuromuscular control, conditioning, and sport-related capacity.	Squat progression from 0-60° toward 0-90°; progressive resisted prone hamstring curls; stationary cycling; graded treadmill running; single-leg stance progressions on unstable foam; dynamic balance perturbations and sport-related drills.

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The passive modalities used in the first phase were adjuncts within a multimodal programme. Because this is a single case and the modalities were not evaluated independently, no inference can be made regarding their individual contribution to recovery.



Figure 2. *Clinical assessment after 12 weeks of structured rehabilitation, demonstrating restoration of active knee flexion to 135°.*

Clinical Outcomes

Serial reassessment demonstrated progressive improvement in pain, motion, strength, limb girth, gait, and functional performance. The most rapid change in knee motion occurred during the first eight weeks of structured rehabilitation: active flexion increased from 60° at baseline to 90° at week 4 and 125° at week 8, while extension lag decreased from 15° to 10° and then resolved by week 8. At week 12, active flexion was 135° and passive flexion was 140°.

Manual muscle testing improved to 5/5 for both quadriceps and hamstrings by week 8 and remained at this level at week 12. Limb girth also increased, although complete symmetry was not achieved at all measurement sites. At discharge, LSI was approximately 94% at 8 cm above the patella, 93% at 19 cm above the patella, and 95% at the calf.

Table 3. Serial clinical outcomes

Outcome	Week 0	Week 4	Week 8	Week 12
Quadriceps tendon pain	7/10	5/10	3/10	1/10
Patellar tendon pain	6/10	4/10	3/10	0/10
Swelling: side-to-side difference	6 cm	4 cm	1 cm	0 cm
Active knee flexion	60°	90°	125°	135°
Passive knee flexion	70°	100°	135°	140°
Extension lag	15°	10°	0°	0°
Quadriceps MMT	3+/5	4/5	5/5	5/5
Hamstrings MMT	3-/5	3+/5	5/5	5/5
Thigh girth, 8 cm above patella	43 vs 53 cm (81% LSI)	43 vs 53 cm (81%)	48 vs 53 cm (91%)	50 vs 53 cm (94%)
Thigh girth, 19 cm above patella	46.5 vs 55.5 cm (84% LSI)	Not measured	50 vs 56 cm (89%)	52 vs 56 cm (93%)
Calf girth, 18 cm below patella	35 vs 38 cm (92% LSI)	35 vs 38 cm (92%)	37 vs 40 cm (93%)	38 vs 40 cm (95%)

Functional testing became possible from week 4 onward. The 1-minute squat test increased from 38 repetitions at week 4 to 44 at week 8 and 48 at week 12. The original clinical record also expressed these scores as percentages of an unspecified normative value; because the source of that reference standard was not documented, the raw repetition counts are presented here without interpreting them as normal or supranormal performance.

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Stork balance time on the involved limb improved from 30 seconds at week 4 to 90 seconds at week 8 and 110 seconds at week 12; the corresponding contralateral values were 60, 120, and 125 seconds. Modified SEBT LSI improved most in the anterior direction, from 88% at week 4 to 94% at discharge. Posteromedial and posterolateral LSI values remained lower at discharge (75% and 82%, respectively). Clinically observed gait progressed from an antalgic pattern to a symmetrical stance and swing pattern by week 12; no instrumented gait analysis was performed.

Table 4. Functional outcomes

Outcome	Week 0	Week 4	Week 8	Week 12
1-minute squat test	Unable	38 repetitions	44 repetitions	48 repetitions
Stork balance: involved limb	Unable	30 s	90 s	110 s
Stork balance: contralateral limb	-	60 s	120 s	125 s
Modified SEBT LSI: anterior	Unable	88%	90%	94%
Modified SEBT LSI: posteromedial	Unable	69%	72%	75%
Modified SEBT LSI: posterolateral	Unable	82%	84%	82%
Gait	Antalgic; reduced swing-phase flexion and limited loading	Improving but residual antalgia	Reduced stance asymmetry; improved swing	Clinically symmetrical stance and swing

Discussion

This case documents substantial functional recovery during a 12-week rehabilitation episode that began only after postoperative stiffness had developed and MUA had been performed. The principal changes were restoration of knee flexion and active extension, reduction of pain and swelling, recovery of manual muscle strength, improvement in limb girth, normalization of clinically observed gait, and progression from inability to perform dynamic tasks to meaningful single-leg balance and squat performance.

The early emphasis on quadriceps activation and controlled loading is consistent with the biomechanical priorities of PCLR rehabilitation. The PCL is the primary restraint to posterior tibial translation [1], and early rehabilitation protocols commonly aim to minimize posterior shear while restoring quadriceps control. Systematic and narrative reviews of PCLR rehabilitation show that isolated hamstring strengthening is often delayed because active knee flexion can increase posterior tibial loading, although published initiation times range from approximately six weeks to several months [4,7,8]. The staged introduction of hamstring strengthening in the present case therefore reflects a commonly used protective principle, while also illustrating the absence of a universally accepted protocol.

The marked improvement in motion is clinically important because the patient entered rehabilitation with severe stiffness after a six-week postoperative interval. Although MUA can improve range of motion in post-traumatic knee arthrofibrosis [6], this case cannot separate the effect of MUA from the subsequent intensive rehabilitation. Similarly, the improvement cannot be attributed to any individual modality or exercise because treatment was multimodal and no control condition was available.

The rehabilitation programme progressed to closed-chain strengthening, dynamic balance, and graded running-related activities as function improved. Current literature supports a criterion-informed approach to return to sport after PCL injury, but PCLR-specific criteria remain poorly standardized [9-11]. Published protocols have reported return-to-sport timeframes ranging broadly from about 4 to 12 months [7], and systematic review data indicate that return to the preinjury level of sport is not assured after PCLR [10]. A 2026 scoping review likewise found substantial inconsistency in PCLR return-to-sport criteria; commonly reported domains included pain, ROM, strength, performance testing, and patient-reported outcomes, with only limited use of explicit LSI thresholds [11].

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Accordingly, the 12-week endpoint in this case should be interpreted as progression toward return-to-sport preparation rather than clearance for unrestricted competitive sprinting. Although anterior SEBT symmetry reached 94%, posteromedial and posterolateral symmetry remained 75% and 82%, respectively, and Stork balance symmetry was approximately 88%. No isokinetic strength testing, hop-test battery, instrumented posterior laxity measurement, patient-reported knee score, psychological readiness assessment, or high-speed sprint biomechanics were available. These residual deficits and missing domains are especially relevant in a 100-m sprinter, for whom maximal-velocity running places substantial demands on lower-limb force production and neuromuscular control.

Another strength of the case is the use of serial measurements rather than a single end-point description. However, manual muscle testing and tape-measure girth are relatively coarse measures, and observed gait symmetry does not replace instrumented gait analysis. The changing contralateral girth values across visits also indicate that measurement variability or whole-limb training effects may have influenced LSI calculations. The figure-of-eight swelling method was recorded in the clinical file, but the precise landmarking protocol was not documented.

Limitations

The report describes a single patient and therefore cannot establish causal effectiveness or generalize the rehabilitation programme to other PCLR patients. The injury was not isolated: an ACL sprain and medial meniscal tear were also present, and the available record did not describe their operative or non-operative management. Important surgical details, including graft choice and reconstruction technique, were unavailable. The exact frequency and supervision dose of rehabilitation sessions were not documented, and the independent contribution of ultrasound, low-level laser therapy, cryotherapy, manual techniques, strengthening, and neuromuscular training cannot be determined.

Outcome assessment also had limitations. Strength was graded by manual muscle testing rather than dynamometry or isokinetic testing; no validated knee-specific patient-reported outcome such as the IKDC or Lysholm score was recorded; no instrumented posterior laxity assessment was available; and no follow-up beyond the 12-week rehabilitation episode was provided. Thus, the report demonstrates short-term functional improvement but does not document unrestricted return to competitive sprinting, maintenance of gains, graft integrity, reinjury status, or longer-term sport participation.

Conclusion

A competitive sprinter who began structured rehabilitation after a six-week postoperative delay, marked knee stiffness, and subsequent MUA demonstrated substantial improvement over a 12-week physiotherapy programme after PCL reconstruction. Knee flexion increased from 60° active and 70° passive to 135° and 140°, extension lag resolved, pain markedly decreased, manual muscle strength recovered to 5/5, gait normalized clinically, and functional test performance improved. Nevertheless, residual asymmetry remained on selected dynamic-balance and limb-girth measures, and no evidence of unrestricted return to competitive sprinting was available. The case illustrates that meaningful functional recovery remains possible after delayed rehabilitation, while underscoring the need for individualized, criterion-based progression and longer-term objective return-to-sport assessment.

Patient Perspective

A formal patient-perspective statement was not recorded in the source clinical documentation.

Declarations

Ethical considerations and consent: Written informed consent was obtained from the patient for publication of this case report, including the clinical information and any accompanying clinical images. Patient confidentiality was protected.

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Conflict of interest: The authors declare no conflicts of interest.

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Figure Legends

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