

Current Concepts in Athletic Groin Pain: An Evidence-Based Narrative Review

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Abstract

Athletic groin pain is a common and clinically challenging condition in sports medicine, particularly among athletes in multidirectional sports, owing to its multifactorial aetiology and overlapping clinical presentations. This narrative review synthesises current evidence on the epidemiology, classification, anatomy, pathophysiology, risk factors, clinical assessment, imaging, conservative management, return to performance, prevention, and surgical treatment of athletic groin pain. PubMed/MEDLINE, Scopus, and Embase were searched up to March 2026, prioritising consensus statements, systematic reviews, meta-analyses, randomised controlled trials, and prospective studies published between 2000 and 2026. Current evidence supports a clinically driven diagnostic framework based on the Doha classification, distinguishing adductor-, iliopsoas-, inguinal-, pubic-, and hip-related groin pain, with multiple entities frequently coexisting in the same athlete. Imaging, particularly magnetic resonance imaging and dynamic ultrasound, should complement rather than replace clinical assessment, as structural abnormalities are also common in asymptomatic athletes. Management generally follows a criterion-based, progressive, exercise-based rehabilitation model centred on restoring tissue capacity, neuromuscular control, and sport-specific load tolerance, with return to sport guided by functional recovery rather than elapsed time alone. Adductor strengthening has been shown to reduce the prevalence of groin problems in male football players, whereas evidence for surgery derives mainly from case series, and surgery should be reserved for carefully selected athletes with persistent symptoms despite appropriate conservative management. Overall, athletic groin pain should be regarded as a multifactorial clinical syndrome rather than a single anatomical diagnosis. Future research should prioritise standardised diagnostic and outcome measures, prospective evaluation of rehabilitation and return-to-sport criteria, and inclusion of female athletes and sports other than football.

Categories: Sports Medicine, Physical Medicine & Rehabilitation

Keywords: athletic groin pain, doha agreement, groin injuries, injury prevention, rehabilitation, sports medicine

Introduction And Background

Athletic groin pain is one of the most frequent and challenging musculoskeletal conditions encountered in sports medicine, particularly among athletes participating in multidirectional sports that require repetitive sprinting, kicking, rapid acceleration, deceleration, and cutting manoeuvres. A recent meta-analysis across multiple sports estimated that hip and groin injuries account for approximately 11% of all sporting injuries, and they are an important cause of time loss, impaired athletic performance, and recurrent symptoms, particularly in football and other field-based sports [1-3].

Despite its high prevalence, athletic groin pain remains diagnostically challenging because multiple anatomical structures may produce similar clinical presentations. Disorders involving the adductor muscles, iliopsoas, inguinal region, pubic symphysis, and hip joint frequently coexist, making it difficult to identify a single pain-generating structure. This complexity is further compounded by the close anatomical and biomechanical relationships within the lumbopelvic-hip complex, where coordinated muscle function is essential for efficient force transmission during athletic activity [4,5].

Historically, the literature has been characterised by inconsistent terminology, with numerous diagnostic labels used to describe comparable clinical presentations, including sports hernia, athletic pubalgia, Gilmore's groin, osteitis pubis, and inguinal disruption. This heterogeneity has limited comparisons between studies, complicated the interpretation of treatment outcomes, and hindered the development of standardised diagnostic and therapeutic strategies. The Doha Agreement provided a widely adopted, clinically based framework for classifying groin pain in athletes, founded on patient history and physical examination, and offered a common language for both research and clinical practice [6]. The subsequent publication of minimum reporting standards further promoted methodological consistency in future investigations of athletic groin pain [7].

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Parallel advances in musculoskeletal imaging, rehabilitation, and sports medicine research have considerably improved the evaluation and management of athletes with groin pain. Nevertheless, important uncertainties remain regarding the biological mechanisms underlying different clinical entities, the interpretation of imaging abnormalities, the optimal rehabilitation strategy, and the indications for surgical intervention. Furthermore, the growing recognition that structural imaging abnormalities are frequently observed in asymptomatic athletes has reinforced the need to integrate imaging findings with clinical assessment rather than interpreting them in isolation [8–11].

Although substantial progress has been achieved over the last decade, contemporary evidence remains dispersed across epidemiology, clinical assessment, imaging, rehabilitation, prevention, and surgical management. The aim of this narrative review is therefore to provide a clinically oriented synthesis of the available evidence on athletic groin pain, focusing on epidemiology, classification, functional anatomy, pathophysiology, clinical assessment, imaging, conservative management, return to performance, prevention strategies, and surgical treatment, while highlighting current controversies, the main limitations of the evidence, and future research priorities.

Review

Methods

This narrative review was undertaken to provide a comprehensive and clinically relevant overview of current concepts in athletic groin pain. A literature search was performed in PubMed/MEDLINE, Scopus, and Embase, with the final search conducted in March 2026. Terms describing the condition ("groin pain", "athletic groin pain", "athletic pubalgia", "sports hernia", "adductor-related groin pain", "inguinal disruption", "osteitis pubis", and "Doha agreement") were combined using the Boolean operators OR and AND with terms describing the population ("athlete", "sport", "football", and "soccer") and, where relevant, with terms for each domain addressed in this review (for example, "epidemiology", "risk factors", "imaging", "magnetic resonance imaging", "ultrasound", "rehabilitation", "exercise therapy", "prevention", "return to sport", and "surgery"). The reference lists of key articles and consensus documents were also screened to identify additional relevant publications.

Publications in English involving athletic populations, particularly football and other multidirectional sports, and addressing at least one of the domains of this review were considered. Eligible publication types included consensus statements, systematic reviews and meta-analyses, randomised controlled trials, prospective and retrospective cohort studies, cross-sectional imaging studies, and narrative reviews. Studies published between 2000 and 2026 were considered, with priority given to more recent publications, and older studies were retained when they represented landmark contributions to terminology, classification, or imaging. Publications outside the scope of athletic groin pain, those focusing on non-athletic populations without direct clinical applicability, and those providing information that substantially overlapped with more recent publications were not prioritised.

Titles, abstracts, and, where appropriate, full texts were screened by the first author for relevance to the objectives of the review. Because the search was conducted for a narrative review, the number of records retrieved, screened, and excluded was not systematically recorded, and no Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow diagram is therefore presented; this is acknowledged as a limitation of the review.

No formal risk-of-bias assessment or Grading of Recommendations, Assessment, Development and Evaluation (GRADE) evaluation was performed, and the literature was synthesised qualitatively. When several studies addressed the same question, greater weight was given to study designs higher in the conventional hierarchy of evidence (consensus statements, systematic reviews and meta-analyses, and randomised controlled trials, followed by prospective cohort studies, retrospective and cross-sectional studies, case series, and narrative reviews) and to more recent publications.

Epidemiology and burden of athletic groin pain

Athletic groin pain represents a substantial health burden in sports requiring repetitive kicking, sprinting, rapid acceleration, deceleration, and multidirectional movements. A recent meta-analysis of 71 studies across 10 sports (85% of them in football), including 5914 injuries recorded over more than nine million exposure hours, reported a pooled hip and groin injury incidence of 0.71 per 1000 hours of exposure (95% CI 0.59–0.86), accounting for 11% of all sporting injuries (95% CI 10–13%), with a seasonal prevalence of 19% (95% CI 5–40%). The incidence rate was 1.8 times higher in male than in female athletes (95% CI 1.25–2.7) and 6.5 times higher during matches than during training sessions (95% CI 3.9–10.9). Because these pooled estimates combine different sports, competition levels, injury definitions, and surveillance methods, and derive predominantly from football, they should be interpreted as approximate [1].

Professional football has been the most extensively investigated sporting population and consistently demonstrates one of the highest incidences of groin injury. A 15-year prospective study of 47 European men's professional football clubs demonstrated that hip and groin injuries accounted for 14% of all time-loss

injuries, with adductor-related injuries representing 63% of all hip and groin injuries [2]. In male elite football, adductor injuries have also been reported as the second most common muscle injury after hamstring injuries, accounting for approximately 23% of all muscle injuries and resulting in considerable time loss from both training and competition [12]. Similar injury patterns have been reported in rugby, ice hockey, Australian football, and Gaelic football, reflecting the comparable biomechanical demands imposed on the lumbopelvic-hip complex [13].

Beyond their frequency, groin injuries are associated with prolonged rehabilitation, reduced athletic performance, and high recurrence rates. Persistent symptoms may impair sprinting, kicking, change-of-direction performance, and overall athletic function, particularly in athletes with longstanding groin pain [14,15]. Previous groin injury consistently emerges as the strongest predictor of future groin problems, emphasising the importance of comprehensive rehabilitation and long-term preventive strategies [13].

Classification and terminology

Historically, athletic groin pain has been described using numerous diagnostic labels, including sports hernia, athletic pubalgia, Gilmore's groin, inguinal disruption, and osteitis pubis. These terms have frequently been applied to athletes with similar clinical presentations despite referring to different anatomical structures or presumed pathological mechanisms, resulting in considerable inconsistency across both clinical practice and research [6].

To address this lack of standardisation, the Doha Agreement proposed a clinically based classification system founded on patient history and physical examination rather than imaging findings or presumed tissue pathology [6]. This framework classifies groin pain into adductor-related, iliopsoas-related, inguinal-related, and pubic-related clinical entities, while also recognising hip-related groin pain and other causes of groin pain that should be considered during differential diagnosis.

Although each clinical entity presents with characteristic examination findings, overlap between diagnoses is common. Adductor-related groin pain remains the most prevalent entity, whereas iliopsoas-, inguinal-, pubic-, and hip-related groin pain frequently coexist in the same athlete, particularly in those with longstanding symptoms [5,6]. Consequently, the primary objective of clinical assessment is not to identify a single anatomical lesion but rather to identify the dominant clinical entity, or entities, that should guide management, recognising that a single symptomatic structure often cannot be identified with certainty.

The Doha classification was not intended to establish a definitive pathological diagnosis but instead to provide a common clinical language that facilitates communication between clinicians, improves consistency in patient classification, and enhances the comparability of future research. These principles were subsequently reinforced by the publication of minimum reporting standards, which recommend standardised terminology together with consistent reporting of clinical findings, imaging, participant characteristics, and outcome measures [7].

The clinical features and examination findings of each Doha entity are summarised in Table 1.

Clinical entity	Typical pain location	Palpation findings	Pain provocation test(s)	Common aggravating activities	References
Adductor-related groin pain	Proximal medial groin	Tenderness at the proximal adductor insertion	Pain on resisted hip adduction (e.g., adductor squeeze test*)	Sprinting, kicking, cutting, change of direction	[6]
Iliopsoas-related groin pain	Anterior groin or anterior hip	Tenderness over the iliopsoas	Pain on resisted hip flexion and/or passive hip flexor stretching	Sprinting, acceleration, kicking, high knee lift	[6,16]
Inguinal-related groin pain	Inguinal canal region	Tenderness of the inguinal canal without palpable inguinal hernia	Pain on abdominal resistance, coughing, or Valsalva manoeuvre	Twisting, coughing, sprinting, abdominal loading	[6]
Pubic-related groin pain	Midline pubic region	Local tenderness directly over the pubic symphysis	No specific validated provocation test	Running, kicking, prolonged standing	[6]
Hip-related groin pain	Deep anterior groin (may radiate to the thigh or buttock)	Usually absent or non-specific	Reduced hip range of motion; hip provocation tests (e.g., FADIR, FABER)**	Squatting, pivoting, prolonged sitting, hip rotation	[6]

TABLE 1: Clinical Classification and Examination Findings of the Doha Entities in Athletic Groin Pain

*The adductor squeeze test may reproduce groin pain but has limited ability to distinguish individual clinical entities; it should not be used as a standalone diagnostic test.

**Hip provocation tests should be used as part of a broader hip assessment; positive FADIR or FABER findings are not specific for a single hip disorder. FADIR, flexion-adduction-internal rotation; FABER, flexion-abduction-external rotation.

Functional anatomy

A thorough understanding of the functional anatomy of the lumbopelvic-hip complex is essential for the clinical evaluation and management of athletic groin pain. Rather than functioning as isolated anatomical structures, the muscles, tendons, ligaments, and osseous elements of this region form an integrated biomechanical unit responsible for efficient force transmission between the trunk and lower limbs during athletic activity [4].

The pubic symphysis occupies a central position within this complex, serving as the convergence point for multiple musculotendinous structures. The adductor longus originates from the anterior surface of the pubic body, where its proximal enthesis is intimately related to the anterior pubic ligament, the rectus abdominis insertion, and the surrounding aponeurotic tissues. Anatomical investigations have demonstrated that these structures constitute a continuous functional complex rather than discrete anatomical entities, with fibrous interconnections that distribute mechanical forces across the anterior pelvis [4].

The adductor musculature, comprising the adductor longus, adductor brevis, adductor magnus, gracilis, and pectineus, provides dynamic stabilisation of the pelvis during weight-bearing activities and generates the adduction and rotational forces required for sprinting, kicking, and rapid changes of direction. The adductor longus is the most frequently injured muscle within this group, likely reflecting its anatomical vulnerability at the proximal enthesis and its exposure to substantial eccentric loading during athletic movements [12].

The iliopsoas complex, formed by the psoas major and iliacus muscles, functions as the primary hip flexor and contributes to anterior pelvic stability. Its close anatomical relationship with the hip joint capsule and the inguinal region explains the frequent clinical overlap between iliopsoas-related and hip-related groin pain [16].

The abdominal wall musculature, including the rectus abdominis, internal and external obliques, and transversus abdominis, provides dynamic trunk stability and contributes to force generation during rotational and kicking activities. The inguinal canal, traversing the lower abdominal wall, represents a region of relative structural vulnerability that may become symptomatic under repetitive mechanical stress [6].

The hip joint itself is a frequent contributor to athletic groin pain. Femoroacetabular morphology, acetabular labral integrity, and capsular function all influence hip mechanics and may predispose athletes to intra-articular pathology that mimics or coexists with extra-articular causes of groin pain [3].

This interconnected architecture provides the anatomical basis for the frequent overlap between clinical entities and for the pathophysiological mechanisms discussed in the following section.

Pathophysiology

Athletic groin pain is increasingly recognised as the consequence of a continuum between physiological tissue adaptation and maladaptation rather than the result of a single traumatic event. During athletic participation, the musculotendinous and osteoarticular structures of the lumbopelvic-hip complex are repeatedly exposed to substantial tensile, compressive, and shear forces generated during sprinting, kicking, jumping, and rapid changes of direction. Under normal conditions, these mechanical stimuli promote tissue remodelling and adaptation. However, when cumulative loading exceeds the biological capacity for repair and recovery, progressive structural and functional changes may develop, ultimately leading to pain and impaired performance [4].

The lumbopelvic-hip complex functions as an integrated kinetic chain in which the adductor muscles, abdominal wall, pubic symphysis, iliopsoas, and hip joint cooperate to transfer forces efficiently between the trunk and lower limbs. Consequently, dysfunction affecting one component may alter load distribution throughout the entire system, predisposing adjacent structures to compensatory overload [4].

Current evidence suggests that the proximal adductor longus enthesis, as part of the continuous aponeurotic complex described above, represents one of the principal sites of pathological loading, which may explain why imaging changes often involve several adjacent tissues simultaneously [8,10].

Several biomechanical mechanisms have been proposed to explain the development of insertional pathology. The stress-shielding hypothesis suggests that alterations in physiological tensile loading may increase local compressive forces at the tendon enthesis, promoting collagen disorganisation and tissue degeneration [4]. Similarly, the compression theory proposes that repetitive mechanical compression of the proximal adductor tendon against the pubic bone during hip movement contributes to chronic insertional pathology [4]. Although both mechanisms are biologically plausible, direct clinical evidence remains limited and neither hypothesis fully explains the diversity of clinical presentations encountered in athletic populations.

Importantly, structural pathology alone does not explain symptom development. Magnetic resonance imaging (MRI) frequently demonstrates bone marrow oedema, tendon abnormalities, and aponeurotic changes in asymptomatic athletes, indicating that imaging abnormalities may represent adaptive responses to repetitive loading rather than clinically significant pathology [8]. Therefore, contemporary evidence supports a multifactorial model in which tissue pathology, biomechanical loading, neuromuscular control, and individual load tolerance collectively determine symptom development.

This interaction between mechanical loading and individual tissue capacity may explain why some athletes develop symptoms whereas others exposed to similar sporting demands remain asymptomatic.

Risk factors

The development of athletic groin pain is best understood through a multifactorial risk model in which intrinsic characteristics interact with external sporting demands. Rather than resulting from a single identifiable cause, injury risk reflects the cumulative influence of previous injury, physical capacity, movement quality, and exposure to repetitive mechanical loading [13].

Among all investigated variables, a previous history of groin injury consistently emerges as the strongest predictor of future groin problems. Athletes with previous groin pain are more likely to experience recurrent symptoms, suggesting that persistent impairments in tissue capacity, neuromuscular control, or movement patterns may remain despite apparent clinical recovery [13].

Reduced hip adductor strength represents one of the most consistently identified modifiable risk factors, although the quality of prospective evidence supporting this association remains limited [13]. Because the adductor musculature is exposed to substantial eccentric loading during sprinting, kicking, and cutting manoeuvres, inadequate force-generating capacity may compromise tissue resilience under high mechanical demand. Indirect support for this concept comes from a cluster-randomised controlled trial in which a targeted adductor strengthening programme reduced the prevalence of groin problems in male football players [17].

Reduced hip internal rotation and decreased total hip range of motion have also been associated with groin pain, although findings are heterogeneous between studies, and these factors should be interpreted as contributors to an individual's overall risk profile rather than independent predictors of injury [13]. Altered lumbopelvic and movement control has been described in athletes with longstanding groin pain [15]. However, these are biomechanical findings in symptomatic athletes, and it has not been established that such deficits cause groin pain or that modifying them prevents it.

Extrinsic factors further influence tissue loading. Participation in multidirectional sports, rapid increases in training volume, congested competition schedules, and inadequate preseason conditioning may collectively increase cumulative mechanical stress beyond individual tissue capacity [12,13].

The principal intrinsic and extrinsic risk factors associated with athletic groin pain, together with their proposed mechanisms, modifiability, clinical implications, and the main type of supporting evidence, are summarised in Table 2.

Risk factor	Main supporting evidence	Modifiable	Proposed mechanism	Clinical implication	Preventive focus	References
Previous groin injury	Mainly observational evidence	No	Residual deficits in tissue capacity, neuromuscular control, and movement quality may increase recurrence risk	Closer monitoring and criterion-based rehabilitation	Secondary prevention	[13]
Reduced hip adductor strength	Mainly observational evidence; preventive RCT (male football)	Yes	Reduced tolerance to eccentric loading during high-demand activities	Adductor strengthening programmes are supported for prevention in male football	Primary prevention	[13,17]
Reduced hip internal rotation/total hip ROM	Observational evidence; inconsistent findings	Partly	Altered load distribution across the pubic region (proposed)	Assess hip mobility as part of the examination; preventive benefit of modifying ROM not established	Primary prevention	[13]
Altered lumbopelvic and movement control	Limited evidence (association only)	Potentially	Reduced efficiency of force transmission through the kinetic chain (proposed)	May be addressed within individualised rehabilitation; causal role and preventive effect not established	Rehabilitation target	[15]
Inadequate preseason conditioning	Limited observational evidence	Yes	Reduced tissue load tolerance at the start of the competitive season (proposed)	Progressive preseason conditioning	Primary prevention	[13]
High training and competition load	Limited observational evidence (indirect)	Yes	Cumulative mechanical overload exceeding tissue adaptation (proposed)	Monitoring and progressive management of training load	Primary prevention	[12]
Participation in multidirectional sports	Mainly observational evidence (meta-analysis)	No	Repetitive sprinting, kicking, and cutting generate high mechanical loads	Consider preventive adductor strengthening in exposed athletes; benefit of broad screening not demonstrated	Primary prevention	[1]

TABLE 2: Risk Factors Associated with Athletic Groin Pain and Their Clinical Implications

Main supporting evidence summarises the type of available evidence and is not a formal grading of certainty. Most data derive from male football players. RCT, randomised controlled trial; ROM, range of motion.

Clinical assessment

Clinical assessment remains the cornerstone of the diagnostic evaluation of athletes presenting with groin pain. Despite substantial advances in musculoskeletal imaging, the diagnosis of athletic groin pain continues to rely primarily on a structured clinical assessment integrating patient history, physical examination, and functional evaluation, as recommended by the Doha Agreement [6].

The diagnostic process begins with a comprehensive clinical history aimed at identifying the characteristics of symptom onset, pain location, symptom behaviour, previous groin injuries, recent changes in training load, and sport-specific demands. Particular attention should be given to activities that reproduce

symptoms, including sprinting, kicking, cutting, twisting, coughing, sneezing, and prolonged sitting, as these may provide valuable clues regarding the dominant clinical entity. The history should also screen for features suggesting other causes of groin pain, including referred pain from the lumbar spine, nerve entrapment, and urological, gynaecological, gastrointestinal, or systemic conditions [6].

Clinical examination should follow a systematic and reproducible sequence. Inspection is followed by palpation of the adductor origin, pubic symphysis, inguinal canal, iliopsoas region, and surrounding soft tissues to identify localised tenderness. Because several entities frequently coexist, a systematic examination of all Doha clinical entities is recommended to identify the dominant clinical entity and recognise coexisting sources of groin pain [5,6].

The examination findings that define each Doha entity are summarised in Table 1.

Assessment of hip adductor function remains a fundamental component of the examination. Pain reproduced during resisted hip adduction together with tenderness over the proximal adductor insertion is consistent with the clinical definition of adductor-related groin pain, although it does not establish a definitive tissue diagnosis. The adductor squeeze test may reproduce groin pain and is widely used in clinical practice; however, its diagnostic performance varies according to the population and reference standard, and it has limited ability to distinguish individual clinical entities. It should therefore not be used as a standalone diagnostic test, and clinical interpretation should consider the overall examination findings rather than isolated test results [6,14].

Evaluation of the hip joint is equally important because intra-articular pathology frequently mimics or coexists with extra-articular causes of groin pain. Assessment should include active and passive range of motion, particularly hip internal rotation, together with provocation tests when hip-related pathology is suspected. Hip provocation tests, such as the flexion-adduction-internal rotation (FADIR) and flexion-abduction-external rotation (FABER) tests, should be used as part of a broader hip assessment, as positive findings are not specific for a single hip disorder. Failure to recognise concomitant hip pathology may contribute to persistent symptoms and suboptimal treatment outcomes [3,6].

Static examination should be complemented by functional assessment whenever possible. Observation of squatting, lunging, single-leg balance, hopping, sprinting, and change-of-direction tasks may reveal deficits in lumbopelvic control, movement quality, or sport-specific mechanics that are not apparent during isolated clinical testing. Biomechanical investigations have demonstrated that athletes with longstanding groin pain frequently adopt altered movement strategies during high-demand activities, supporting the integration of functional assessment into contemporary clinical practice [15].

This clinical reasoning, which aims to identify the dominant clinical entity or entities rather than a single anatomical lesion, guides the selection of imaging investigations and subsequent management [5,6].

Imaging assessment

Imaging should be regarded as an extension of the clinical assessment rather than an independent diagnostic tool. Its primary roles are to exclude alternative diagnoses, evaluate persistent or atypical symptoms, support treatment planning, and, where appropriate, refine a clinically suspected diagnosis. Routine imaging of all athletes presenting with groin pain is not recommended [6,8,9]. However, early imaging or specialist referral is warranted when red flags or atypical features are present, such as suspected fracture, stress fracture or avulsion injury, infection, malignancy, or non-musculoskeletal causes of groin pain, or when symptoms are severe, progressive, or unresponsive to initial management.

Selection of the imaging modality should be guided by the clinical question rather than by availability alone. A structured imaging strategy according to the clinical presentation is presented in Table 3, summarising the principal indications, advantages, limitations, and diagnostic objectives of each imaging modality. Conventional radiographs remain valuable when osseous abnormalities, femoroacetabular impingement morphology, stress fractures, or advanced degenerative changes are suspected. Although radiographs provide limited assessment of soft tissues, they represent an appropriate first-line investigation in selected clinical scenarios [11].

Clinical scenario	Recommended imaging modality	Primary diagnostic objective	Main advantage	Major limitation	Main supporting evidence	References
Suspected fracture, femoroacetabular impingement or other osseous pathology	Plain radiography	Evaluate osseous morphology and exclude fractures	Widely available and inexpensive	Limited assessment of soft tissues	Expert opinion/limited evidence	[9,11]
Suspected tendon or inguinal pathology requiring dynamic assessment	Musculoskeletal ultrasound	Dynamic assessment of tendons and inguinal canal	Real-time evaluation and image-guided procedures	Highly operator dependent; findings supportive rather than diagnostic	Expert opinion/limited evidence	[9]
Persistent symptoms or uncertain diagnosis	MRI	Comprehensive assessment of bone, musculotendinous, and intra-articular structures	Excellent soft-tissue contrast and multiplanar evaluation	High prevalence of abnormalities in asymptomatic athletes	Mainly observational evidence	[9,10]
Typical clinical presentation with a clear clinical diagnosis and no red flags*	No immediate imaging	Initiate conservative management	Avoids unnecessary investigations and overdiagnosis	Imaging required if red flags* or atypical features are present, or if symptoms persist	Expert consensus; observational evidence	[6,8]

TABLE 3: Imaging Strategy for Athletes Presenting with Groin Pain

Main supporting evidence summarises the type of available evidence and is not a formal grading of certainty.
*Red flags include suspected fracture, stress fracture or avulsion injury, infection, malignancy, and non-musculoskeletal causes of groin pain.
MRI, magnetic resonance imaging.

Musculoskeletal ultrasound provides dynamic assessment of superficial soft-tissue structures and is particularly useful for evaluating the adductor tendons, iliopsoas tendon, and inguinal region. Dynamic examination during muscle contraction or Valsalva manoeuvre may demonstrate posterior inguinal wall abnormalities and facilitate image-guided diagnostic and therapeutic procedures; however, because inguinal-related groin pain is a clinical diagnosis, such findings should be interpreted as supportive rather than confirmatory. Ultrasound remains highly operator-dependent and provides limited assessment of deep pelvic structures and the pubic symphysis [9].

MRI currently represents the most comprehensive imaging modality for athletes with persistent or diagnostically challenging groin pain. MRI enables simultaneous evaluation of musculotendinous structures, the pubic symphysis, bone marrow, hip joint, and surrounding soft tissues [10,11]. Findings reported in association with individual entities include adductor tendinopathy, enthesopathy, partial tears, and peritendinous oedema in adductor-related groin pain; iliopsoas tendinopathy, bursitis, or muscle oedema in iliopsoas-related groin pain; aponeurotic and rectus abdominis abnormalities in inguinal-related groin pain; bone marrow oedema, symphyseal degeneration, and subchondral changes in pubic-related groin pain; and femoroacetabular impingement morphology, labral tears, and chondral lesions in hip-related groin pain [9-11,16].

Nevertheless, imaging abnormalities should not be interpreted in isolation. Bone marrow oedema, degenerative symphyseal changes, tendon abnormalities, and acetabular labral lesions are frequently identified in asymptomatic athletes exposed to repetitive high mechanical loading. Consequently, overreliance on MRI findings may result in overdiagnosis or unnecessary concern if imaging is not interpreted alongside clinical examination [8].

Imaging is therefore likely to be most useful when integrated into a structured diagnostic pathway in which clinical assessment establishes the diagnostic hypothesis and imaging is used to exclude alternative diagnoses or refine that hypothesis. Such an approach may help limit unnecessary investigations and reduce the risk of attributing symptoms to incidental findings, although its effect on diagnostic accuracy and treatment outcomes has not been formally evaluated [9,11].

Conservative management and exercise-based rehabilitation

Exercise-based rehabilitation is commonly recommended as first-line treatment, particularly for adductor-related presentations, although the optimal programme may differ according to clinical entity, chronicity,

and sport. A stepwise strategy is generally advocated, in which surgery is considered only for carefully selected athletes who fail to improve despite comprehensive, criterion-based conservative management. Rather than focusing exclusively on symptom resolution or isolated tissue healing, rehabilitation aims to restore the athlete's capacity to tolerate sport-specific mechanical loads through progressive, multimodal, exercise-based interventions [4,18].

The fundamental principle of rehabilitation is the gradual restoration of tissue load tolerance. Early management should seek to minimise pain provocation while maintaining appropriate mechanical loading to stimulate tissue adaptation and prevent physical deconditioning. As symptoms improve, rehabilitation should target strength, neuromuscular control, movement quality, and functional performance rather than isolated flexibility or passive therapeutic modalities [4].

Progressive adductor strengthening is commonly included in rehabilitation, especially for adductor-related symptoms, alongside individualised loading and functional retraining. Both concentric and eccentric strengthening are frequently emphasised because of their proposed role in improving tissue tolerance during high-demand activities such as sprinting, kicking, and rapid changes of direction, although the strongest evidence for adductor strengthening currently derives from prevention rather than treatment studies [4,17].

However, contemporary rehabilitation extends beyond isolated muscle strengthening. Athletes with longstanding groin pain frequently demonstrate deficits in lumbopelvic control, altered movement strategies, and reduced kinetic chain efficiency. Consequently, rehabilitation should progressively incorporate trunk control, multiplanar strength, balance, coordination, and sport-specific movement retraining to optimise force distribution throughout the kinetic chain [4,15].

Return-to-sport decisions should not rely solely on pain resolution or elapsed rehabilitation time; they should also consider function, sport-specific load tolerance, and the athlete's performance demands. Progression should therefore depend on the athlete's ability to tolerate progressively increasing sport-specific loads while demonstrating adequate strength, movement quality, and functional performance, with the aim of reducing the risk of symptom recurrence [4,18].

Adjunctive interventions, including image-guided injections, may be considered in carefully selected cases with persistent symptoms despite appropriate rehabilitation. Nevertheless, current evidence supporting these interventions remains limited, and they should be regarded as complementary to, rather than substitutes for, structured exercise-based rehabilitation [4].

Overall, conservative management should be viewed as a process of restoring function and load tolerance rather than simply eliminating pain. This contemporary rehabilitation philosophy provides the basis for safe progression towards return to performance.

The principal components of criterion-based rehabilitation are summarised in Table 4 as a pragmatic clinical framework for progression from symptom management to unrestricted return to performance.

Rehabilitation phase	Primary objective	Main interventions	Criteria for progression	Expected outcome	Main supporting evidence	References
Phase 1 – Pain management and load modification	Reduce symptom irritability while maintaining tissue capacity	Relative load modification, patient education, and exercise within acceptable symptom levels	Symptoms controlled during daily activities and low-load exercise	Pain reduction and restoration of basic function	Mainly observational evidence	[18]
Phase 2 – Strength restoration	Restore hip adductor, trunk and lower-limb strength	Progressive resistance training, eccentric adductor strengthening, and lumbopelvic strengthening	Progressive improvement in strength with minimal symptom provocation	Recovery of muscle strength and tissue capacity	Mainly observational evidence; preventive RCT	[17,18]
Phase 3 – Movement optimisation	Improve neuromuscular control and kinetic chain efficiency	Balance training, multiplanar strengthening, trunk control, and movement retraining	Satisfactory movement quality during functional tasks	Improved movement quality and load transfer	Expert opinion/limited evidence	[15]
Phase 4 – Sport-specific rehabilitation	Restore tolerance to sport-specific mechanical loading	Running progression, sprinting, kicking, cutting and change-of-direction drills	Completion of sport-specific activities without symptom exacerbation	Recovery of sport-specific performance capacity	Mainly observational evidence	[15,18]
Phase 5 – Return to performance	Restore unrestricted competitive performance	Progressive return to full training and competition with continued load monitoring	Completion of unrestricted sport-specific training with acceptable symptoms and maintained physical performance	Return to unrestricted performance	Mainly observational evidence	[18]

TABLE 4: Contemporary Principles of Conservative Management

Main supporting evidence summarises the type of available evidence and is not a formal grading of certainty. Supporting studies were conducted mainly in male athletes with acute adductor injuries. RCT, randomised controlled trial.

Return to performance

Return to performance should be regarded as a continuum rather than a single event. In this review, return to sport refers to clearance for unrestricted training and competition, whereas return to performance refers to recovery of the athlete's pre-injury competitive level. Successful return to performance therefore requires not only symptom control but also recovery of the physical qualities necessary to meet the mechanical demands of competition [4,18].

Current evidence supports a criterion-based approach integrating clinical findings, functional performance, and progressive exposure to sport-specific loading. Athletes should demonstrate acceptable symptoms that do not worsen during or after progressive sport-specific loading, although some criteria-based protocols require pain-free performance, together with restoration of hip adductor strength, satisfactory lumbopelvic control, and satisfactory performance in running, sprinting, kicking, and multidirectional activities [4,18].

Training exposure should increase progressively, allowing tissues to adapt to increasing mechanical demands while monitoring symptom response. Abrupt progression from rehabilitation to unrestricted competition may exceed tissue capacity and increase recurrence risk, particularly in sports characterised by repetitive kicking and rapid directional changes [4,17].

Objective assessment should complement clinical judgement whenever possible. However, no single strength threshold or functional test has demonstrated sufficient evidence to support universal application across all athletes with groin pain, and current return-to-sport criteria remain largely derived from observational cohort studies rather than robust comparative evidence [13,18]. In practice, readiness is best judged using a battery of clinical, functional, sport-specific, and athlete-reported measures, such as pain during the adductor squeeze and resisted tests, hip adduction strength compared with the uninjured side or pre-injury values, completion of sprinting, kicking, and change-of-direction tasks, and validated patient-

reported outcome measures.

Ultimately, the goal of rehabilitation is not merely return to participation but return to sustainable athletic performance. This broader perspective recognises that successful return to performance should minimise recurrence while enabling athletes to resume their previous competitive level safely and efficiently.

Prevention strategies

The prevention of athletic groin pain should be considered a continuous component of athlete development rather than an intervention initiated only after injury. Contemporary prevention strategies seek to optimise tissue capacity, improve movement quality, and enhance the athlete's ability to tolerate the cumulative mechanical demands imposed by sport [13].

Among currently available interventions, programmes targeting hip adductor strengthening are supported by the strongest evidence. In a cluster-randomised controlled trial including 652 male semiprofessional football players from 35 Norwegian teams, the average weekly prevalence of groin problems during the competitive season was 13.5% (95% CI 12.3–14.7%) in teams performing the Adductor Strengthening Programme, based on the Copenhagen adduction exercise, compared with 21.3% (95% CI 20.0–22.6%) in control teams, corresponding to a 41% lower risk of reporting groin problems (odds ratio 0.59, 95% CI 0.40–0.86) [17]. It therefore represents one of the few preventive interventions supported by randomised evidence, although its effect in female athletes and in other sports remains to be established.

Nevertheless, prevention should not rely exclusively on isolated strengthening exercises. Comprehensive programmes may also address lumbopelvic control, lower-limb strength, movement quality, progressive load exposure, and adequate preseason conditioning, although the additional preventive value of these components has not been established [4,13].

Athletes with previous groin injury require particular attention because recurrence remains the strongest predictor of future symptoms. Regular monitoring of physical capacity, training exposure, and symptom progression may facilitate early identification of athletes at increased risk and allow timely modification of training programmes [13].

Although strengthening-based prevention programmes demonstrate encouraging results, several questions remain unanswered regarding optimal exercise dosage, long-term adherence, and applicability across different sports, competition levels, and female athletes. Future preventive strategies will likely evolve towards more individualised programmes integrating athlete profiling, workload monitoring, and sport-specific performance demands.

When to consider surgery

Surgical intervention should be considered only after an appropriate course of structured, criterion-based rehabilitation has failed to restore acceptable levels of pain, function, and sport-specific performance. Because the majority of athletes improve with comprehensive conservative management, surgery is reserved for carefully selected individuals with persistent symptoms [4,19]. Surgical decisions should be based on a concordant clinical presentation, exclusion of relevant alternative diagnoses, imaging when appropriate, failure of well-delivered rehabilitation, and shared decision-making with the athlete.

The decision to operate should not be based solely on imaging abnormalities, given their high prevalence in asymptomatic athletes; surgical planning should integrate patient history, physical examination, functional assessment, and imaging [6,8].

Because the Doha entities are clinical classifications rather than surgical diagnoses, the choice of procedure should be individualised. Selective adductor longus procedures, such as partial or selective tenotomy, have been reported in selected athletes with persistent adductor-related symptoms despite prolonged rehabilitation; however, this evidence derives mainly from case series and does not establish comparative effectiveness [4].

In athletes with persistent inguinal-related groin pain despite appropriate conservative management, procedures such as posterior inguinal wall repair or reinforcement have been described. However, there is no diagnostic reference standard for inguinal-related groin pain, the underlying pathology is heterogeneous, and comparative evidence is limited; such procedures should therefore be considered only after careful multidisciplinary evaluation and shared decision-making. Historically, these presentations have been described using terms such as sports hernia or athletic pubalgia, which encompass heterogeneous pathological processes; contemporary practice is better guided by the clinically based Doha terminology [6,19].

Although favourable postoperative outcomes have been reported in selected athletic populations, the overall quality of evidence supporting surgical intervention remains limited. Most available studies are

retrospective case series characterised by heterogeneous diagnostic criteria, variable rehabilitation protocols, and inconsistent outcome measures. Consequently, direct comparison between surgical techniques remains difficult, and definitive recommendations regarding procedure selection cannot currently be made [3,19].

Surgery should therefore be regarded as one component of a multidisciplinary management pathway rather than a definitive solution. Postoperative rehabilitation remains essential for restoring strength, neuromuscular control, movement quality, and sport-specific performance before return to unrestricted competition. Future advances in surgical management will depend not only on refinements in operative techniques but also on improved patient selection based on robust clinical criteria.

Future directions

Although substantial progress has been achieved in the understanding and management of athletic groin pain, several important knowledge gaps remain. Future research should move beyond the investigation of isolated anatomical abnormalities towards a more comprehensive understanding of the interactions between tissue adaptation, biomechanics, neuromuscular function, and sport-specific loading. Such an integrated approach may better explain the considerable heterogeneity observed among athletes with similar clinical presentations but different recovery trajectories [4,15].

Prospective longitudinal studies incorporating standardised clinical assessment, biomechanical evaluation, imaging findings, and patient-reported outcome measures are required to improve the identification of clinically meaningful subgroups and support more individualised rehabilitation strategies. Further research should also establish robust, evidence-based criteria for rehabilitation progression and return to performance, as current recommendations remain largely based on expert consensus and observational evidence [13,18].

Advances in musculoskeletal imaging should focus not only on improving lesion detection but also on identifying imaging findings with prognostic value capable of guiding treatment selection, monitoring rehabilitation, and predicting return-to-performance outcomes. Likewise, preventive strategies require further validation across female athletes, youth populations, and sports other than football, where the current evidence remains comparatively limited [13,17].

Continued adoption of the Doha terminology and the Minimum Reporting Standards will be fundamental to improving methodological consistency across future studies. Greater standardisation of diagnostic criteria, rehabilitation protocols, and outcome measures will facilitate meaningful comparisons between investigations and strengthen the quality of future evidence synthesis [6,7].

Limitations

This review has several limitations. As a narrative review, it did not follow a systematic search and selection protocol: the number of records retrieved and screened was not recorded, study selection was performed by a single author, and no formal risk-of-bias or certainty-of-evidence assessment was undertaken, so selection bias cannot be excluded. Restriction to English-language publications may have led to relevant studies being missed. In addition, much of the available evidence, particularly regarding prevention and return to sport, derives from male football players, and its applicability to female athletes, youth athletes, and other sports remains uncertain.

Conclusions

Athletic groin pain remains one of the most challenging conditions encountered in sports medicine owing to its multifactorial aetiology, overlapping clinical presentations, and the frequent coexistence of multiple clinical entities. Current evidence supports a clinically driven approach based on the Doha classification, in which diagnosis is established through the integration of patient history, systematic physical examination, and appropriately selected imaging interpreted within the clinical context. Management has evolved from symptom-focused treatment towards criterion-based rehabilitation centred on progressive load management, restoration of tissue capacity, optimisation of neuromuscular function, and recovery of sport-specific performance, complemented by preventive strategies, of which adductor strengthening programmes are currently the best supported.

Despite these advances, important uncertainties remain regarding the biological mechanisms underlying symptom development, the prognostic significance of imaging abnormalities, objective return-to-performance criteria, and the identification of athletes most likely to benefit from surgical intervention. Much of the available evidence derives from male football players and from observational studies, and its applicability to other athletic populations requires confirmation. Addressing these challenges will require high-quality prospective research using standardised terminology, clinically relevant outcome measures, and robust methodological reporting. Ultimately, effective management of athletic groin pain depends on integrating sound clinical reasoning with exercise-based rehabilitation, judicious use of imaging, and individualised athlete-centred care.

Additional Information

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All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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