

# Post-Operative Rehabilitation and Return-to-Sport Following ACL Reconstruction with Trochlear Dysplasia and Medial Meniscal Tear: Case Report

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## Abstract

Anterior cruciate ligament reconstruction requires progressive rehabilitation and objective return-to-sport decision-making. This case report describes a 19-year-old male recreational cricketer who began physiotherapy four weeks after arthroscopic anterior cruciate ligament reconstruction with a bone-patellar tendon-bone autograft. Preoperative magnetic resonance imaging showed a near-complete anterior cruciate ligament tear, grade 2 medial meniscal signal change, lateral patellar tilt, and type C trochlear dysplasia. At presentation, activity-related pain was 8/10, active knee extension lag was 12 degrees, knee flexion was 125 degrees compared with 130 degrees on the uninvolved side, and quadriceps activation was impaired. A 30-week, three-phase rehabilitation programme progressed from pain management, range-of-motion restoration, and neuromuscular activation to resistance training, trunk conditioning, agility, plyometrics, and cricket-specific running. Objective testing at 18 weeks after surgery identified residual balance, strength, aerobic, and trunk-endurance deficits and informed the final return-to-sport phase. At 34 weeks after surgery, pain was 0/10, active extension was full, lower-limb manual muscle testing was 5/5, Y-Balance limb symmetry was 96%, and leg-press limb symmetry was 92%. The patient returned to recreational cricket without pain, effusion, instability, or post-activity symptoms. This case illustrates how criteria-based progression can identify residual deficits and guide sport-specific rehabilitation after anterior cruciate ligament reconstruction in the presence of patellofemoral anatomical variation.

**Keywords:** ACL Reconstruction, Cricket, Criteria-Based Rehabilitation, Return to Sport, Trochlear Dysplasia

## 1. Introduction

Anterior cruciate ligament (ACL) rupture is a frequent traumatic knee injury in sports requiring rapid deceleration, planting, cutting, and pivoting. In cricket, running between the wickets exposes the knee to repeated acceleration, abrupt deceleration, and rapid changes of direction on variable surfaces [2].

Rehabilitation may be more complex when ACL reconstruction (ACLR) coexists with meniscal pathology and patellofemoral anatomical variation. Trochlear dysplasia can alter patellar tracking and may contribute to anterior knee symptoms, while postoperative arthrogenic muscle inhibition can delay quadriceps recovery and active knee extension.

Time after surgery alone does not demonstrate readiness for unrestricted sport. Contemporary return-to-sport decision-making therefore combines clinical status with strength, balance, neuromuscular control, psychological readiness, and sport-specific performance [1]. This case report describes the presentation, phased rehabilitation, objective reassessment, and return-to-sport progression of a recreational cricketer after ACLR in the presence of type C trochlear dysplasia and grade 2 medial meniscal signal change.

## 2. Case Presentation

### 2.1 Patient Information

A 19-year-old male student and recreational cricketer (batter and fielder) sustained a non-contact injury to the right knee on 16 June 2025. The injury occurred when he planted the right foot and turned while running between the wickets. He described a popping sensation, immediate severe pain, and swelling within two hours. Arthroscopic ACL reconstruction using a bone-patellar tendon-bone autograft was performed on 12 July 2025. He attended the Sports Physiotherapy outpatient department on 12 August 2025, four weeks after surgery.

At presentation, the main complaints were medial and anterior knee pain, difficulty fully straightening the knee during walking, pain during stair negotiation, and restricted flexion.

### 2.2 Clinical Findings and Diagnostic Assessment

Pain was assessed using the Numeric Pain Rating Scale and measured 6/10 at rest and 8/10 during weight-bearing activity and stair climbing. Active and passive knee flexion were 125 degrees on the involved side and 130 degrees on the uninvolved side, representing a 5-degree side-to-side difference. A 12-degree active extension lag was present during straight-leg raise, although full passive extension was achievable with mild discomfort. Manual muscle testing was 4/5 for the right hip abductors, knee flexors, and knee extensors; quadriceps performance was limited by pain and arthrogenic muscle inhibition. Gait was antalgic, with reduced stance-phase knee extension and walking speed.

Preoperative magnetic resonance imaging demonstrated a near-complete ACL tear with disruption of mid-substance fibres, grade 2 signal alteration in the posterior body of the medial meniscus, mild joint effusion, lateral patellar tilt, and type C trochlear dysplasia. Grade 2 meniscal signal was reported as an intrameniscal abnormality; no meniscal surgical procedure was documented in the information available for this report.

**Table 1. Clinical Timeline**

| Date or Stage            | Clinical Event                                                                 |
|--------------------------|--------------------------------------------------------------------------------|
| 16 June 2025             | Non-contact right-knee injury while turning during cricket                     |
| 12 July 2025             | Arthroscopic right ACL reconstruction with bone-patellar tendon-bone autograft |
| 12 August 2025           | Physiotherapy assessment at four weeks after surgery                           |
| Weeks 4-18 after surgery | Pain, motion, neuromuscular activation, and                                    |

| Date or Stage             | Clinical Event                                                             |
|---------------------------|----------------------------------------------------------------------------|
|                           | progressive resistance phases                                              |
| 18 weeks after surgery    | Objective test battery before high-impact rehabilitation                   |
| Weeks 18-34 after surgery | Advanced agility, plyometric, aerobic, and cricket-specific rehabilitation |
| 34 weeks after surgery    | Final reassessment and return to recreational cricket                      |

### 3. Therapeutic Intervention

Rehabilitation followed a three-phase, criteria-based model adapted to the patient's symptoms, patellofemoral mechanics, functional deficits, and cricket-specific demands. Exercise dosage was progressed when the preceding workload was completed without increased pain, effusion, or deterioration in movement quality.

#### 3.1 Phase 1: Pain Management and Motor Activation

During physiotherapy weeks 1-6 (postoperative weeks 4-10), goals were to reduce pain, restore symmetrical knee motion, eliminate active extension lag, and improve quadriceps and hip-muscle activation. Continuous therapeutic ultrasound (1 MHz, 0.9-1.2 W/cm<sup>2</sup> for five minutes) was applied over the symptomatic anterior knee and quadriceps tendon region as an adjunct for local symptom management. The exercise programme included quadriceps setting and terminal knee extension, straight-leg raise with a terminal isometric hold, hamstring curls, side-lying hip abduction, clamshells, bilateral bridging, and standing calf raises. Exercises were initially performed without external resistance for two sets of 12 repetitions daily.

#### 3.2 Phase 2: Progressive Resistance

During physiotherapy weeks 7-14 (postoperative weeks 10-18), the goals were to increase strength and tissue tolerance and restore independence in activities of daily living. Ankle-cuff resistance progressed from 1 kg in weeks 7-8 to 2 kg in weeks 9-10, 3 kg in weeks 11-12, and 4 kg in weeks 13-14, subject to symptom response and movement quality. Step-ups, wall sits within 0-60 degrees of knee flexion, and body-weight mini-squats were added as closed-kinetic-chain exercises.

#### 3.3 Mid-Rehabilitation Objective Assessment

At 18 weeks after surgery, a test battery was completed before the introduction of higher-impact agility and plyometric tasks. Testing identified clinically relevant balance, strength, aerobic, and trunk-endurance deficits. These findings supported a further 16-week targeted return-to-sport phase rather than clearance based on postoperative time alone.

**Table 2. Objective Assessment at 18 Weeks After Surgery**

| Domain              | Test                             | Patient Result                                | Target                           | Interpretation            |
|---------------------|----------------------------------|-----------------------------------------------|----------------------------------|---------------------------|
| Dynamic balance     | Y-Balance Test                   | Anterior reach difference greater than 4.2 cm | Difference less than 4.0 cm      | Residual asymmetry        |
| Lower-limb strength | One-repetition maximum leg press | Limb Symmetry Index 68%                       | Limb Symmetry Index at least 90% | Marked strength asymmetry |

| Domain           | Test                                    | Patient Result                                                   | Target                                  | Interpretation                               |
|------------------|-----------------------------------------|------------------------------------------------------------------|-----------------------------------------|----------------------------------------------|
| Aerobic capacity | Queen's College Step Test and beep test | Predicted aerobic capacity below the 35th percentile             | Average or above for sport              | Aerobic deconditioning                       |
| Trunk endurance  | McGill torso endurance battery          | Flexor 42 s; extensor 58 s; side bridge right 28 s and left 35 s | Balanced ratios and improved hold times | Reduced endurance and side-to-side imbalance |

### 3.4 Phase 3: Advanced Return-to-Sport Progression

During physiotherapy weeks 15-30 (postoperative weeks 18-34), training addressed lower-limb power, multidirectional control, trunk endurance, and cricket-specific acceleration and deceleration [3]. Trunk training included modified curl-up, side bridge, bird-dog, farmer's carry, and dynamic wood-chop exercises three times per week. Plyometric tasks progressed from double-leg jump-and-land drills to single-leg stick landings, box jumps, lateral bounds, and depth jumps, with emphasis on controlled landing and avoidance of dynamic knee valgus. Agility training included ladder drills, T-test patterns, 5-10-5 shuttle runs, and turning drills that simulated running between the wickets while holding a bat. Conditioning used high-intensity intervals over 18-20 m with work-to-rest periods selected to approximate cricket demands.

### 4. Outcomes and Follow-Up

At the final reassessment, 34 weeks after surgery, the patient had no pain at rest or during activity, full active knee extension without lag, full pain-free knee flexion, and manual muscle test grades of 5/5. Y-Balance limb symmetry improved to 96%, with a reach difference below 2 cm, and leg-press limb symmetry improved to 92%. He returned to full recreational cricket participation, including batting, fielding, and running between the wickets, without effusion, giving way, or post-activity pain.

**Table 3. Clinical Outcomes Across Rehabilitation**

| Parameter                          | 4 Weeks After Surgery                         | 18 Weeks After Surgery   | 34 Weeks After Surgery                         |
|------------------------------------|-----------------------------------------------|--------------------------|------------------------------------------------|
| Pain at rest                       | 6/10                                          | 1/10                     | 0/10                                           |
| Pain during activity               | 8/10                                          | 2/10                     | 0/10                                           |
| Active knee extension lag          | 12 degrees                                    | 0 degrees                | 0 degrees                                      |
| Knee flexion                       | 125 degrees; 5-degree side-to-side difference | Equal to uninvolved side | Full and pain-free                             |
| Hip and knee manual muscle testing | 4/5                                           | 4+/5                     | 5/5 bilaterally                                |
| Y-Balance Test                     | Not formally tested                           | Limb Symmetry Index 82%  | Limb Symmetry Index 96%; difference below 2 cm |
| Leg-press one-                     | Not tested                                    | Limb Symmetry Index      | Limb Symmetry Index                            |

| Parameter               | 4 Weeks After Surgery | 18 Weeks After Surgery                   | 34 Weeks After Surgery           |
|-------------------------|-----------------------|------------------------------------------|----------------------------------|
| repetition maximum      |                       | 68%                                      | 92%                              |
| Trunk endurance battery | Not tested            | Below target with side-to-side imbalance | Improved to clinical target      |
| Participation status    | Restricted            | Activities of daily living unrestricted  | Returned to recreational cricket |

## 5. Discussion

This case describes a staged rehabilitation pathway after ACLR in a recreational cricketer with patellofemoral anatomical variation and medial meniscal signal change. The clinically important feature was the use of serial findings to guide progression: early extension lag and quadriceps inhibition shaped the first phase, while objective deficits at 18 weeks after surgery delayed higher-level sport clearance and directed subsequent training.

The 12-degree active extension lag, despite full passive extension, was consistent with impaired voluntary quadriceps activation rather than a fixed loss of joint motion. Quadriceps setting, terminal knee extension, and straight-leg raise progression were therefore prioritised. Hip-abductor and external-rotator strengthening was included to improve proximal control during single-leg loading; this was particularly relevant because lateral patellar tilt and trochlear dysplasia could increase sensitivity to poorly controlled frontal-plane motion.

Objective testing at 18 weeks showed that symptom improvement and unrestricted daily activities did not equate to sport readiness. Leg-press limb symmetry was 68%, anterior-reach asymmetry exceeded the selected clinical target, and trunk and aerobic performance remained below target. This observation is consistent with recommendations that return-to-sport decisions should combine time after surgery with a multidomain test battery [1]. The final phase therefore addressed the specific deficits through progressive resistance, trunk conditioning, landing tasks, change-of-direction drills, and cricket-specific running. Core-stability training has been reported to improve neuromuscular function after ACLR and provided a rationale for the trunk component used in this case [3].

The report has limitations. It describes one recreational athlete and cannot establish that any single intervention caused the observed recovery. No patient-reported knee function scale, psychological readiness measure, instrumented strength test, or preinjury performance data were available. The test battery and clearance thresholds were used for clinical decision-making but do not represent a universally validated cricket-specific return-to-sport algorithm. The contribution of therapeutic ultrasound cannot be isolated from natural recovery and concurrent exercise. Longer follow-up is also needed to determine whether return to cricket was sustained without reinjury.

## 6. Clinical Implications

- Full passive extension with active extension lag should prompt focused assessment and treatment of quadriceps activation before heavy loading.
- Serial testing can reveal residual strength, balance, aerobic, and trunk deficits after pain and daily function have improved.
- Return-to-sport rehabilitation should progress from impairment restoration to landing, change-of-direction, conditioning, and tasks that reproduce the athlete's sport demands.

- Patellofemoral anatomical variation warrants symptom-guided loading and careful monitoring of movement quality.

## 7. Conclusion

A 30-week, criteria-based rehabilitation programme was associated with resolution of pain and extension lag, restoration of lower-limb strength and balance symmetry, and return to recreational cricket after ACLR in a patient with type C trochlear dysplasia. The case highlights the clinical value of reassessment before high-impact rehabilitation and of using identified deficits to individualise sport-specific progression. These findings should be interpreted as a single-patient clinical observation rather than evidence of comparative treatment effectiveness.

## 9. References

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