

# DEFINING PERFORMANCE AFTER HAMSTRING STRAIN INJURY

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## INTRODUCTION

"I was petrified of running into a channel. I just knew I was going to tear a muscle... the worst thing about it is that your instinct tells you to do what you have done all your life but you start thinking: oh no, don't... for six or seven years I hated it... I couldn't wait to retire... mentally I could do it, but physically I couldn't". This was Michael Owen's recent admission of the impact the hamstring injuries that plagued a large part of his footballing career had on himself and the team<sup>1</sup>.

## HAMSTRING IMPORTANCE AND PERFORMANCE

Coaches, players and supporters are for the most part, concerned with their team winning. The medical and sport science staff play an important role towards this objective by mitigating the risk of injury and enhancing performance. In doing this it

is expected that the coach will have a squad ready and capable to perform on the field. Unfortunately, most teams will encounter players being lost through injury during crucial times of the season, for extended periods of time, and/or on repeated occasions. The outcome of this will likely have significant implications on morale, finances, and the team's chances of success.

Hamstring strain injury (HSI) remains common in team sports and one of the most challenging issues facing sports medicine practitioners<sup>2</sup>. In elite European football, the incidence of HSI has increased annually by 4% between 2001 and 2014<sup>3</sup> with high reinjury rates. The hamstrings play a significant role during important match winning actions such as sprinting past an opposing defender<sup>4</sup>. Accordingly, there is a growing body of research demonstrating measures of hamstring function, notably eccentric strength, as well as high speed

running/sprinting exposure, as beneficial to performance<sup>5,6</sup>.

## FUNCTIONAL PERFORMANCE

Although not impossible, a hamstring strain is unlikely to be a career ending injury. However, while an athlete should eventually be able to return to the field without any complications, there may be lingering morphological, physical, or psychological concerns which individually or collectively may negatively impact performance<sup>7</sup>. It is suggested that players may return to competition after hamstring injury having developed maladaptations that predispose them to subsequent injury<sup>8</sup>. In addition, following the initial trauma, players may worry about whether the muscle will fully return to its previous capacity, the potential effect on their physical ability, and the likely impact of being absent for any forthcoming important matches.



The force producing capabilities of the muscle have also shown to be altered during tasks such as running, which may further contribute to reinjury risk<sup>9</sup>. Players returning from an injury have shown to be moderately slower compared to uninjured players<sup>2</sup>, although this does improve over time. There is also evidence of a horizontal, but not vertical, force application deficit in the injured limb during running<sup>10</sup>. Such a scenario may resonate more with those ‘chronic rehabbers’ (i.e. players with persistent symptoms, or subsequent injuries of the same type and nature), particularly since the relevance of previous injury is perceived differently for injured than non-injured players<sup>11</sup>.

Following a HSI, changes may also occur in the connective tissue content of the scar tissue. This may include selective residual atrophy, damage to the intramuscular

nerve branches at the site of injury, shifts in the knee flexor torque-joint angle relationship and associated neuromuscular activity deficits. These changes may induce potentially injurious kinematics<sup>8,12</sup>. For example, sagittal asymmetry in hip flexion, pelvic tilt, and medial rotation of the knee have also been reported following an injury, effectively altering certain movement patterns. The concern is that these may be moderating factors of future hamstring function.

#### TRAINING PERFORMANCE

Regaining hamstring function early and safely, while minimizing any detraining induced decline in physical performance, is an important part of the rehabilitation process. While there is no single intervention which optimally re-conditions the injured hamstring, performing strengthening exer-

cises, notably the Nordic hamstring exercise and high-speed running, have gained support as being effective to mitigate injury risk as well as improving performance<sup>13,14</sup>.

Specifically, improvements in peak eccentric hamstring strength and force capacity, sprint and change of direction performance have also been found with the introduction of the Nordic hamstring exercise and/or high-speed running training<sup>5,15</sup>. Interestingly, the gains in change of direction performance were shown to be maintained despite an approximate 10% decrease in eccentric hamstring strength following a detraining period. This has led to inferences regarding several adaptations that may occur in response to training, such as: increased fascicle length<sup>16</sup> and/or enhanced neuromuscular parameters<sup>15</sup>. Practically, this indicates that performance improvements may still be maintained even when the Nordic hamstring exercise is removed or reduced during specific periods, such as the winter break and congested match schedules. These findings are valuable to aid practitioners in their programming.

The implementation of hamstring strengthening exercises is likely to differ between sports teams and clubs, based on a myriad of factors such as match schedules, player and coach perceptions; and education around such interventions. Accordingly, teams may adopt a different model of training that represents an experience-based approach. This approach might not resemble general recommendation, but conforms with these circumstances. For example, performing the Nordic hamstring exercise before training attenuated sprint performance declines but decreased eccentric hamstring peak torque during football-specific exercise<sup>17</sup>. More recently, Lovell and colleagues<sup>18</sup> showed biceps femoris fascicle length increases were more likely to increase when performing the Nordic hamstring exercise before, compared to after, training. However, increases in biceps femoris muscle thickness and pennation angle were found when Nordics were performed after, compared to before, training. As inadequate eccentric strength and fatigue are both risk factors for HSI, strength training should be considered along with the development of peak



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eccentric strength, as a component of programmes aimed at reducing injury risk in multiple-sprint sports<sup>19</sup>. Such findings demonstrate there may be benefits to performing these exercises both before and after a training session, perhaps reducing the negative influence of fatigue.

#### RETURN TO SPORT PERFORMANCE

The return to sport (RTS) criteria are suggested to represent a key component of the rehabilitation process. It is considered a vital part in order to fully address and prepare the player. Recently, van der Horst and colleagues<sup>20</sup> published an expert consensus on the RTS after HSI. Consensus (defined as agreement of >70%) was only reached for repeated sprint ability, single leg bridge, deceleration drills and position specific global positioning system targeted match specific rehabilitation, highlighting the disparity in approaches. The RTS decision-making process is based on the evaluation of the relevant health (medical and injury-specific factors) and activity (performance factors) risks, but is also influenced by contextual factors known as decision modifiers (e.g., timing of the season, competitive level, coach and /or stakeholder pressure)<sup>21</sup>. Considering the multidimensional nature of HSI, the return to sport criteria should not be validated as univariate factors, but interaction of context dependent criteria that also includes different weighting.

It is believed that a criteria-based rather than a time-based approach will objectify all physical variables involved in the return to sport, allowing for a decision to be less subjective or experience dependent. While a returning athlete may achieve the specified performance outcomes, there may still be gaps within the rehabilitation programme that may not fully prepare them to perform on the field. Blanch and Gabbett<sup>22</sup> noted that most protocols for ascertaining RTS clearance focused on healing status and functional tests, with little information pertaining to the completion of an appropriate volume of training. This is consistent with some potential concerns of a mismatch between what is currently performed in training and what is expected in match play.

Targeting a set performance criterion (e.g. time to complete a sprint test) may offer an appealing framework; however, judging an athlete's capacity solely on some isolated measures of performance has its limitations.

#### MATCH PERFORMANCE

There is a level of acceptance that an athlete may return to the competition even though they may not have fully completed the final stages of the rehabilitation process. However, simply returning to the field does not mean that the player can achieve optimal performance, as there is a significant distinction between fit to play and fit to perform.

Deficits in eccentric and concentric strength and strength ratios have been shown to persist beyond the return to sport process<sup>23</sup>. Worryingly, the ability to perform repeated sprints may also be impaired as long as two years after returning to competition<sup>24</sup> while greater reductions in isokinetic knee flexor torque and the concentric hamstring: quadriceps peak torque ratio have been observed after repeated-sprint running only in the injured (kicking) leg, and only in the previously injured subjects<sup>25</sup>. Such findings are insightful to the long-term care and management of players, even after returning to competition.

Sport teams are investing heavily into staff, facilities, and equipment to better their understanding and advance current practice of athlete care and performance. Daily subjective and objective measures, monitoring training and match activity, as well as calculating workloads, seem to be daily duties within sports science and medicine teams. Commonly, teams do some form of benchmarking, identifying 'red flags', and comparing pre- and post-injury data to aid the decision-making during the rehabilitation process. While such data may offer a reference point, it should also be interpreted with a sense of caution when considering a player's return. Classifying a post-injury drop in match workload (e.g. sprints), compared to pre-injury data, as being solely a physical limitation is a reductionist viewpoint, and

ignores the context and complexity of sports performance.

A reluctance to sprint may be attributed to several factors, including a general fear of reinjury (psychological reservations), or conserving oneself for selection of the national team (environmental contextual factors). It may even be a player's (non) subliminal action of pacing themselves, constituting part of a self-determined final phase of their rehabilitation. Indeed, it would seem intuitive for some players to 'ease their way back' into the competitive environment. A player taking this approach may be cognizant of their injury history, playing age and/or experience; it may even have been recommended by a teammate whom has previously had a similar injury. Such context specific details cannot be captured solely from the physical workloads presented from time and motion analyses. Nonetheless, if the returning player produces a significant action (scoring a goal) or match winning performance, the relatively low match workloads may simply be a distant secondary consideration for the coach!

#### TEAM PERFORMANCE

HSI carries a high burden and substantial financial implications<sup>26,27</sup>. For the professional player, an average of 18 days and three matches are missed per season, and cumulatively, this equates to a club average of 15 matches and 90 days missed per season<sup>28</sup>. The inability to play and prolonged absence from play during rehabilitation affects both the individual player and the team. Losing the star player can have an impact on winning important games/competitions, marketing, and even ticket sales, which may produce an unwanted burden to the finances of a club. While this is relevant to any injury, the high frequency of reinjury suggests this may be particularly pertinent to HSI.

It is well established that player availability is highly important for success<sup>29</sup>. However, even when a player has returned to the team following a HSI, the coach's opinion of player performance appears to be lower than pre-injury. Statistics show that staff (coaches, medical) and a large percentage of players (67%), believe a lower limb injury to have a negative

impact on team performance<sup>30</sup>. This also suggests that some players may return to sport prior to complete resolution of the injury and in a suboptimal state<sup>31</sup>. If this occurs, consider the effect it may have on the coach and the player's teammates. The difficulty is establishing whether this is a normal part of the RTS process, or whether it is indicative of some shortfalls in the player's physical preparation and overall rehabilitation process. If it is communicated to the coach that they are unlikely to be receiving back the same player (in terms of performance) that was in the team prior to the injury, it then may impact upon the coach's selection process. However, coaches may be willing to take the risk, and should clearly be made aware of the potential impact on team performance, and the increased risk of reinjury. Since team sports can be multimillion-dollar industries, and the difference between winning and losing games hold enormous financial impact, coaches need to be mindful that certain decisions regarding players can prove very costly.

There are many challenges to losing a player - possibly a repositioning of players in the team, a different playing style or selecting a substitute player who has had very little game time over recent weeks or months. However, following the loss of influential team members, the support staff have an important role in providing a strategy that will not adversely impact on the team. Rather than seeing the situation as a threat to success, players should be encouraged to see the situation as a challenge they are capable of overcoming.

#### SUMMARY

HSI can impact muscle morphology, an athlete's capacity to perform optimally, and the team's chances of success, which may not go unnoticed by the coach and support staff. Establishing reference points may be useful but should not be the sole focus of a rehabilitation process, rather a holistic approach should be the objective. Appropriate strategies such as strengthening exercises and performing sprinting activities as part of training should provide some reinjury protection as well as increasing functional performance. The coach should be informed when

it is suspected that RTS may impact performance, particularly during the earlier stages of rehabilitation. It is important that the process of returning to performance is a shared decision making and that the player plays a significant role throughout the process.

*References available at  
[www.aspetar.com/journal](http://www.aspetar.com/journal)*

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