

GROIN INJURIES IN FOOTBALL

– *Written by Andreas Serner, Switzerland, Willem Heijboer, The Netherlands, Zarko Vuckovic, Qatar, and Adam Weir, The Netherlands*

GROIN PAIN IS PART OF THE GAME

Almost all football players will experience some degree of groin pain at some stage in their career. During a season around half of players will have groin pain¹, and if you ask a team in any given week, about 20% of the players will have some groin problems - even more in the beginning of a season^{2,3}. So, for most football players groin pain isn't really a big deal, it's just part of the game. But that's only until it becomes too bad. The usual pattern will be a gradual onset of discomfort that can turn into increasing pain, which can later start to affect the player's performance, and subsequently lead to reduced participation or stop them from playing altogether. This happens to about 20% of all players per season^{1,4}. If players have pushed themselves through the pain for longer, the timeline for full recovery usually also gets longer. Progression is very precarious. In the early stages it can be difficult for a player to know if their type and level of discomfort or pain will resolve easily or could be more concerning. If nothing is done, the result is often that a player will continue playing as long as they are able to or until they are forced to stop. This is the turning point when groin pain becomes a big deal.

Monitoring for ongoing symptoms is essential, but that unfortunately still

doesn't capture all groin injuries. Acute groin injuries (with a sudden onset) do not usually have a clear warning sign. We found that only 15 percent of players who had acute adductor injuries felt any discomfort or pain on the day of their injury, or even in the week before⁵. So rather than creeping up on a player, these injuries happen out of the blue resulting in immediate time-loss. Acute groin injuries happen to 2-4 players per team per season^{4,6}.

CAN WE MAKE IT A SMALLER PART?

Given the amount of groin pain in both men's and women's football, any respectable team should have a prevention strategy. While it is generally considered by coaches and medical staff that training planning is an important factor influencing injury occurrence, evidence for specific modifications aimed at reducing groin pain is lacking. Anecdotally, fluctuations in the amount of kicking and change of direction drills can increase the risk of groin pain. Knowledge about this is still very limited, but scientific advances that could influence training planning are expected in the near future. Currently there are several laboratory studies, which investigated movement and muscles during different types of kicking⁷⁻¹¹. Additionally, average kicking amounts and intensity in matches have been estimated,

including position-specific overviews¹². Movement analysis of change of direction may also be able to provide further insight in load transfer across the groin area and potentially influence training to reduce groin injury risk¹³. This currently remains theoretical.

Monitoring of movement and load in relation to groin injuries is quite far behind some other areas. Most notably the amount of accelerations and high-speed running, which can be related to hamstring injury prevention, is a basic element of training assessment and planning in elite football and has been for quite some time. We expect an increasing use of technology to measure both foot and ball movements during play. This will enable assessment of kick velocity, ball speed, ball touches, ball releases, ball possession, shot distance, and more. Hopefully this will provide further insight into how training planning can improve our ability to reduce groin pain and injury incidence. Until then, we have to rely on theory and experience, and instead look at the other side of the load vs capacity scale for scientific evidence.

Increasing the capacity of players to handle the load they are exposed to during sport has proven effective in reducing injuries across different injury types. Structured exercise programmes can reduce



Image: Illustration.

groin injuries in football. As a first step, a general warm-up programme is essential. The FIFA 11+ injury prevention programme has shown reduction of groin injuries by 39% across studies¹⁴. New research is developing the FIFA 11+ with easier implementation, where part of the programme can be performed after training or at home with the same effects^{15,16}. Structured warm-up is a basic element of most elite and sub-elite teams, but groin injury rates are still high. Therefore, additional options need to be considered.

Low adductor strength is the most consistent modifiable risk factor for groin pain¹⁷. The FIFA 11+ does not include an exercise targeting the adductors and does not improve adductor strength¹⁸. Adding an adductor resistance exercise to the training should therefore be relevant. Performing just one simple adductor exercise with a single set a few times a week in the preseason and once a week during the season, reduced the prevalence of groin problems in football players by almost 50%, and substantial groin problems by 30%¹⁹. The Copenhagen Adduction exercise is an easy choice, as it does not require

equipment and can be performed by anyone anywhere²⁰. Additionally, there could potentially be an even larger if players would perform it more, as the strengthening effect increases considerably with a higher exercise volume²¹. Despite good effects, implementation in practice is still inadequate²². This unfortunately goes for most resistance exercises, which do not have a sufficiently clear or large performance improvement focus. Performance investigations are still lacking for specific resistance exercises for muscles in the groin area, so implementation strategies probably require more creative approaches related to the specific team contexts. Additional strategies beyond resistance exercises are also necessary.

CATCH SYMPTOMS EARLY!

Even with perfect prevention exercise implementation groin problems will still be an issue to some extent. To minimize time-loss resulting from groin pain, it is important to monitor the players' condition. The earlier you detect symptoms, the more time you have to intervene. Without being prompted, players are unlikely to report problems until

they perceive their performance on the pitch is considerably affected. Beyond a simple occasional question, there are standardised approaches which have been shown to be relevant.

Previous injury is a risk factor for most injuries in football, and this is also the case for groin pain¹⁷. Just looking at past injury is an insufficient predictor of who will experience pain during a season. Asking about the duration of symptoms in the previous season can help detect which players which are more likely to be affected in the new season, and who could need closer monitoring. Overall, the longer duration of groin pain in the previous season, the greater chance of symptoms in the new season¹, and the more severe the symptoms were in the pre-season the larger risk of time-loss injury during a season²³. Despite the associations of this pre-season information and injury, the predictive (and therefore practical) value is limited²⁴.

Continuous monitoring can provide a better insight into which players could need a higher focus. Whenever monitoring test are implemented, a key element is that they have to be very quick to perform. A simple

approach of asking four standardized questions related to problems influencing participation, training volume, performance, and pain, has been shown to have a decent predictive power of a subsequent time-loss injury²⁵. This can provide a quick and easy insight into which players need further assessment and potential modification of their training.

Quick and easy clinical testing can also provide relevant information. Pain on a 0-10 scale during a simple adductor squeeze correlates well the level of symptoms during sport²⁶. Players with a pain level of 0-2 can be considered to have normal function, a pain level of 3-5 indicates a moderate level of symptoms that requires further assessment, and with a pain level of 6 or more, you can expect that a player has a considerable amount of symptoms during football, to an extent where they probably should not be playing²⁶.

Adding a dynamometer to the squeeze test may provide even further information. There is some evidence that adductor strength decreases in the weeks preceding a time-loss groin injury²⁷. Implementing in-season strength monitoring is becoming more common in elite football. For example, a specific cut-off value for reductions in adductor strength of >15% have been used as part of an alert system leading to further assessment of individual players and potential intervention²⁸. Initial results indicate a good effect of this approach, but the normal weekly variation in adductor strength is still unknown, as well as a cut-off values for when changes in adduction strength lead to subsequent groin problems.

INJURY TIME

Despite all this knowledge players still get injured. In these cases, we need to provide a diagnosis, treatment plan, and expectations. Once we enter this realm we can see that it has historically been influenced by many different opinions, with experts using and recommending different terminology²⁹. Some clinicians do not feel comfortable examining the area due to the close proximity to or involvement of the genitals. Inexperience may lead clinicians to be less critical of recommended approaches and less reflective of their own examination. Additionally, there is no gold standard examination test for groin pain. Fortunately, most experts agree that history and clinical examination remain

the foundation for the diagnosis of athletes with groin pain. Not long ago, a group of international experts in groin pain from different specialties, countries, ages, and clinical and scientific backgrounds agreed on classifying groin pain using a clinical entity approach³⁰. This is referred to as the Doha agreement classification system³⁰. The system classifies history and clinical examination findings into one or more of the following clinical entities: adductor-, pubic, inguinal-, iliopsoas-, hip-related groin pain, or other causes. We have recently written an article in the *Aspetar Journal* on the diagnosis of groin pain, including description of clinically relevant anatomy and examination techniques. You can read more about this here:



We have been investigating the classification system further and have found that classifying using these clinical entities has excellent reliability between examiners when only one clinical entity is classified. There was lower reliability when multiple entities are involved, so caution is recommended when diagnosing more complicated cases³¹. We have also found that there has been a good international uptake of the classification system among clinicians working at FIFA Medical Centres of Excellence and the IOC research centres³². Some argue that the entity approach is not specific enough, but currently groin pain experts do not agree on suggested alterations of classification system³², so there is still a need for further original research studies to improve diagnosis.

The clinical entities were developed for gradual onset/long-standing groin pain. For sudden onset pain (acute groin injuries), diagnoses are usually made for specific muscle injuries rather than clinical entities. If we consider a clinical entity approach

for acute groin injuries, the classification could be a bit different with only three main clinical entities: adductor injuries, hip flexor injuries, and abdominal wall injuries. Adductor injuries are still the most common, and the adductor longus muscle is most frequently injured muscle, involved in 9 out of 10 adductor injuries³³. The diagnosis of an acute adductor injuries can be made using a clinical examination with adductor palpation, adductor stretch, and adductor resistance tests, with similar methods as described for long-standing adductor-related groin pain³⁴. These tests have a high accuracy (compared to imaging), which means the diagnosis of an acute adductor injury can be made through clinical examination only.

Around one third of acute groin injuries affect the hip flexor muscles, which includes both injuries in the iliopsoas and the proximal rectus femoris muscle. The reason these two muscle injuries are grouped is because differentiating between them is difficult on initial clinical examination³⁵. There is often widespread groin pain, which leads to specific clinical examination tests being positive for both locations. This results in general poor accuracy of the clinical examination tests³⁴. A delayed clinical examination can be helpful, as pain extent usually decreases continuously in the days following injury³⁶ leading to clearer localisation of pain and injury. If a fast differentiation is required, imaging will be helpful. Iliopsoas and rectus femoris injuries very rarely occur together³⁷.

Pain in the lower abdominal wall area may be present in 10-20% of players with acute groin injuries and is often present in combination with a more severe injury in a different location (such as an adductor longus avulsion). Isolated acute lower abdominal wall or inguinal pain is rare, and even in combined injuries, positive imaging findings in the abdominal muscles are present less than 5% of the time³³.

IMAGING THE GROIN

“We will know more about the injury after imaging” is a common expression in football when a player is injured. Unfortunately, this rarely applies to groin pain. In longstanding groin pain, imaging findings are rarely able to determine the cause of pain³⁸. Similarly, expectations on the duration of return to play will rarely be influenced by the imaging findings.

Imaging often shows load-related changes. The challenge is to understand which of these related to the specific groin pain. When imaging of football players is compared to that of other athletes or sedentary people, there will often be findings that could be considered “abnormal”, but only few changes seem to be different between football players with groin pain and those without. There is evidence that the extent of pubic bone marrow oedema or a symphyseal disc protrusion are associated with adductor- and pubic-related groin pain³⁸, but these findings are also found in players without groin pain, and not all players with groin pain have them. This makes it more challenging to give a specific diagnosis. The scientific relevance of imaging findings has been hampered by poor descriptions of clinical examination findings and diagnosis, and by poor study methodology³⁹. As a result, the importance of specific imaging findings in players with groin pain is still unclear. Although it is unlikely that imaging will answer all the questions, there is a still good potential for imaging to improve our understanding of the variance in groin pain diagnoses and prognosis. Currently, imaging of players with longstanding groin pain is most helpful to rule out potential serious pathology.

For players with acute groin pain, the relevance of imaging findings in the diagnosis is clearer. When imaging is positive for an acute muscle injury (indicating intramuscular oedema), it

is generally accepted that this is a valid finding. MRI is slightly more sensitive than ultrasound for acute groin injuries³⁵. Imaging can provide detailed information on injury location and injury extent, which can provide a specific diagnosis. There are several general muscle injury classification systems⁴⁰, but with a recent improved understanding of the variance in anatomy between commonly injured muscles, it has been suggested that there should be muscle-specific classifications⁴¹. We have provided a detailed imaging descriptions of both acute adductor and hip flexor injuries^{33,37}. About 90% of acute adductor injuries involve the adductor longus, while other adductor muscle injuries are rarer and are often combined with an adductor longus injury. We see that there are three characteristic locations of adductor longus injuries: (1) the proximal insertion, (2) the musculotendinous junction (MTJ) of the proximal tendon, and (3) the MTJ of the distal tendon. In the MTJ injuries at both the proximal and distal insertion, there is rarely any injury to the tendon structure itself, whereas at the proximal insertion, most injuries are complete avulsions of the proximal tendon attachment. These avulsions do not involve a bony avulsion, just the tendon insertion³³.

In addition to the diagnosis, imaging is often used to try and improve the estimation of prognosis. This is difficult because of large variations in recovery times between players with similar injuries. We have investigated details of the history,

clinical examination, and MRI findings for athletes with acute adductor injuries who performed a standardised criteria-based rehabilitation protocol. We found that the strongest predictors of a longer time to return to sport after an acute adductor injury were palpation pain at the proximal adductor longus insertion, a palpable defect, and/or an injury at the bone-tendon junction on MRI. For athletes without any of these findings, even extensive clinical and MRI examination did not assist considerably in providing a more precise estimate of time to return to sport⁵.

Athletes with an MRI grade 0-2 adductor injury were clinically pain-free after approximately 2 weeks and returned to full team training after approximately 3 weeks. Most athletes with an MRI grade 3 adductor injury (avulsion of the proximal tendon) were clinically pain-free and returned to full team training within 3 months⁴².

MANAGING THE INJURED PLAYER

Players can often still perform well for a considerable period despite having groin pain. Keeping the player on the pitch is often a key initial goal and the pain can sometimes be controlled by just modifying training. There is also evidence that manual muscle treatments and wearing compression shorts can give relevant reductions in pain level⁴³⁻⁴⁵. Close monitoring of these players is essential for a successful outcome, as prolonged periods of playing with pain can create a more persistent injury that will be increasingly difficult to treat.



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For players with long-standing groin pain, the evidence for specific treatment options is unfortunately limited by poor research methodology²⁹. For players with adductor-related groin pain, it is pretty clear that just doing passive treatments is insufficient, and that a progressive increase in load is essential²⁹. Additionally, it seems that recent treatment programmes have been able to reduce expected timelines from around 4-5 months^{45,46} to around 2-3 months^{47,48}. There is still a considerable variation between individual players' recovery timelines, which has not been accounted for. Even groin pain experts struggle to provide a specific timeline for recovery for an individual player. In theory, the longer you set the expected timeline the more likely it is that the player will be fully recovered within expectations. In practice, setting a longer timeline will come with many challenges. Initially, it can be very difficult to understand that full recovery may be several months away when they were actually playing until recently. This will influence their trust in the provided advice and challenge the process. When timelines are uncertain, players will often seek several opinions. They will often be attracted to the clinicians who offer the shortest duration regardless of the approach. Opinions will also come from peers, who have had a similar injury or know of someone who has. So as a clinician it is essential to get a deeper understanding of how the individual player has been influenced, and what their expectations are. Managing a player with groin pain, is often much more difficult than managing a groin injury itself. If you work in a club, you may be the first contact, which makes things easier in this regard, but if you work in a clinic you are likely not the first to provide your opinion on the best approach. Early discussions about the pain, contributing factors, individual context (external pressure, relationships, previous treatment, etc.), and setting short term goals and realistic expectations is essential to success⁴⁹.

The variation in return to play times means that time-based rehabilitation approaches are not optimal. Previously, all players with groin pain would start at the same level: no football-specific drills, similar rehabilitation exercises, and identical progression timelines. This may work well for some, but not for others. Most players want to return to sport as fast as possible

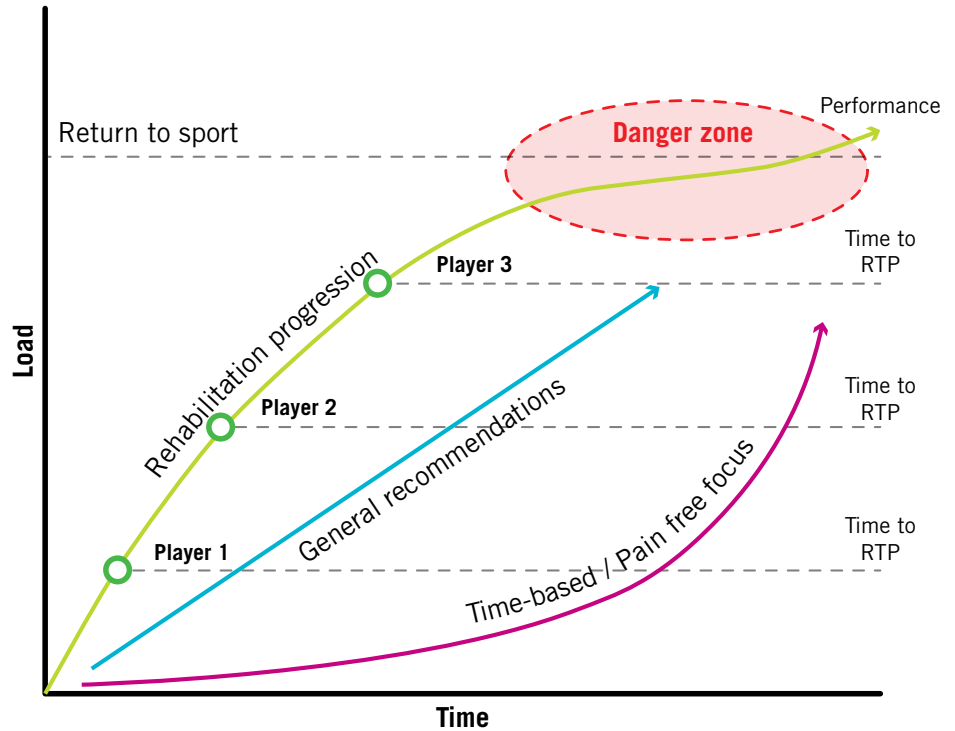


Figure 1: Illustration of rehabilitation progression with early increase in rehabilitation load and longer time closer to required playing level (green), compared to standard stepwise progression models (blue) and time-based or pain free progression focused rehabilitation. The figure also highlights how players with different starting points theoretically will have shorter time to return to sport (dotted lines).

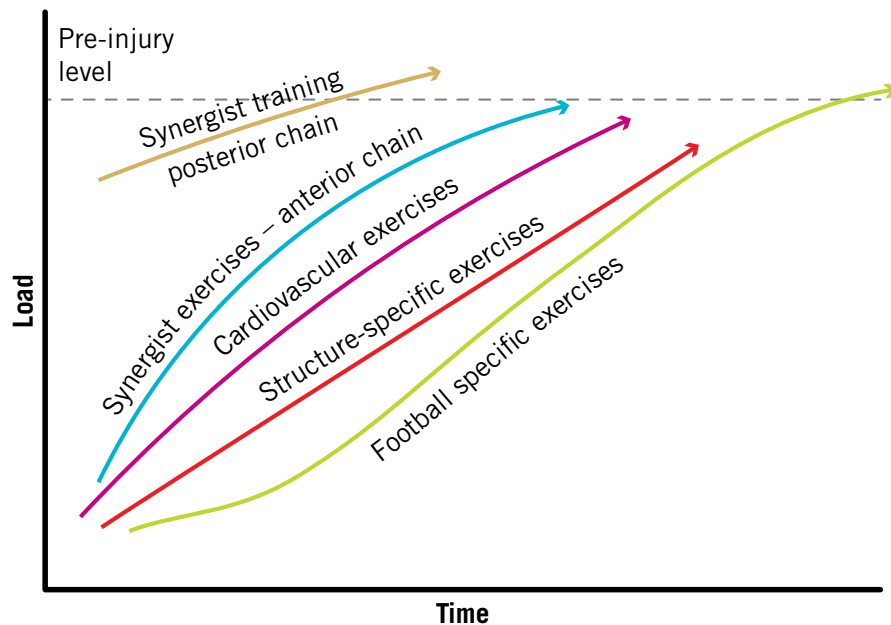


Figure 2: Illustration of how different exercise focus areas within rehabilitation may have different starting points and different courses of progression and should be considered individually depending on the individual players abilities. Focus areas may adjusted according to individual rehabilitation goals.

and adapting the treatment approach to an individual player is one way to improve recovery timelines. We have also experienced that many players can progress exercises relatively early in rehabilitation. Allowing or even pushing early progression according to exercise-specific ability rather than correlating clinical examination criteria has been key in optimizing recovery timelines. The alternative often focuses on players performing exercises completely pain free and that clinical examinations tests are pain free prior to progression. This can result in players being underloaded for a considerable period of time, and lead to steep increases in load in the end-stage rehabilitation, often with shorter periods of sports-specific training. This can in turn lead to inadequate load adaptation and increased recurrence risk. We believe the time spent at the highest possible level is essential for a successful return to sport and to return at a higher performance level (Figure 1).

Rehabilitating football players will have several focus areas apart from injury specific exercises. Players can often perform many exercises at or close to normal training levels even early in the rehabilitation, and progression may be different for different exercises. Allowing separate progression within different exercises/focus areas when possible can also assist in returning the player at a higher level, and potentially reduce recovery time. For instance, a player may be able to perform high speed linear running, despite having considerable pain during isolated adductor exercises. Similarly, patients may be able to perform a deadlift at pre-injury load already in the beginning of the rehabilitation, despite not being able to run. As the key groin injury mechanisms in football are kicking and change of direction⁵⁰, these should have a strong focus both in terms of actual functional progression (e.g. from dribbling, to short passing to kicking, low to high intensity change of direction to reactive agility exercises) and progression of specific strength exercises, which will include both an anterior and posterior muscle chain focus (Figure 2). We have published a general approach to this for acute adductor injuries⁴², but it may be more relevant for players with longstanding groin pain, due to the longer rehabilitation periods.

The main risk with this approach is that when players experience how much they can actually do at a relatively early

stage, they can decide to return to normal football training prematurely without understanding the recurrence risk. Clear return to play criteria are very helpful.

RETURN TO PLAY

Deciding on return to training and matches is a challenge in the rehabilitation process. Players can often play despite remaining symptoms, and it can be difficult to assess the risk of exacerbation or recurrence. The general groin re-injury risk in football is relatively high, especially the first two months after return to football^{4,6}. A good rule of thumb is to start your re-injury risk assessment at 10% and then increase for each consideration you assess as being suboptimal.

In acute injuries, we recommend not accepting any pain clinically or functionally. We know that muscle injury healing is usually not complete despite complete pain resolution⁵¹. So even when players are clinically and functionally pain free, we are sending them back with an increased re-injury risk. Just like the initial acute injury, a recurrence often happens without prior warning. A key clinical finding following muscle injuries is palpation pain, which can increase re-injury risk fourfold⁵². Palpation pain is one of the last pain assessments that resolves³⁶ and therefore a good marker for readiness for high load activity. We have been using set criteria for acute adductor injuries, which have shown lower re-injury risk. This includes both clinical and functional pain resolution⁴². We believe these can also be transferred to rehabilitation of players with long-standing adductor-related groin pain, who will likely also benefit from additional criteria, such as specific strength and performance assessments.

In the end, the RTP decision will come down to what level of risk the player accepts as tolerable. Knowing that the player and clinicians may have completely different re-injury risk assessments⁵³ is key and highlights the need for open discussions. In cases, where a clinician would usually not recommend return to play, the player may be influenced by several risk tolerance modifiers not related to the injury, such as the time of season, current match schedule, pressure from the coach, the players own desire to play, as well as potential financial and other conflicts of interest⁵⁴.

Regardless of the re-injury risk assessment, it is important to advise, and

monitor if possible, with a continuous focus on preventing re-injury. This goes beyond the immediate period following return to play, as players are still at increased re-injury risk the following season^{1,55}.

WHEN IS SURGERY NEEDED?

Exercise-based rehabilitation is often but not always successful and surgery is rarely the first choice, especially for recreational players. There are different surgical indications and the type of surgery depends on which clinical entity is involved. Contextual factors are important, along with the injury itself, in influencing the decision and timing of surgery. Reasons for considering surgery are; insufficient progress during rehabilitation, lack of player compliance with an exercise-based treatment program, multiple pain recurrences, or other non-injury related decision modifiers.

There are two main surgical approaches: An adductor longus release (partial or complete) for adductor-related groin pain, and an inguinal-repair (various techniques) for inguinal-related groin pain. While there are few high quality studies on surgical treatment, current evidence does suggest these approaches are generally successful^{29,56}.

Adductor longus tenotomy (release of the tendon, but not the muscular attachment) for players with long-standing adductor longus insertion pain who were considered to have failed non-surgical treatment had an almost perfect return to sport rate with an average of 9.2 weeks to return to the same level of sports as prior to the injury⁵⁷. Surgery is sometimes chosen to provide a more definite recovery timeline (as some studies for rehabilitation of adductor related groin pain show large variance and sometimes very long recovery times) and because of a perceived lower reinjury risk. However, similar to exercise-based treatment, partial tenotomies also have a considerable range in the time to return to play (2-24 weeks), although around 3 out of 4 players return between 6-12 weeks⁵⁷. Long-term follow-up studies on recurrence following adductor tenotomies are lacking, but it is worth noting that 30% of players participating in the referenced study had a previous groin repair meaning that recurrence risk is clearly not completely eliminated⁵⁷. In the future randomised studies where surgery is compared to

optimized rehabilitation would be useful to inform practice.

Acute groin injuries have good prognosis without surgical treatment. Some surgeons who encounter acute proximal adductor longus tendon avulsions choose to perform surgical reattachment. This is a topic of current debate. In these proximal tendon avulsions, there are good results for both exercise-based treatment and for surgical reattachment. There are currently no randomized controlled trials comparing the two approaches, but both are reported separately to achieve higher than 95% return to play rates⁶³. The main difference is that exercise-based treatment lead to a considerably shorter time to return to play of around 2-3 months compared to 3-5 months⁶³⁻⁶⁵. Given the good follow up outcomes with low injury risk, exercise-based treatment should be the first choice for adductor longus avulsions. In rare cases with delayed or inadequate muscle/tendon loading during rehabilitation there might be excessive/suboptimal scar tissue formation leading to ongoing discomfort and affected performance, where surgical debridement might be considered.

For players with inguinal-related groin pain, inguinal surgery has a high success rate (>90%)⁵⁸. Different surgeons use different surgical procedures, but a recent randomized controlled trial comparing two types of inguinal repair (open non-mesh vs endoscopic mesh repair) did not show significant differences in return to sport rates or times⁵⁹. When comparing inguinal surgery to a standardized exercise-based treatment programme, a randomized controlled trial showed a much higher return to sport rates within 3 months in favour of the surgical intervention (90% vs 23%)⁶⁰. A different lower quality study on exercise-based treatment showed good to excellent results in 75% of players after 8 weeks of treatment⁶¹. While it is our experience that improved exercise-based treatment programmes have better results, there is currently no evidence that provides clear time-lines for non-surgical management of players with inguinal-related groin pain. In contrast, surgical intervention offers return to play for most players within 3 months, and for many players even in 4 weeks^{58,59,62}. For elite football players, where longer recovery times can have greater consequences, the potential of a faster return to play following inguinal surgery should be discussed at an

early stage. For injured players returning to play sooner, or minimizing the risk of recurrence, could have great financial rewards and often players are not given adequate time for complete rehabilitation. These are the times where more than ever contextual factors might be influencing medical decisions. Professional players are often risk tolerant and open to earlier surgical intervention than amateurs.

It is important to note that even in cases that end up having any type of surgery, early post-operative exercise-based rehabilitation is important to achieve optimal results, and that potential surgical complications are poorly reported in the literature.

SUMMARY

If you work with football players, you need to understand groin pain prevention, diagnosis, and management. The good news is that you can prevent many groin problems by implementing a single resistance exercise. For further prevention, the evidence is poor, but advances in our understanding of injury mechanisms and load management will hopefully allow further improvements.

The bad news is that players will still get injured. Early detection and intervention are important to reduce the injury burden. When a player is out of play, a diagnostic classification using clinical entities is useful, and criteria-based progression of exercise-based treatment should be the first choice. Fortunately, if the groin pain does not resolve, surgical interventions also have good results.

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Andreas Serner, PT., Ph.D.
Medical Researcher
Fédération Internationale de Football Association (FIFA)
Zurich, Switzerland

Adam Weir, M.B.B.S., Ph.D.
Sports medicine physician
Erasmus MC, University Medical Centre
Rotterdam, The Netherlands.
Aspetar – Orthopaedic and Sports
Medicine Hospital
Doha, Qatar
Sport medicine and exercise clinic Haarlem
(SBK)
Haarlem, The Netherlands

Zarko Vuckovic, MD
General Surgeon
Aspetar – Orthopaedic and Sports
Medicine Hospital
Doha, Qatar

Willem Heijboer, PT, MSc
Physiotherapist & PhD candidate
Amsterdam UMC, Academic Medical
Center, University of Amsterdam,
Amsterdam Movement Sciences, Academic
Center for Evidence Based Medicine, IOC
Center, ACHSS
Amsterdam, The Netherlands
REHABfysio
Rotterdam/Barendrecht, The Netherlands

Contact: andreas.serner@fifa.org