

Pharmacological and Nutritional Support for Muscle-Injury Rehabilitation in Football Players: A Focused Narrative Review

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Abstract

Muscle injuries are among the most frequent causes of time loss in professional football, with hamstring, adductor, quadriceps, and calf injuries accounting for most cases. This focused narrative review evaluates three commonly discussed intervention categories—non-steroidal anti-inflammatory drugs (NSAIDs), platelet-rich plasma (PRP), and protein/creatine support—and considers how they may contribute to rehabilitation without replacing progressive exercise-based care. Literature was identified through PubMed, ScienceDirect, and related sports-medicine sources, with priority given to reviews, controlled trials, and professional-football evidence. The findings indicate that NSAIDs may reduce pain and excessive inflammation in selected acute cases, but prolonged or routine use may interfere with tissue adaptation and increase gastrointestinal or renal risk. PRP has a plausible biological rationale and may reduce return-to-sport time in some grade I–II muscle injuries, although results remain inconsistent because protocols, injury definitions, and outcome measures vary. Protein and creatine are best understood as supportive strategies that help preserve muscle mass, strength, and training capacity during reduced loading; they do not directly regenerate injured tissue. Overall, no single intervention reliably accelerates biological healing. The most defensible approach is phase-specific, individualized, medically supervised, and integrated with load management, progressive strengthening, movement retraining, and psychological readiness.

Key words

football; muscle injury; NSAIDs; platelet-rich plasma; protein; creatine; return to sport

1. Introduction

Football requires repeated sprinting, rapid deceler-

ation, kicking, change of direction, and physical contact. These demands explain why muscle injuries remain a major source of absence in professional players. In a

large prospective study of professional football, muscle injuries represented 31% of all injuries, and hamstring injuries were the largest single subgroup (Ekstrand et al., 2011). Reinjuries are especially important because they usually cause longer absences and may undermine performance after return.

Muscle healing is not a single event. It progresses through overlapping destruction/inflammatory, repair, and remodeling phases (Järvinen et al., 2007). Treatment therefore has to balance early symptom control with the need to preserve inflammation-driven repair, restore muscle architecture, and progressively reload the tissue. In elite football, this balance is complicated by congested schedules, pressure for rapid return, and the consequences of recurrent injury.

This review concentrates on NSAIDs, PRP, and nutritional support because they represent three different clinical functions: symptom modification, biological stimulation, and metabolic support. The central question is not which intervention is universally 'best', but how each may contribute to a broader rehabilitation pathway and where the evidence is too uncertain for strong recommendations.

2. Methods

This study adopts a focused narrative review methodology to evaluate the current evidence regarding pharmacological and nutritional interventions for muscle injury rehabilitation in football players. Relevant literature was identified through systematic searches of PubMed, ScienceDirect, and CNKI using combinations of keywords including football, muscle injury, hamstring strain, NSAIDs, platelet-rich plasma, protein supplementation, creatine, rehabilitation, and return to sport.

Studies were screened according to predefined eligibility criteria. Priority was given to systematic reviews, meta-analyses, randomized controlled trials, prospective cohort studies, and professional consensus statements involving human participants, particularly competitive or professional football players. Animal studies, case reports, studies with very small sample sizes, and articles unrelated to football-specific muscle injuries were excluded where possible.

The selected literature was subsequently organized into three analytical domains. The first focused on the

epidemiology, classification, and characteristics of football-related muscle injuries. The second examined the biological mechanisms underlying muscle damage and tissue repair across different injury severities. The third evaluated pharmacological and nutritional interventions, including their mechanisms of action, clinical effectiveness, safety profiles, and potential influence on rehabilitation outcomes and return-to-sport timelines.

Owing to substantial heterogeneity in injury grading, intervention protocols, rehabilitation programmes, and outcome measures, findings were synthesized qualitatively rather than through formal meta-analysis.

3. Muscle Injury and Rehabilitation Context

3.1 Injury mechanisms and football-specific risk profile

Football muscle injuries usually arise when high mechanical force is imposed on actively contracting tissue, particularly during eccentric actions. Hamstring strains are strongly associated with the terminal-swing phase of sprinting, when the muscle-tendon unit is lengthened while producing high force (Thelen et al., 2005). Adductor injuries are more closely linked to kicking, reaching, rapid lateral movement, and change-of-direction tasks. Quadriceps and calf injuries may similarly occur during acceleration, deceleration, jumping, or repeated high-intensity running. These mechanisms are especially relevant in football because players repeatedly transition between maximal or near-maximal efforts and short recovery periods.

The likelihood of injury and recurrence is not determined by a single factor. Previous muscle injury, residual strength deficits, inter-limb asymmetry, insufficient eccentric capacity, altered running mechanics, fixture congestion, and sudden changes in training load can interact to increase risk. Professional football therefore requires an interpretation of muscle injury that combines tissue pathology with the athlete's recent loading history and functional demands. Epidemiological evidence also indicates that muscle-injury rates rise during periods of fixture congestion, highlighting the importance of recovery and load management in addition to local tissue

treatment (Bengtsson et al., 2013).

3.2 Injury classification and biological healing

In clinical practice, muscle injuries are often described according to the extent of structural disruption and functional impairment, ranging from mild strains with limited fibre damage to partial tears and complete ruptures. However, injury grade should not be inferred from imaging alone. Pain, swelling, strength loss, range-of-motion restriction, functional capacity, mechanism of injury, and imaging findings must be interpreted together because structural abnormalities do not always correspond directly to readiness for sport.

Biological recovery progresses through overlapping destruction/inflammatory, repair, and remodeling phases (Järvinen et al., 2005; Peake et al., 2017). The early inflammatory response contributes to removal of damaged tissue and initiates signaling required for regeneration. During the repair phase, satellite-cell activity, new myofibre formation, extracellular-matrix remodeling, and revascularization support restoration of the injured region. In the later remodeling phase, regenerated fibres and connective tissue adapt to progressively increasing mechanical load. Because these stages overlap rather than occur as isolated time windows, rehabilitation decisions should be based on clinical and functional progression rather than a fixed calendar.

3.3 Rehabilitation principles and recurrence prevention

The central objective of rehabilitation is not merely to reduce pain but to restore the player's capacity to tolerate football-specific loading. Early management should protect the injured tissue while maintaining safe movement and limiting unnecessary deconditioning. As symptoms settle, rehabilitation should progress through isometric, concentric, and eccentric strengthening, followed by running exposure, acceleration and deceleration tasks, change-of-direction work, and position-specific football actions. Evidence from hamstring research supports particular attention to eccentric strength because unresolved strength imbalance is associated with injury risk, while structured preventive eccentric exercise can reduce subsequent hamstring injury incidence

(Croisier et al., 2008; Van der Horst et al., 2015).

Pharmacological or nutritional interventions should therefore be positioned within, rather than outside, this progression. Medication may improve symptom tolerance, PRP may provide a biological adjunct in selected cases, and protein or creatine may help preserve muscle mass and training capacity. None of these strategies can correct residual eccentric weakness, poor intermuscular coordination, altered running mechanics, excessive acute load, inadequate recovery, or fear of reinjury. Return-to-sport decisions should consequently integrate pain status, strength and range of motion, exposure to high-speed running and football-specific tasks, and psychological readiness (Ardern et al., 2014). This context provides the basis for evaluating the intervention categories discussed in the following chapter.

4. Findings

4.1 Non-steroidal anti-inflammatory drugs

NSAIDs inhibit cyclooxygenase activity and reduce prostaglandin synthesis, producing analgesic and anti-inflammatory effects. Their most defensible role in acute muscle injury is short-term symptom control when pain or excessive inflammation prevents basic movement or sleep. They do not reconstruct damaged fibres and should not be interpreted as agents that directly shorten biological healing.

The main concern is that prostaglandins and inflammatory signaling also contribute to satellite-cell activity and tissue adaptation. Experimental and clinical literature therefore raises concern about prolonged, high-dose, or routine use. In athletes, dehydration and intensive exercise may further increase gastrointestinal and renal risk (Paoloni et al., 2009). Pain reduction may also create false confidence and encourage premature loading. Consequently, NSAID use should be indication-specific, time-limited, and supervised by qualified medical staff rather than applied automatically after every strain.

4.2 Platelet-rich plasma

PRP is prepared from the athlete's own blood and

contains a higher-than-baseline concentration of platelets. After activation, platelets release growth factors involved in cell signaling, angiogenesis, and modulation of inflammation. This biological rationale has made PRP attractive for acute muscle injuries, particularly hamstring strains.

Systematic reviews suggest that PRP may reduce return-to-sport time across mixed acute muscle injuries, but hamstring-only analyses have not always shown a significant advantage (Grassi et al., 2018; Sheth et al., 2018). Results are difficult to compare because studies use different platelet concentrations, preparation methods, injection timing, imaging guidance, rehabilitation programmes, and return-to-sport criteria. Evidence for improved long-term tissue quality, performance stability, or reinjury reduction remains limited.

PRP should therefore be described as an optional, context-dependent adjunct rather than a standard cure. Decisions should consider injury grade, location, previous injury, the player's rehabilitation response, cost, procedural risk, and the quality of the available protocol. It should not replace a criteria-based loading programmes.

4.3 Protein and creatine support

Protein provides amino acids needed for muscle-protein synthesis and tissue remodeling. During immobilization or reduced training, an athlete may experience anabolic resistance and loss of lean mass; adequate protein distribution can help limit these effects. Creatine increases intramuscular phosphocreatine availability and may support strength, lean-mass maintenance, and training quality when rehabilitation loading resumes (Kreider et al., 2017).

These strategies have a favorable safety profile when used appropriately, but their function is supportive rather than regenerative. Protein does not independently control pain or inflammation, and creatine does not deliver growth factors or repair scar tissue. Their value is greatest when combined with sufficient energy availability, a structured rehabilitation programmes, and product-quality controls relevant to anti-doping practice.

5. Integrated Rehabilitation

Framework

The evidence does not support a rigid schedule in which one product is automatically used in each post-injury window. A safer framework is criteria-based. In the early phase, clinicians should confirm the diagnosis, control excessive pain and swelling, protect the injury from further damage, and begin tolerated movement. NSAIDs may be considered selectively, but symptom relief should not be used as proof of tissue readiness.

During the repair phase, progressive isometric, concentric, and eccentric loading should be advanced according to pain, strength, range of motion, and imaging when clinically indicated. PRP may be discussed for selected injuries, but the uncertainty of benefit should be explained. Protein and creatine can support the athlete throughout rehabilitation, particularly when training volume is reduced and muscle loss is a concern.

In the remodeling and return-to-sport phases, mechanical loading is the main stimulus for tissue organization and functional recovery. Decisions should combine clinical resolution, near-restoration of strength and range of motion, successful exposure to sprinting and football-specific tasks, and psychological readiness. Calendar pressure alone is not a valid return criterion.

6. Conclusions, Limitations, and Future Prospects

This focused review finds that NSAIDs, PRP, and protein/creatine support can each contribute to football muscle-injury rehabilitation, but they operate through different clinical functions and should not be evaluated as interchangeable treatments. NSAIDs are best regarded as selective, short-term symptom modifiers; PRP is an optional biological adjunct with plausible mechanisms but inconsistent clinical effects; and protein/creatine provide metabolic and training support, particularly when reduced loading threatens muscle mass or strength. Across all three categories, the evidence does not support replacing progressive exercise-based rehabilitation with a pharmacological, injectable, or nutritional intervention.

A second finding is that intervention value is phase- and context-dependent. Symptom relief in the acute stage should not be interpreted as restored tissue

capacity, while potential biological or nutritional support is most useful when integrated with appropriate loading. The most defensible rehabilitation strategy is therefore criteria-based and individualized, combining diagnosis, load management, progressive strengthening, football-specific reconditioning, and psychological readiness. Return to sport should depend on objective and functional recovery rather than pain relief alone or an externally imposed timetable.

This review is limited by its narrative design and by the heterogeneity of the underlying evidence. Many studies include recreational athletes or mixed injury populations rather than professional footballers. Intervention protocols and return-to-sport definitions vary substantially, particularly for PRP, where platelet concentration, preparation method, injection timing, imaging guidance, and accompanying rehabilitation differ across studies. Some conclusions also draw on mechanistic or animal research because football-specific clinical evidence remains limited. In addition, the review concentrates on three intervention categories and does not evaluate the full range of rehabilitation modalities, such as other pharmacological agents, physiotherapeutic technologies, sleep interventions, or detailed periodization strategies. Accordingly, the conclusions should be interpreted as an evidence-informed synthesis rather than a prescriptive clinical protocol.

Future research should prioritize prospective and randomized studies involving professional football players and should use standardized injury definitions, severity classifications, rehabilitation reporting, and return-to-sport criteria. For PRP in particular, trials should clearly report preparation characteristics and injection protocols so that differences between products can be distinguished from true treatment effects. Studies of NSAIDs should examine dose, timing, and duration in relation not only to pain control but also to tissue adaptation and reinjury. Nutritional studies should evaluate whether protein distribution, total energy availability, and creatine supplementation improve maintenance of lean mass, rehabilitation quality, and return-to-performance outcomes during periods of reduced loading.

Outcome selection should also move beyond the number of days until return to sport. Reinjury rates, high-speed running capacity, strength symmetry, player availability, tissue quality, match performance, and psy-

chological readiness across the subsequent competitive period are more informative indicators of successful rehabilitation. Better integration of these outcomes could support individualized decision-making and clarify which athletes are most likely to benefit from each adjunctive strategy.

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