Criterion-based rehabilitation and return-to-sport decision-making after arthroscopic partial medial meniscectomy in an elite athlete

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Abstract

An elite male athlete in his mid-20s sustained a non-contact twisting knee injury resulting in a mechanically unstable medial meniscal tear. Persistent locking and functional limitation despite conservative management prompted arthroscopic partial medial meniscectomy. Postoperatively, the athlete underwent a criterion-based rehabilitation programme with immediate weight bearing and unrestricted range of motion. Rehabilitation progression was guided by objective clinical milestones, including pain, effusion, neuromuscular control, and functional performance, rather than predefined time points. Progressive loading and sport-specific drills were introduced in accordance with symptom response, supported by wearable-derived workload monitoring as an adjunct to clinical assessment. The athlete returned to unrestricted full-contact competitive sport following completion of rehabilitation criteria and remained asymptomatic at six-month follow-up, with full return to pre-injury training and competition and excellent patient-reported outcomes. This case illustrates the practical operationalisation of criterion-based return-to-sport decision-making following partial meniscectomy in a selected high-demand athlete.

Background

Meniscal tears are common knee injuries in athletic populations, and arthroscopic partial meniscectomy is frequently performed to relieve mechanical symptoms and restore functional capacity for return to activity1,2. Conventional rehabilitation guidance has historically recommended return to higher-level activity at approximately 4–6 weeks, with unrestricted return to sport often delayed to around 12 weeks, reflecting predominantly time-based rehabilitation models[3]. However, postoperative rehabilitation following meniscal surgery remains heterogeneous, with limited high-level evidence guiding optimal progression or return-to-sport decision-making4,5.

Recent international EU–US consensus recommendations advocate for a criterion-based rather than time-based rehabilitation approach following partial meniscectomy, with progression guided by objective clinical milestones including pain, effusion, range of motion, strength, and neuromuscular control, rather than predefined timelines[4]. This contrasts with meniscal repair, where time-based restrictions remain necessary, reinforcing the distinct rehabilitation strategy applicable to partial meniscectomy[4]. Despite these recommendations, reported return-to-sport timelines after partial meniscectomy remain highly variable across athletic populations6,7.

Baseline conditioning and pre-injury performance capacity may influence postoperative recovery, with highly conditioned athletes demonstrating more favourable functional trajectories than population averages2,8,9. However, there remains a paucity of elite-athlete-specific data describing how criterion- based rehabilitation principles are operationalised in practice to guide return-to-sport decision-making. Detailed case reports therefore offer value by illustrating real-world application of consensus recommendations in selected high-demand athletes, rather than defining expected timelines or generalisable outcomes.

Case Presentation

A male elite-level athlete in his mid-20s presented following a non-contact twisting injury to the right knee sustained during sport. He reported immediate medial joint line pain, swelling, and mechanical locking, with difficulty achieving full knee extension and weight bearing. Clinical examination demonstrated a knee effusion and medial joint line tenderness. Cruciate and collateral ligament stability was preserved, and distal neurovascular examination was normal.

Magnetic resonance imaging demonstrated a horizontal undersurface tear of the posterior horn of the medial meniscus with a small joint effusion. Articular cartilage surfaces were preserved, and the lateral meniscus and ligamentous structures were intact. Initial management consisted of activity modification and conservative physiotherapy. Due to persistent mechanical locking and functional limitation consistent with an unstable meniscal tear, operative management was pursued. Arthroscopic partial medial meniscectomy was performed, with no additional intra-articular pathology identified.

Treatment

Initial management consisted of activity modification and a trial of conservative physiotherapy. Ongoing mechanical locking and functional limitation prompted operative intervention, and the patient underwent arthroscopic partial medial meniscectomy.

Intraoperatively, the medial meniscal tear was debrided, with no additional intra-articular pathology identified.

Postoperatively, the patient commenced an accelerated rehabilitation programme with immediate weight bearing as tolerated and unrestricted range of motion. Rehabilitation progression was criterion-based and guided by symptom response and functional performance rather than predefined time points, in line with contemporary consensus recommendations[4]. A short course of oral analgesia was prescribed on an as-required basis.

The accelerated postoperative rehabilitation protocol and progression criteria are outlined in Table 1

OUTCOME AND FOLLOW-UP

Postoperatively, the patient demonstrated rapid resolution of symptoms. Pain reduced to 0/10 within the first postoperative week and remained absent thereafter. Swelling and stiffness decreased progressively, with one episode of transient reactive effusion during progressive loading on day 5 (Figure 3). Full, pain-free knee range of motion, including full extension and flexion, was restored early. No recurrent locking, catching, or instability was reported.

Rehabilitation progression followed a criterion-based approach guided by symptom response, effusion control, neuromuscular performance, and functional capacity. The patient tolerated progressive strengthening, plyometric loading, running, and sport-specific drills without symptom exacerbation. Unrestricted return to full-contact sport was achieved 19 days postoperatively without complication.

At six-month follow-up, the patient remained asymptomatic with full return to pre-injury daily activity, training, and competitive sport. Patient-reported outcome measures demonstrated excellent recovery, including IKDC 100, KOOS 99–100 across all domains, Tegner–Lysholm 100, and VAS pain score 0. No further interventions were required.

Table 1 Meniscal Rehabilitation Protocol

Time (Post-op)	Exercise / Therapy	Goals	Progression Criteria
Day 1–3*	• Early range-of-motion exercises (ankle pumps, knee swings, heel slides) • Quadriceps activation (quad sets, straight-leg raises, short-arc quads) • Low-load cycling (stationary bike, high seat) • Bilateral lower limb strengthening (glute bridges, calf raises) • Static balance tasks (single leg stand, tandem walk) • Walking programme	• Pain and effusion reduction • Restore full knee extension • Early quadriceps activation • Maintain cardiovascular fitness	• Full knee extension achieved • Independent ambulation without assistive devices • Minimal effusion • Adequate quadriceps activation
Day 4–7*	• Progressive closed-chain strengthening (wall sits, sit-to-stand, step-ups) • Increased cycling load • Proprioceptive training (balance pad, BOSU, tandem walk with head turns) • Introduction of low-level plyometrics (ankle bounces)	• Improve lower-limb strength • Normalise gait • Enhance balance and neuromuscular control	• Pain-free full active range of motion • Normal gait pattern • Tolerance of closed-chain loading without symptom flare • Stable bilateral balance
Day 8–10*	• Advanced strengthening (weighted step-ups, eccentric step-downs) • Multiplanar plyometrics (broad jump to stick, box drops, skater bounds) • Running mechanics drills (A-march, A-skip, high knees) • Controlled cutting and deceleration drills	• Develop force absorption and landing control • Prepare knee for running and change of direction • Improve movement quality under load	• Pain-free plyometric • Controlled landings/deceleration •Symmetrical step-down and jump mechanics • No reactive effusion
Day 11–14*	• Field-based running progression** (walk-jog → jog → submaximal runs) • Change-of-direction drills (zigzag runs, lateral shuffles, plant-and-stick) • Reactive agility tasks (partner cue drills, ball handling)	• Restore running capacity • Reintroduce sport-specific movement patterns • Enhance reactive neuromuscular control	• Pain-free running ≤75% intensity** • Controlled deceleration and cutting • No effusion at 24 hours
Day 15–17	• High-speed sprinting**(up to 90% intensity) • High-load deceleration and aggressive change-of-direction drills • Sport-specific conditioning and skill integration • Progressive reintroduction of contact elements and game-pattern drills	• Prepare for competitive match demands • Restore confidence and performance capacity • Achieve return-to-play readiness	• FLEE test*** • Completion of full-intensity training without symptoms • Stable knee control under fatigue • Medical and functional clearance for match play
Day 18-19	• Match exposure** (graduated minutes) • post-match recovery (mobility, cycling flush, cryotherapy) • Symptom monitoring (24-hour review)	• Successful return to competitive play • Maintain knee function post-match • Confirm tolerance to match load	• Match exposure without pain or instability • No effusion or symptom flare at 24 hours • Cleared for unrestricted competition

** Adjunctive recovery measures (cryotherapy, compression, elevation) and short-course analgesia as required.*
*** Progression/loading increased as tolerated.*
**** Functional lower extremity evaluation[11].*

Table 2 Reported return-to-sport timelines following partial medial meniscectomy. Data derived from published cohorts6,7,10,12

Author	Sport	Procedure	n (athletes)	Return to sport (days)
Nawabi et al	Professional soccer	Partial medial meniscectomy	48	31.5
Bolia et al.	NCAA Division I American football	Partial medial meniscectomy	7	77 ± 56
Kim et al.	Mixed sports†	Partial medial meniscectomy	16	79
Erickson et al	Baseball	Partial medial meniscectomy	77	42

Discussion

Return to sport following arthroscopic partial meniscectomy is well described; however, reported timelines remain highly variable and are largely derived from heterogeneous cohorts differing in age, sporting demands, tear characteristics, and rehabilitation approaches. Many rehabilitation resources continue to recommend return to higher-level activity at 4–6 weeks, with unrestricted return to sport delayed to approximately 12 weeks postoperatively, reflecting the persistence of time-based rehabilitation paradigms in routine practice[3]. This variability highlights the absence of a unified return-to-sport framework and the influence of pathology, athlete, and rehabilitation-specific factors on recovery trajectories.

In response, recent international consensus guidance has advocated a shift toward criterion-based rehabilitation following partial meniscectomy. The 2024 ESSKA–AOSSM–AASPT EU–US consensus recommends progression guided by clinical milestones such as pain, effusion, range of motion, strength, and neuromuscular control, rather than predefined time points[4]. Unlike meniscal repair, partial meniscectomy allows immediate weight bearing and unrestricted range of motion as tolerated, facilitating early mobilisation and low-load aerobic activity[4]. Although supported primarily by expert consensus, there is broad agreement that individualised, milestone-driven rehabilitation can meaningfully influence recovery timelines following meniscectomy4,5.

Despite this guidance, return-to-sport data in high-demand athletic populations remain limited and inconsistent. Retrospective cohort studies in elite professional soccer players report median return-to-play timelines of approximately five weeks following partial meniscectomy, with isolated cases returning as early as three weeks[6]. In collegiate Division I American football, return to play as early as 19 days has been reported, although such early-return cohorts remain under-represented in the literature[7]. Importantly, pooled systematic review data reporting mean return-to-play timelines of approximately four months in elite athletes encompass both meniscal repair and partial meniscectomy and reflect population averages rather than physiological limits; outcomes are influenced by surgical indication, baseline conditioning, concomitant pathology, and rehabilitation strategy [2]. Representative athletic cohort data following partial medial meniscectomy are summarised in Table 2.

The present case represents an extreme early return relative to commonly reported norms, with unrestricted return to full-contact sport achieved 19 days following surgery. Multiple factors likely contributed to this accelerated recovery. The pathology consisted of an isolated medial meniscal tear with preserved articular cartilage and intact ligamentous structures; features associated with favourable outcomes following meniscectomy1-2. In addition, the athlete demonstrated a high pre-injury baseline level of conditioning, previously shown to predict successful return to running and sport after partial meniscectomy8.

Preoperative training data indicated preserved aerobic capacity and neuromuscular conditioning at the time of intervention (Figure 4).

Notably, preoperative training was characterised by a predominance of non-impact endurance modalities, including cycling and swimming, with relatively limited running exposure (Figure 4). This multimodal conditioning profile may have mitigated postoperative deconditioning and facilitated early tolerance of progressive loading, consistent with prior observations in endurance athletes demonstrating safe early reintroduction of non-impact activity following meniscectomy [9]. In contrast to traditional rehabilitation models that prioritise rebuilding global conditioning postoperatively, this athlete entered surgery with a preserved endurance base, allowing rehabilitation to focus primarily on tissue tolerance, movement quality, and neuromuscular control rather than general reconditioning, neuromuscular stability informed each stage of loading. Continuous wearable-derived physiological and training data including training duration, modality-specific workload, heart rate, and estimated energy expenditure were available and used as adjunctive tools to corroborate clinical recovery and inform progressive load advancement, consistent with their increasing incorporation in elite athlete rehabilitation[10], rather than as validated return-to-play criteria

Despite favourable short-term outcomes, partial meniscectomy carries long-term risks, including higher rates of knee osteoarthritis and chondral degeneration than meniscal repair or non-operative care1-2. High-level athletes may be particularly susceptible due to cumulative joint loading; therefore, early return to sport must be balanced against potential longer-term joint morbidity and supported by continued longitudinal follow-up.

This case should not be interpreted as evidence that early return to sport following meniscectomy is universally safe, achievable, or reproducible in routine clinical practice. Rather, it demonstrates that return-to-sport timelines are not inherently fixed and may be shortened in carefully selected elite individuals with favourable pathology, high baseline conditioning, strong motivation, and access to closely supervised, expert rehabilitation.

Conclusion

In summary, this report documents a markedly accelerated, criterion-based return to sport following partial medial meniscectomy in a high-demand athlete. The findings highlight the influence of favourable pathology, high baseline conditioning, multimodal preoperative training, and objective workload monitoring on recovery trajectories, with progression guided by clinical recovery rather than arbitrary time points. Further prospective studies evaluating structured, criterion-based rehabilitation frameworks and the role of objective monitoring are required to better define safe and effective return-to-sport strategies following meniscectomy in athletic populations.

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