

PRIMARY AND SECONDARY PREVENTION STRATEGIES FOR ADDUCTOR RELATED GROIN PAIN IN FOOTBALL

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THE BURDEN: GROIN PAIN IN FOOTBALL

Groin pain represents a particular burden in both elite academy and professional football players. Time-loss groin injuries are among the most frequent of any body region^{1,2}, and yet still under-represent how often groin pain affects football players. Non-time-loss groin pain accounts for 66-90% of all groin problems³⁻⁶. Retrospective investigations similarly suggest that groin pain is experienced by roughly half of football players over the course of a year⁷⁻⁹.

Players reporting groin pain despite maintaining availability for training and matches may experience poorer sporting function^{10,11} and impaired football performance¹². Importantly, non-time-loss groin pain may develop gradually into time-loss. Previous research has also shown that hip and groin complaints may precede subsequent injury¹³.

Broadly speaking, groin pain is an umbrella term with a variety of more specific clinical diagnoses¹⁴ – many of which can constitute severe time-loss injury. Inguinal-related groin pain may require⁸⁻¹² weeks of conservative management, with surgical intervention as the next line of treatment if conservative care fails¹⁵. Pubic-related groin pain often requires prolonged rehabilitation¹⁶. Athletes presenting with multiple clinical entities may experience particularly troublesome and persistent symptoms^{17,18}.

More specifically, the adductors warrant particular attention in football. Adductor-related groin pain is consistently reported as the most frequent clinical entity, and is involved in more than 80% of cases where more than one clinical entity is present^{17,19}. Serner et al. used pain mapping distributions for groin pain cases, finding

that the most common area of complaint centers around the proximal adductor insertion¹⁹. The intimate relationship of tissues in the hip and groin complex further expose the adductor as a key component. The downward force vector of the adductor longus is met in opposition by the upward vector of the rectus abdominis²⁰. These structures, in opposition, pose a threat of stress across their shared attachment site: the pubic bone. Perhaps, then, it is no surprise that pubic-related groin pain cases are associated microtearing of the adductor longus proximal attachment²¹. Perhaps the adductors being the centerpiece – or even a gateway – to extra-articular groin pain in football players is a plausible approach.

Applied prevention strategies discussed in this article therefore deliberately emphasize an adductor-related focus. While not all football-related groin pain originates



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Illustration

from the adductors, the region does provide a practical target to address: it is commonly involved, experiences high demands during football participation, and is the most widely-studied area to apply evidence-based practice. Furthermore, interventions directed toward the adductors may influence the broader region of the hip and groin. First, we explore on-pitch adductor demands during football.

THE EXPOSURE: ADDUCTOR DEMANDS IN FOOTBALL

Anatomy textbooks describe the adductor longus' action as a muscle that "adducts the thigh (and assists in hip flexion)"²². It is a superficial muscle located relatively far from the hip joint center. It has long fascicles, a moderate pennation angle, and a relatively high proportion of type II

fibers. All of which constitute the adductor longus as a phasic muscle, well-suited for force generation capacity over a wide range of motion. However, this description is an incomplete picture of how the adductor longus functions during football.

Rather than merely adducting the thigh in open chain, the adductor longus is often challenged in closed chain movements while the lower limb must be controlled and stabilized against larger external forces. Analyses of acute adductor injuries indicate that closed-chain mechanisms constitute 59% of injuries²³. Experimental studies examining football movements provide a similar perspective. Change of direction tasks generate greater and more prolonged adductor longus activity than passing actions²⁴. Sprint accelerations place considerable demands on the adductors

during ground contact²⁵. Even kicking should not be considered an exclusively open chain demand, as the stance limb exceeds the kicking limb in terms of adductor demands²⁶.

These football actions – changes of direction, sprint accelerations, kicking, and more – do not occur in isolation. Rather, they are highly repetitive and accumulated in a day, week, month, and season. While research on quantifying hip adductor demands during football is still evolving, current evidence indicates that post-training and post-match hip adduction strength reductions can be 4-12%^{27,28} and 12-22% respectively^{29,30}. It's also apparent that congested periods without full recovery create greater strength deficits than an isolated exposure³¹. Tracking technologies can help practitioners quantify adductor exposure on-pitch. Global positioning system (GPS) data quantifies running characteristics, while foot-mounted inertial measurement units (IMUs) allow for kicking volume and intensity to be estimated³². Football periodization also seems to matter, as drill selection influences acceleration and deceleration exposure³³. Importantly, none of these variables can be considered a direct measurement of adductor tissue stress but rather provides collective estimates about the adductor demands experienced by a player during football.

These concepts provide a backdrop for primary and secondary prevention to commence. Groin pain in general is common, and non-time-loss groin pain must be surveilled to avoid under-estimating its burden. Particularly, adductor-related groin pain is commonly involved and provides a window for intervention. Football exposure requires high adductor demands, and those accumulated actions may contribute to the most common groin injury pathway of gradual, overuse onset. Therefore, primary and secondary prevention strategies should target each of these areas to monitor, intervene, and mitigate risk.

THE APPROACH: PRIMARY PREVENTION

Primary prevention aims to reduce risk of future injury by targeting modifiable risk factors in healthy players³⁴. While a multitude of factors may contribute to groin injury risk including previous injury and playing level, the most clear modifiable risk factor for groin injury in athletes is decreased hip adduction strength³⁵.

Because primary prevention seeks to improve hip adduction strength in healthy players before an injury occurs, all players in a cohort should be exposed to targeted programming. Elastic band strengthening and general hip/groin programs (e.g., Hölmich protocol) provide options to induce strength gains and mitigate injury risk^{36,37}. However, the strongest evidence for an intervention to 1) improve hip adduction strength and 2) reduce groin injury risk remains the Copenhagen Adductor Exercise (CAE).

Studies have demonstrated significant strength gains following the CAE, both in eccentric³⁸ and isometric strength³⁹. By way of increasing strength and tissue resiliency, groin injury risk may be reduced. A randomized controlled trial showed the risk of reporting groin problems reduced by 41% when exposed to the CAE compared to a control group in Norwegian semiprofessional players⁴⁰.

While structured intervention programs have shown consistent strength gains, the CAE is often implemented in elite football clubs with modifications⁴¹. Competitive football imposes a weekly structure by which match performance, training load, and recovery strategies must co-exist. Teams generally implement similar planning structures whereby the initial days post-match emphasize recovery, while the “loading” or “acquisition” days are placed midweek, three to four days before the next match^{42,43}. Eccentric strength deficits can remain up to 72 hours post-football exposure⁴⁴, providing a unique challenge to program the CAE – a highly dynamic exercise with high eccentric activation that risks occurrence of delayed-onset muscle soreness. Implementing the CAE may be further constrained during congested periods that compress recovery and preparation time.

Fortunately, Dalen-Lorentsen et al.⁴¹ also concluded that although CAE programs are often modified in elite football, they seem to maintain the essence of the exercise’s intention. While the original standardized protocol of the CAE described a long-lever position with a three-second eccentric contraction, linearly periodized from two to three sessions per week³⁸, such linear periodization is not often feasible in elite football settings. Rather, progressions and regression can be implemented based on the surrounding football demands and an individual’s needs.

One strategy to combat residual fatigue and delayed-onset muscle soreness from the CAE is prescribing an isometric iteration of the exercise. Even isometrically, adductor activation remains high – particularly with added external resistance. O’Connor et al.⁴⁵ demonstrated that two-thirds of rugby union players could tolerate the CAE at 130–140% body mass. Hip adduction strength can incrementally increase with isometric, externally-resisted iterations of the CAE – while at the same time mitigating residual fatigue.

The CAE can also be modified with a series of regressions. Long lever can be adjusted to short lever, reducing the overall demands placed on the stabilizing limb. Short lever positions may be particularly useful in younger athletes with open physal growth plates to reduce the stress and strain on the pubic apophysitis and proximal adductor insertion. Therefore, the CAE should be viewed as a continuum of exercises rather than a rigid, one-size-fits-all approach. Although all players across the cohort should be prescribed primary prevention interventions, different players are able to tolerate different levels of the exercise to fit within the constraints of ongoing football participation, mitigating residual fatigue, and simultaneously increasing or maintaining strength. For example, an incoming transfer player into a men’s first team where the squad has been regularly performing externally-resisted isometric CAEs is not likely prepared to immediately begin the same exercise. Rather, a trial-and-error period to personalize exercise prescription to match the player’s capacity and needs is far more appropriate.

Beyond the CAE, other adductor-specific programming can also contribute to maintaining and increasing strength. While a weighted CAE targets maximal strength, elastic/cable (or even pneumatic Keiser or flywheel devices) hip adduction can target strength endurance. Elastic band strength endurance yields the lowest demand, since force is not uniform and is less resistant in wider ranges of motion. Furthermore, functional exercises should also be considered. Given the context that the adductors are commonly exposed to closed chain demands on-pitch, gym-based exercise prescription should also target the adductors as a stabilizer and synergist. For example, a squat or hinge pattern requires adductor stability, with

increasing demand on the medial thigh as stance width increases⁴⁶. Functional exercise prescription that is not “isolated” to the adductors but indirectly biased to promote adductor demands are important adjuncts to adductor-specific strengthening programs. A lateral cross-over sled pull can imitate closed chain demands on the pitch during change of direction maneuvers or simulating the stance limb during kicking.

Targeting the adductors alone would fail to consider the bigger picture of preparing an athlete to play football. Hip adduction: abduction ratios have indicated that an imbalance may increase groin injury risk⁴⁷. Regional strengthening to target antagonists and associated synergists is also important when managing the hip and groin complex.

Even with a systematic and structured primary prevention protocol implemented with individual considerations in an entire team/club – primary prevention alone will not eliminate all groin injuries. Inevitably, the multifactorial nature of injury onset will find cracks in even the most stable foundation. Secondary prevention is the next line of defense.

THE APPROACH: SECONDARY PREVENTION

Whereas primary prevention is implemented at a group level, secondary prevention targets an individual by “dealing with early detection when this improves chances for positive health outcomes”⁴⁸. Secondary prevention is a uniquely fitting concept for groin pain – since many groin complaints do not initially cause missed training or matches.

The first step to successful secondary prevention requires detecting when non-time-loss groin pain occurs through serial monitoring. While simply asking players to report if and when non-time-loss groin pain occurs, serial monitoring may not be so simple. Players often under-report their groin pain symptoms, especially when reporting pain is perceived as a threat to their football participation⁴⁹. Fortunately, objective hip adduction squeeze strength deficits are associated with groin pain^{49,50}, providing a window to further assess groin status on individual players.

Practically, serial monitoring must satisfy a few key requirements: the procedure needs to be quick, sustainable, reproducible, and capable of exposing subclinical symptoms. The Copenhagen five-second



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squeeze test (5SST) offers an approach to not only check off these boxes, but also provide a combination of subjective pain and objective strength data.

The 5SST is conducted as a long-lever, bilateral isometric screening test⁵¹. To be quick and efficient, the long lever set up can be implemented without modifications from player-to-player (whereas short lever testing requires adjustments to standardized hip and knee joint angles). More recent iterations of the 5SST have also added load cells to ascertain objective strength measurements^{52,53,52}. The test can be reliably collected with just one repetition per testing session⁵⁴. Lastly, the 5SST utilizes a wider hip abduction angle that is optimal for detecting pain⁵³.

Collectively, incoming subjective pain and objective strength data can be compiled to create regular reports on players' groin status. The serial monitoring components are complementary. While players may have a tendency to under-report their symptoms, the strength measurement provides an objective insight. But subjective pain also can elicit valuable information. Recently, a study showed that pain during the 5SST is associated with on-pitch performance deficits and pain during football¹². Likewise, training load data should not be interpreted as a risk factor in isolation.

Lastly, serial monitoring should also consider the surrounding exposure. Monitoring football training load through GPS and/or IMU measurements and cross-referencing pain and strength data can further guide practitioners on player management. Recently, higher football

training load in the previous week has shown amplified strength deficits in players experiencing groin pain¹².

From Screening to Action

Serial monitoring provides a wealth of incoming data with subjective pain, objective strength, and preceding training load concurrently collected. The next step is interpreting the findings.

Suppose a player demonstrates a 25% hip adduction squeeze strength deficit compared to the previous week. In isolation, the datapoint appears relevant and actionable. A 25% decrease exceeds the minimal detectable change⁵⁵, and presumably the player is at a higher risk of developing an injury. But did the player play ninety minutes in a match the previous day? Is it possible the deficit is simply post-football fatigue? Is he also reporting pain concurrently during the squeeze test? If football training exposure has been high, perhaps retesting the following day is appropriate to assess whether deficits have resolved. If there is a perceived problem, then a further clinical examination should take place – although the squeeze test is sensitive to screening the adductors, the problem may not be adductor-specific. Practitioners should resist over-reacting to every small abnormality. The monitoring system is simply in place to uncover and detect groin pain problems – and conduct further clinical testing when appropriate.

Findings from a screening test do not make the diagnosis. If a flagged deficit is discovered, accompanied by symptoms, or not reasonably explained by the preceding

football exposure, further assessment is needed. At this stage, the clinician simply uses screening information to undergo further examination. Palpation, resistance testing, mobility, and other symptom provocation tests can help classify the presentation according to relevant clinical entities and determine a management approach.

Once a relevant problem is identified, early management provides options to resolve problems before time-loss occurs. Practitioners may modify selected football activities, adjust total training exposure, alter gym loading, or introduce targeted exercise. Importantly, the appropriate response depends on the clinical presentation and the context in which the problem developed. Screening findings should prompt clinical reasoning rather than prescribe the intervention.

The practical challenge is deciphering and interpreting incoming data from serial monitor to parse through what matters (and what does not). When deficits are flagged, interventions can occur prior to time-loss, and therefore as a secondary prevention measure. Practitioners should strive to avoid two key mistakes: first, ignoring symptoms until time-loss erupts; and second, over-interpreting monitoring findings and unnecessarily restricting players who should participate.

PRIMARY AND SECONDARY PREVENTION CONTINUUM

Primary and secondary prevention strategies should not operate as separate programs, but rather across a continuum to



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respond to a player's changing status. In the primary prevention phase – with the player participating pain-free in regular football activities, the focus remains improving and/or maintaining hip adduction strength. An individualized approach, considering the player's baseline strength (and target strength), the surrounding football exposure, and individual characteristics such as age and injury history provide insights to find the correct load recipe. Once symptoms are reported, secondary prevention strategies should consider whether strengthening programs should continue or be modified, how pain modulation can improve symptom presentation, and whether football training load needs to be modified. Once symptoms resolve, the player returns to the primary prevention strategy – with the “new” symptom history also influencing the primary programming being prescribed.

CASE EXAMPLE

Consider a 19-year-old male professional football player with hip adduction squeeze strength consistently one standard deviation below his peers. In preseason, during spikes in football training load relative to the offseason period, he intermittently reported pain during the 5SST and had high week-to-week variation in squeeze strength. However, once the in-season period began and weekly training volume stabilized, he has been consistent week-to-week and has not reported groin pain symptoms. Through the past eight weeks (preseason + inseason), he has regularly performed hip adduction strengthening as a primary prevention approach.

Now, in the fourth matchweek of the season, the player earned a spot in the

starting lineup. He played 90' for the first time in competitive, senior-level football. On matchday+1, his hip adduction squeeze strength dropped 30%. He does not report groin pain. His previous week's training load has spiked relative to the preceding month, culminated by a 90' match exposure the night before. How should we interpret the findings?

Option #1: The player is under-reporting his groin pain symptoms because he's finally cracked the starting lineup and does not want to be deselected. The objective strength drop may be interpreted as a clear indicator of underlying groin pain, especially given that the medical staff was aware of his intermittent groin pain throughout the preseason. The match exposure was the breaking point – and failure to act now is likely to lead to a gradually worsening symptom presentation.

Option #2: The player experienced a spike in his football load from the match, and is simply fatigued on presentation for the weekly monitoring. His squeeze strength deficit is secondary to fatigue; not some under-reported, underlying groin pain that will inevitably become worse.

So which is it? Either explanation is plausible. The monitoring findings flagged something worth investigating; it has not identified the cause. This is where a clinician's expertise comes into play. Gather more data points to help parse through the case: engage in further discussions with the player about how his recent match exposure might yield groin pain onset. Conduct further testing to see if any findings from the screening test are visible on a clinical examination. Retest the next day to see if fatigue-based deficits resolve with rest,

or if the strength deficit persists. Consider altering the hip adduction strengthening program in the upcoming week by shifting to more pain modulation strategies.

The 30% strength deficit, spike in football exposure, and absence of subjective groin pain as stand-alone markers are not sufficient to make a clinical decision. Serial monitoring provides the information; the clinician makes the interpretation.

SUMMARY

The wide array of extra-articular groin injuries cannot be simply captured by a single screening test, nor is that the intention of prevention strategies. Evidence-based practice points to targeting adductor-related groin pain first, although a wider scope of groin problems can occur. Nonetheless, the first line of attack remains adductor-related groin pain. Primary and secondary prevention strategies implemented consistently can provide a stable foundation to mitigate the risk of groin injuries in football players.

References

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